



# Chapter 10: Application Layer

Introduction to Networks - R&S 6.0

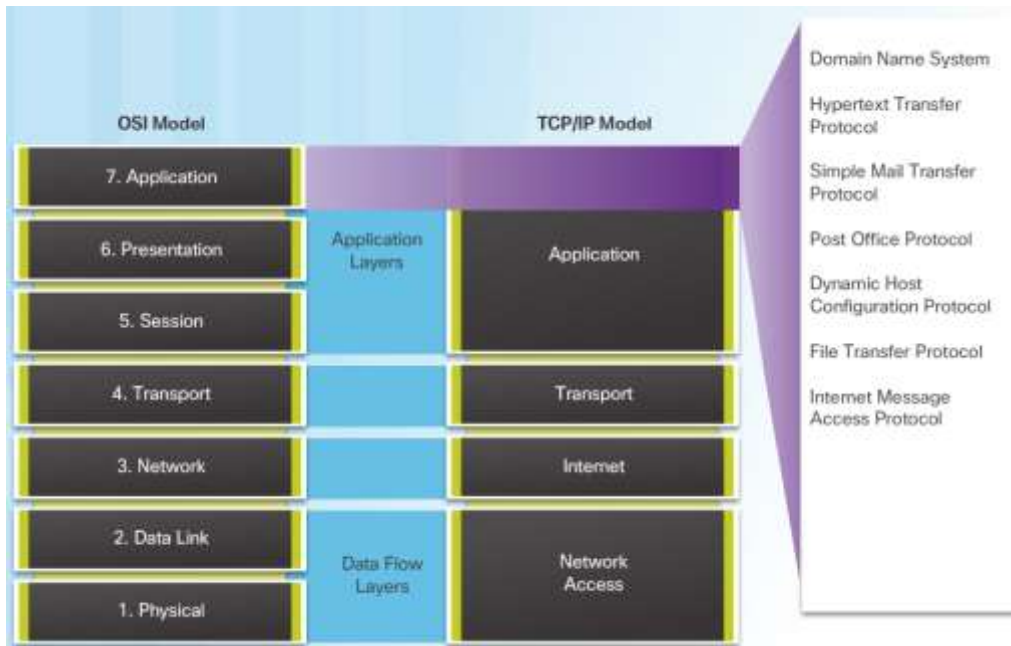
## Chapter 10 - Sections

- **Application Layer**
  - **Closest to the end user**
  - **Application layer protocols help exchange data between programs running on the source and destination hosts**
- **Presentation and Session Layer**
  - **Format, compress and encrypt data**
  - **The session layer handles the exchange of information to initiate dialogs, keep them active, and to restart sessions that are disrupted or idle.**



## 10.1 Application Layer Protocols

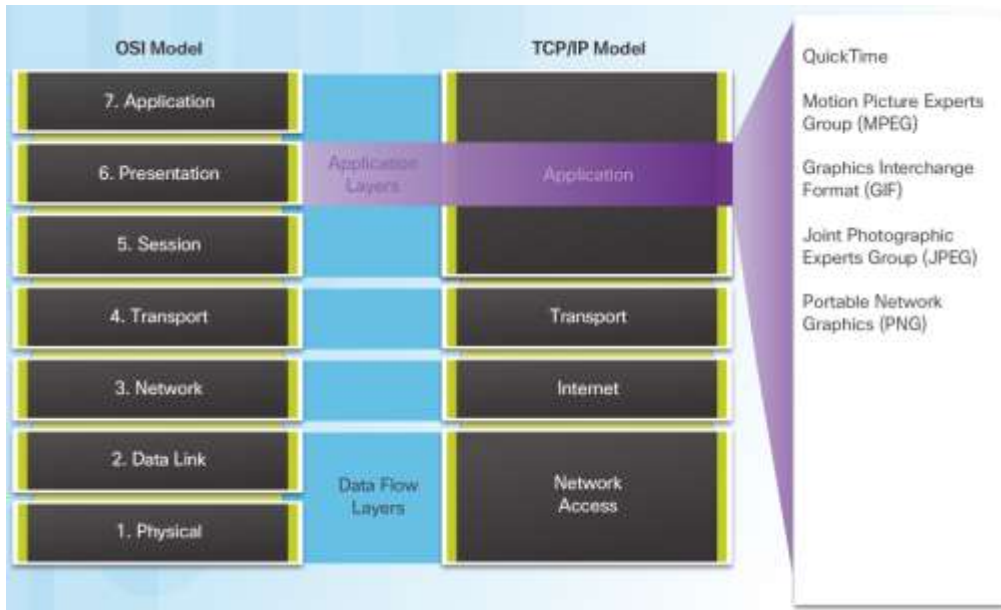
# Application, Presentation, Session



- **Application Layer**

- **Closest to the end user**
- **Application layer protocols help exchange data between programs running on the source and destination hosts**
- **The TCP/IP application layer performs the functions of the upper three layers of the OSI model**
- **Common application layer protocols include: HTTP, FTP, TFTP, DNS.**

