COMPUTER NETWORK

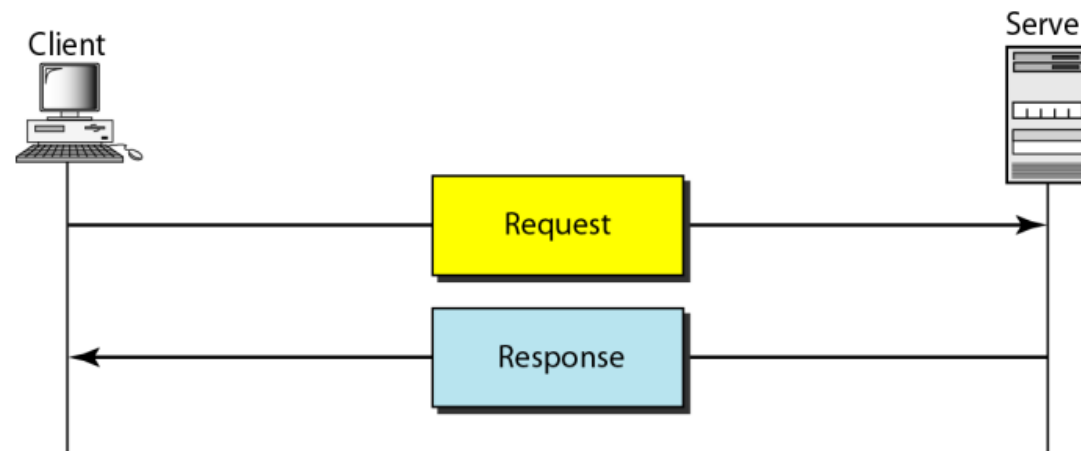## UNIT 6: APPLICATION LAYER

Prof. Ishani Saha
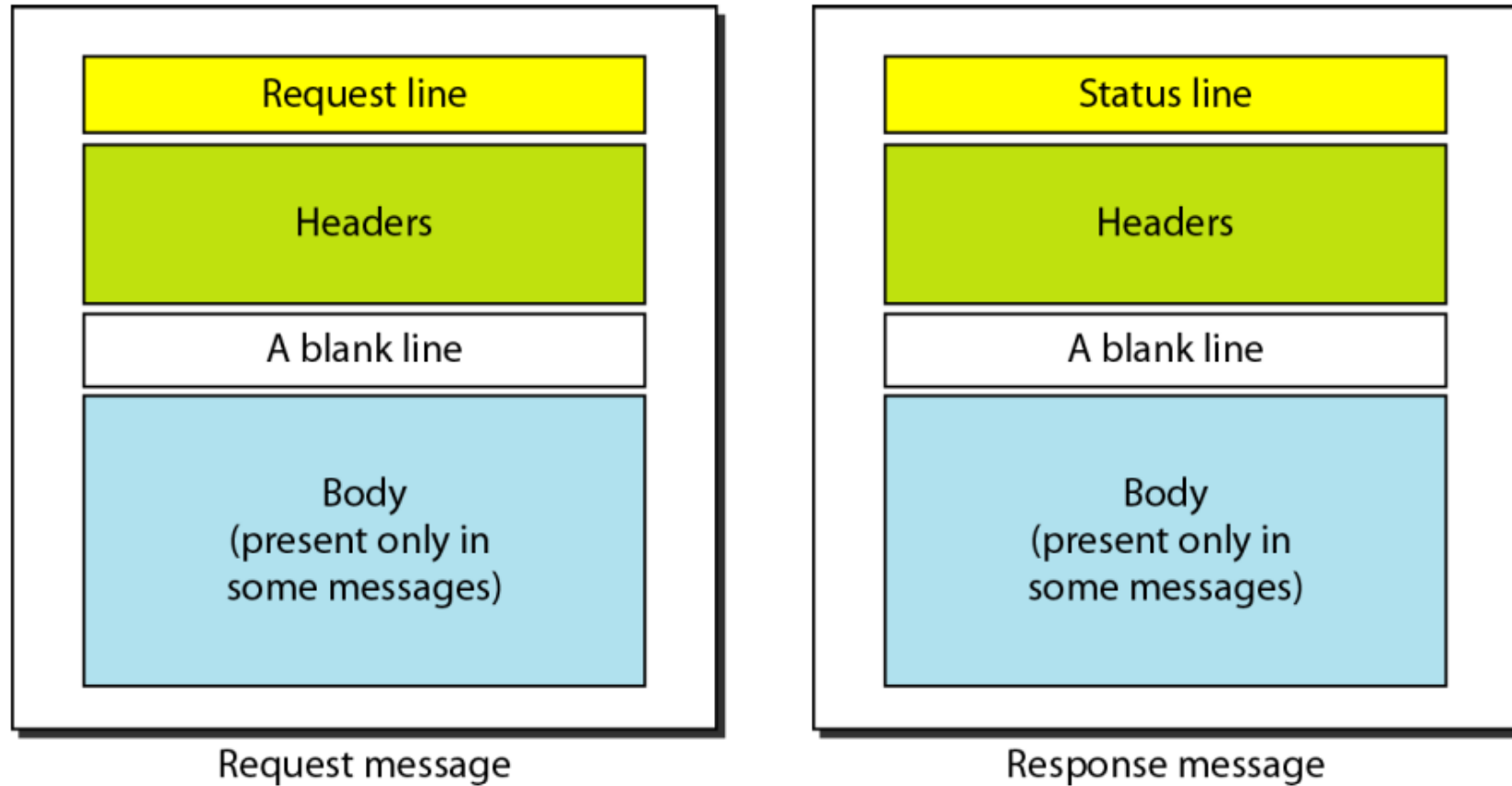
TOPICS

- HTTP
- DNS
- FTP
- SMTP

HTTP

- The Hypertext Transfer Protocol (HTTP) is a protocol used mainly to access data on the World Wide Web.

