Application Layer

Chapter 3

CCNA Exploration 1

Part II

SMTP/POP/IMAP Protocols

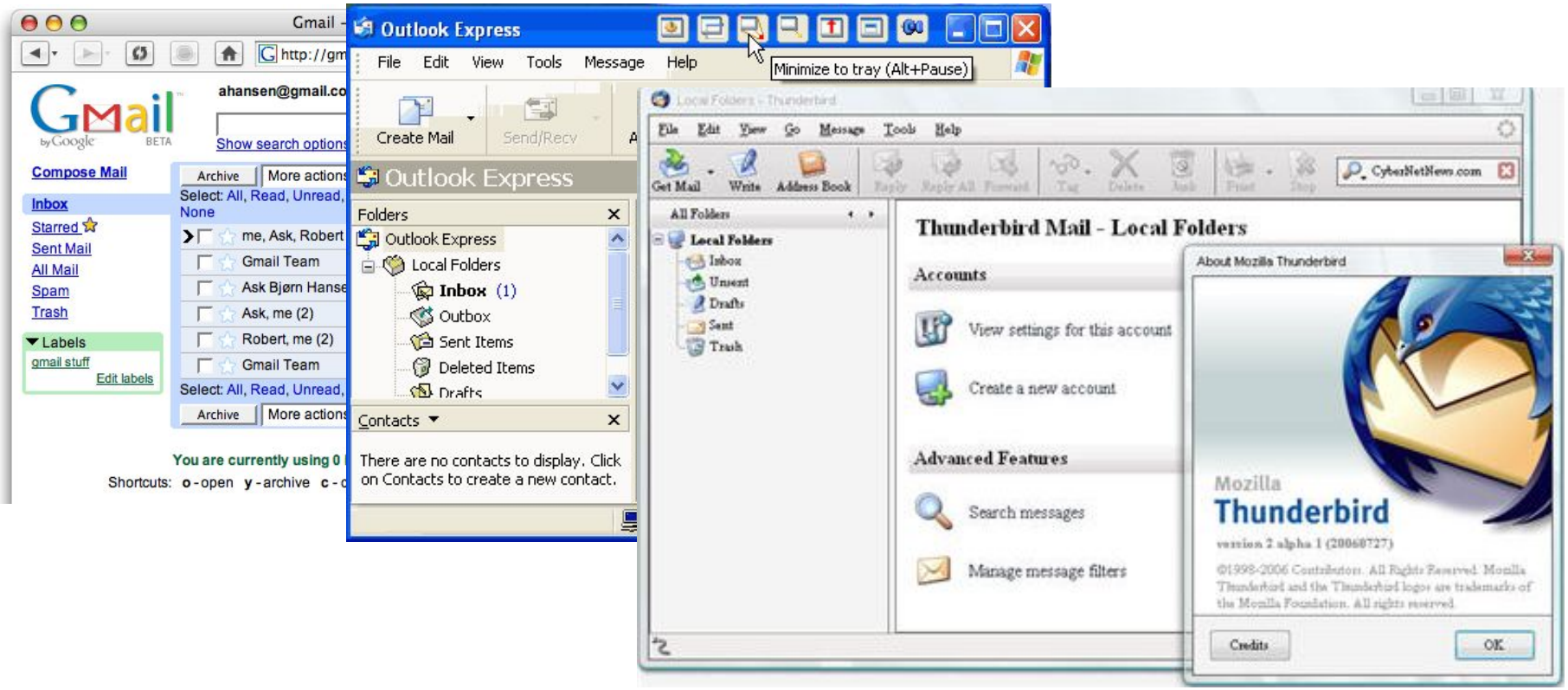
Email Services

Simple Mail Transfer Protocol

Post Office Protocol

Internet Message Access Protocol

E-Mail Services and SMTP/POP Protocols

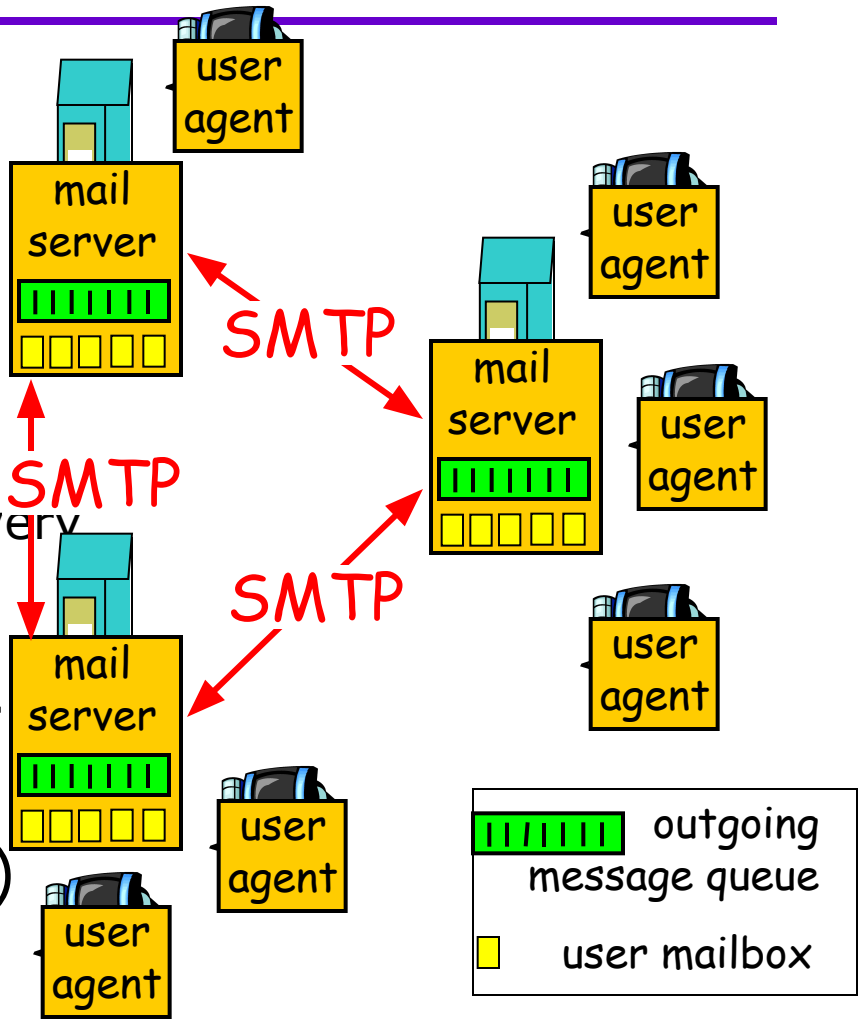


- Revolutionized how people communicate.

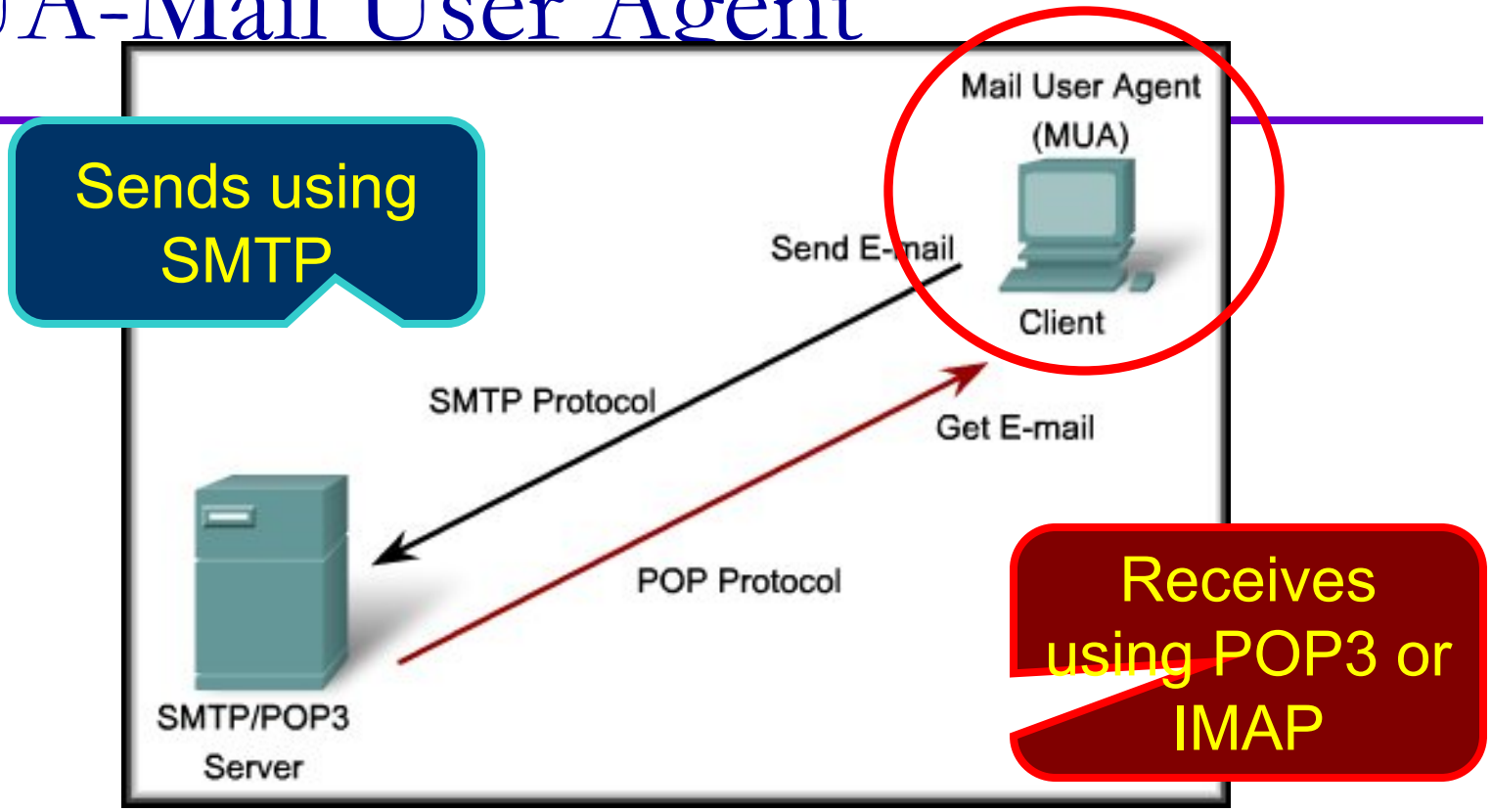
Electronic Mail

Three major components:

- Mail User agents
- Mail servers
  - MDA(is a computer software component that is responsible for the delivery of e-mail messages to a local recipient's mailbox.)
  - MTA (The Mail Transfer Agent (MTA) process is used to forward e-mail)
- Protocol: SMTP



MUA-Mail User Agent

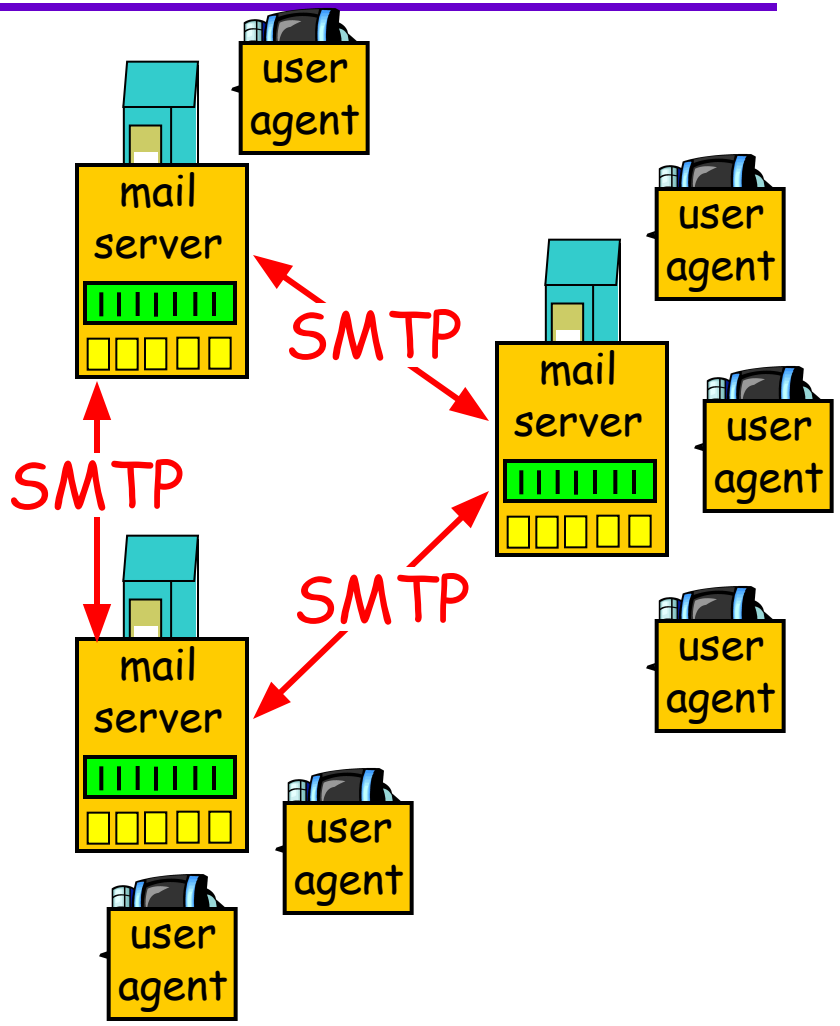


- Mail User Agent (MUA) also known as an email client.
  - Composing, editing, reading mail messages
  - E.g., Eudora, Outlook,Mozilla Thunderbird
  - Outgoing, incoming messages stored on server

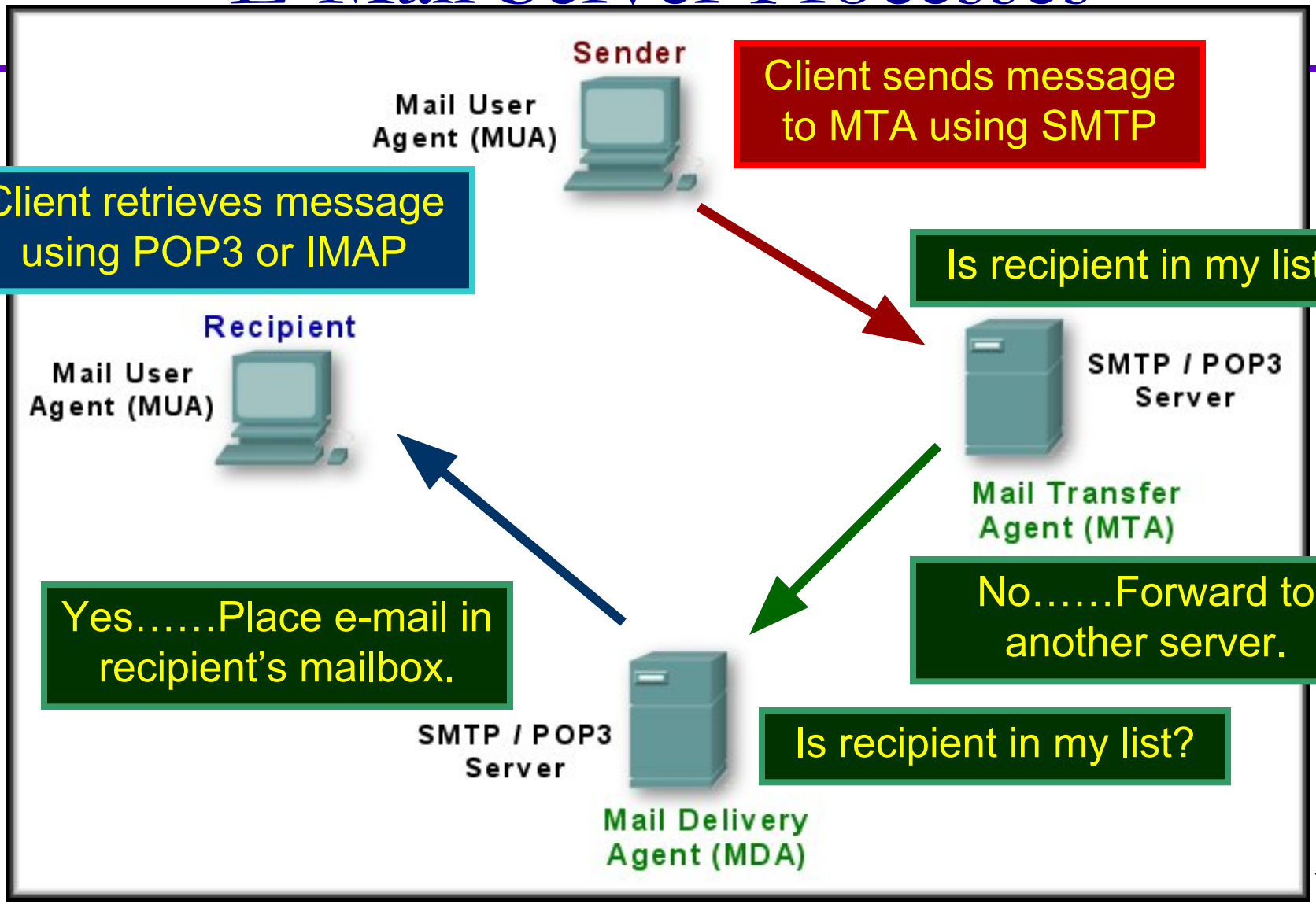
Electronic Mail: mail servers

Mail Servers

- mailbox contains incoming messages for user
- message queue of outgoing (to be sent) mail messages
- SMTP protocol between mail servers to send email messages
  - client: sending mail server
  - "server": receiving mail server
  - **PUSH** Protocol