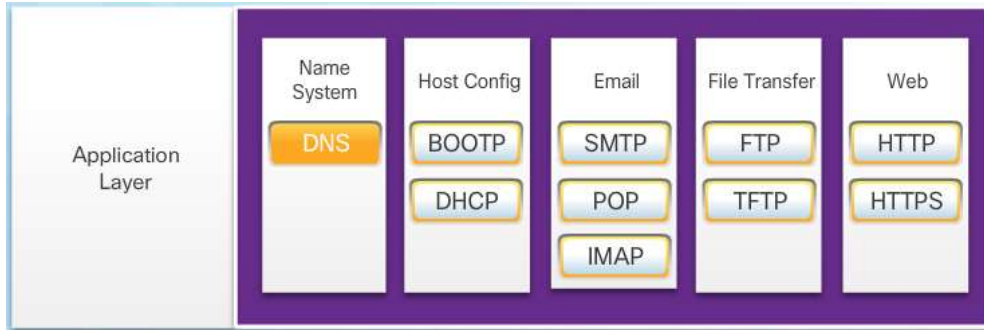
# Application, Presentation, Session



- **Presentation and Session Layer**

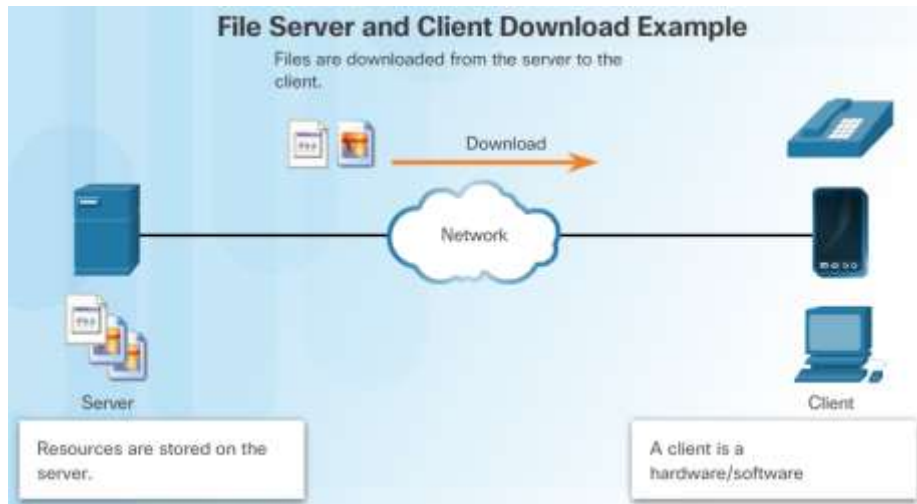
- **Format data, compress and encrypt data**
- **Common standards for video include QuickTime and Motion Picture Experts Group (MPEG)**
- **Common graphic image formats are: GIF, JPEG and PNG**
- **The session layer creates and maintains dialogs between source and destination applications**
- **The session layer handles the exchange of**

