

Ministry of Higher Education and Scientific Researches
Al-Mansour University College
Department of Computer Technology Engineering
Fourth Class



Computer Networks Protocols

Lecture Six: Transport & Application Layer Protocols

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Transport Layer Protocols

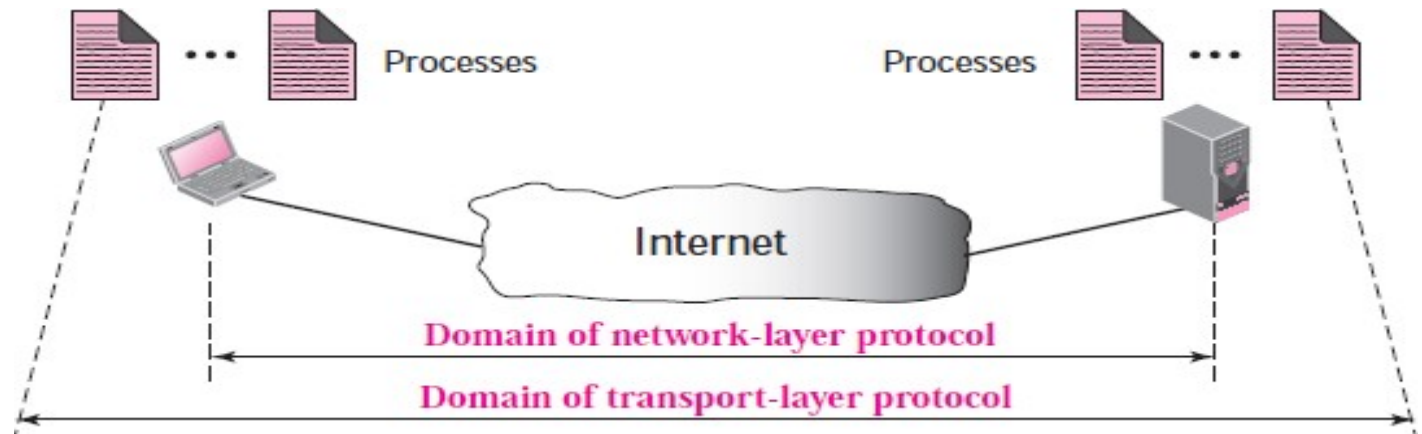
Transport layer provide ***logical communication*** between application processes running on different hosts, Transport protocols run in **end systems**.

Network layer: logical communication **between hosts**

Transport layer: logical communication **between processes**

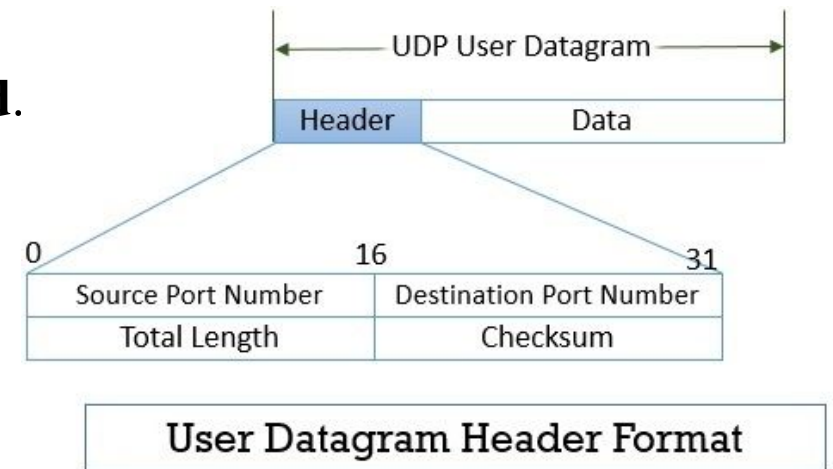
The transport layer deals with:

- The quality-of-service (QoS) issues of reliability
- End-to-end flow control
- Error correction and recovery
- Connection oriented and connectionless.