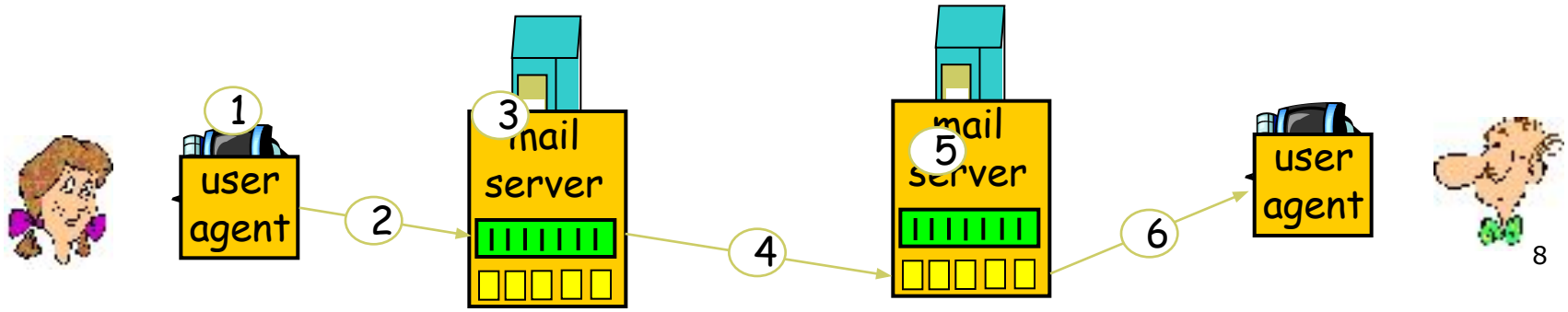


E-Mail Server Processes

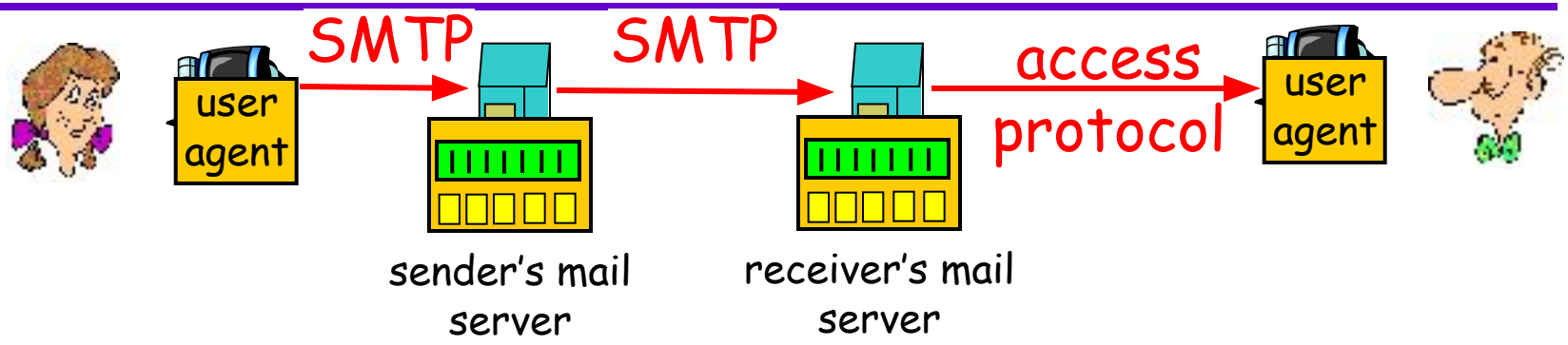


Scenario: Naz sends an email message to Arif

1) Naz uses UA to compose message and "to" `arif@someschool.edu`
2) Naz's UA sends message to her mail server; message placed in message queue
3) Client side of SMTP opens TCP connection with Arif's mail server
4) SMTP client sends Naz's message over the TCP connection
5) Arif's mail server places the message in Arif's mailbox using POP.
6) Arif invokes his user agent to read message



Mail access protocols

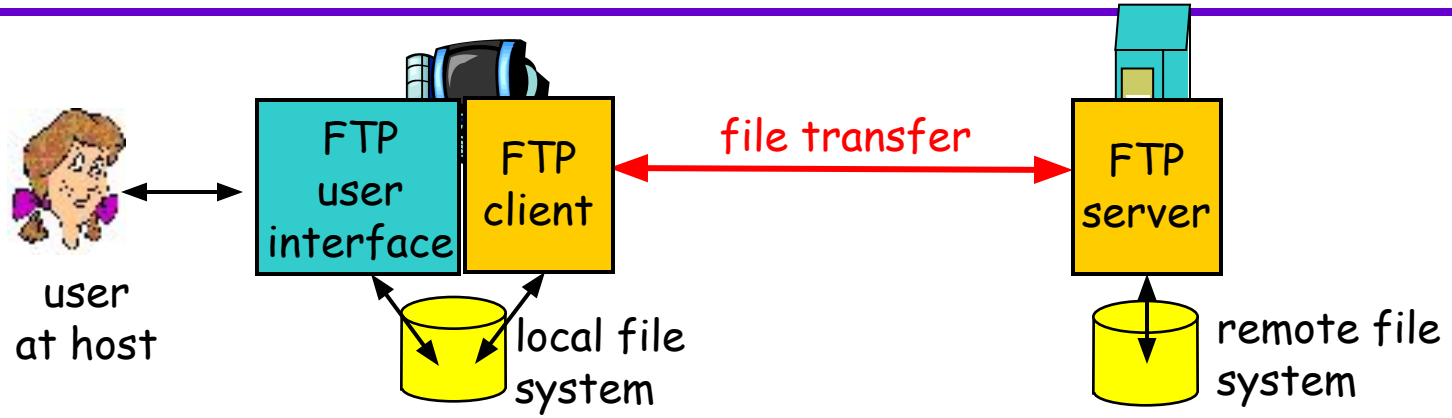


- SMTP: delivery/storage to receiver's server
- Mail access protocol: retrieval from server
  - **POP**: Post Office Protocol [RFC 1939]
    - authorization (agent <-->server) and download
  - **IMAP**: Internet Mail Access Protocol [RFC 1730]
    - more features (more complex)
    - manipulation of stored msgs on server
  - **HTTP**: gmail, Hotmail, Yahoo! Mail, etc.

FTP

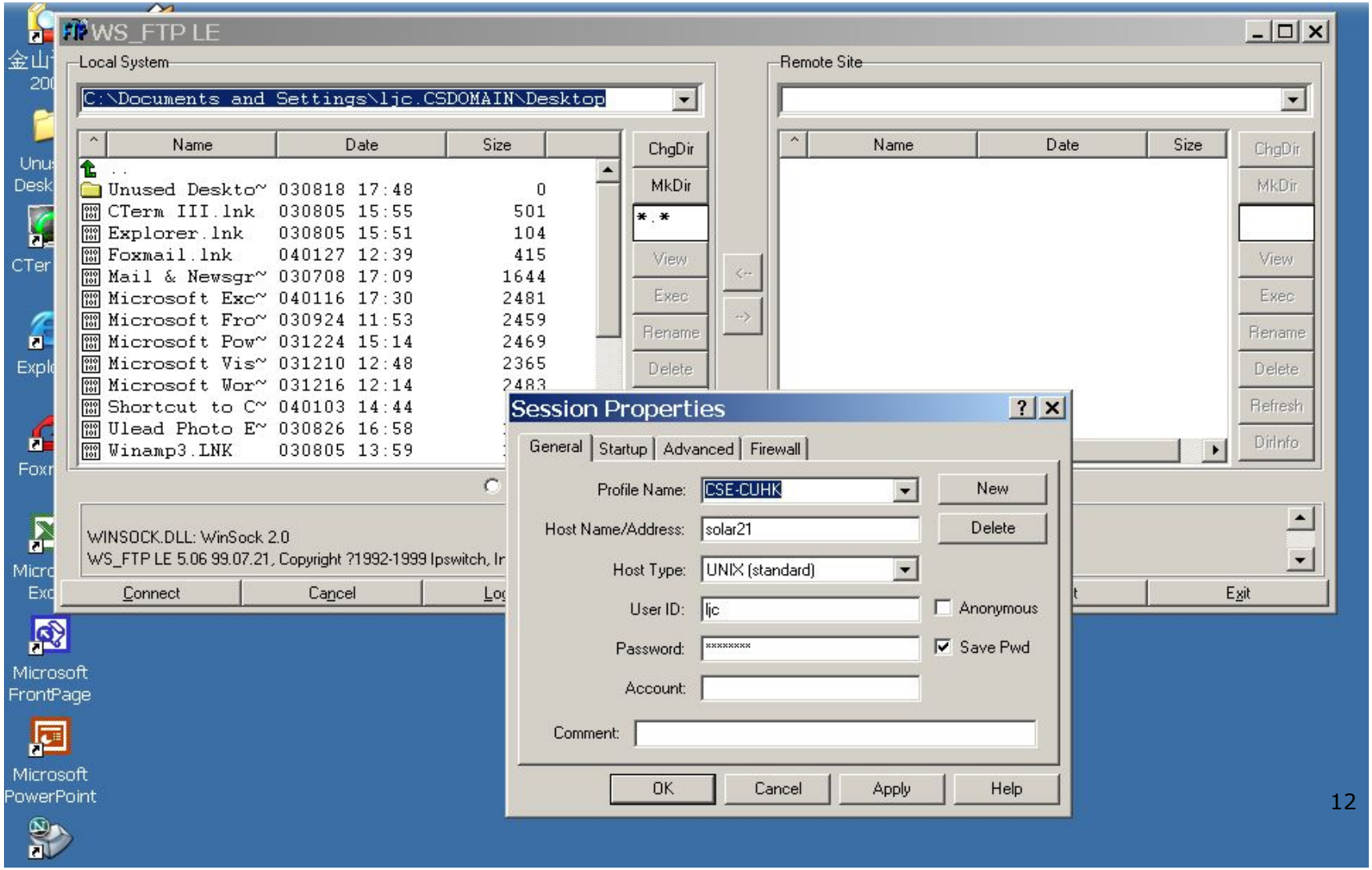
File Transfer Protocol

FTP: the file transfer protocol

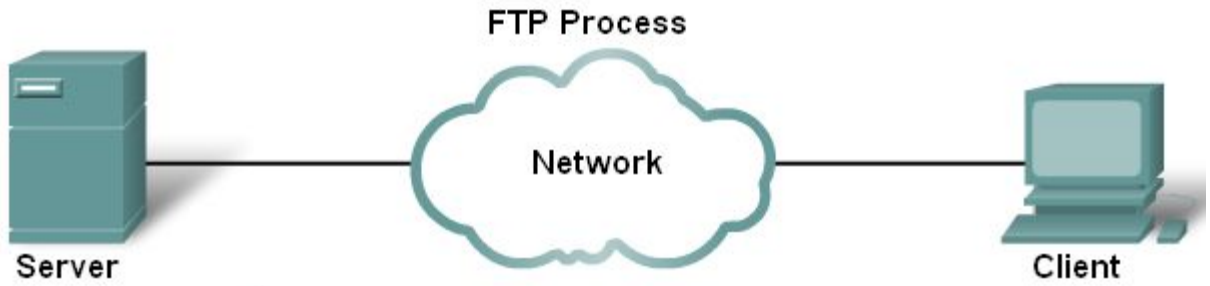


- transfer files between a client and a server.
- client/server model
- ftp: RFC 959
- Requires two connections between the client and the server:
  - one for commands and replies, TCP port 21
  - the other for the actual file transfer,TCP port 20

FTP Client Software



File Transfer Protocol (FTP)



Control Connection:
Client opens first connection to the server for control traffic.