# Application, Presentation, Session



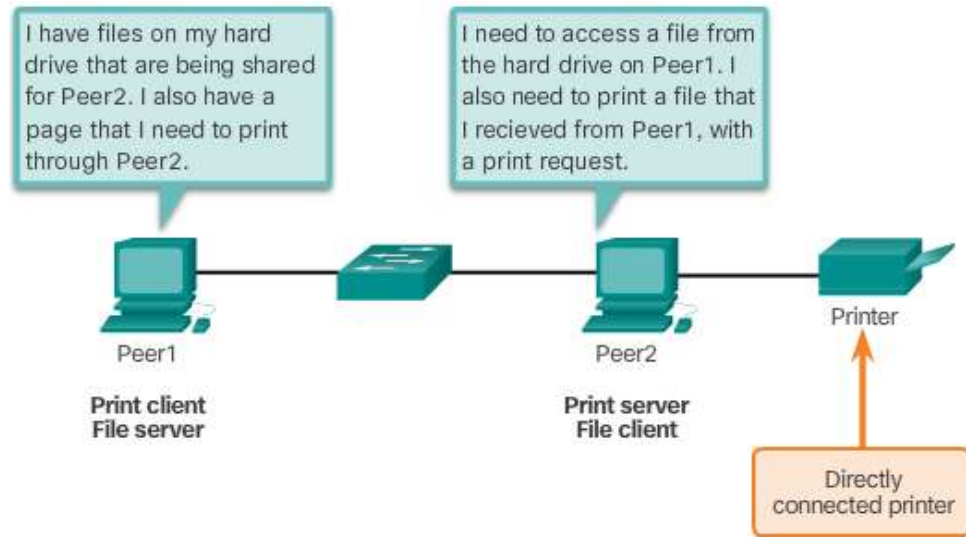
- **TCP/IP Application Layer Protocols**
  - **TCP/IP application protocols specify the format and control information necessary for common Internet functions**
  - **Application layer protocols must be implemented in both the source and destination devices**
  - **Application layer protocols implemented on the source and destination host must be compatible to allow communication.**

# How Application Protocols Interact with End-User Applications



- **Client-Server Model**
  - **Clients request information while servers provide it**
  - **Client and server processes are considered to be in the application layer**
  - **The contents of the data exchange will depend of the application in use**
  - **Email is an example of a Client-Server interaction.**

# How Application Protocols Interact with End-User Applications

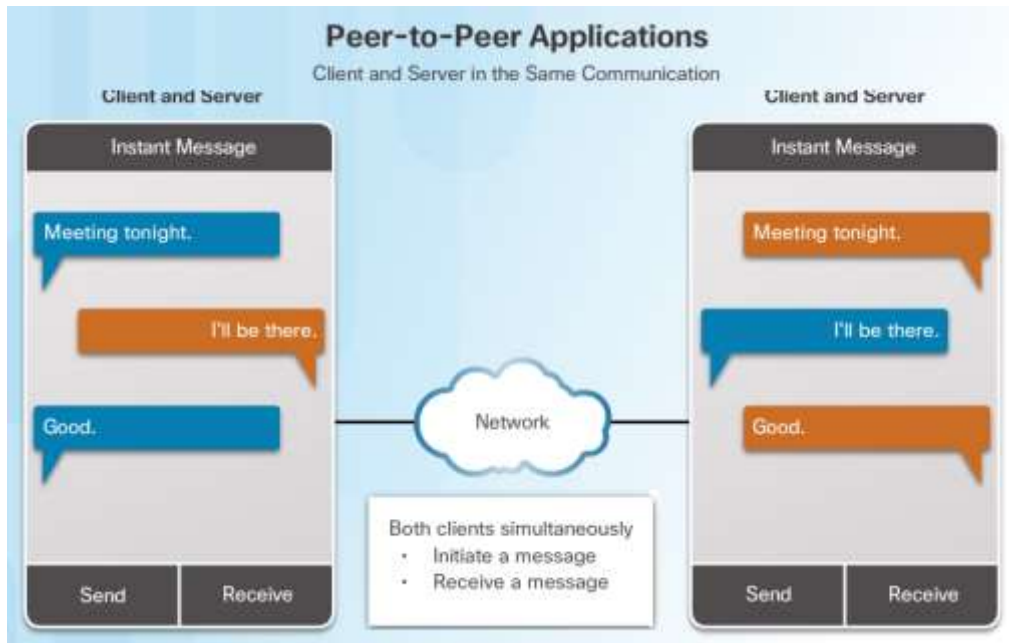


- **Peer-to-Peer Networks**

- **Data is accessed without the use of a dedicated server**
- **Two or more computers can be connected to a P2P network to share resources**
- **Every connected end device (a peer) can function as both a server and a client**
- **The roles of client and server are set on a per-request basis.**