- HTTP uses the services of TCP on well-known port 80.
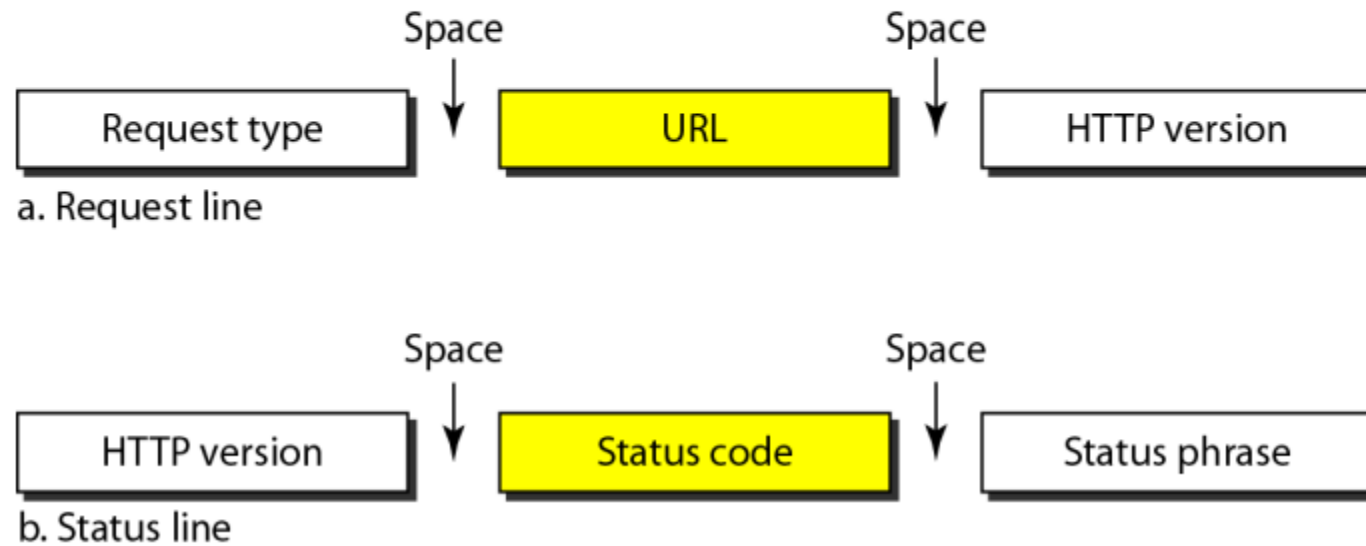

Figure 27.12 *HTTP transaction*

HTTP

Figure 27.13 Request and response messages

Request message:
- Request line
- Headers
- A blank line
- Body (present only in some messages)

Response message:
- Status line
- Headers
- A blank line
- Body (present only in some messages)

HTTP

Figure 27.14 *Request and status lines*

Space   Space

| Request type | URL | HTTP version |

a. Request line

Space   Space

| HTTP version | Status code | Status phrase |

b. Status line

HTTP

Table 27.1 *Methods*

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

Table 27.2 *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.

HTTP

Non persistent connection

- In a Non persistent connection ,one TCP connection is made for each request/response.

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.

Persistent connection

HTTP version 1.1 specifies a persistent connection by default.

The server leaves the connection open for more requests after sending a response.

DNS

- There are several applications in the application layer of the Internet model that follow the client/server paradigm.

- The client/server programs can be divided into two categories: those that can be directly used by the user, such as e-mail, and those that support other application programs.

- The Domain Name System (DNS) is a supporting program that is used by other programs such as e-mail.
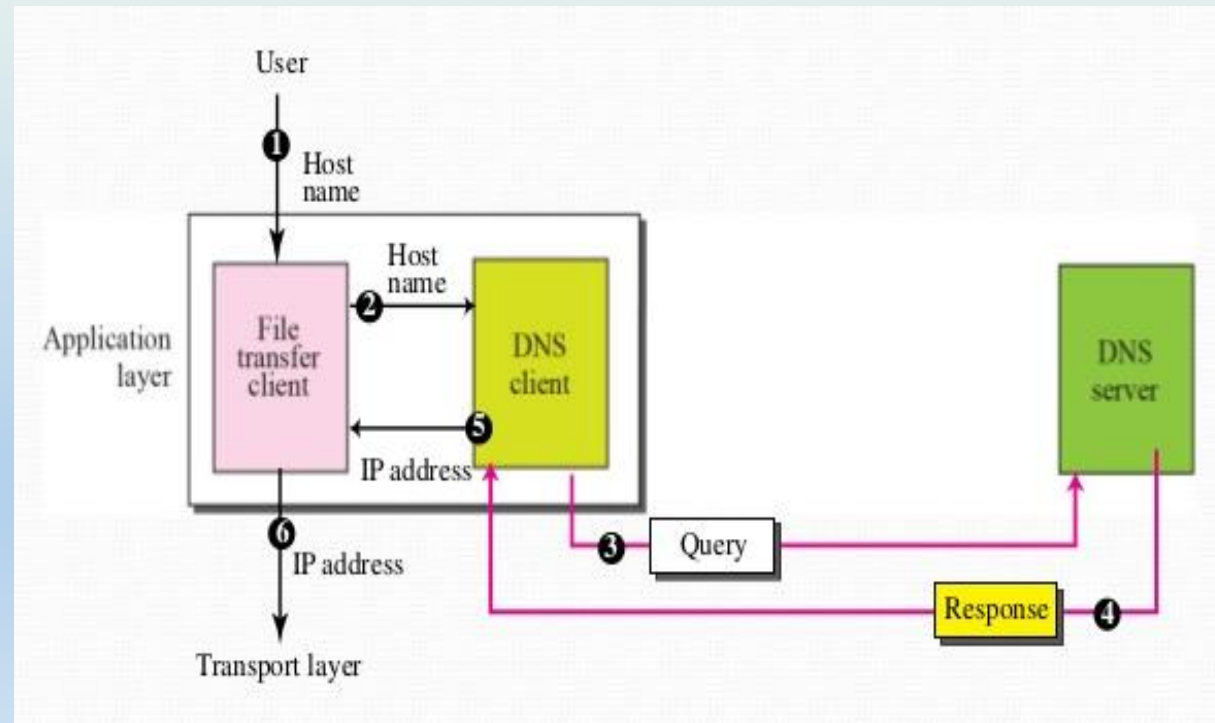
NAMESPACE

- The names assigned to machines must be unique because the addresses are unique.