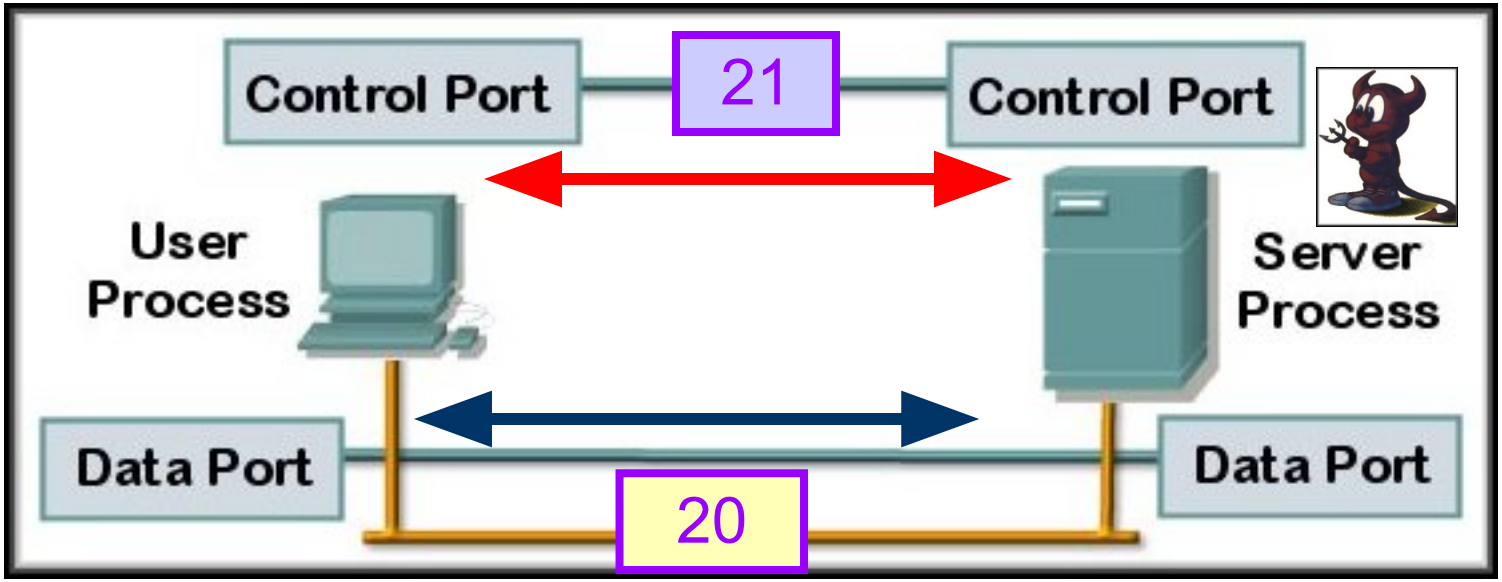
Data Connection:
Client opens second connection for data traffic.

Get Data

Based on command sent across control connection, data can be downloaded from server or uploaded from client.

File Transfer Protocol (FTP)

Client initiates a TCP control connection on Port 21. Username and password….



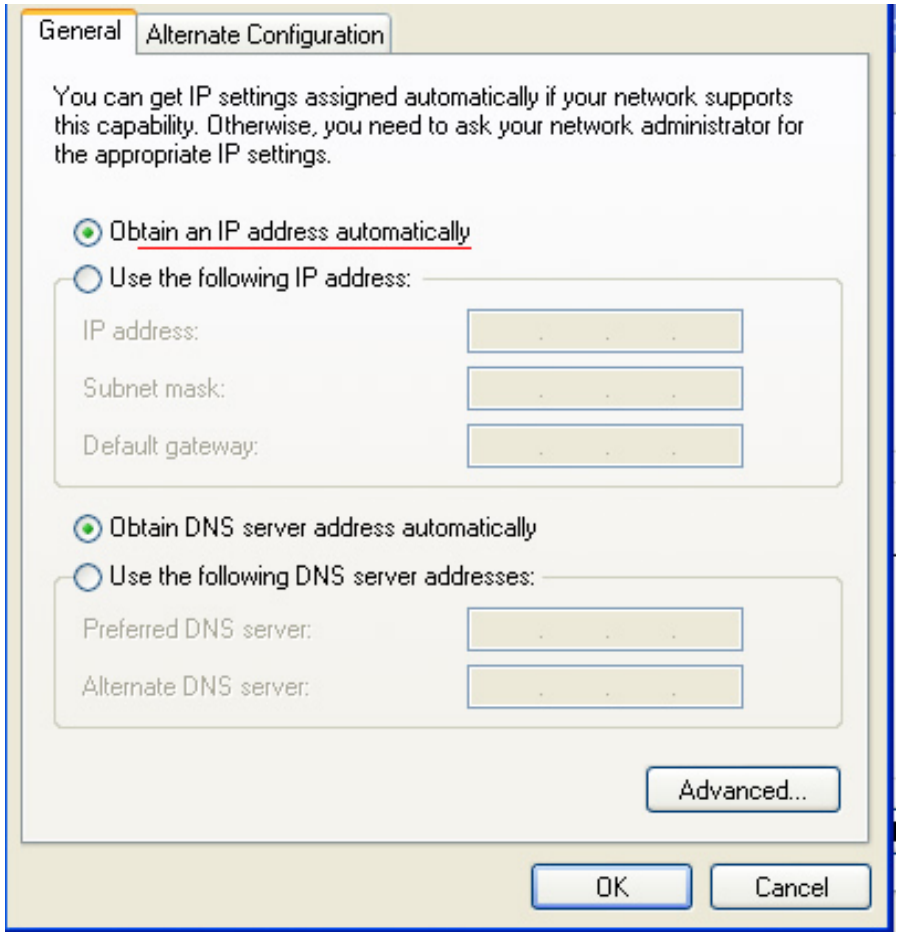
For *each file transferred*, TCP opens and closes a Data connection on Port 20.

DHCP

Dynamic Host Configuration Protocol

DHCP

- Client /Server
- DHCP service enables devices on a network automatically to obtain IP addresses and other information from a DHCP server.



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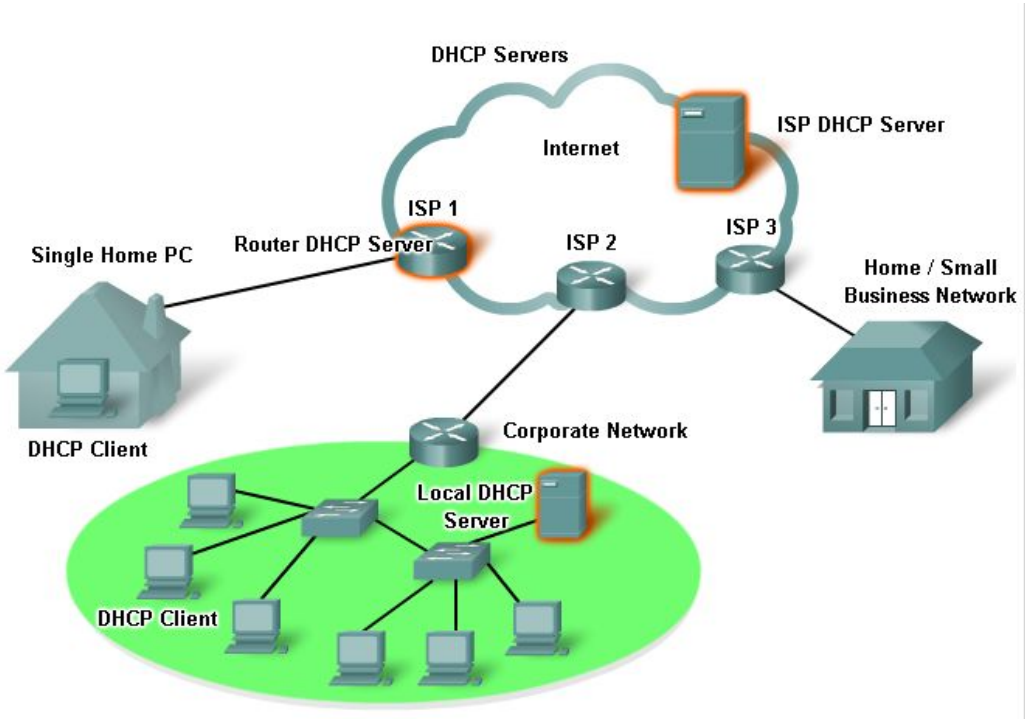
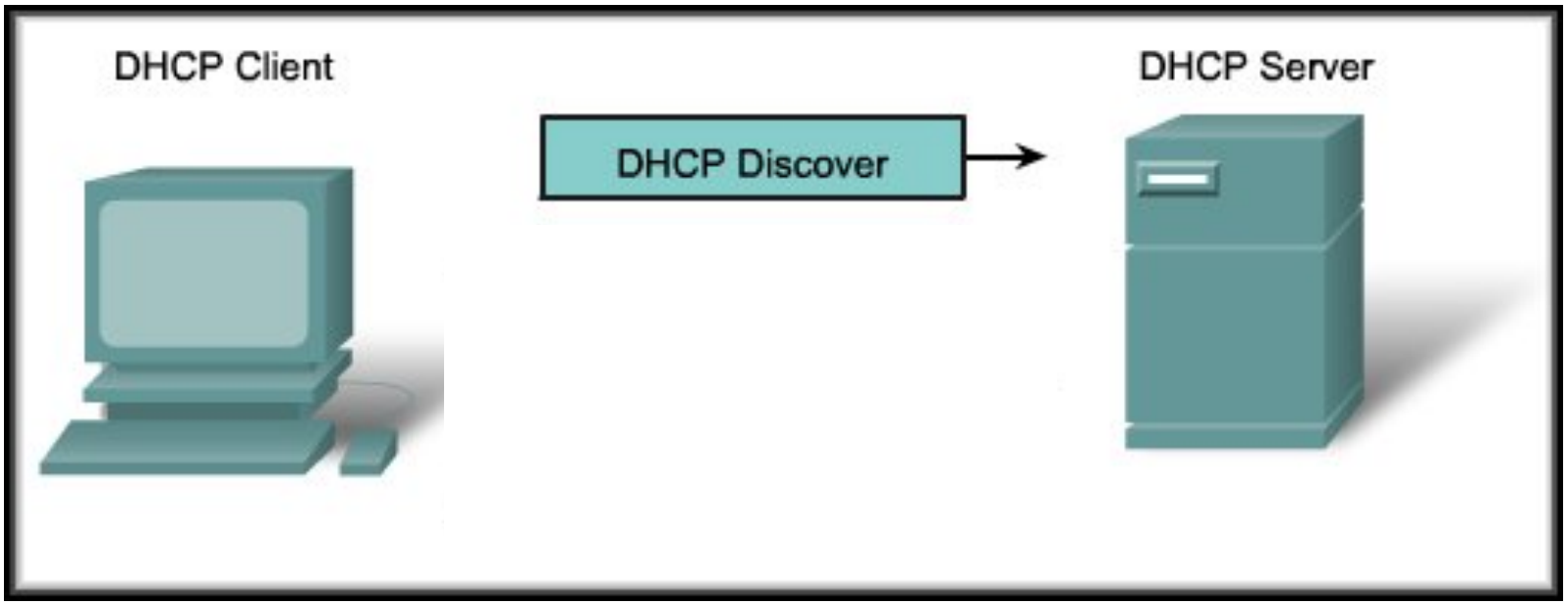
DHCP

- DHCP servers can be on a LAN, on a router or at an ISP.
- The DHCP server maintains a pool of IP addresses and leases an address to any DHCP-enabled client when the client is powered on.