User Datagram Protocol (UDP)

- **Connectionless (unreliable transport protocol)** (best-effort), This means that each user datagram sent by UDP is an **independent datagram** and no handshaking between UDP sender, receiver.
- UDP segments may be: (lost, delivered out-of-order to app)
- The user datagrams **are not numbered**.
- Also, there is **no connection establishment and no connection termination**, this means that each user datagram **can travel on a different path**.
- UDP is a very **simple protocol using a minimum of overhead**.
- There is **no flow control** and hence **no window mechanism**.
- Unreliable but **fast**.



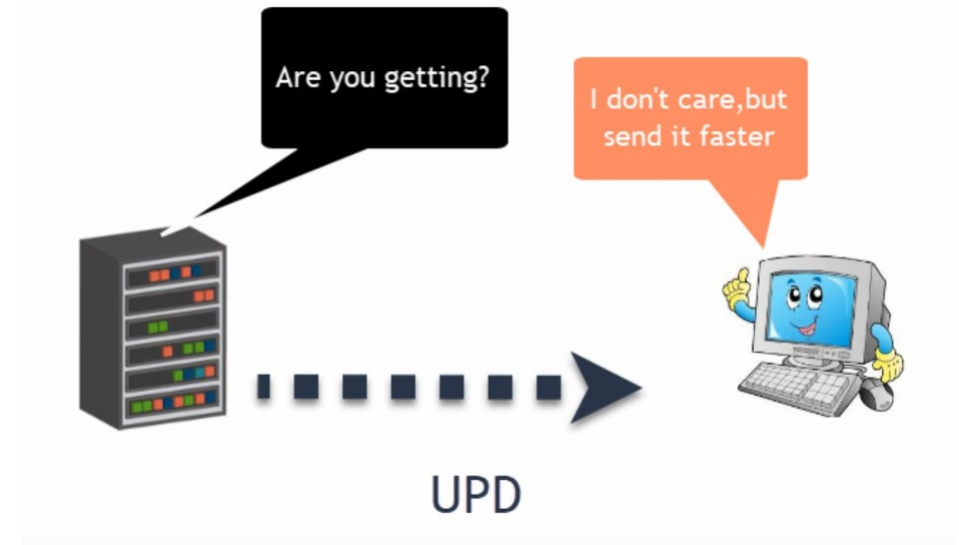
Q: Why is there a UDP?

- ✓ No connection establishment (which can add delay)
- ✓ Simple: no connection state at the sender, receiver (stateless)
- ✓ Small header size
- ✓ No congestion controls.

Use of UDP

The following lists some uses of the UDP protocol:

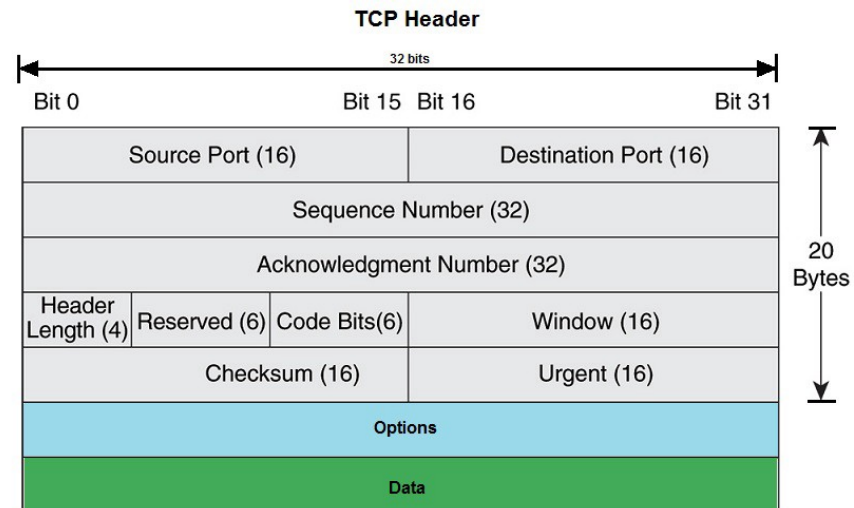
- ☐ Routing Information Protocol (**RIP**)
- ☐ Domain Name System (**DNS**)
- ☐ Streaming **multimedia apps** (loss tolerant, rate-sensitive)
- ☐ **SNMP**



Transmission Control Protocol (TCP)