- A namespace is organized in two ways:

1. Flat

- In a flat name space, a name is assigned to an address.

- A name in this space is a sequence of characters without structure. The names may or may not have a common section; if they do, it has no meaning.

2. Hierarchical

- In a hierarchical name space, each name is made of several parts.

- The first part can define the nature of the organization, the second part can define the name of an organization, the third part can define departments in the organization, and so on.
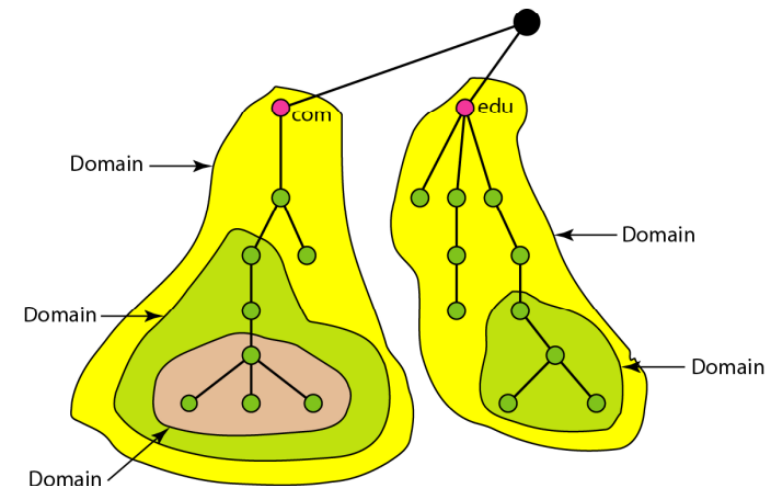
DOMAIN NAME SPACE

- In this design the names are defined in an inverted tree structure with root at the top.
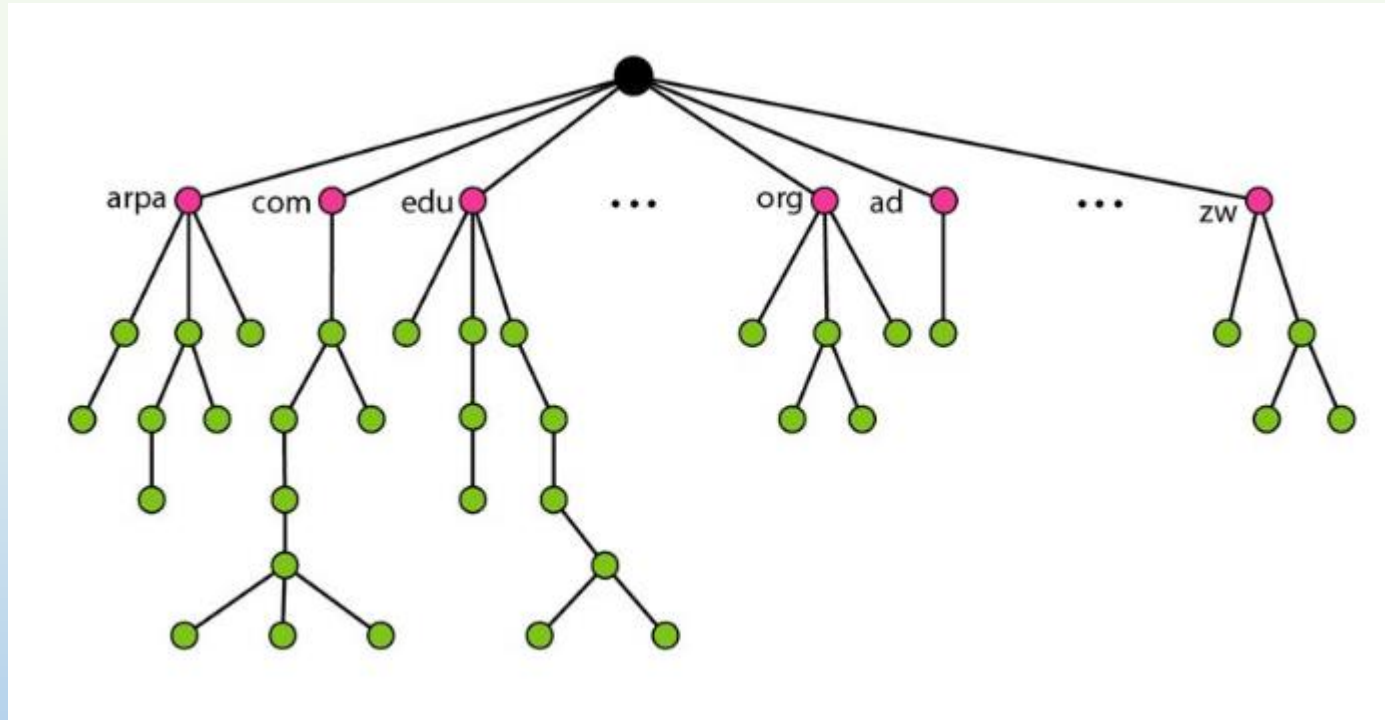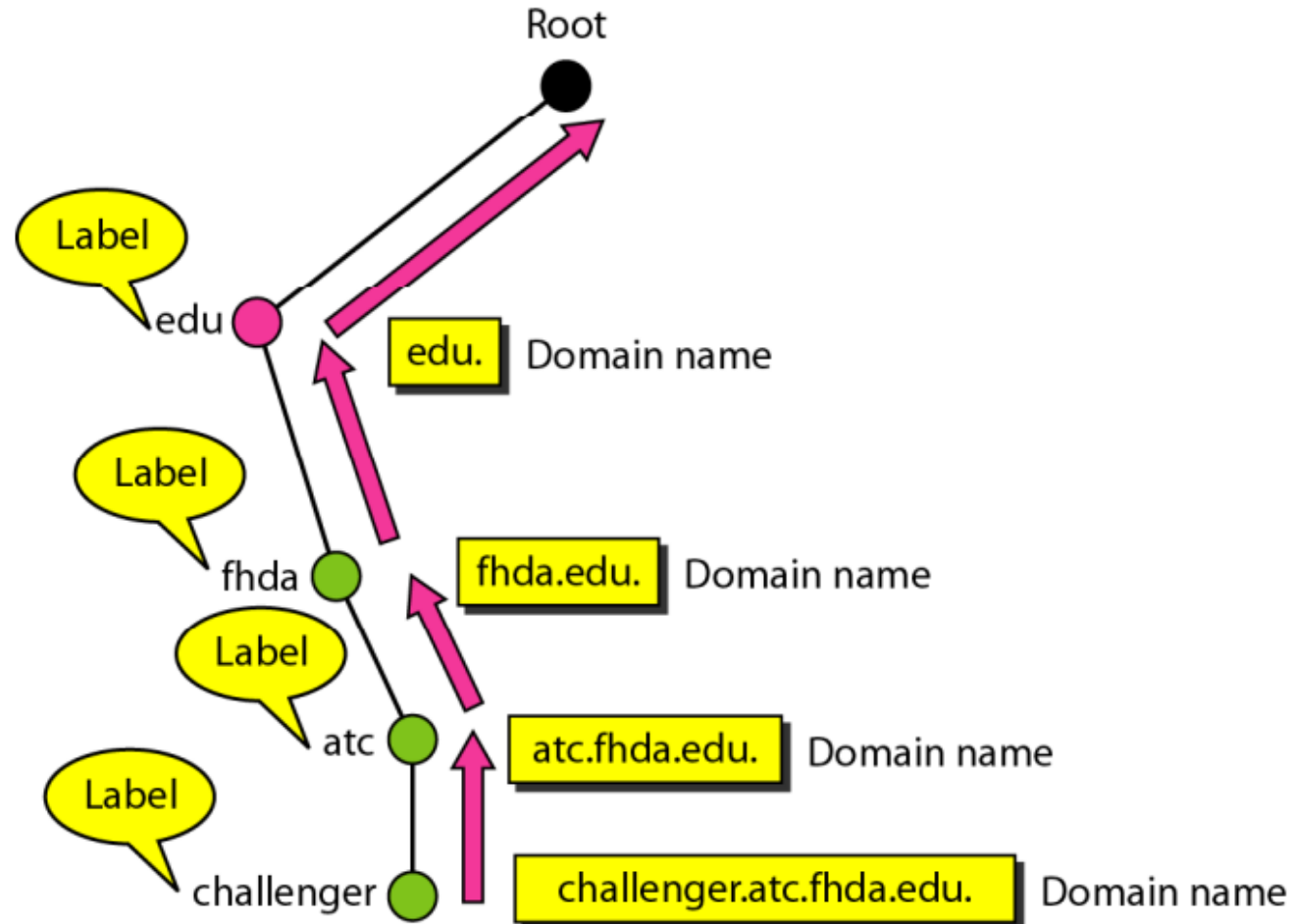
DOMAIN NAME SPACE