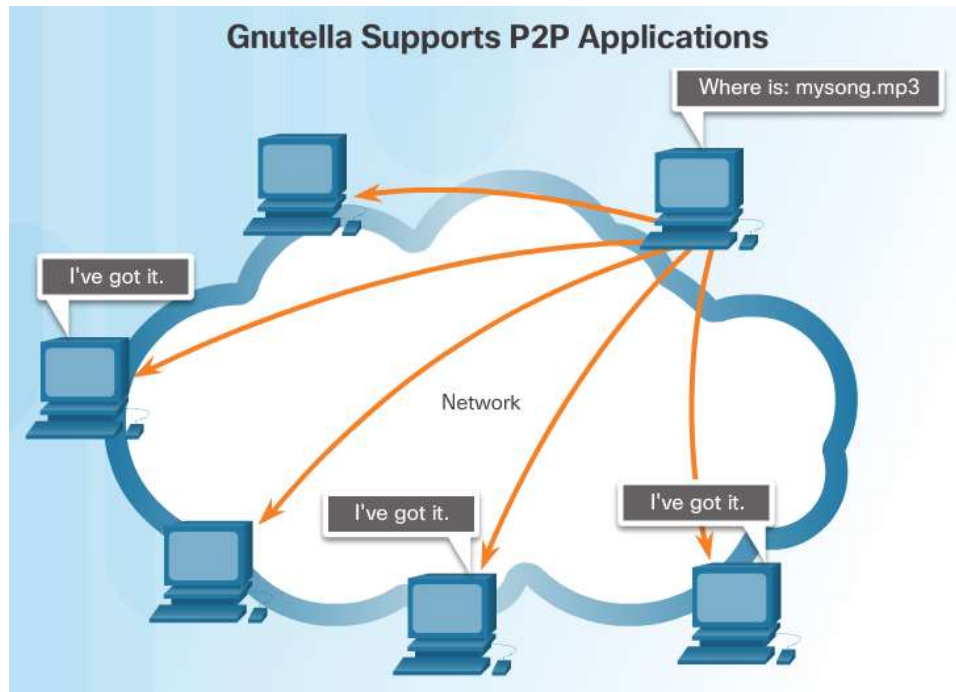
# How Application Protocols Interact with End-User Applications



- **Peer-to-Peer Applications**

- **Some P2P applications use a hybrid system, where resource sharing is decentralized**
- **Indexes that point to resource locations are stored in a centralized directory**
- **In a hybrid system, each peer accesses an index server to get the location of a resource stored on another peer.**

# How Application Protocols Interact with End-User Applications



- **Common P2P Applications**

- **Common P2P networks include: eDonkey, G2, BitTorrent**
- **Many P2P applications allow users to share pieces of many files with each other at the same time**
- **A small torrent file contains information about the location of other users and tracker computers**
- **Trackers are computers keeping track of the files hosted by users**



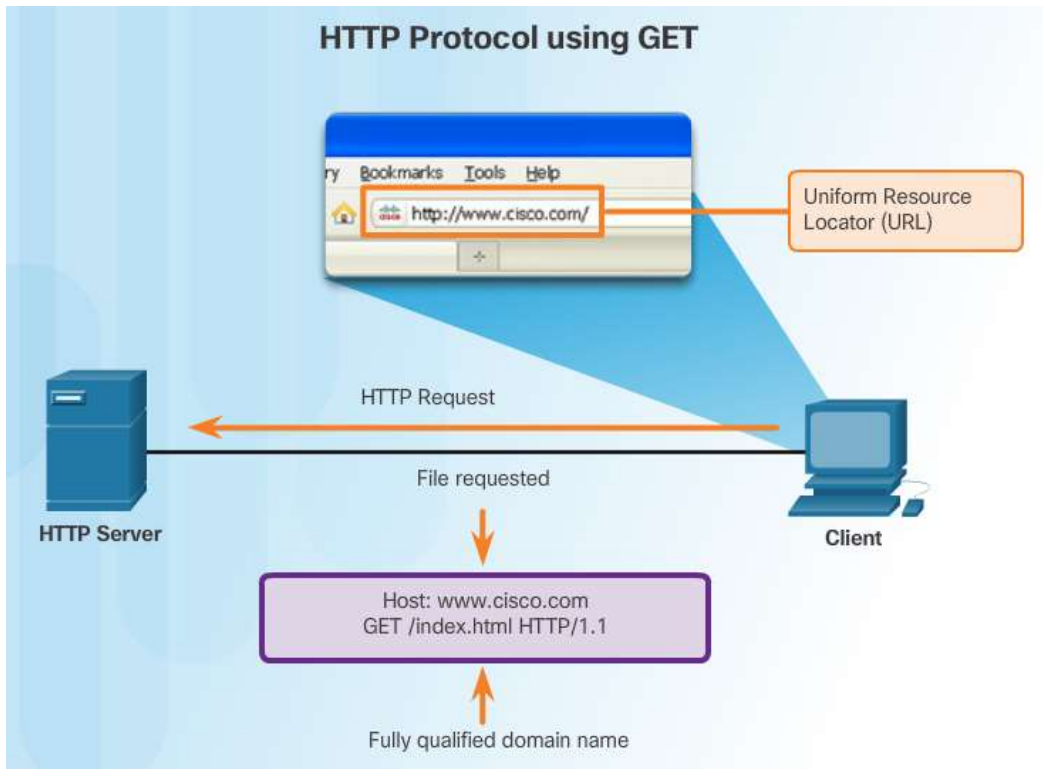
## **10.2 Well-Known Application Layer Protocols and Services**