- Reliable, in-order delivery (congestion control, flow control, connection setup)
- TCP, like UDP, is a **process-to-process** (program-to-program) protocol. TCP, therefore, like UDP, **uses port numbers**.
- **Unlike** UDP, TCP is a **connection-oriented** protocol; it creates a virtual connection between two TCPs to send data.
- In addition, TCP **uses flow and error control mechanisms** at the transport level.
- **Reliable delivery**: no packet loss, error, duplication, disorder
- In brief, TCP is called a *connection-oriented, reliable* transport protocol. It adds connection-oriented and reliability features to the services of IP.
- Most of the user application protocols, such as **Telnet, SMTP, HTTP and FTP**, use TCP.

TCP: three-way handshake



O: Compare between UDP and TCP protocols

UDP	TCP
<ol style="list-style-type: none">1. Connectionless service, UDP datagrams are delivered independently.2. Unreliable delivery: packet loss, corruption, duplication, disorder.3. Fast as compared with TCP4. No sequencing5. No acknowledge6. Simple request-response communication without internal flow and error control7. RIP, DNS use UDP	<ol style="list-style-type: none">1. Connection-oriented: connection establishment & termination2. Reliable delivery: no loss, error, duplication, disorder.3. Slow: retransmission, flow control4. Segment sequencing5. Acknowledge segment6. Connection overhead7. Telnet, SMTP, HTTP and FTP, use TCP