- **Label :** Each node in the tree has a label which is a string with a maximum of 63 characters.

- **Domain name:** A full domain name is a sequence of labels separated by dots(.). The domain names are always read from the node up to the root.

- **Domain:** A domain is a subtree of the domain name space.

Figure 25.5 *Domains*

DOMAIN NAME SPACE

Figure 25.3 *Domain names and labels*

DOMAIN NAME SPACE

Fully Qualified Domain Name

- If a label is terminated by a null string, it is called a fully qualified domain name (FQDN). An FQDN is a domain name that contains the full name of a host.

- A DNS server can only match an FQDN to an address.

Partially Qualified Domain Name

- If a label is not terminated by a null string, it is called a partially qualified domain name (PQDN).

- A PQDN starts from a node, but it does not reach the root.

- It is used when the name to be resolved belongs to the same site as the client.

- Here the resolver can supply the missing part, called the suffix, to create an FQDN.

HIERARCHY OF NAME SERVERS

- One way of dividing the entire information among many computers is to divide the whole space into many domains based on the first level.

Zone

- What a server is responsible for or has authority over is called as zone.

- If a server does not divide the domain into smaller domains then the domain and zone refer to same thing.

HIERARCHY OF NAME SERVERS

Root server:

- A root server is a server whose zone consists of the whole tree.

- A root server does not store any information about domains but delegates its authority to other servers, keeping references to those servers.

## Primary and Secondary Servers:

- A primary server stores a file about the zone for which it has authority.

- A secondary server transfers the complete information about a zone from another server and stores the file on its local disk.

DNS IN THE INTERNET

- The domain name space was originally divided into 3 different sections:
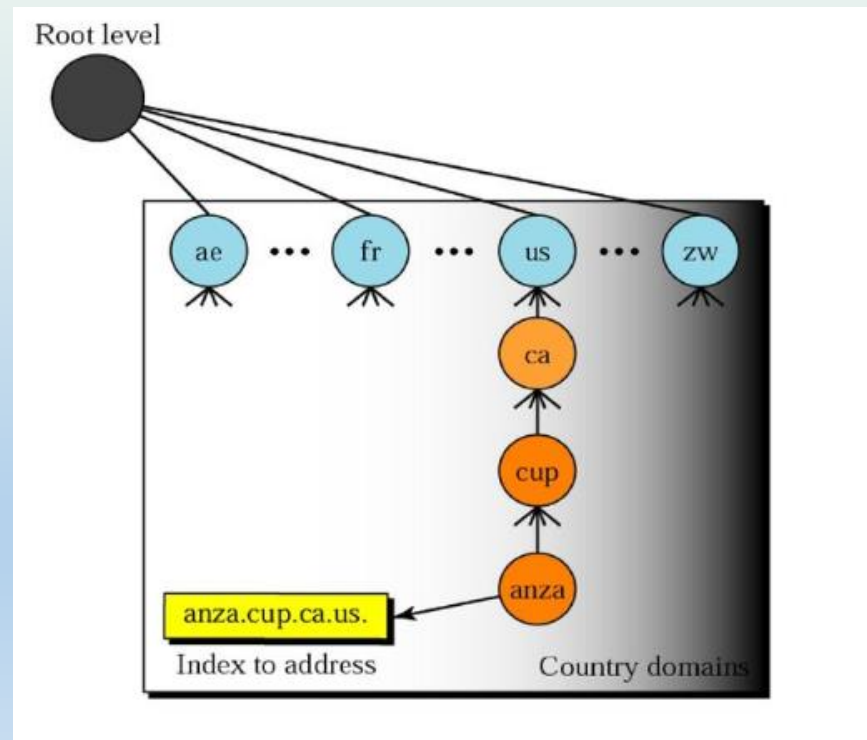
1. Generic domain

