TCP/IP-(18MCA45E)

UNIT-IV

` File Transfer Protocol ’

FACULTY:

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FTP

- File Transfer Protocol (FTP) is the standard mechanism provided by TCP/IP for copying a file from one host to another. Although transferring files from one system to another seems simple and straightforward, some problems must be dealt with first.
- For example, two systems may use different file name conventions. Two systems may have different ways to represent text and data. Two systems may have different directory structures. All of these problems have been solved by FTP in a very simple and elegant approach.

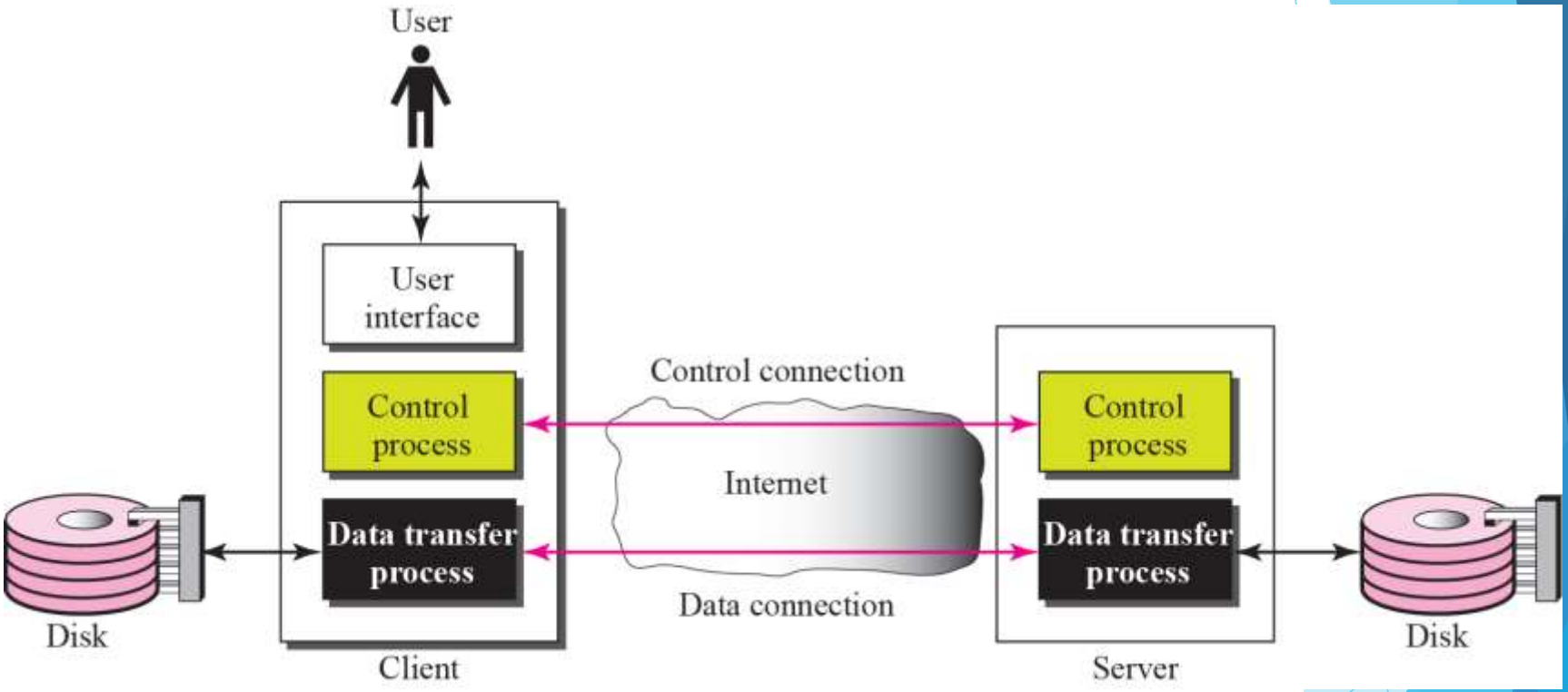
Note

FTP uses the services of TCP. It needs two TCP connections. The well-known port 21 is used for the control connection and the well-known port 20 for the data connection.

Connections

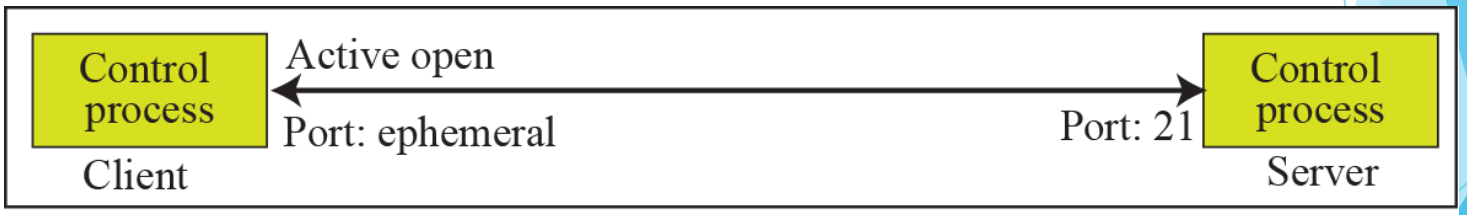
- The File Transfer Protocol (FTP) is a standard network protocol used for the transfer of computer files between a client and server on a computer network. FTP is built on a client-server model architecture using separate control and data connections between the client and the server.

FTP


User
User interface
Control process
Data transfer process
Client
Disk
Control connection
Internet
Data connection
Control process
Data transfer process
Server
Disk

Opening the control connection

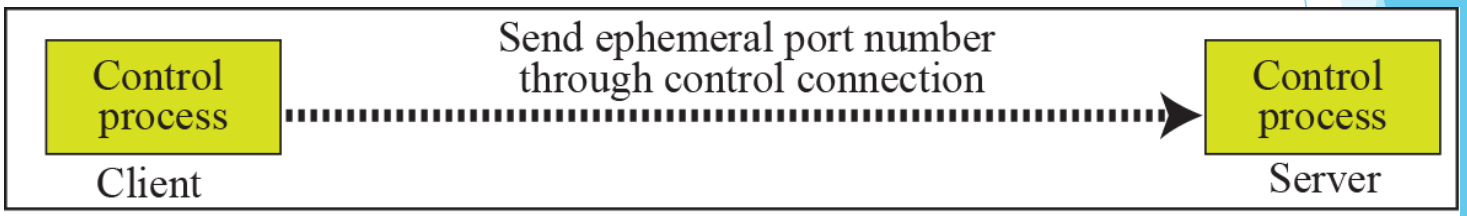
a. First, passive open by server



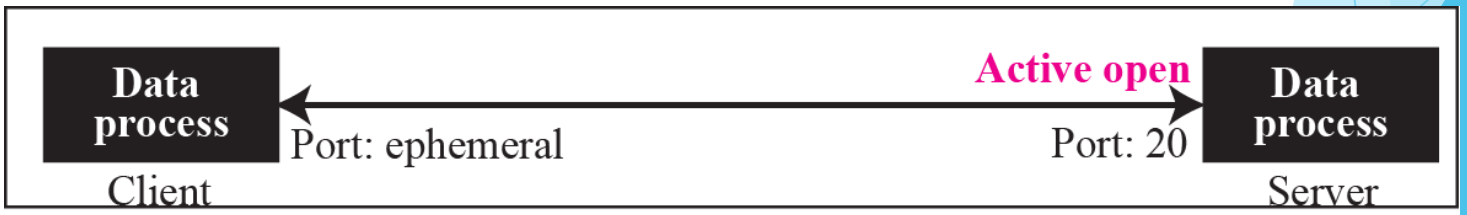
b. Later, active open by client

Creating the data connection

a. First, passive open by client

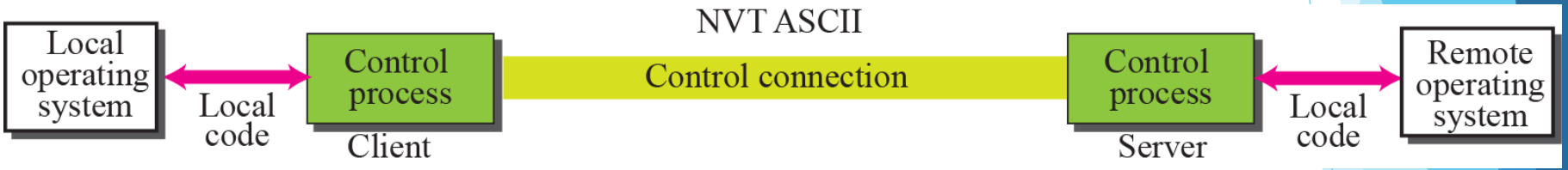


b. Second, sending of ephemeral port

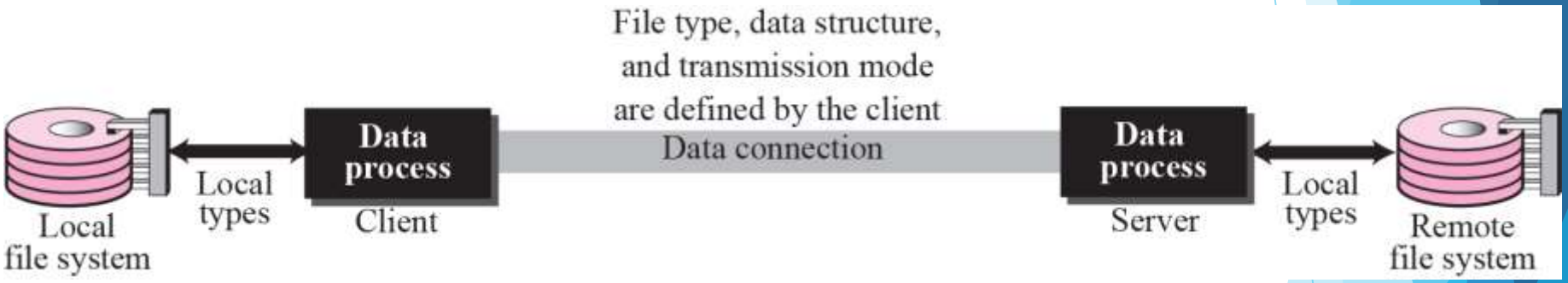


c. Third, active open by server

Using the control connection



Using the data connection



Command processing

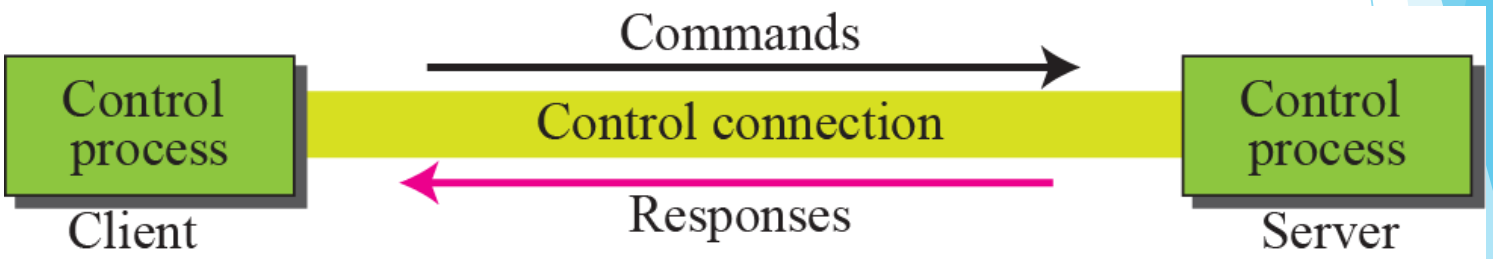


Table 21.1 *Access commands*

Command	*Argument(s)*	*Description*
USER	User id	User information
PASS	User password	Password
ACCT	Account to be charged	Account information
REIN		Reinitialize
QUIT		Log out of the system
ABOR		Abort the previous command