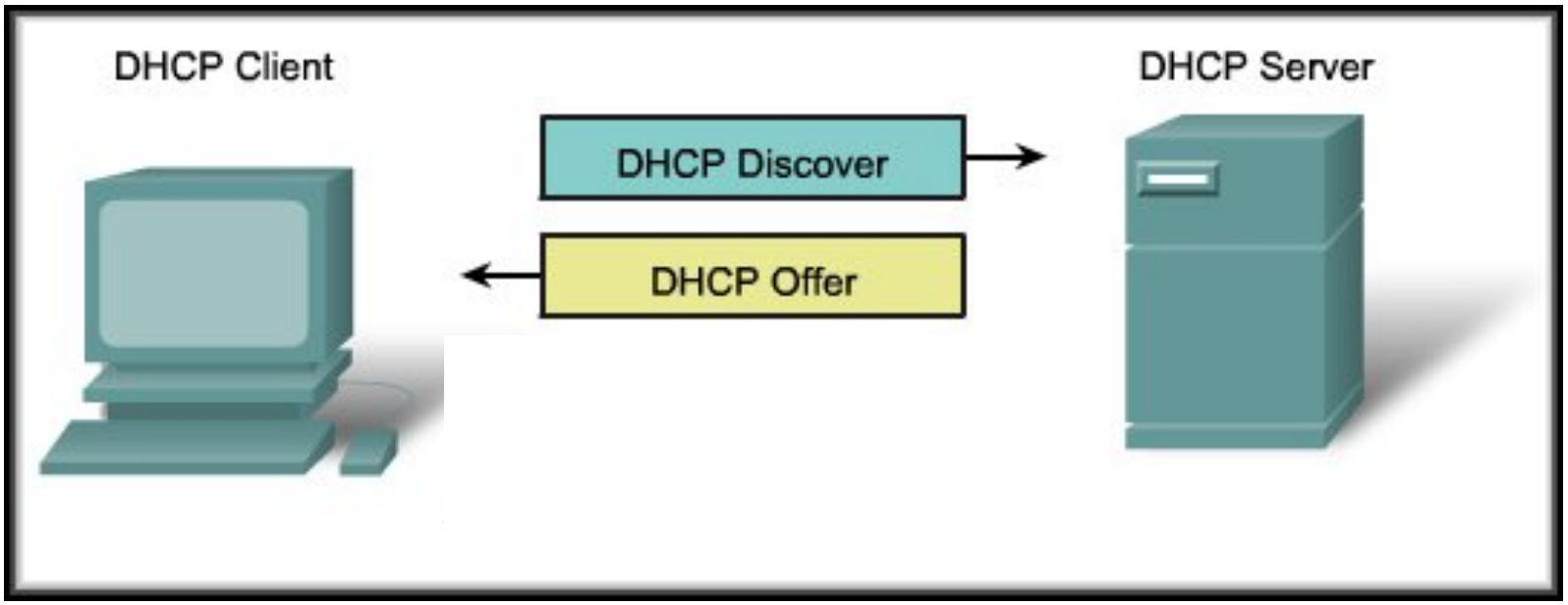
DHCP Operation

- DHCP is a four step process.



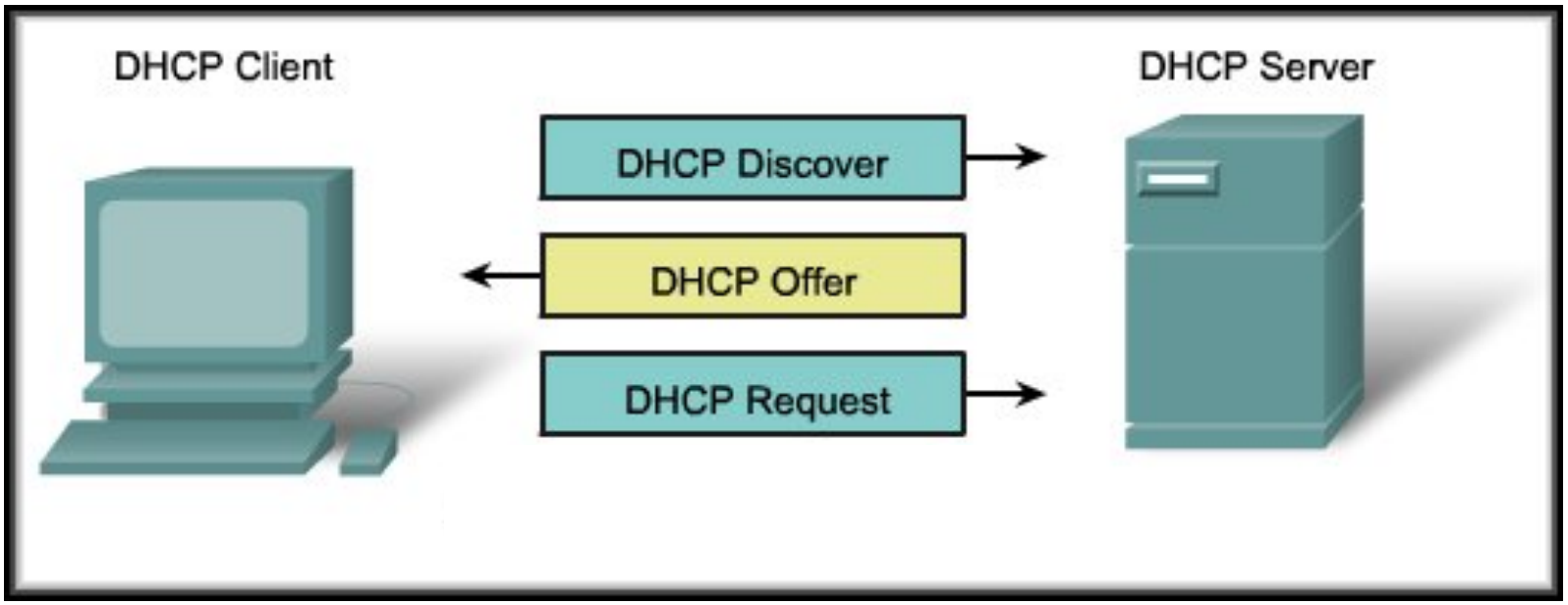
1. Client broadcasts a DHCP Discover frame to find a DHCP server. There may be more than one available.

DHCP Operation



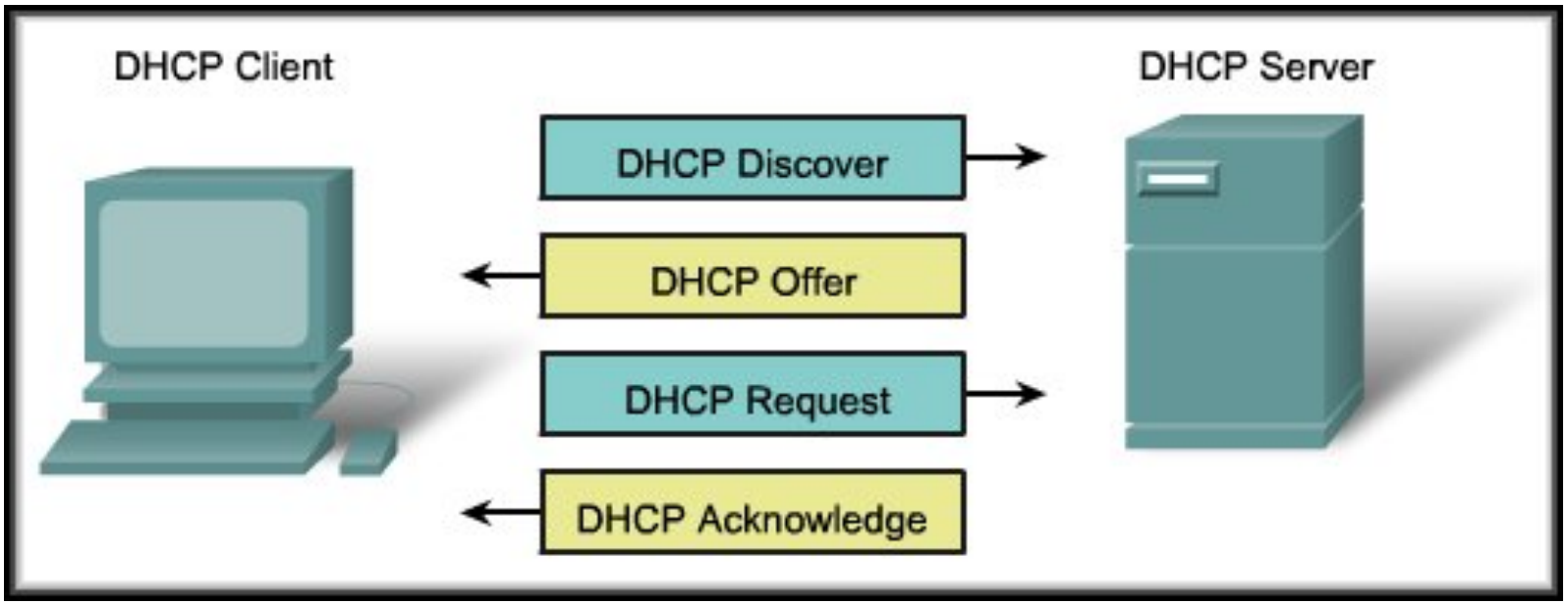
2. A DHCP server responds with a DHCP Offer frame containing a lease time, an IP Address, Subnet Mask, and addresses for a Default Gateway and DNS Server.