2. Country domain

3. Inverse domain

GENERIC DOMAIN

- Each node in the tree defines a domain, which is an index to the domain name space database.
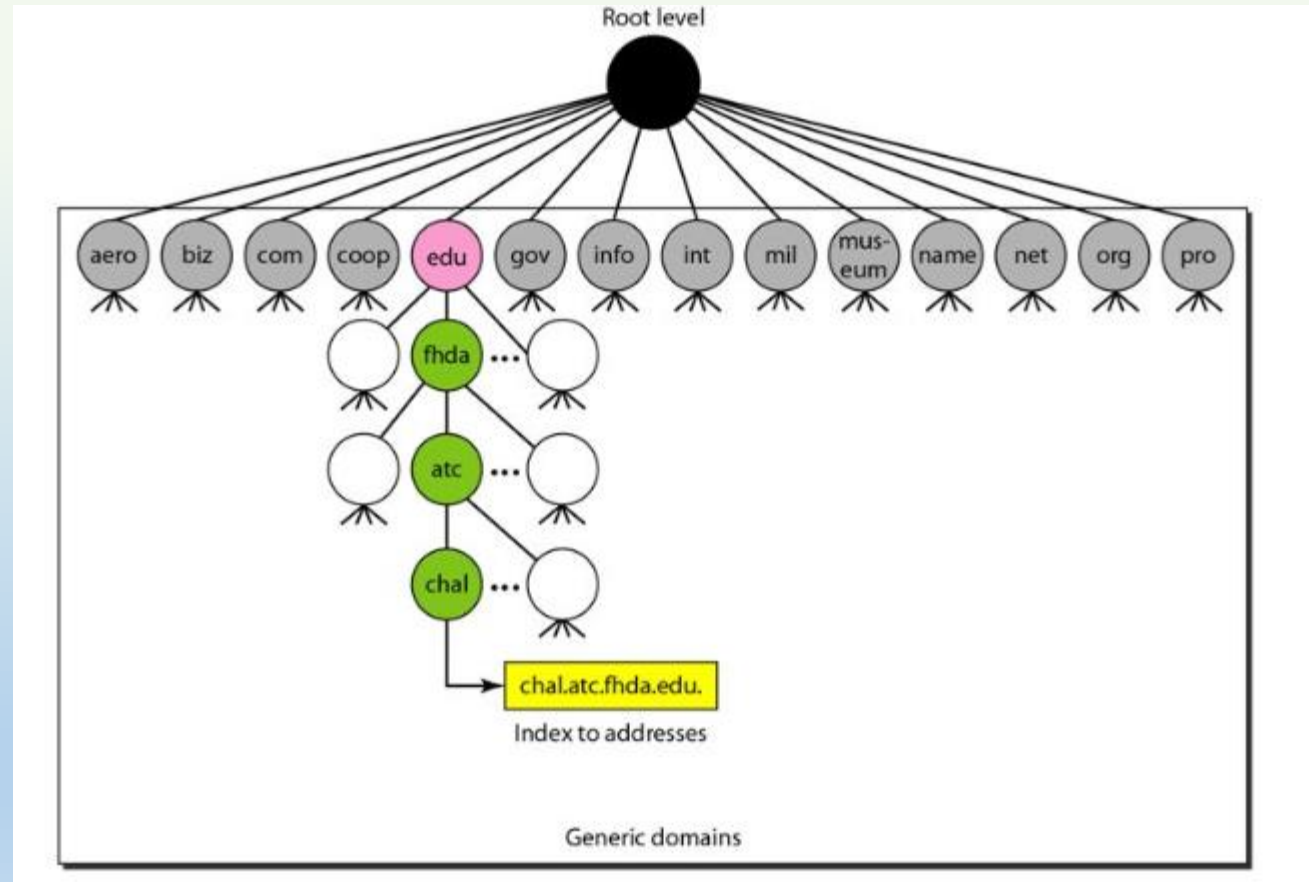
COUNTRY DOMAIN

- The country domains section uses two-character country abbreviations (e.g., us for United States).

- Second labels can be organizational, or they can be more specific, national designations.

INVERSE DOMAIN

- The inverse domain is used to map an address to a name. This may happen, for example, when a server has received a request from a client to do a task.

- Although the server has a file that contains a list of authorized clients, only the IP address of the client (extracted from the received IP packet) is listed.

- The server asks its resolver to send a query to the DNS server to map an address to a name to determine if the client is on the authorized list.

RESOLUTION

- Mapping a name to an address or an address to a name is called name-address resolution.

<u>Resolver</u>

- DNS is designed as a client/server application.

- A host that needs to map an address to a name or a name to an address calls a DNS client called a resolver.

- The resolver accesses the closest DNS server with a mapping request.

- If the server has the information, it satisfies the resolver; otherwise, it either refers the resolver to other servers or asks other servers to provide the information.

RESOLUTION

- After the resolver receives the mapping, it interprets the response to see if it is a real resolution or an error, and finally delivers the result to the process that requested it.

- In this case, the server checks the generic domains or the country domains to find the mapping.