Table 21.2 *File management commands*

Command	*Argument(s)*	*Description*
CWD	Directory name	Change to another directory
CDUP		Change to parent directory
DELE	File name	Delete a file
LIST	Directory name	List subdirectories or files
NLIST	Directory name	List subdirectories or files without attributes
MKD	Directory name	Create a new directory
PWD		Display name of current directory
RMD	Directory name	Delete a directory
RNFR	File name (old)	Identify a file to be renamed
RNTO	File name (new)	Rename the file
SMNT	File system name	Mount a file system

Table 21.4 *Port defining commands*

Command	*Argument(s)*	*Description*
PORT	6-digit identifier	Client chooses a port
PASV		Server chooses a port

Table 21.6 *Miscellaneous commands*

Command	*Argument(s)*	*Description*
HELP		Ask information about the server
NOOP		Check if server is alive
SITE	Commands	Specify the site-specific commands
SYST		Ask about operating system used by the server

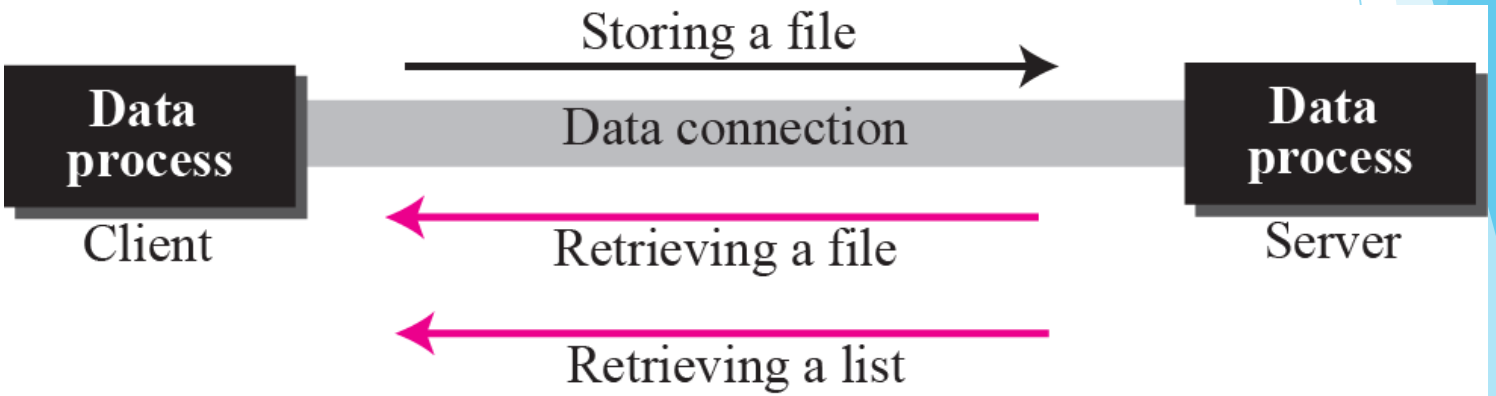
Table 21.7 *Responses*

Code	*Description*
Positive Preliminary Reply	
120	Service will be ready shortly
125	Data connection open; data transfer will start shortly
150	File status is OK; data connection will be open shortly
Positive Completion Reply	
200	Command OK
211	System status or help reply
212	Directory status
213	File status
214	Help message
215	Naming the system type (operating system)
220	Service ready
221	Service closing
225	Data connection open
226	Closing data connection
227	Entering passive mode; server sends its IP address and port number
230	User login OK
250	Request file action OK
Positive Intermediate Reply	
331	User name OK; password is needed
332	Need account for logging
350	The file action is pending; more information needed

Table 21.7 *Responses (continued)*

Code	*Description*
Transient Negative Completion Reply	
425	Cannot open data connection
426	Connection closed; transfer aborted
450	File action not taken; file not available
451	Action aborted; local error
452	Action aborted; insufficient storage
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 parameter not implemented
530	User not logged in
532	Need account for storing file
550	Action is not done; file unavailable
552	Requested action aborted; exceeded storage allocation
553	Requested action not taken; file name not allowed

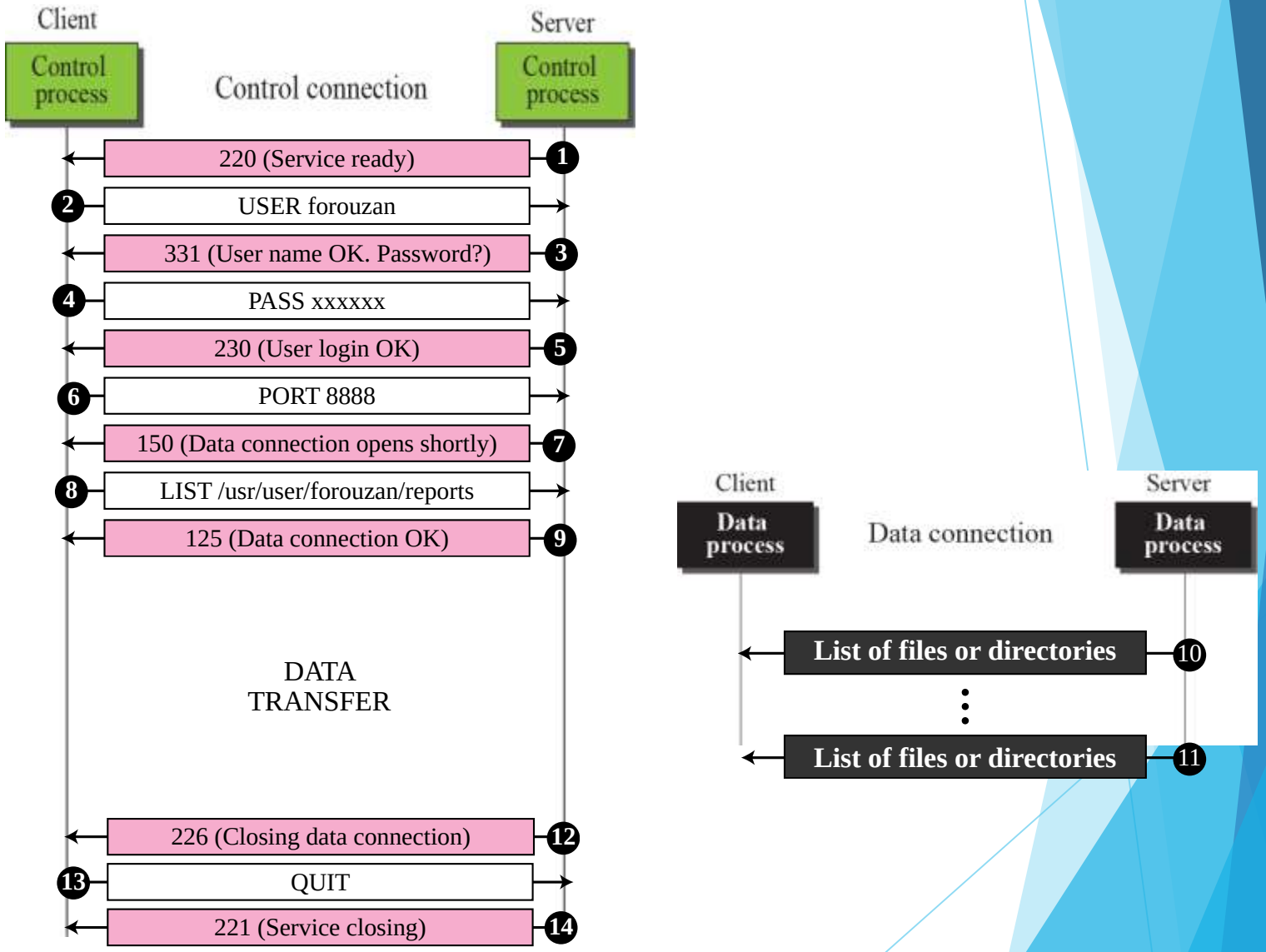
File transfer



Example

Figure 21.8 shows an example of using FTP for retrieving a list of items in a directory.