# Web and Email Protocols



- **Hypertext transfer Protocol and Hypertext Markup Language**
  - **A URL is a reference to a web server**
  - **URLs and URIs are the names most people associate with web addresses**
  - **URLs contain the protocol, the server name and the requested filename**
  - **Using DNS, the server name portion of the URL is then translated to the associated IP address before the server can be contacted**

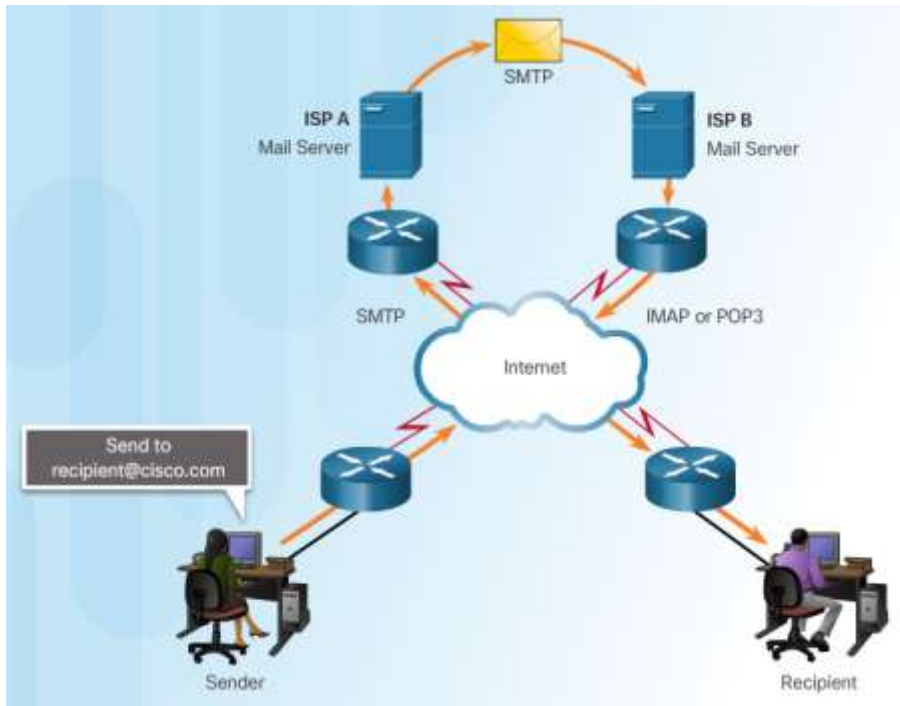
# Web and Email Protocols



- **HTTP and HTTPS**

- **The browser sends a GET request to the server's IP address and asks for the index.html file**
- **The server sends the requested file to the client**
- **The index.html was specified in the URL and contains the HTML code for this web page**
- **The browser processes the HTML code and formats the page for the browser**