- If the domain name is from the generic domains section, the resolver receives a domain name such as "chal.atc.jhda.edu.".

- The query is sent by the resolver to the local DNS server for resolution.

- If the local server cannot resolve the query, it either refers the resolver to other servers or asks other servers directly.

SMTP

- One of the most popular Internet services is electronic mail (e-mail).
- E-mail allow users to exchange messages. It is considered as a one-way transaction.
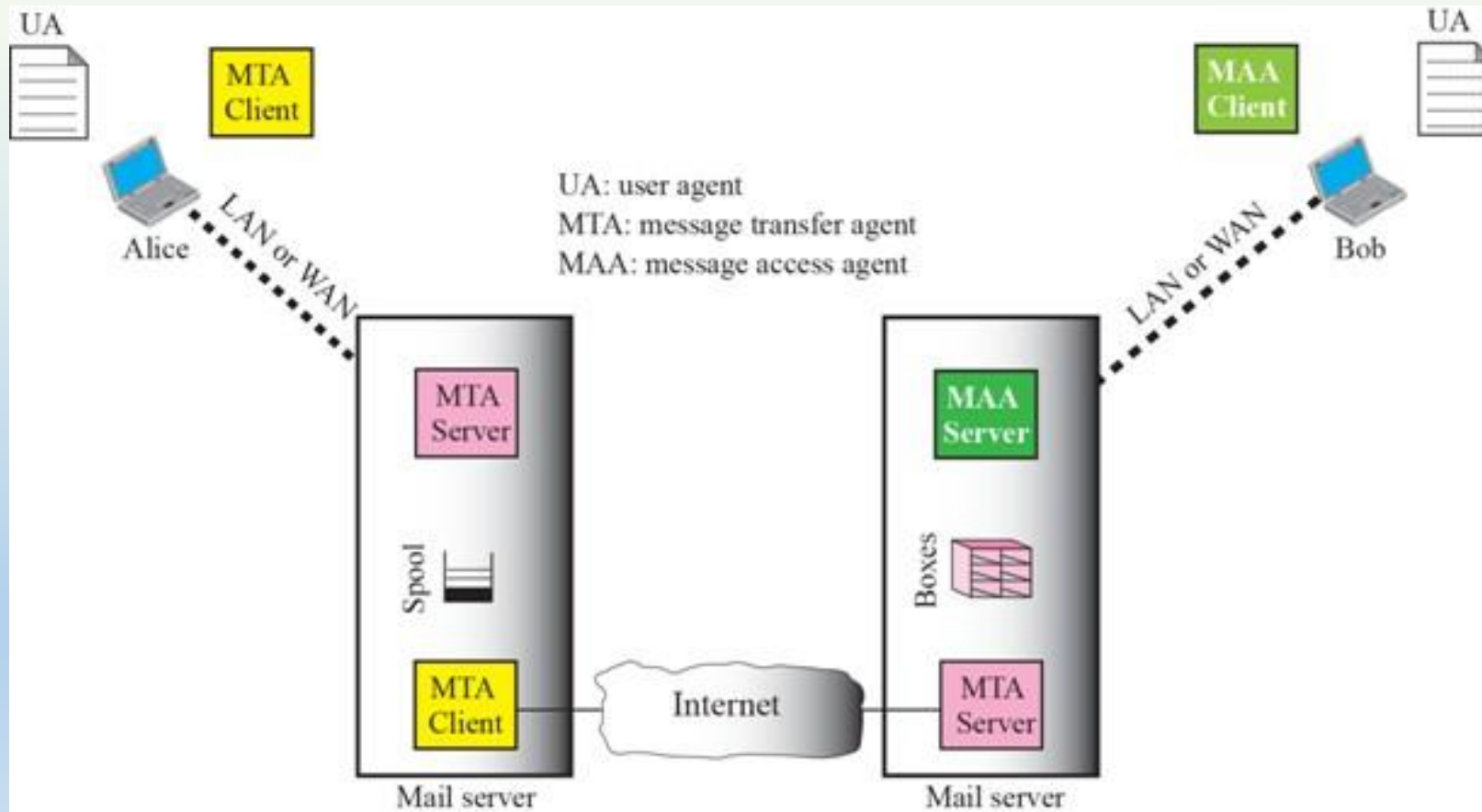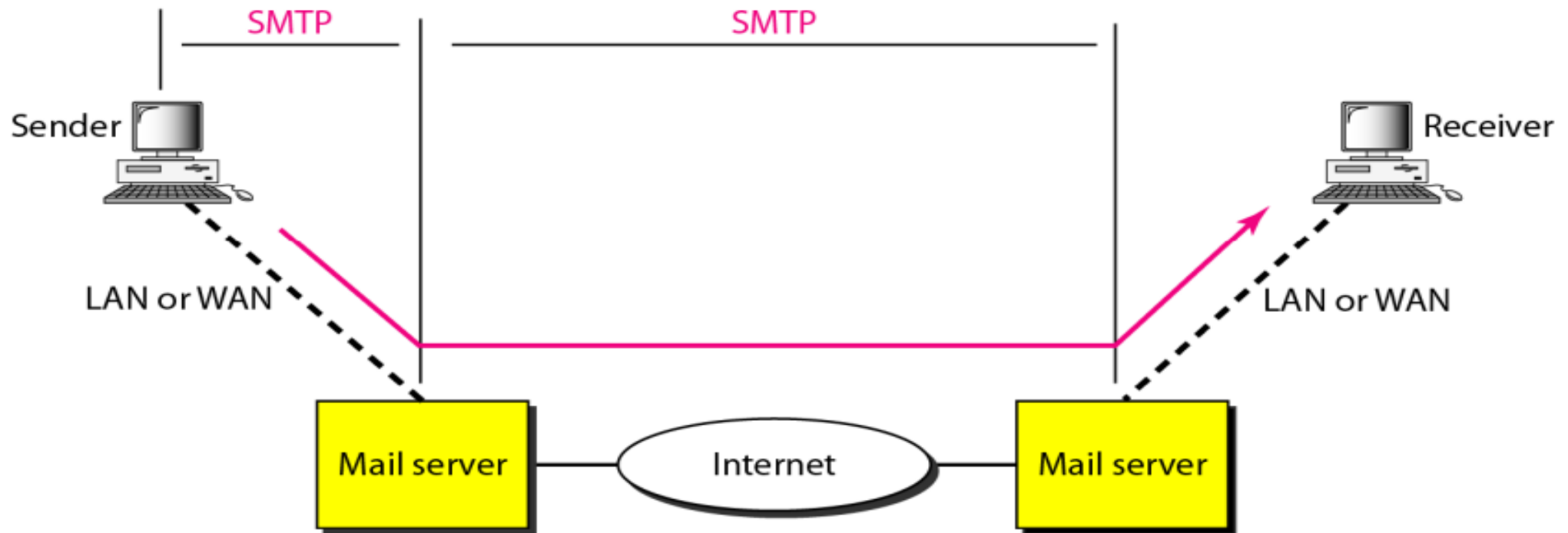
SMTP