Example 21.1

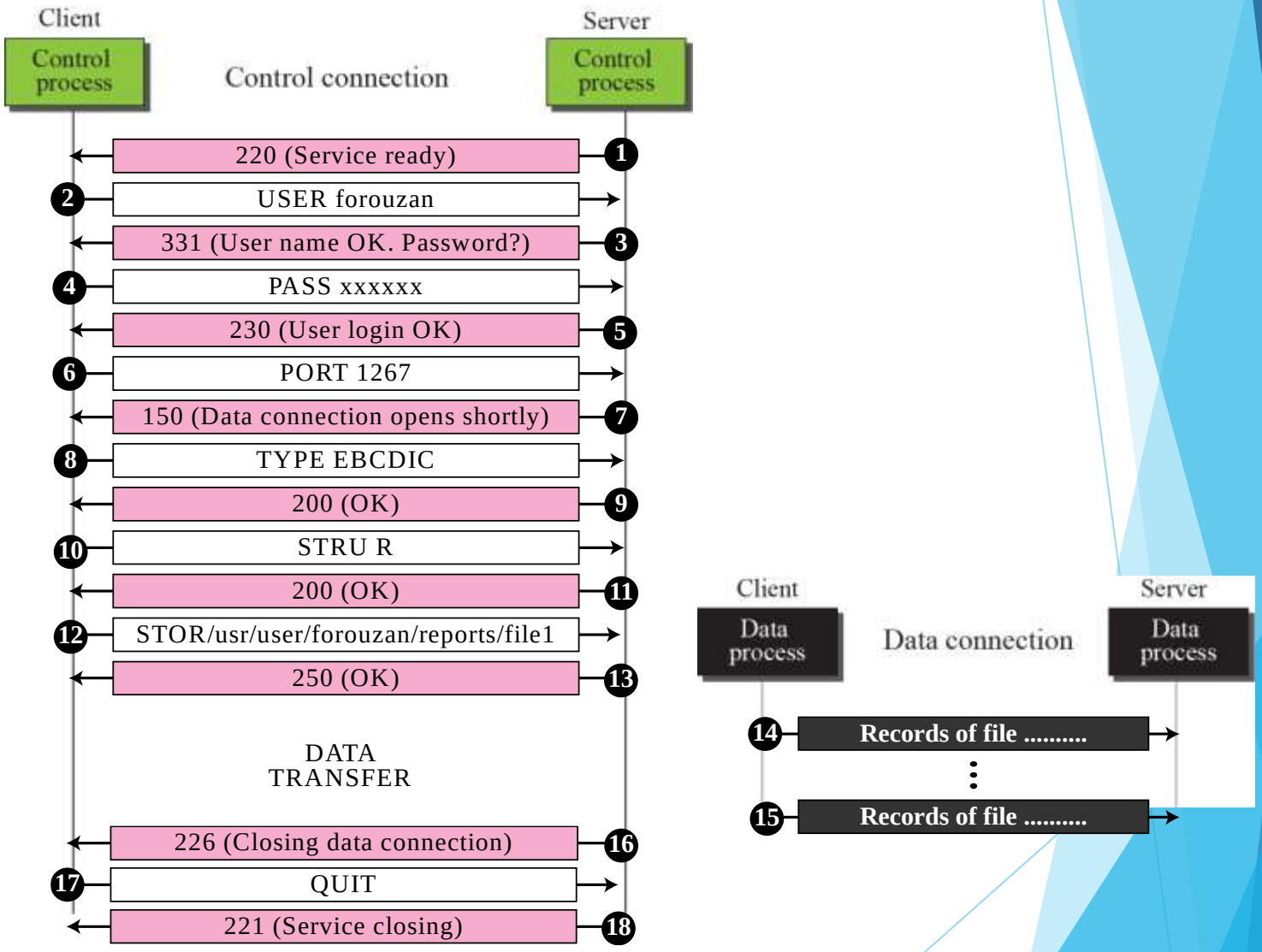

Client
Server
Control process
Control connection
Control process
220 (Service ready)
1
2
USER forouzan
331 (User name OK. Password?)
3
4
PASS xxxxxx
230 (User login OK)
5
6
PORT 8888
150 (Data connection opens shortly)
7
8
LIST /usr/user/forouzan/reports
125 (Data connection OK)
9
Client
Server
Data process
Data connection
Data process
DATA TRANSFER
List of files or directories
10
List of files or directories
11
226 (Closing data connection)
12
13
QUIT
221 (Service closing)
14

Example

The following shows an actual FTP session that parallels Example 21.1. The colored lines show the responses from the server control connection; the black lines show the commands sent by the client. The lines in white with black background show data transfer.

```
$ ftp voyager.deanza.fhda.edu
Connected to voyager.deanza.fhda.edu.
220 (vsFTPd 1.2.1)
530 Please login with USER and PASS.
Name (voyager.deanza.fhda.edu:forouzan): forouzan
331 Please specify the password.
Password:
230 Login successful.
Remote system type is UNIX.
Using binary mode to transfer files.
ftp> ls reports
227 Entering Passive Mode (153,18,17,11,238,169)
150 Here comes the directory listing.
drwxr-xr-x   2    3027    411    4096   Sep 24   2002    business
drwxr-xr-x   2    3027    411    4096   Sep 24   2002    personal
drwxr-xr-x   2    3027    411    4096   Sep 24   2002    school
226 Directory send OK.
ftp> quit
221 Goodbye.
```

Example 21.3


Client
Server
Control process
Control connection
Control process
220 (Service ready)
1
2
USER forouzan
331 (User name OK. Password?)
3
4
PASS xxxxxx
230 (User login OK)
5
6
PORT 1267
150 (Data connection opens shortly)
7
8
TYPE EBCDIC
200 (OK)
9
10
STRU R
200 (OK)
11
12
STOR/usr/user/forouzan/reports/file1
250 (OK)
13
DATA
TRANSFER
226 (Closing data connection)
16
17
QUIT
221 (Service closing)
18
Client
Server
Data process
Data connection
Data process
14
Records of file .....
15
Records of file .....

Example

We show an example of anonymous FTP. We assume that some public data are available at internic.net.

```
$ ftp internic.net
Connected to internic.net
220 Server ready
Name: anonymous
331 Guest login OK, send "guest" as password
Password: guest
ftp > pwd
257 '/' is current directory
ftp > ls
200 OK
150 Opening ASCII mode
bin
. . .
. . .
. . .
ftp > close
221 Goodbye
ftp > quit
```

Electronic Mail: SMTP, POP, and IMAP

ARCHITECTURE

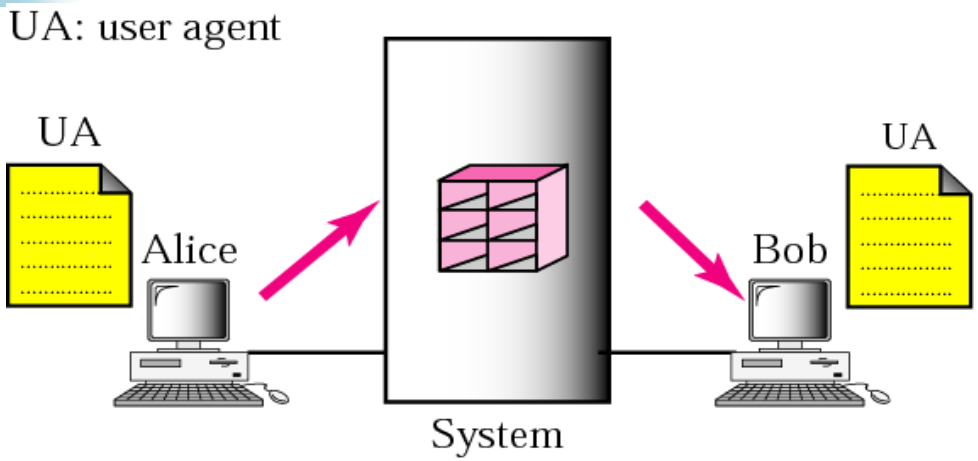
To explain the architecture of email, we give four scenarios. We begin with the simplest situation and add complexity as we proceed. The fourth scenario is the most common in the exchange of email.

User Agent - software program that composes, reads, replies to, and forwards messages. It also handles mailboxes.

Message Transfer Agent - the actual mail transfer is done through message transfer agents. SMTP is an example of an MTA.

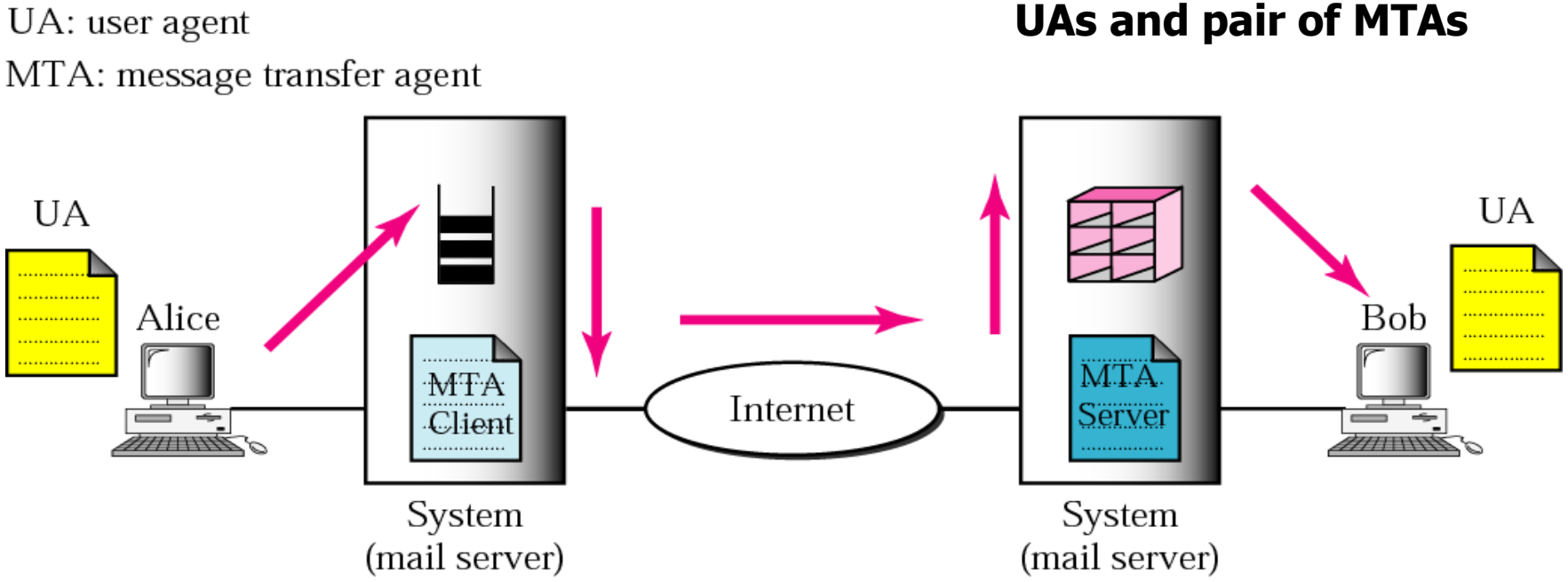
Message Access Agent - the software that pulls messages out of a mailbox. POP3 and IMAP4 are examples of MAAs.