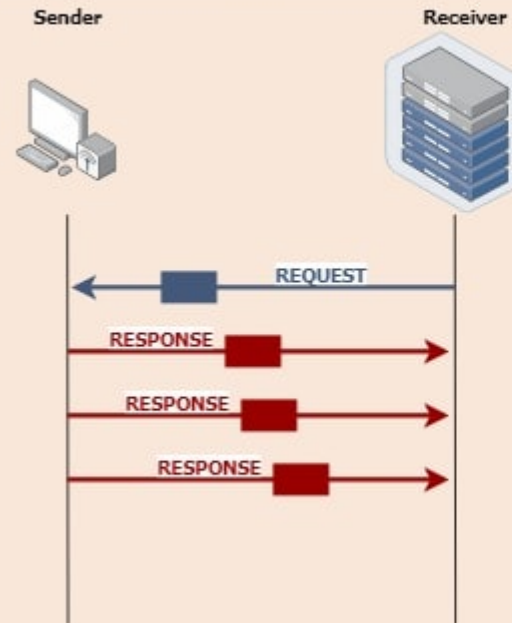
TCP



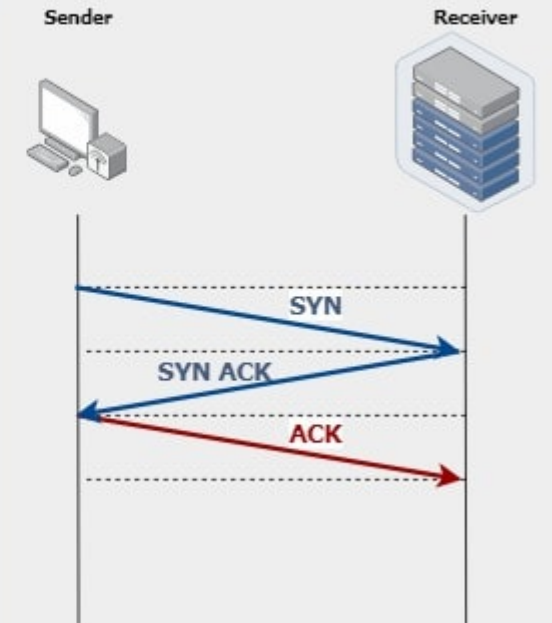
UDP



UDP

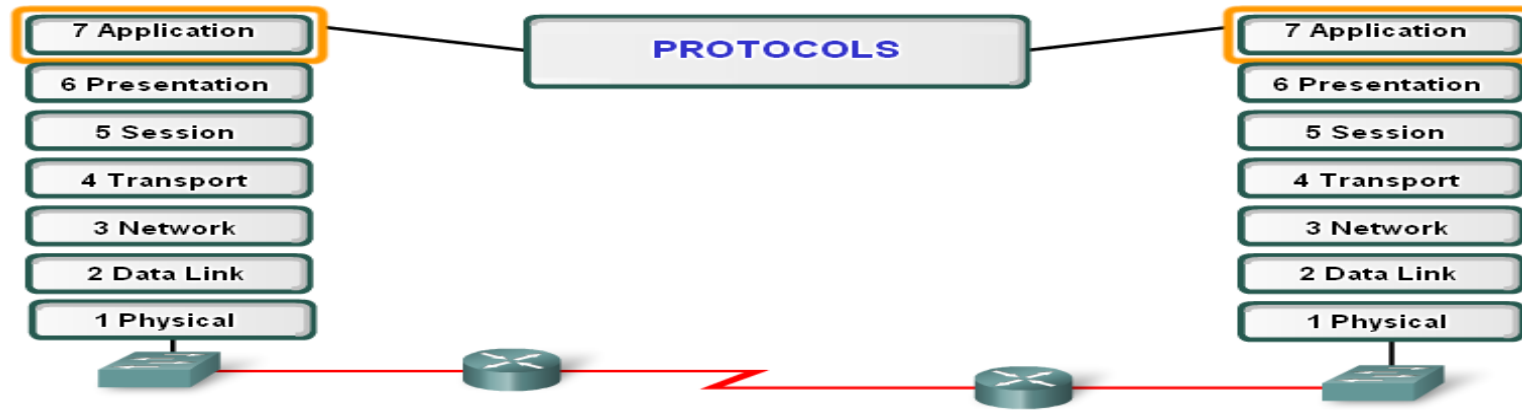


TCP



Application layer Protocols

- Allows user to **interface** with the network.
- Provides the **interface** between the applications on either end of the network.

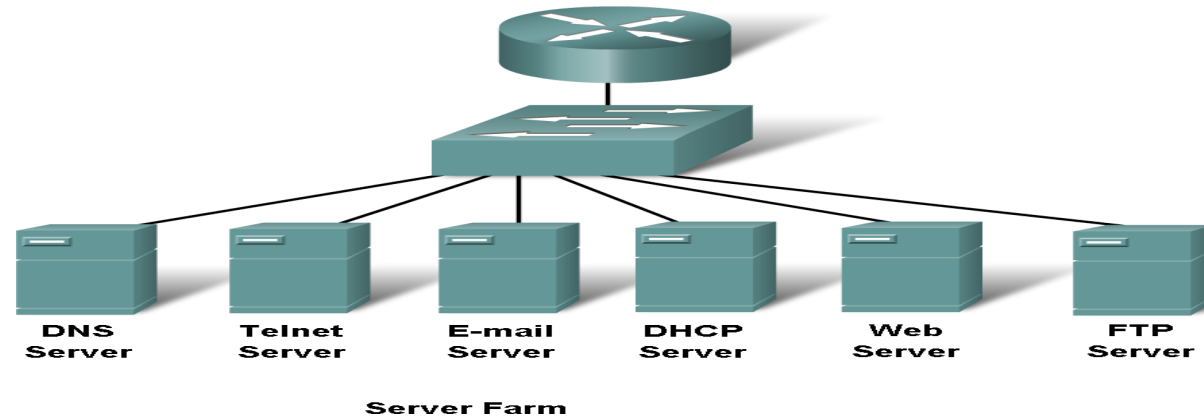


Application layer protocols provide the rules for communication between applications.

Protocols:

- Define processes on either end of the communication
- Define the types of messages
- Define the syntax of messages
- Define the meaning of any informational fields
- Define how messages are sent and the expected response
- Define interaction with the next lower layer

Application layer Protocols



Protocols	Description
DNS	Matches domain names with IP addresses
HTTP	Used to transfer data between clients/servers using a web browser
SMTP & POP3	used to send email messages from clients to servers over the internet
FTP	allows the download/upload of files between a client/server
Telnet	allows users to login to a host from a remote location and take control as if they were sitting at the machine (virtual connection)
DHCP	assigns IP addresses, subnet masks, default gateways, DNS servers, etc. To users as they login the network