DHCP Operation



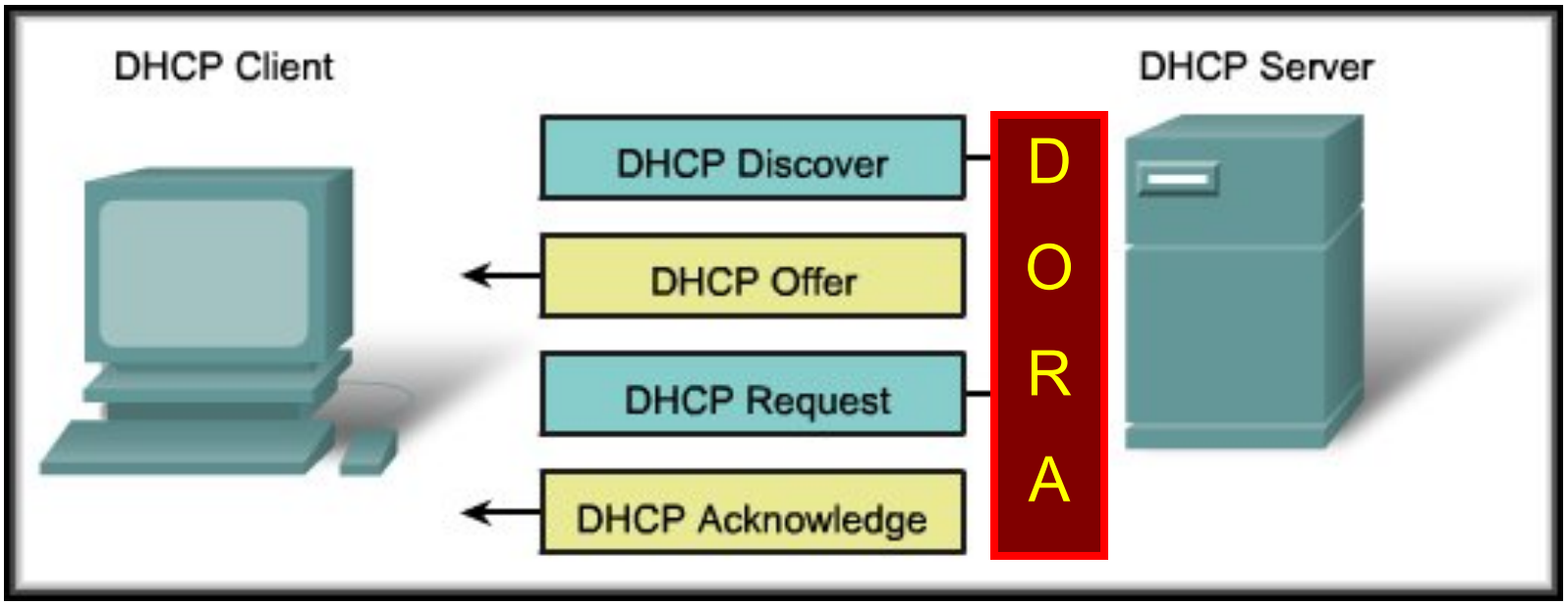
3. The client responds by broadcasting a DHCP Request that identifies the server and the lease offer it is accepting.

DHCP Operation



4. If the offer is still valid, the server returns a DHCP Acknowledgement and records that information as used. If it is no longer valid, a DHCP Negative Acknowledgement is sent and the process begins again.

DHCP Operation



DHCP

- DHCP can pose a security risk because any device connected to the network can receive an address….
- This risk makes physical security an important factor when determining whether to use dynamic or manual addressing.
- Dynamic and static addressing both have their places in network designs.

DHCP

- Dynamic Addressing:
  - Used for general purpose hosts such as end user devices.

- Static Addressing:
  - Used for network devices such as gateways, switches, servers and printers.



P2P

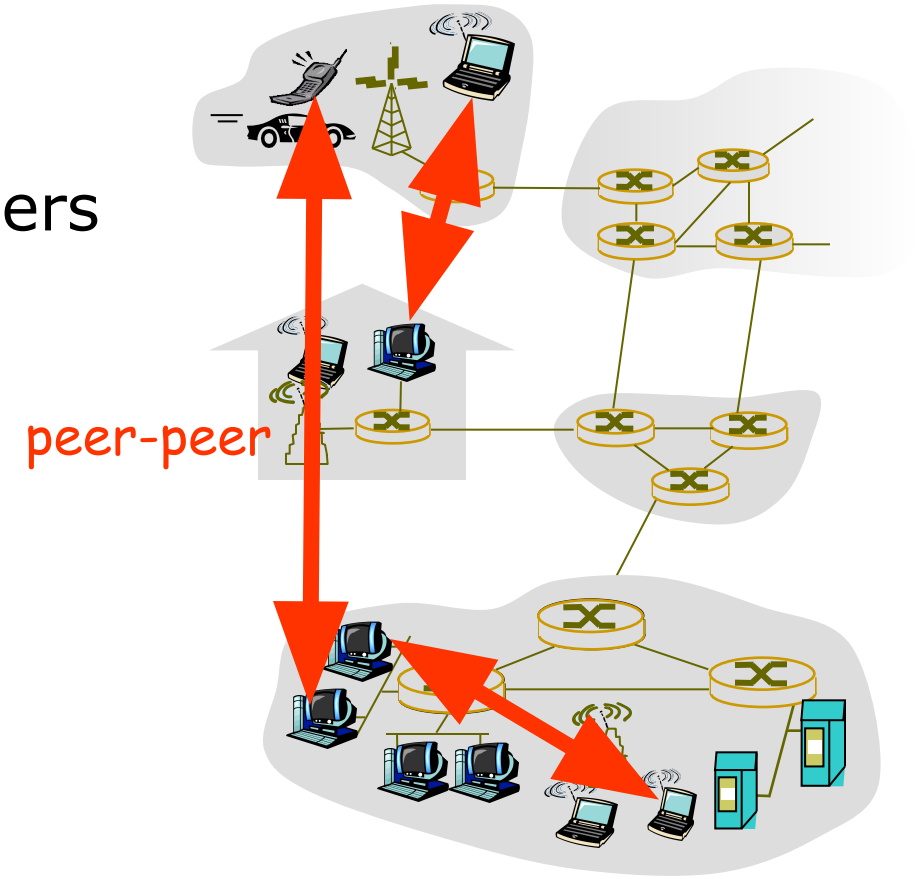
Peer to Peer

P2P Applications

- Roughly 60% of all upstream traffic and 25% of all downstream traffic on an average day can be attributed to P2P applications in Asia Pacific in 2010.
  - Source :Article from TorrentFreak

Pure P2P architecture

- *No* always-on server
- Peers (hosts) act as both clients and servers
- Most popular P2P protocol now is **BitTorrent.**



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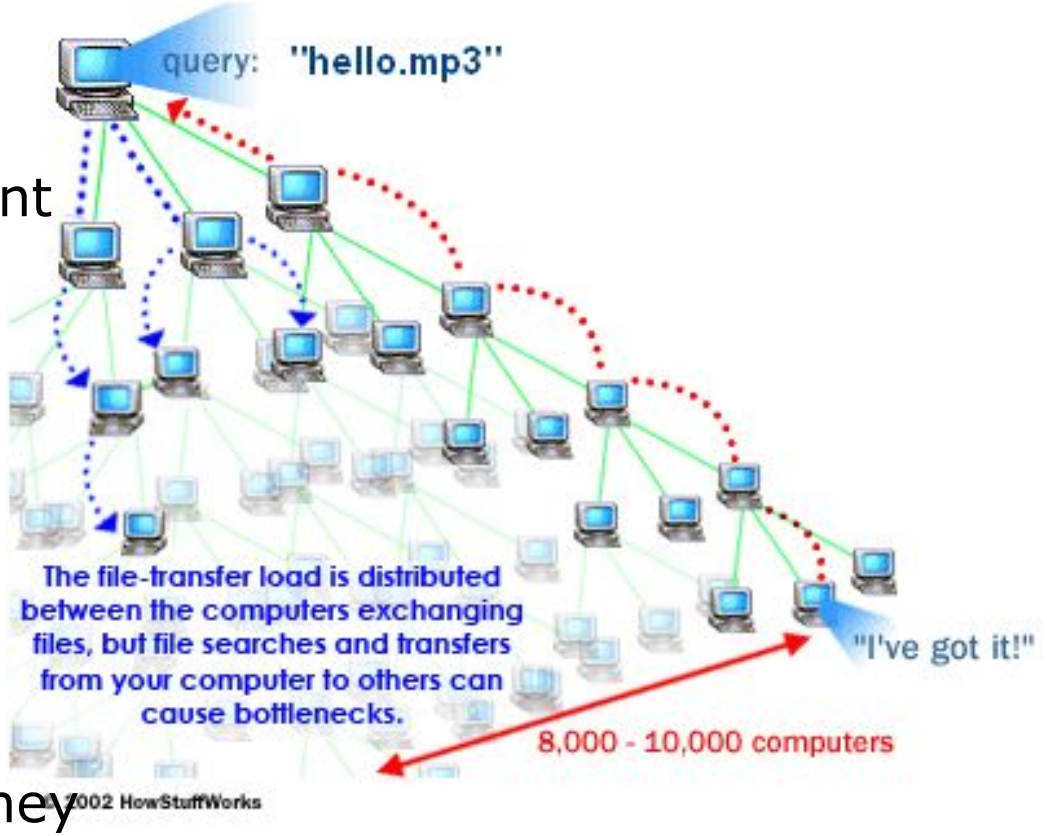
P2P Applications in general