First and second scenario

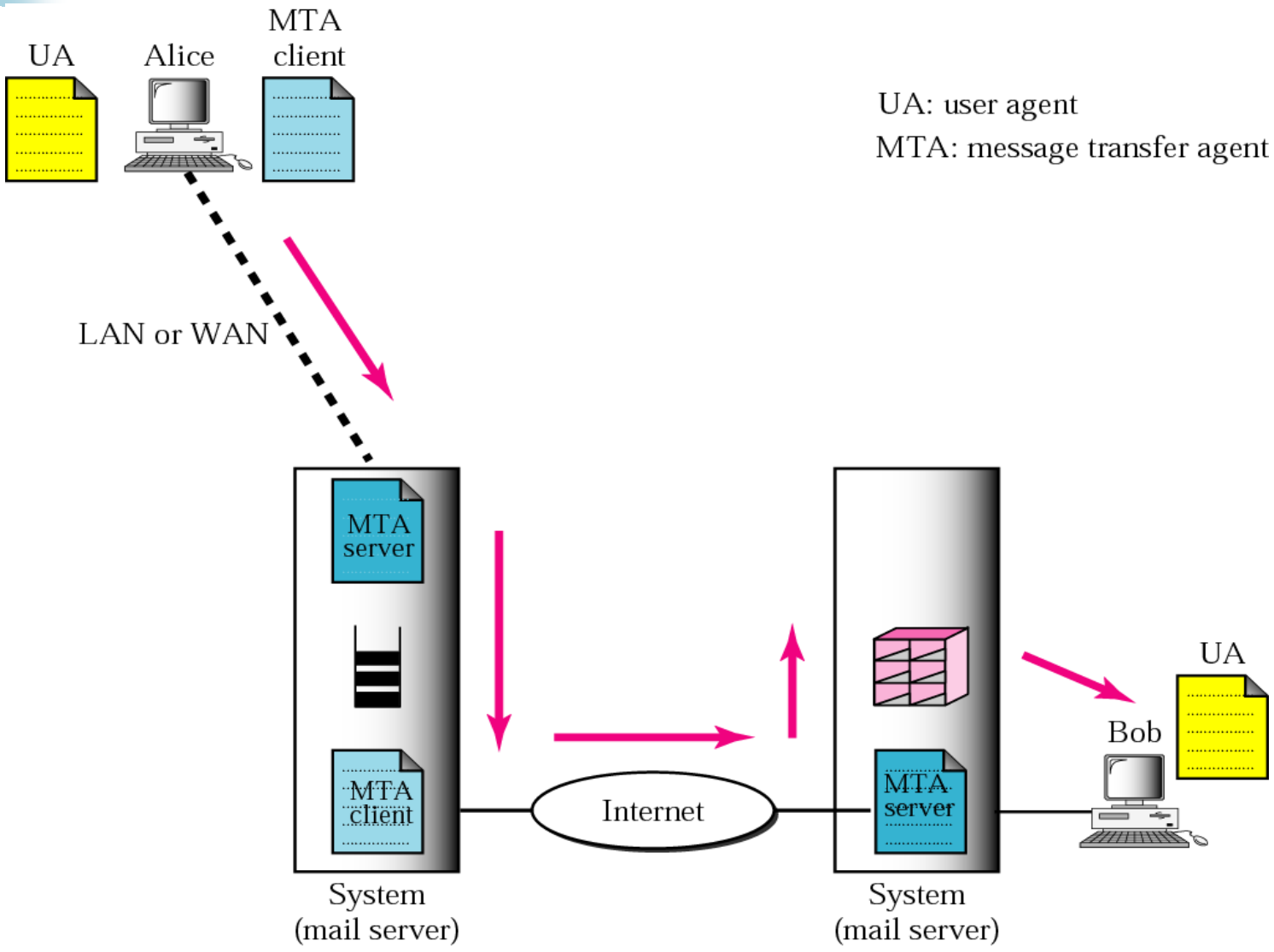


First scenario: sender and receiver on same system so need only two UAs.

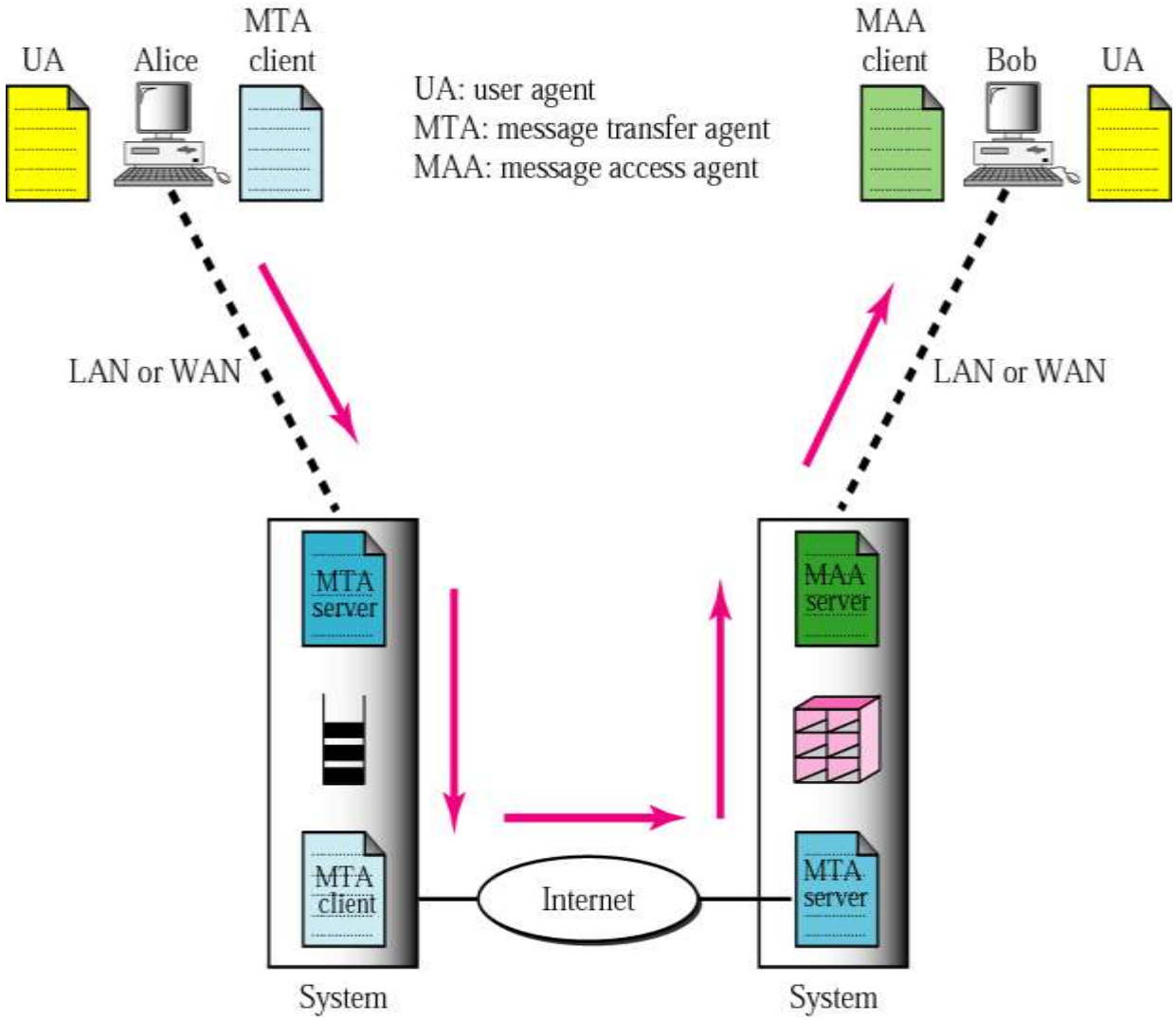
Second scenario: sender and receiver on different systems so need two UAs and pair of MTAs



Third scenario



Fourth scenario



When both sender and receiver are connected to the mail server via a LAN or a WAN, we need
two UAs, two pairs of MTAs (client and server),and a pair of MAAs (client and server).
This is the most common situation today.

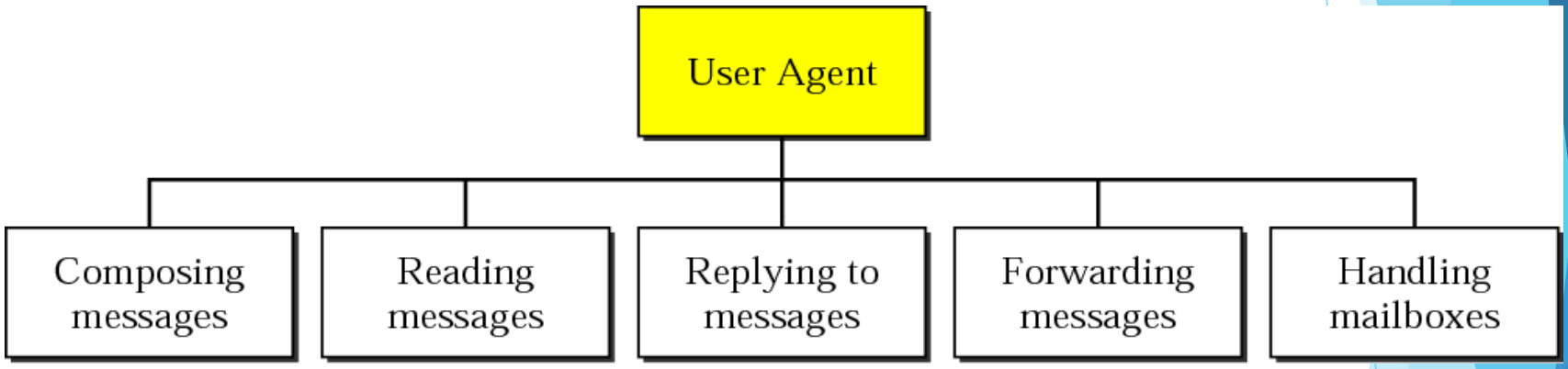
USER AGENT

The user agent (UA) provides service to the user to make the process of sending and receiving a message easier.

The topics discussed in this section include:

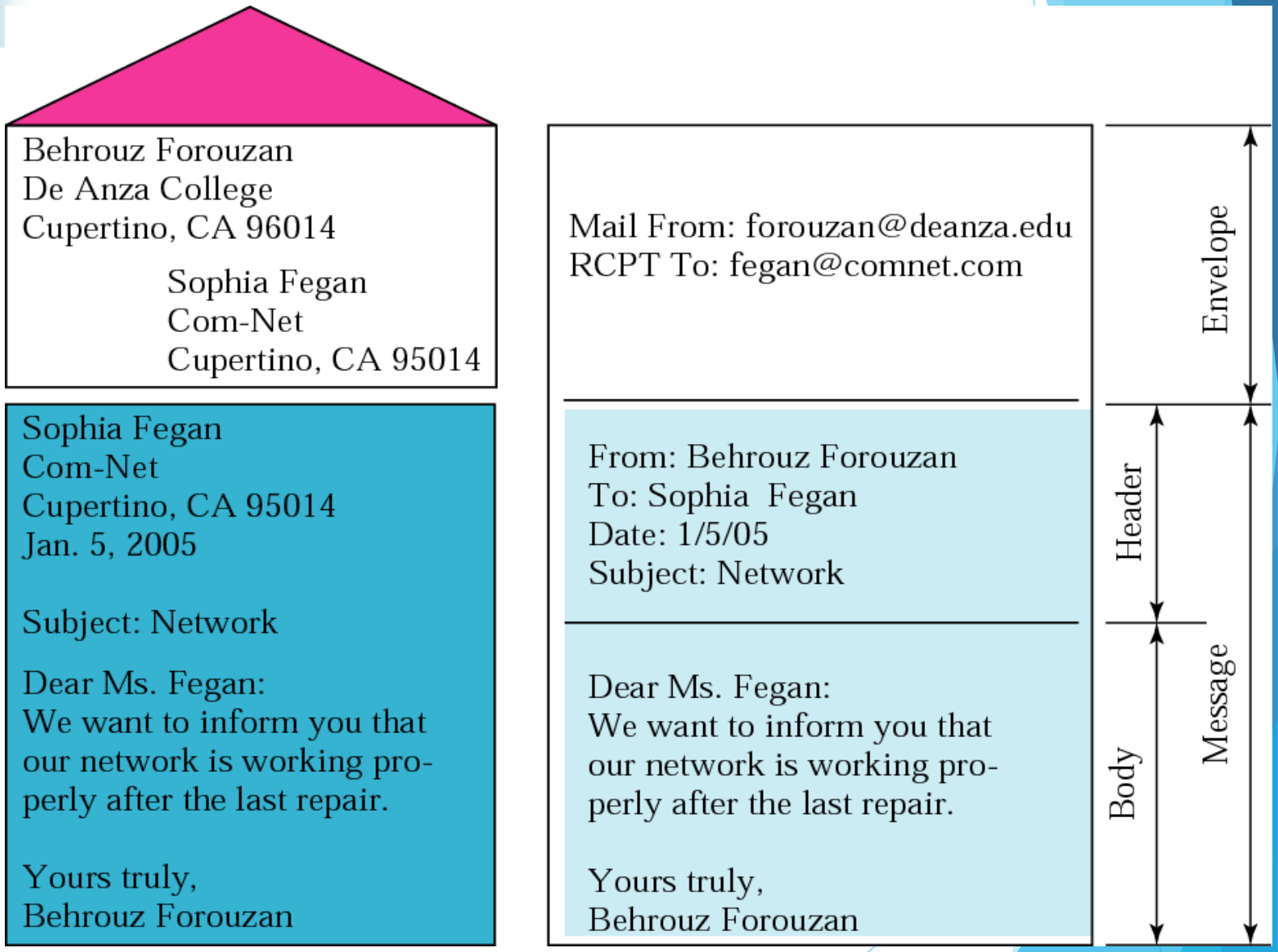
Services Provided by a User Agent
User Agent Types
Sending Mail
Receiving Mail
Addresses
Mailing List
MIME