Common Port Numbers

TCP	UDP
<ul style="list-style-type: none">• FTP – 20-21• Telnet – 23• SMTP – 25• DNS – 53 (Both TCP & UDP)• HTTP – 80	<ul style="list-style-type: none">• DHCP – 67 & 68• POP – 110

NETWORK PORTS

Well-known Ports

0 - 1023

Registered Ports

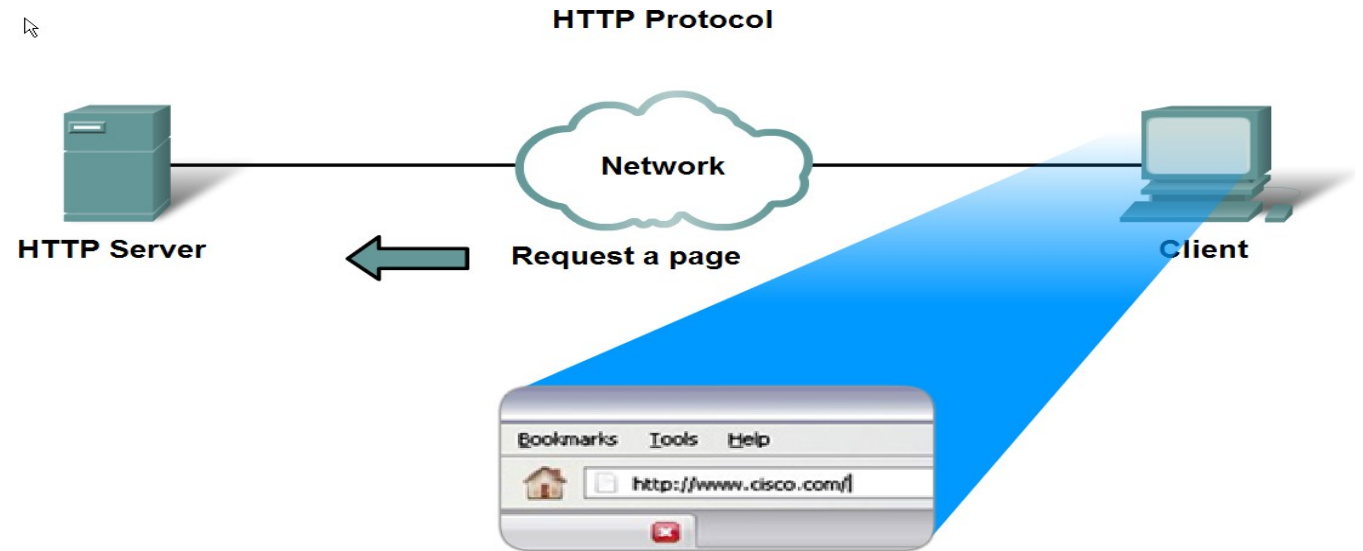
1024 - 49151

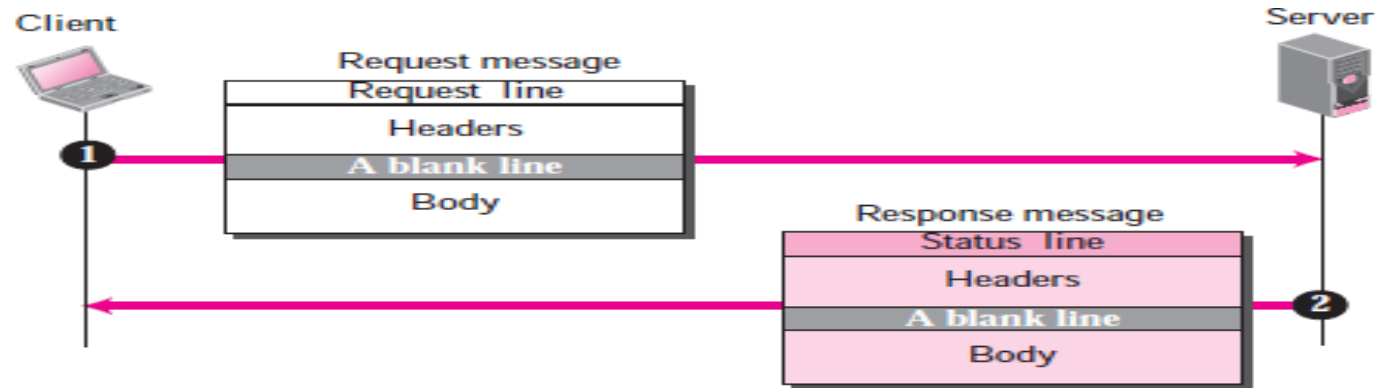
Dynamic Ports

49152 - 65565

Hypertext Transfer Protocol (HTTP)