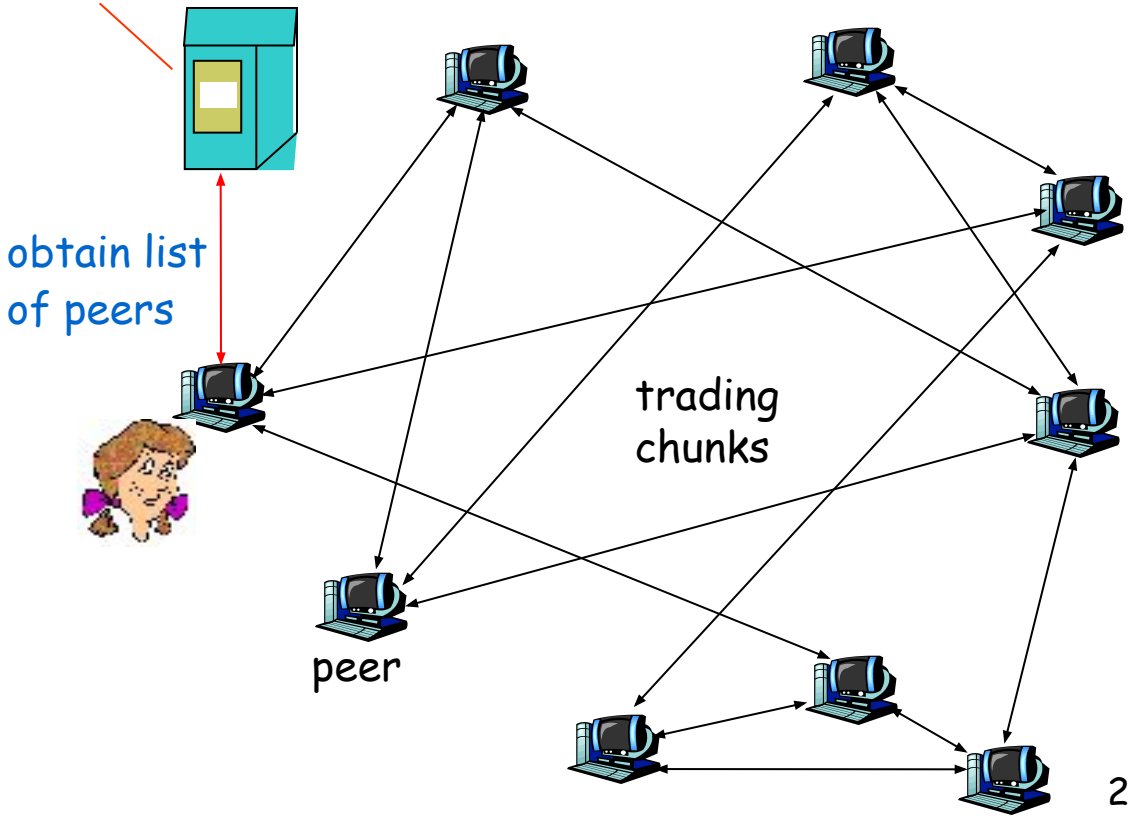
- P2P software on your computer sends out a request for the file you want to download.
- To locate the file, the software queries other computers.
- When the software finds a computer that has the file the download begins.
- Others using the P2P software can obtain files they want from your computer's hard drive.



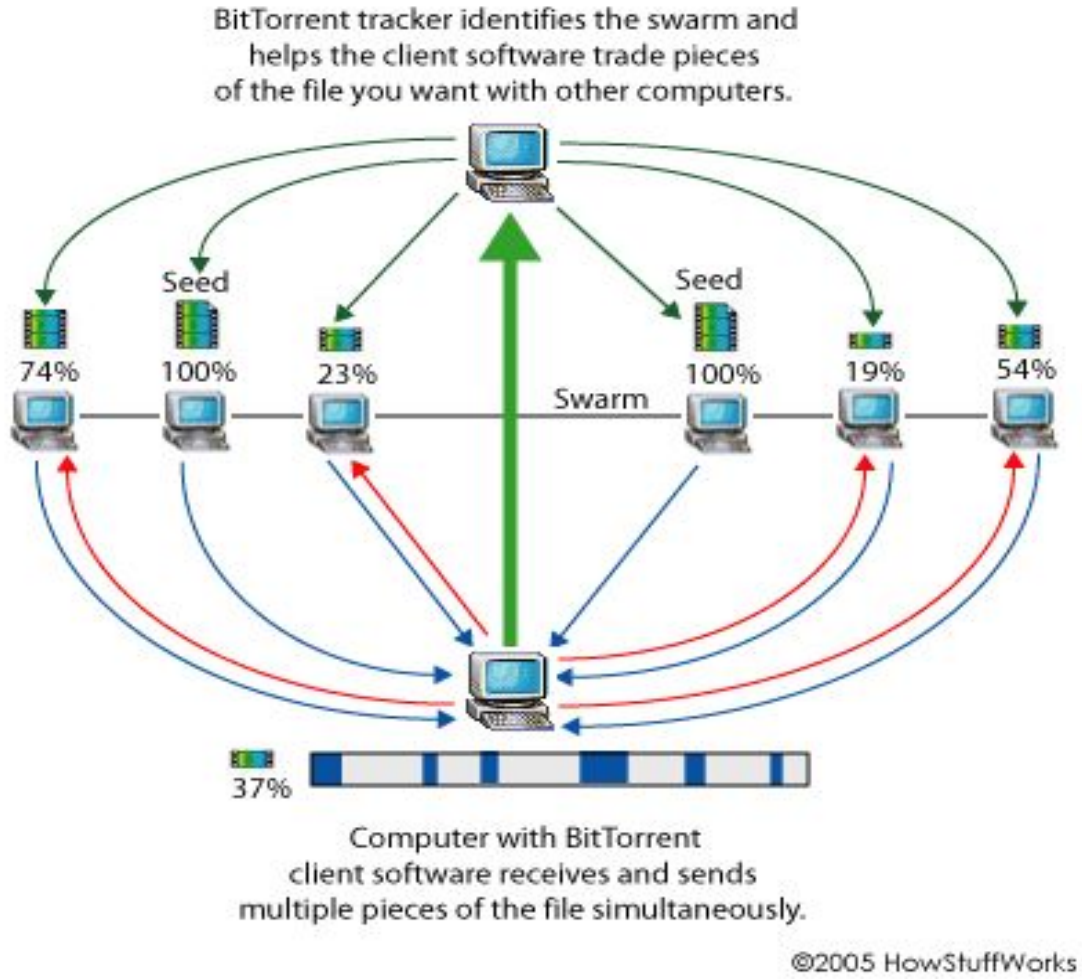
BitTorrent: Operation

tracker: tracks peers participating in torrent

Torrent/Swarm: group of peers exchanging chunks of a file



BitTorrent: Operation



BitTorrent: Operation

- You open a Web page and click on a link for the file you want.
- BitTorrent client software communicates with a tracker to find other computers running BitTorrent that have the complete file (seed computers) and those with a portion of the file (peers that are usually in the process of downloading the file).
- The tracker identifies the swarm, which is the connected computers that have all of or a portion of the file and are in the process of sending or receiving it.
- The tracker helps the client software trade pieces of the file you want with other computers in the swarm. Your computer receives multiple pieces of the file simultaneously.

BitTorrent: Operation

- If you continue to run the BitTorrent client software after your download is complete.
- Others can receive .torrent files from your computer.
- Your future download rates improve because you are ranked higher in the "tit-for-tat" system.