User agent

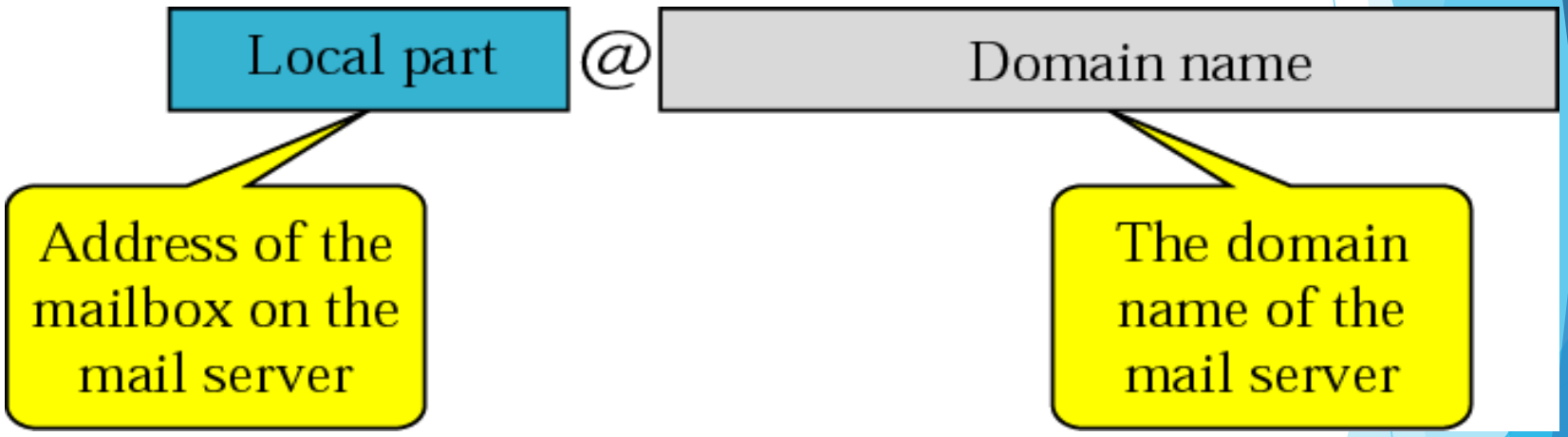


Like many applications, email programs can be command driven or GUI-based.

Format of an email



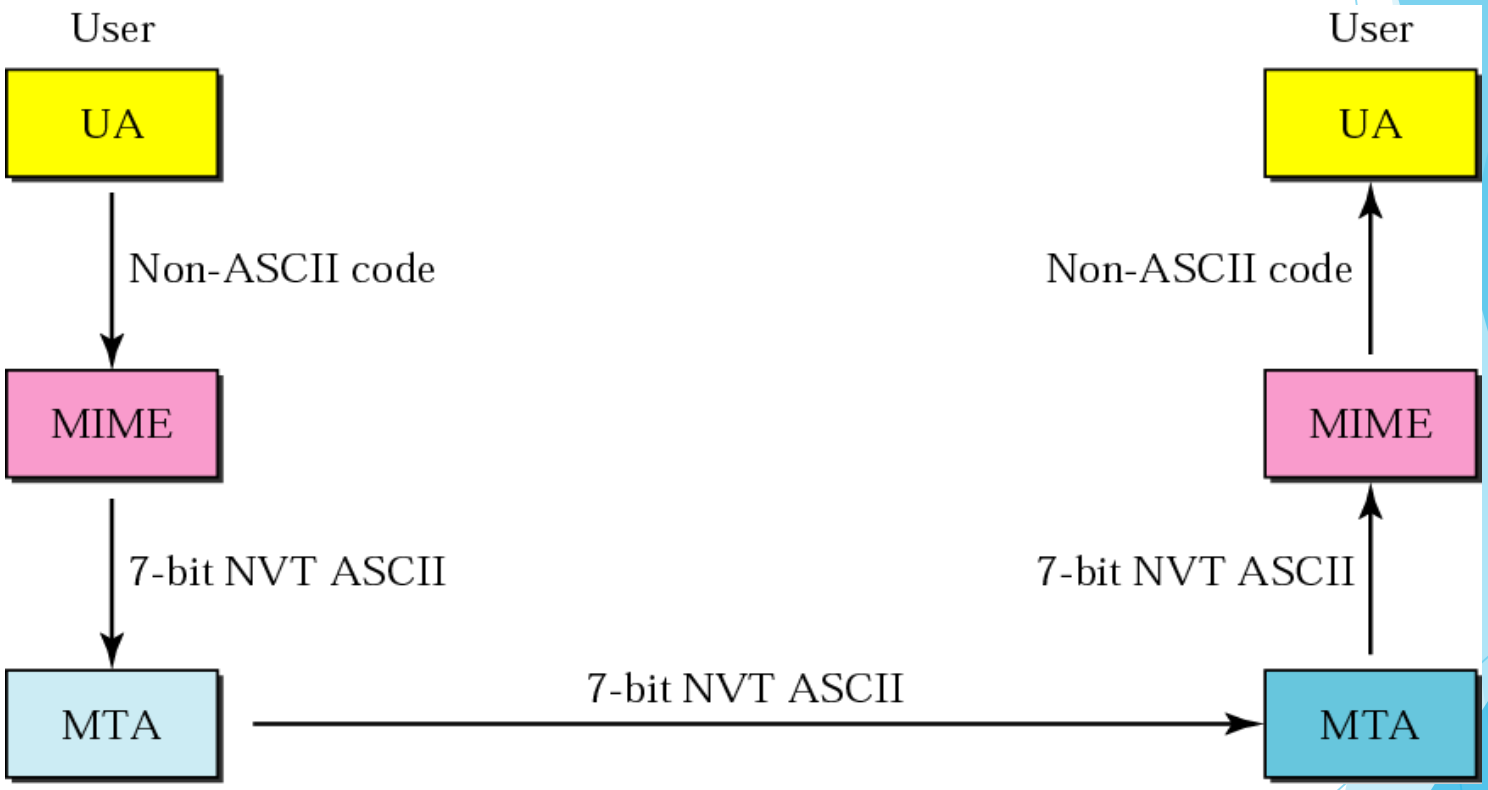
Email address



Email also allows one name, an alias, to represent several different email addresses: this is called a *mailing list*. Every time an email is sent, the system checks the recipient's name against the alias database.

MIME

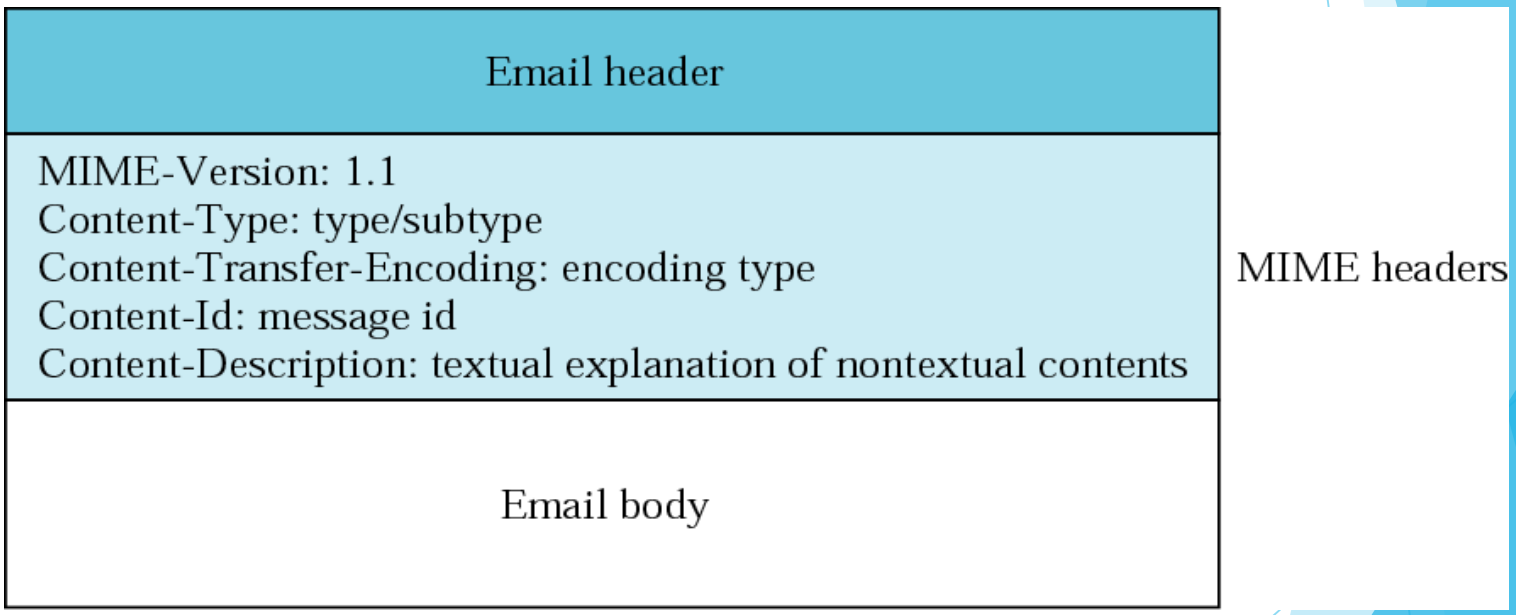
Email can only send messages composed of 7-bit NVT ASCII. (NVT = network virtual terminal) What if you tried to send a file that was not in 7-bit ASCII?



MIME (Multipurpose Internet Mail Extensions) allows an email system to send non-ASCII data.

MIME header

MIME defines 5 headers that can be added to the original email header section to define the transformation parameters:



MIME version is currently 1.1

MIME allows seven different types of data (five of those have subtypes).