User Agent:

- A user agent is a software package that composes , reads , replies to , and forwards messages.

- Types of user agents:

➢Command driven

➢GUI based

- **Mailing list:** E-mail allows one name, an alias to represent several different e-mail addresses

SMTP

Figure 26.16 *SMTP range*

SMTP

- The protocol that defines the MTA client and server in the internet is called as Simple Mail Transfer Protocol(SMTP)

- SMTP uses commands and responses to transfer messages between an MTA client and MTA server.

- **Commands:** Keyword: argument(s)

- **Responses:** Responses are sent from the server to the client. A response is a three digit code that may be followed by additional textual information

Keyword	Argument(s)	Description
HELLO	Sender's host name	Identifies itself
MAIL FROM	Sender of the message	Identifies the sender of the message
DATA	Body of the mail	Sends the actual message
VRFY	Name of the recipient	Verifies the address of the recipient

MAIL TRANSFER PHASES

Connection Establishment

1. The server sends code 220(service ready) to tell the client that it is ready to receive mail. If the server is not ready it sends code 421(service not available)

2. The client sends the HELLO message to identify itself, using its domain name address.

3. The server responds with code 250(request command completed)

MAIL TRANSFER PHASES

Message transfers

1. The client sends the MAIL FROM message to introduce the sender of the message.

2. The server responds with code 250 or some other appropriate code.

3. The client sends the RCPT TO message, which includes the mail address of the recipient.

4. The server responds with code 250 or some other appropriate code.

5. The client sends the DATA message to initialize the message transfer.

6. The server responds with code 354(start mail input)

7. The client sends the contents of the message in consecutive lines.

8. The server responds with code 250 or some other appropriate code

MAIL TRANSFER PHASES

Connection Termination

1. The client sends the QUIT command

2. The server responds with code 221(service closing transmission channel)

FTP

- FTP is a standard protocol provided by TCP/IP for copying a file from one host to another.

- 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.


File Transfer Protocol
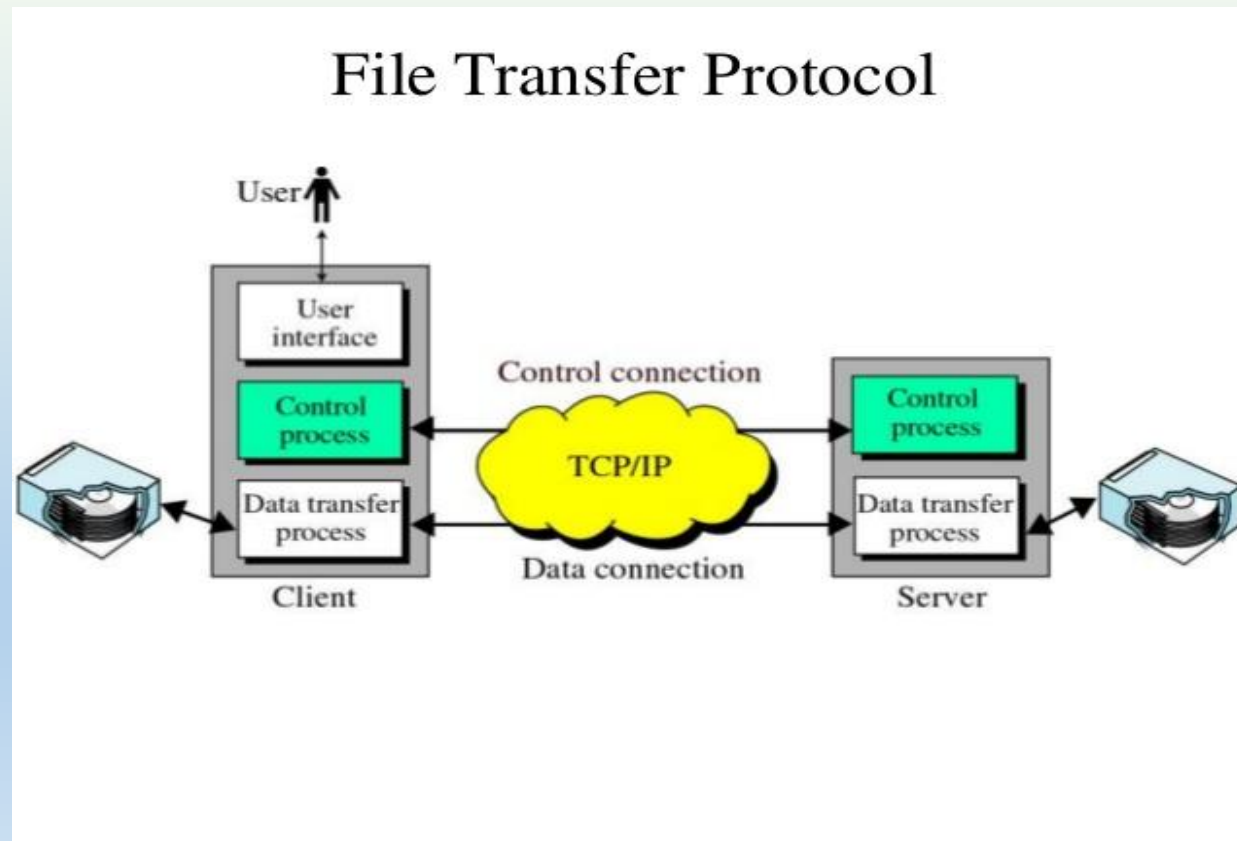
FTP

- The control connection remains connected during the entire interactive FTP session.