- The (HTTP) is a protocol used mainly to **access data on the World Wide Web.**
- HTTP use **TCP connection and port 80.**
- HTTP messages are not destined to be read by humans; (**read and interpreted by the HTTP server and HTTP client (browser).**)
- It is a **stateless protocol**, which means that the server does not keep information about the client. The client initializes the transaction by sending a request. The server replies by sending a response.





- A client that wants to access a Web page needs the **file name and the address**.
- The uniform resource locator (URL) is a standard locator for specifying any kind of information on the Internet, The URL defines four things:

Protocol **::** **Host** **:** **Port** **/** **Path**

Steps:

- 1- URL is typed in the address bar.
- 2- Browser checks with DNS server to convert it to an IP address
- 3- Connects to the server requested
- 4- Using HTTP or HTTPS protocol requirements, the browser sends a GET request to the server to ask for the desired html document (usually index.html)
- 5- The server sends the HTML code for the web page to the browser.
- 6- The browser interprets the HTML code and formats the page to fit the browser window.

HTTPS (HTTP + SSL)

- **HTTPS** = HTTPS stands for Hypertext Transfer Protocol over **Secure Socket Layer** (SSL), or HTTP over SSL.
- HTTPS by default uses port 443.
- URL's beginning with HTTPS indicate that the connection is encrypted using SSL.
- The main **disadvantage of HTTPS** is that it is slightly slower than HTTP because of the encryption of data.

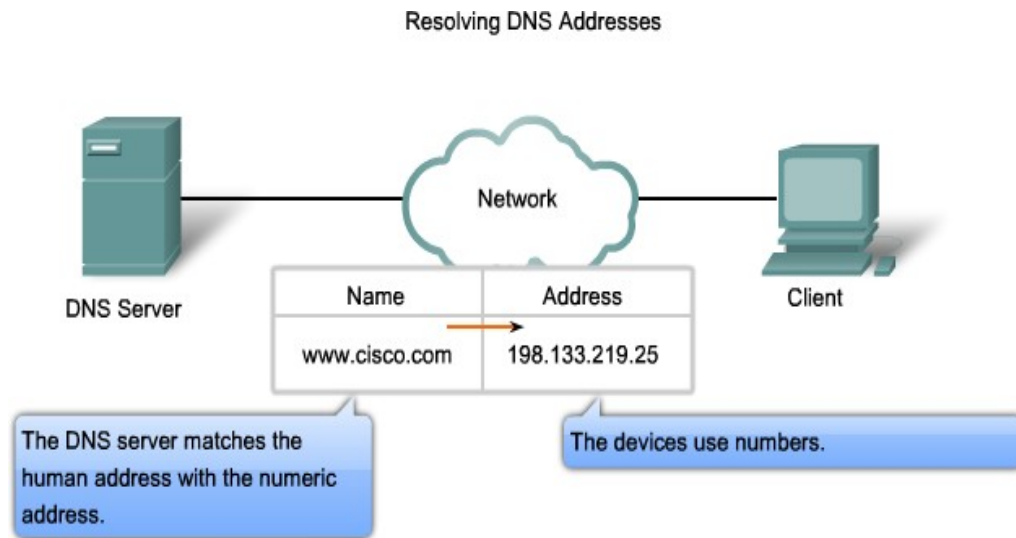


Q: Compare between HTTP & HTTPS.