Table 20.1 Data types and subtypes in MIME

Type	*Subtype*	*Description*
Text	Plain	Unformatted
	HTML	HTML format (see Chapter 22)
Multipart	Mixed	Body contains ordered parts of different data types
	Parallel	Same as above, but no order
	Digest	Similar to Mixed, but the default is message/RFC822
	Alternative	Parts are different versions of the same message

Text: the original message is in 7-bit ASCII and no transformation by MIME is needed.

Type	*Subtype*	*Description*
Text	Plain	Unformatted
	HTML	HTML format (see Chapter 22)
Multipart	Mixed	Body contains ordered parts of different data types
	Parallel	Same as above, but no order
	Digest	Similar to Mixed, but the default is message/RFC822
	Alternative	Parts are different versions of the same message

Multipart: the body contains multiple, independent parts. Some type of boundary is defined and this boundary is used to separate the parts. For example:

```
Content-Type: multipart/mixed; boundary=xxxx
        --xxxx
        Content-type: text/plain;
        ……….
        --xxxx
        Content-type: image/gif;
        ……….
        --xxxx--
```

Data types and subtypes in MIME (Continued)

Type	*Subtype*	*Description*
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 (eight-bit bytes)

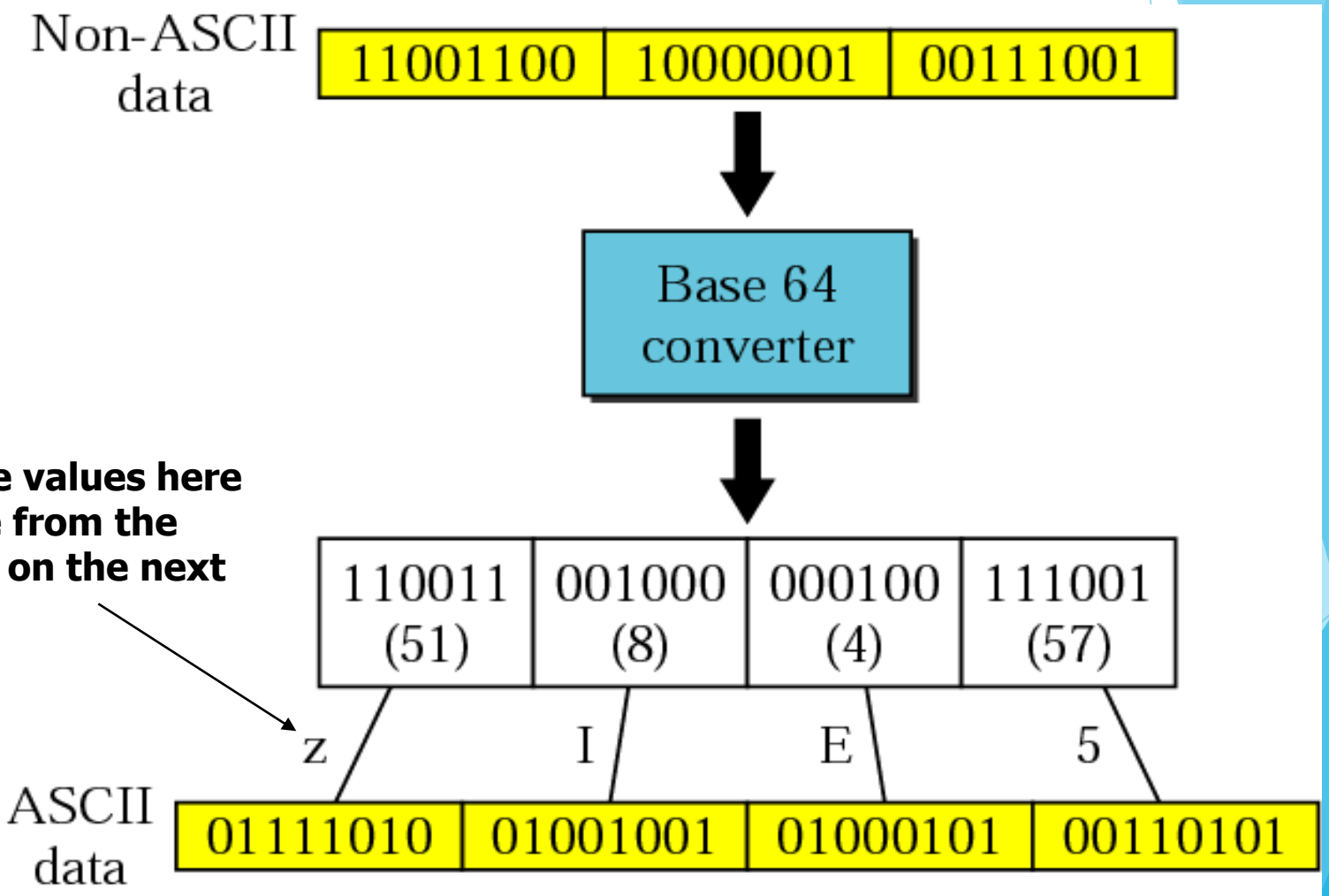
Video: MPEG - if the video includes sound, then the sound must be sent separately using the audio content type

Application: Octet-stream - used for binary files

The next header defines the method used to encode the messages into 0s and 1s for transport.

Content-transfer-encoding

Type	*Description*
7bit	NVT ASCII characters and short lines
8bit	Non-ASCII characters and short lines
Binary	Non-ASCII characters with unlimited-length lines
Base64	6-bit blocks of data are encoded into 8-bit ASCII characters
Quoted-printable	Non-ASCII characters are encoded as an equal sign followed by an ASCII code



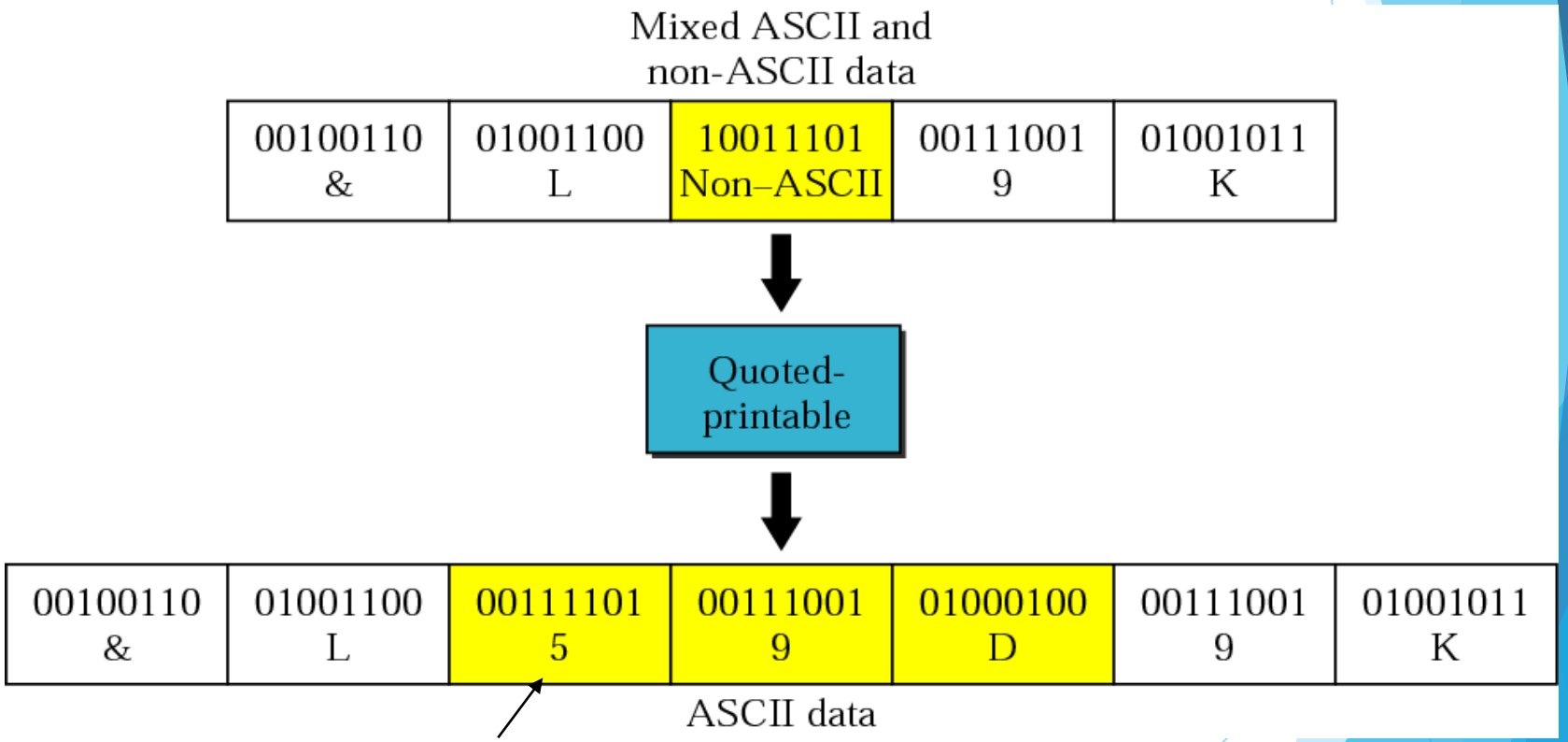
These values here come from the table on the next slide.

Base64 encoding table

Value	*Code*	*Value*	*Code*	*Value*	*Code*	*Value*	*Code*	*Value*	*Code*	*Value*	*Code*
0	**A**	11	**L**	22	**W**	33	**h**	44	**s**	55	**3**
1	**B**	12	**M**	23	**X**	34	**i**	45	**t**	56	**4**
2	**C**	13	**N**	24	**Y**	35	**j**	46	**u**	57	**5**
3	**D**	14	**O**	25	**Z**	36	**k**	47	**v**	58	**6**
4	**E**	15	**P**	26	**a**	37	**l**	48	**w**	59	**7**
5	**F**	16	**Q**	27	**b**	38	**m**	49	**x**	60	**8**
6	**G**	17	**R**	28	**c**	39	**n**	50	**y**	61	**9**
7	**H**	18	**S**	29	**d**	40	**o**	51	**z**	62	+
8	**I**	19	**T**	30	**e**	41	**p**	52	**0**	63	/
9	**J**	20	**U**	31	**f**	42	**q**	53	**1**		
10	**K**	21	**V**	32	**g**	43	**r**	54	**2**		

Quoted-printable

Base-64 has a 25% overhead. If the data has a high percentage of ASCII characters already, then use this technique. (Not as common as Base-64.)



= sign (not a 5)

9D is ASCII rep of hex data

delivery delay

- **a user is receiving delivery delay notifications, the message is most likely still queued for outgoing delivery on the MailEnable server.** Determine why messages are generating delay notifications by reviewing the SMTP Activity and Debug logs.