- The data connection is opened and then closed for each file transferred. It opens each time commands that involve transferring files are used, and it closes when the file is transferred.

- In other words, when a user starts an FTP session, the control connection opens. While the control connection is open, the data connection can be opened and closed multiple times if several files are transferred.

FTP: Communication over Control Connection

- It uses the 7-bit ASCII character set . Communication is achieved through commands and responses.

- This simple method is adequate for the control connection because we send one command (or response) at a time.

- Each command or response is only one short line, so we need not worry about file format or file structure.

- Each line is terminated with a two-character (carriage return and line feed) end-of-line token.

**Figure 26.22** *Using the control connection*
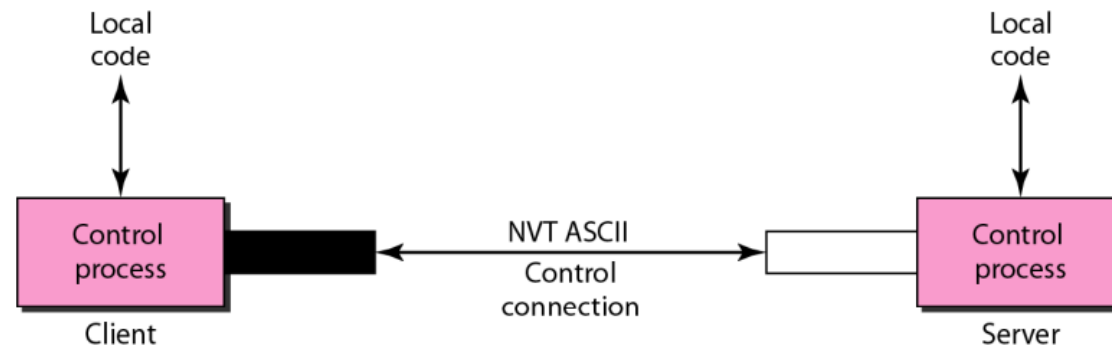
FTP: Communication over Data Connection

- File transfer occurs over the data connection under the control of the commands sent over the control connection.

- However, we should remember that file transfer in FTP means one of three things:

➢ A file is to be copied from the server to the client. This is called retrieving aft/e. It is done under the supervision of the RETR command.

➢ A file is to be copied from the client to the server. This is called storing aft/e. It is done under the supervision of the STOR command.

➢ A list of directory or file names is to be sent from the server to the client. This is done under the supervision of the LIST command.

- Note that FTP treats a list of directory or file names as a file. It is sent over the data connection.

- The client must define the type of file to be transferred, the structure of the data, and the transmission mode.

- Before sending the file through the data connection, we prepare for transmission through the control connection.

- The heterogeneity problem is resolved by defining three attributes of communication: file type, data structure, and transmission mode .

FTP: Communication over Data Connection

Figure 26.23 *Using the data connection*
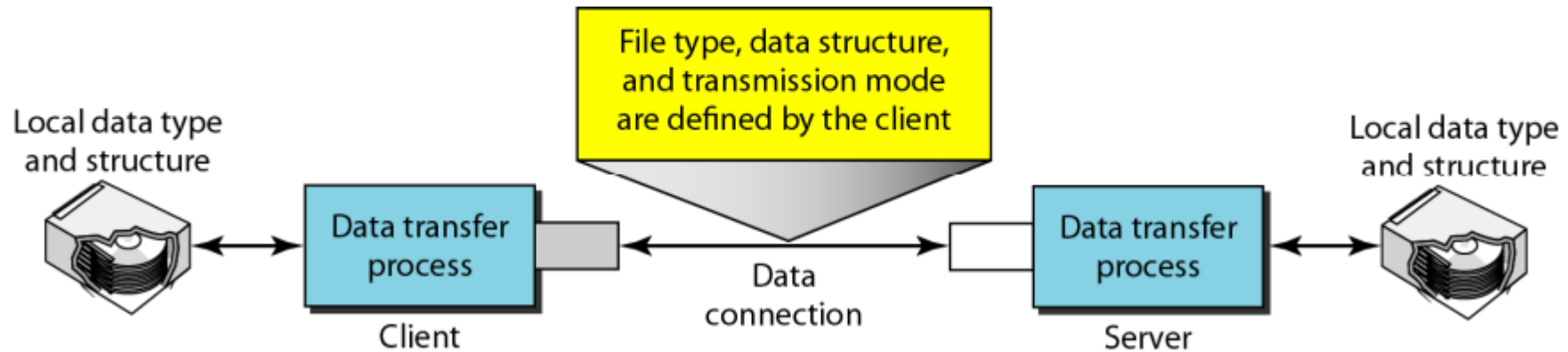
FTP: Communication over Data Connection

- **File Type:** FTP can transfer one of the following file types across the data connection: an ASCII file, EBCDIC file, or image file.

- **Data Structure :** FTP can transfer a file across the data connection by using one of the following interpretations about the structure of the data: file structure, record structure, and page structure.

- **Transmission Mode:** FTP can transfer a file across the data connection by using one of the following three transmission modes: stream mode, block mode, and compressed mode.

ANONYMOUS FTP

- To use FTP, a user needs an account (user name) and a password on the remote server.

- Some sites have a set of files available for public access, to enable anonymous FTP.

- To access these files, a user does not need to have an account or password. Instead, the user can use anonymous as the user name and guest as the password.

- User access to the system is very limited. Some sites allow anonymous users only a subset of commands.

- For example, most sites allow the user to copy some files, but do not allow navigation through the directories.