Leeches

Seeder

.torrent

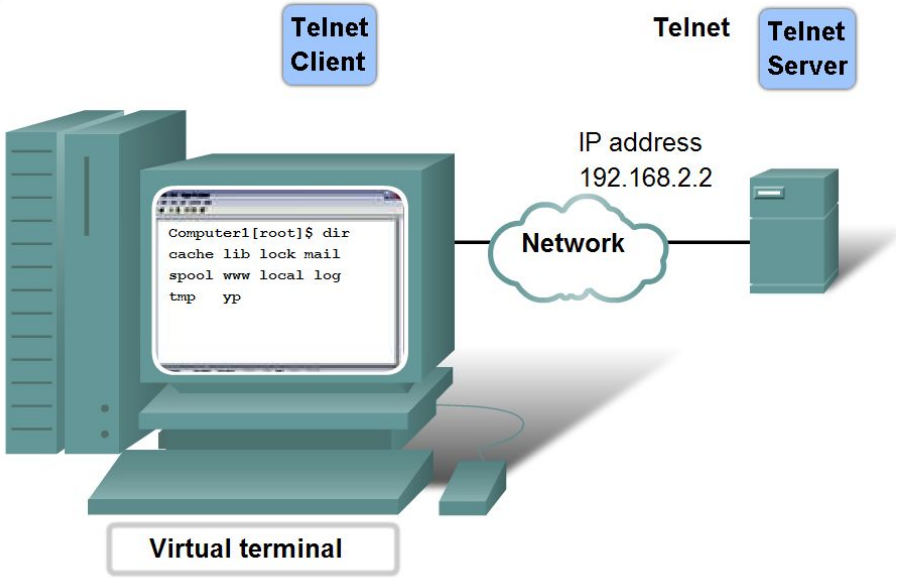
Swarm

Tracker

Telnet

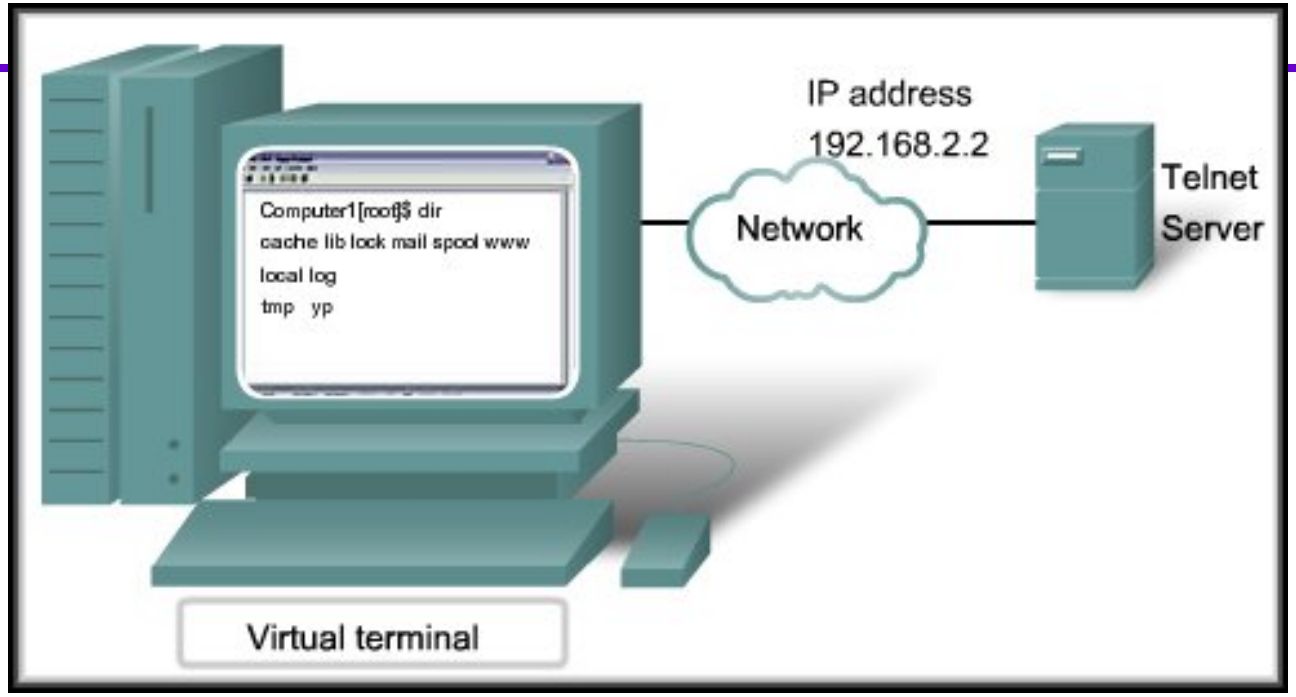
Telnet Services and Protocols

- Once networks were available, people needed a way to remotely access the computer systems.



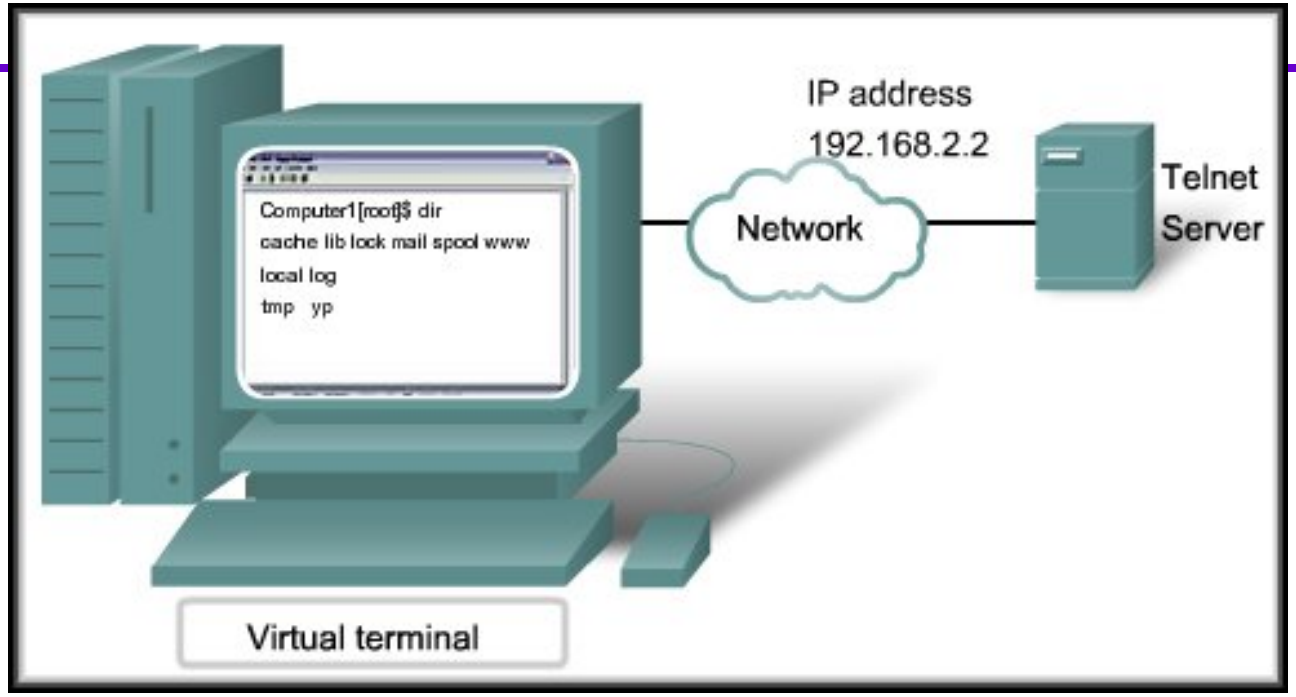
Telnet provides a way to use a computer, connected via the network, to access a network device as if the keyboard and monitor were directly connected to the device.

Telnet Services and Protocol



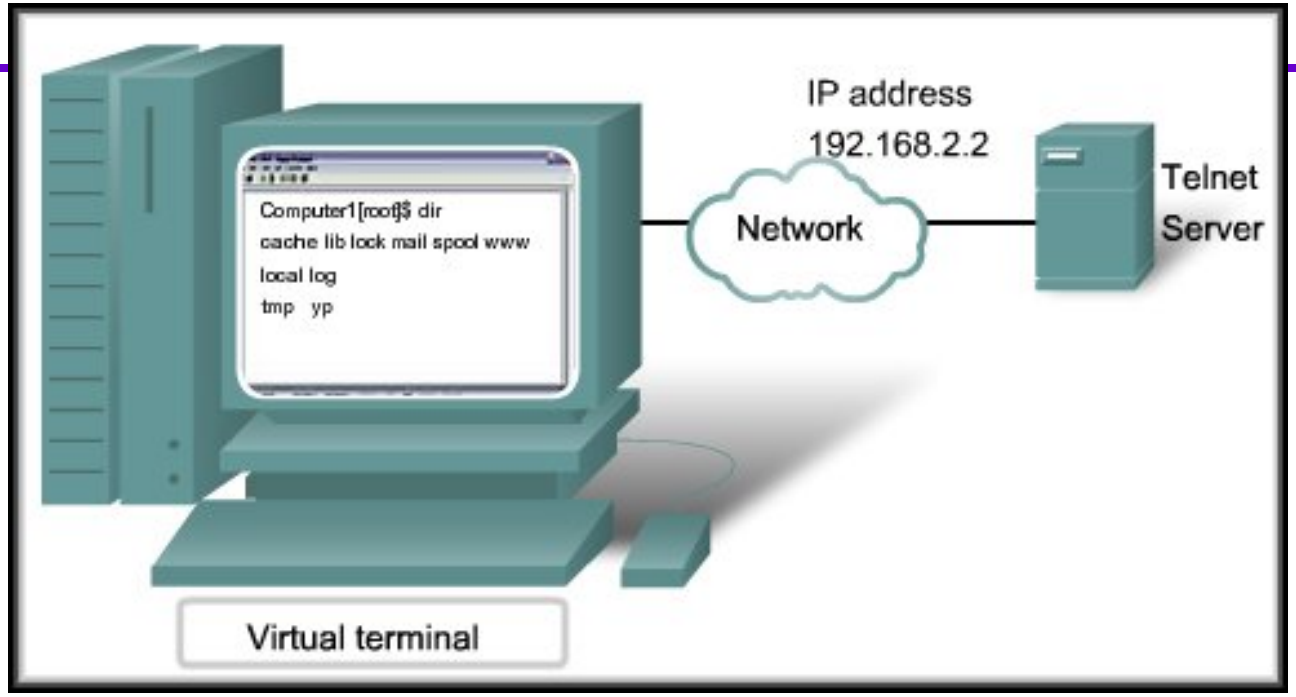
- Allows a user to remotely access another device (host, router, switch).
- A connection using Telnet is called a Virtual Terminal (VTY) session or connection.

Telnet Services and Protocol



- Telnet uses software to create a virtual device that offers the same features as a terminal session command line interface (CLI).
- Telnet Clients: Putty, Teraterm, HyperTerminal

Telnet Services and Protocol



- Telnet supports user authentication but does not encrypt data (clear text).
- Secure Shell (SSH) protocol offers a secure method for server access.
  - Stronger authentication, encrypts data

Telnet Example

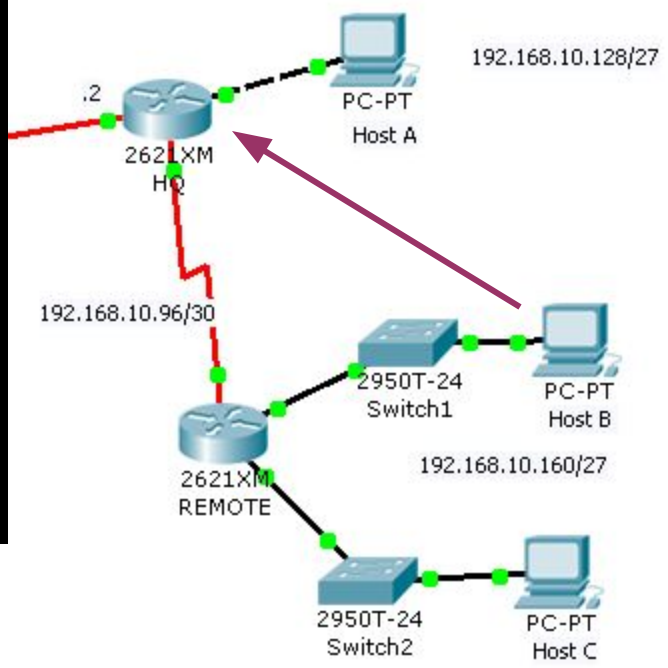
```
Command Prompt

Packet Tracer PC Command Line 1.0
PC>telnet 192.168.10.222
Trying 192.168.10.222 ...


[Connection to 192.168.10.222 closed by foreign host]
PC>telnet 192.168.10.158
Trying 192.168.10.158 ...


User Access Verification

Password:
HQ>
```



Does it feel like this????