Aliases

- Email aliases can be created on a mail server. The mail server simply forwards email messages addressed to an email alias on to another, the specified email address. An email alias may be used to create a simple replacement for a long or difficult-to-remember email address. It can also be used to create a generic email address such as webmaster@example.com and info@example…

MESSAGE TRANSFER AGENT: SMTP

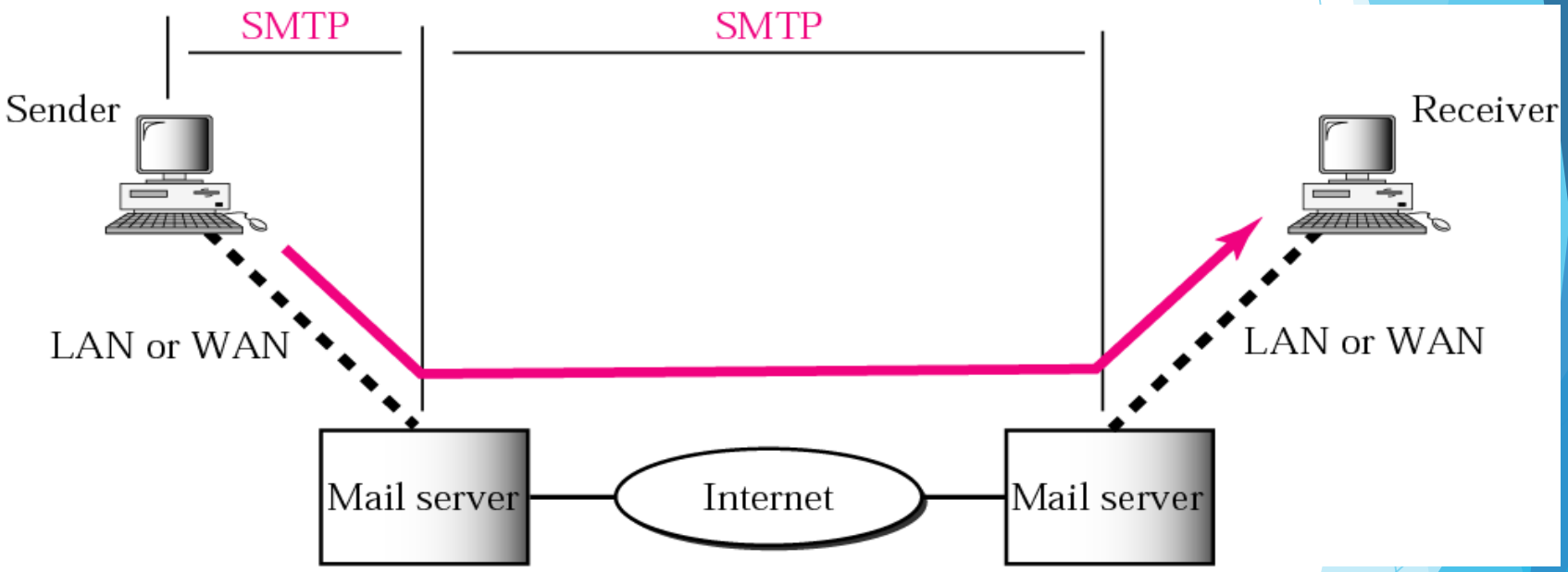
The actual mail transfer requires message transfer agents (MTAs). The protocol that defines the MTA client and server in the Internet is called Simple Mail Transfer Protocol (SMTP).

The topics discussed in this section include:

Commands and Responses
Mail Transfer Phases

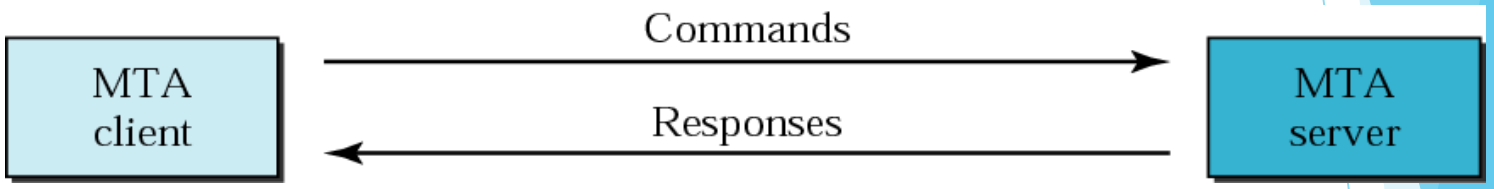
SMTP range

SMTP is used once between Sender and Sender's mail server, and then again between the two mail servers.



Commands and responses

Commands are sent from client to server; responses vice versa.



Commands consist of keyword followed by zero or more arguments.

14 different commands. First 5 are required by all institutions.

Next 3 are often used and highly recommended.

Last 6 are seldom used.

And the commands are……

Commands

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

Commands

HELO - used by client to identify himself. The argument is the domain name of the client host.
HELO: cs.depaul.edu

MAIL FROM - Used to identify the sender of the message
MAIL FROM:cwhite@cs.depaul.edu

RCPT TO - used by client to identify the intended recipient of the message. If multiple recipients, the command is repeated.
RCPT TO: myers@trinity.edu

DATA - all lines that follow the DATA command are treated as the mail message. The message is terminated by a line containing just one period.

QUIT - this command terminates the message

Commands

RSET - aborts the current mail transaction. The stored information about the sender and recipient is deleted.

VRFY - used to verify the address of the recipient, which is sent as the argument.
VRFY: myers@trinity.edu

NOOP - used by the client to check the status of the recipient. It requires an answer from the recipient.

Responses

Responses are 3-digit codes

Codes that begin with a 2 are positive completions etc.

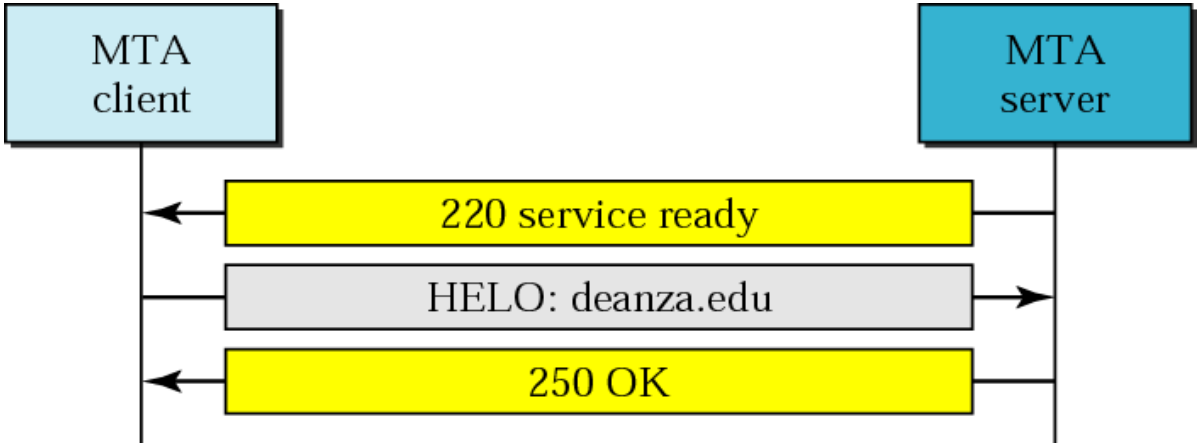
Code	*Description*
Positive Completion Reply	
211	System status or help reply
214	Help message
220	Service ready
221	Service closing transmission channel
250	Request command completed
251	User not local; the message will be forwarded
Positive Intermediate Reply	
354	Start mail input
Transient Negative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

Responses (Continued)

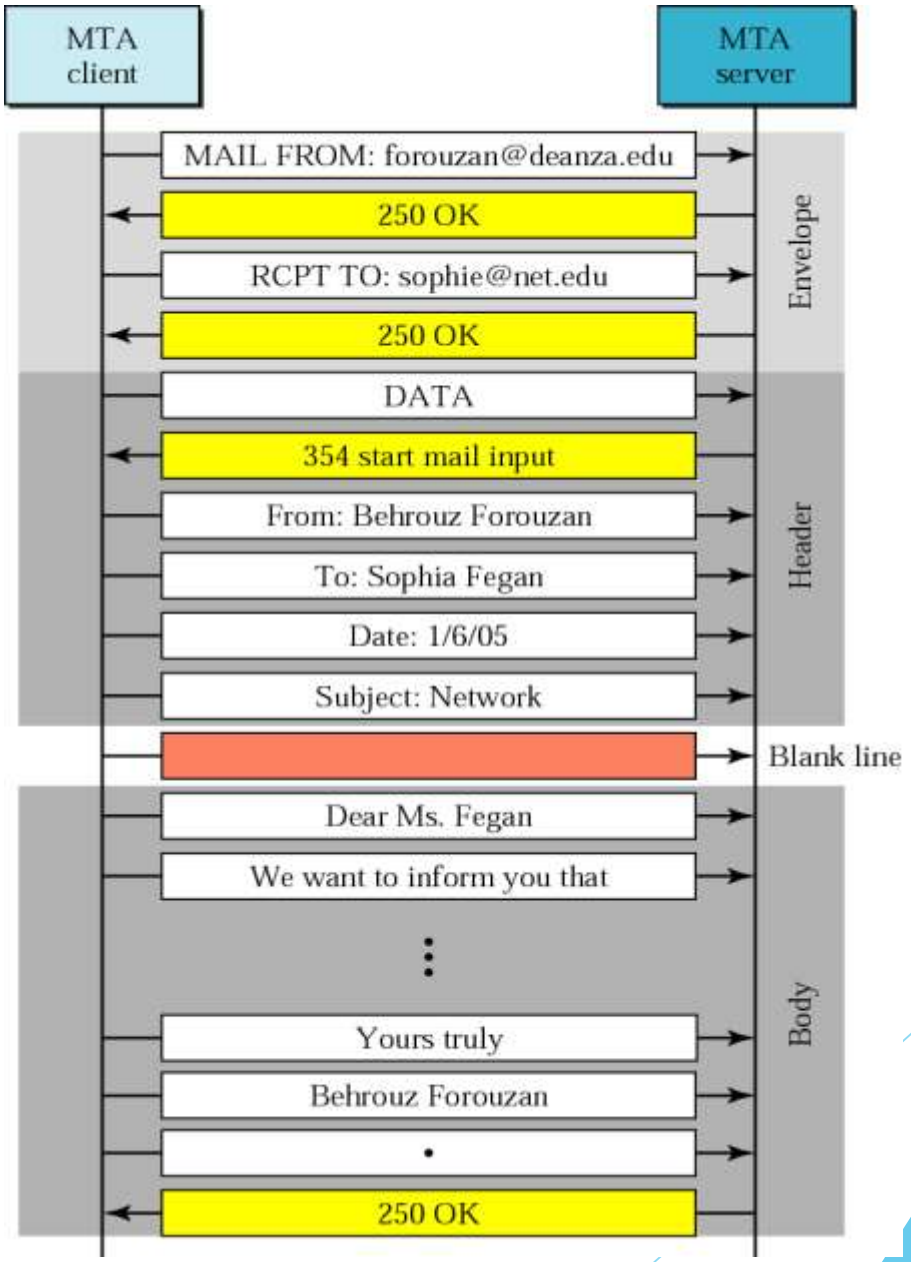
Permanent Negative Completion Reply	
500	Syntax error; unrecognized command
501	Syntax error in parameters or arguments
502	Command not implemented
503	Bad sequence of commands
504	Command temporarily not implemented
550	Command is not executed; mailbox unavailable
551	User not local
552	Requested action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