HTTP	HTTPS
1. URL begins with “http://”	1. URL begins with “https://”
2. unsecured	2. secured
3. uses port 80 for communication	3. uses port 443 for communication.
4. operates at Application Layer	4. operates at Transport and application Layer.
5. No encryption	5. uses encryption
6. No certificates required	6. certificates required

Domain Name Service (DNS)

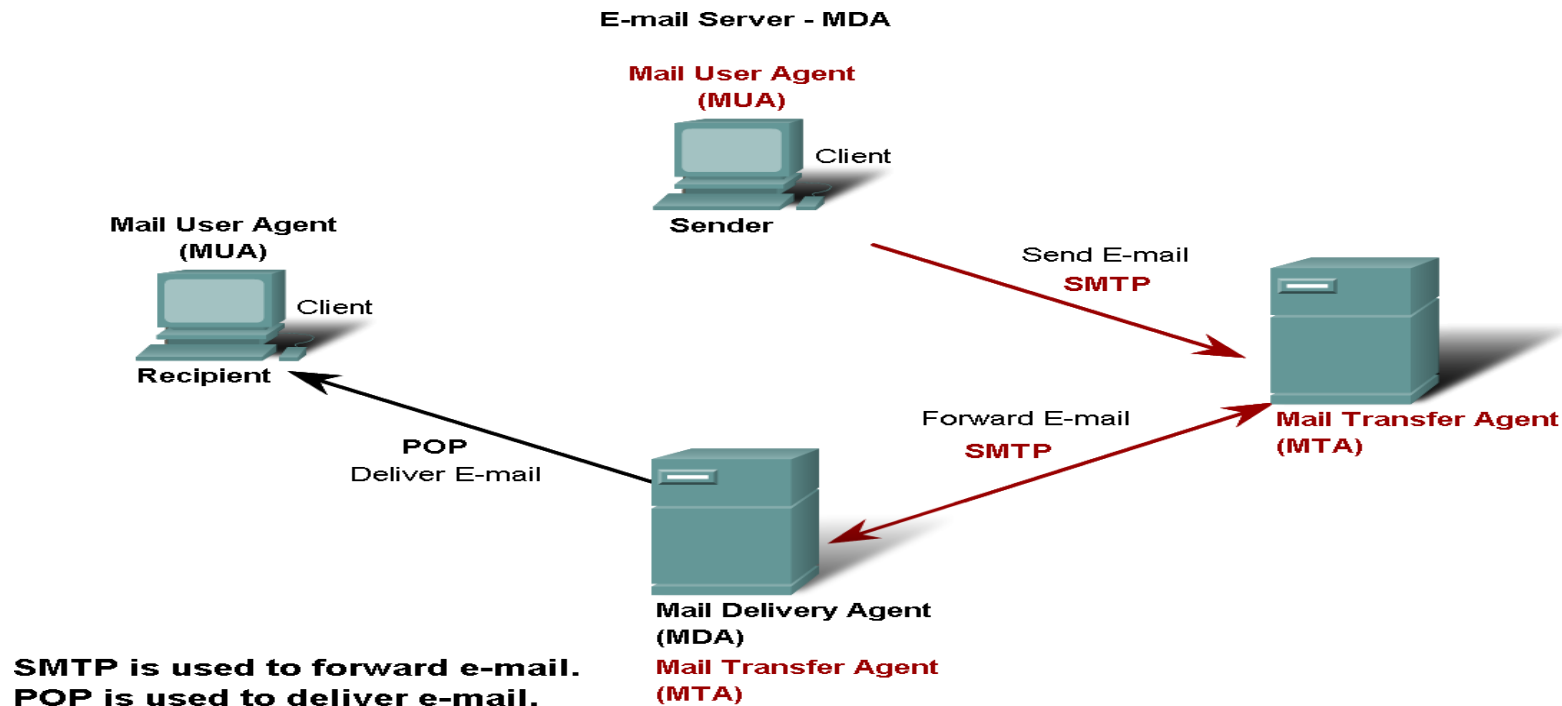
- It is a client-server application that identifies each host on the Internet with a **unique user- friendly name**.
- The names must be unique because the addresses are unique.
- DNS Servers resolve names to IP addresses. It would be difficult to remember the IP address of every website we like to visit, but we can remember names.