Connection establishment

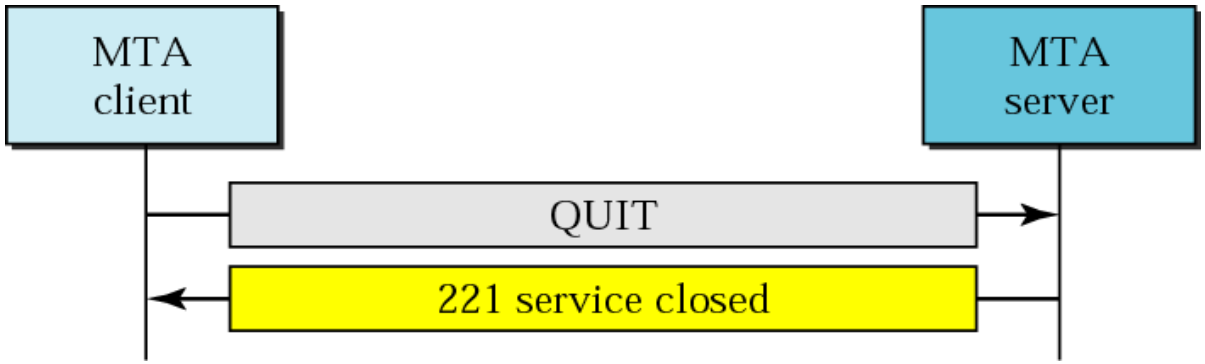
The process of transferring a mail message occurs in three phases: connection establishment, mail transfer, and connection termination.



Message transfer



Connection termination



MESSAGE ACCESS AGENT: POP AND IMAP

The third stage of mail delivery uses a message access agent; the client must pull messages from the server. Currently two message access protocols are available: Post Office Protocol, version 3 (POP3) and Internet Mail Access Protocol, version 4.

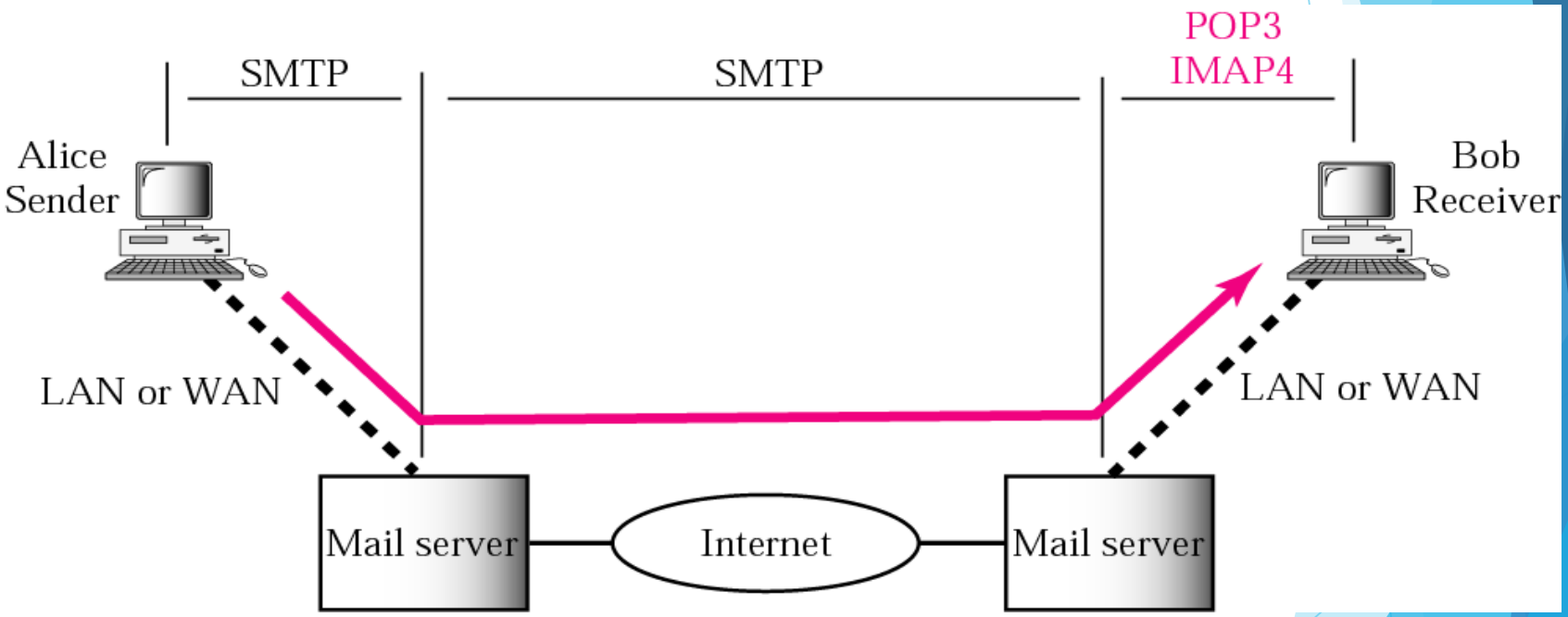
The topics discussed in this section include:

POP3
IMAP4

Mail Transfer Phases

- To transfer mails, SMTP uses three phases i.e. **connection establishment, mail transfer** and connection termination and commands which are used to send data from client to server and responses which is used to send data from server to client. It can also perform the following tasks: It can transmit a message to more than one recipient.

POP3 and IMAP4



POP3 is simple and limited in functionality.

Need POP3 client on user machine and POP3 server on the mail server machine.

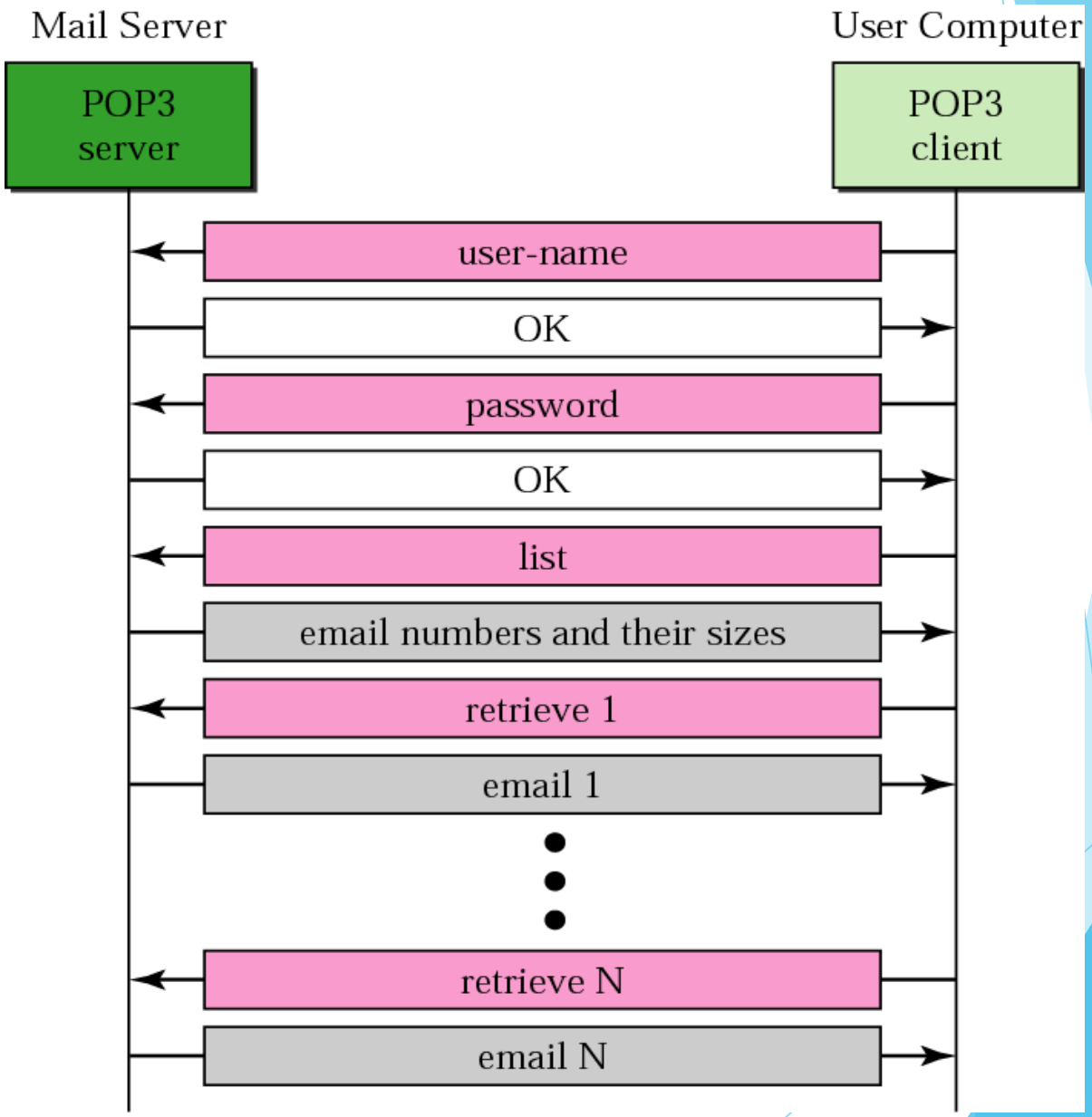
The client opens a connection to the server on TCP port 110.

It then sends its user name and password to access the mailbox.

User can then access the email.

Example on next slide:

POP3


Mail Server
User Computer
POP3 server
POP3 client
user-name
OK
password
OK
list
email numbers and their sizes
retrieve 1
email 1
retrieve N
email N

IMAP is more powerful and more complex than POP3.

In particular, with IMAP:

A user can check the email header prior to downloading

A user can search the contents of the email for a specific string of characters prior to downloading

A user can partially download email (helpful if email contains huge attachments and connection is slow

A user can create, delete, or rename mailboxes on the mail server

A user can create a hierarchy of mailboxes in a folder for email storage

Multipurpose Internet Mail Extensions (MIME)

- MIME (Multi-Purpose Internet Mail Extensions) is an **extension of the original Internet e-mail protocol** that lets people use the protocol to exchange different kinds of data files on the Internet: audio, video, images, application programs, and other kinds, as well as the ASCII text handled in the original protocol, the Simple Mail Transport Protocol (SMTP).

Mail Delivery

- SMTP is a **delivery protocol only**. In normal use, mail is "pushed" to a destination mail server (or next-hop mail server) as it arrives. Mail is routed based on the destination server, not the individual user (s) to which it is addressed.

Mail access protocols

- There are currently a number of popular mail access protocols, including Post Office Protocol- Version 3 (POP3), Internet Mail Access Protocol (IMAP), and HTTP. The protocols that are used for internet mail: SMTP is used to transfer mail from the sender's mail server to the recipients mail server

Thank you

The Content in this Material are from the Textbooks and Reference books given in the Syllabus