Record Type	Purpose
Addresses	
A	Maps a fully qualified domain name (FQDN) to an IPv4 address
AAAA	Maps a FQDN to an IPv6 address
Aliases	
CNAME	Maps a FQDN to another FQDN
DNAME	Maps all subdomains of a FQDN to another FQDN
Servers	
NS	Maps a subdomain to a FQDN of a name server
MX	Maps an email domain to a FQDN of a mail server

E-mail Protocols (SMTP/POP/IMAP)

- E-mail is the most popular network **service**.
- E-mail **client** (when people compose e-mail) is called Mail User Agent (**MUA**)
- MUA **allows** messages to be **sent/retrieved** to and from your mailbox
- Requires several applications and services:
 - POP or POP3** – deliver email from server to client (incoming messages) post office prot.
 - SMTP** – handles outbound messages from clients



File Transfer Protocol (FTP)

- Commonly used application layer protocol
- Allows for the **transfer of files** between clients/servers.
- Requires 2 connections to the server: Commands – uses TCP port 21 Actual data – uses TCP port 20

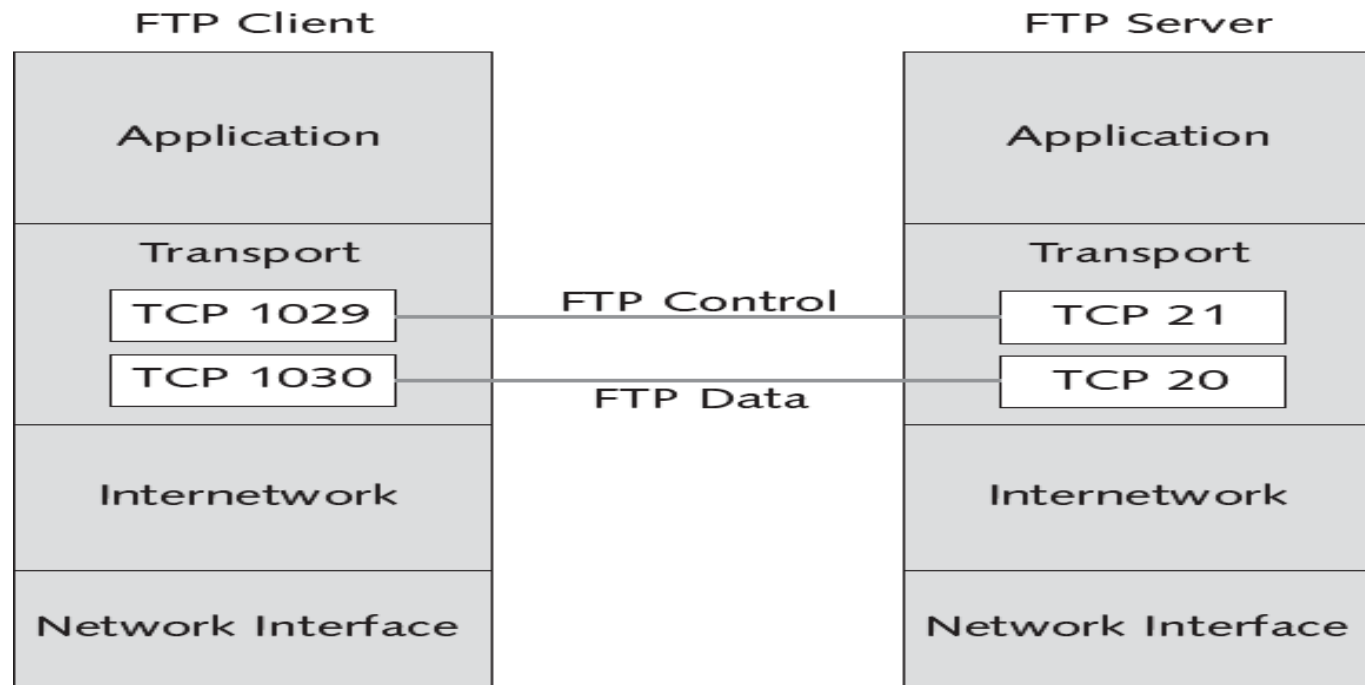


Figure 3-2 TCP port usage in FTP communications