# Web and Email Protocols

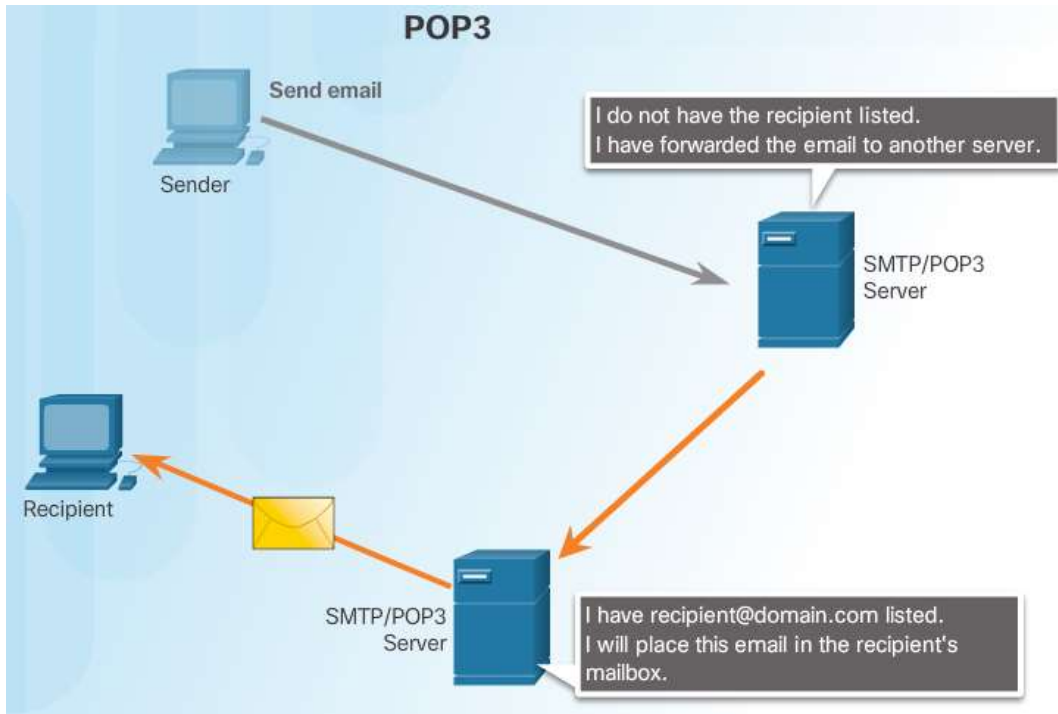


- **Email Protocols**

- **Email is a store-and-forward method of sending, storing, and retrieving electronic messages**
- **Email messages are stored on mail servers**
- **Email clients communicate with mail servers to send and receive email**
- **Mail servers communicate with other mail servers to transport messages from one domain to another**
- **Email relies on three separate protocols for**

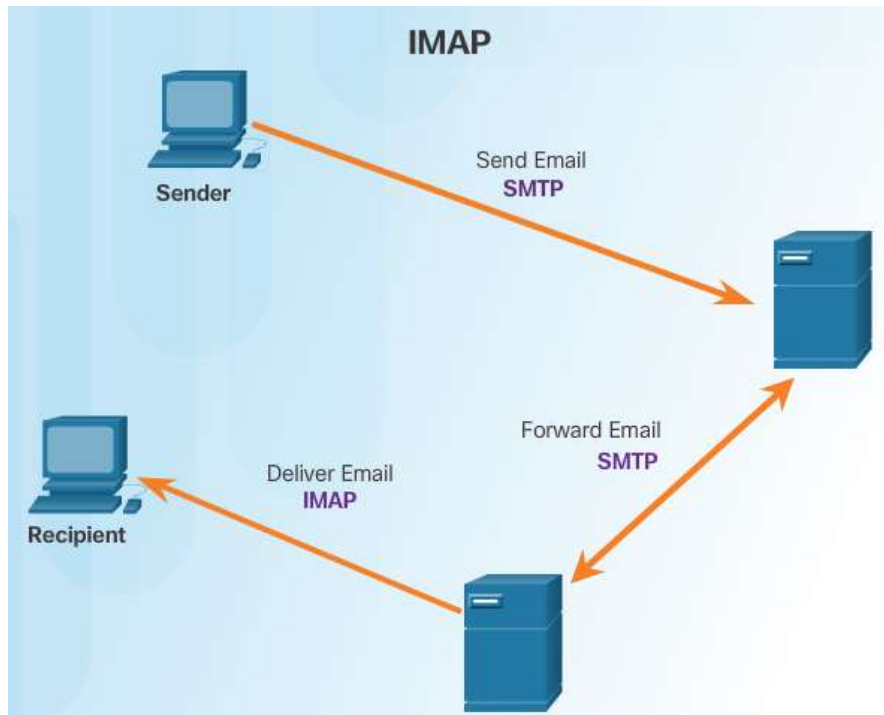
# Web and Email Protocols

- **POP Operation**



- **Messages are downloaded from the server to the client**
- **Email clients direct their POP requests to mail servers on port TCP 110**
- **POP allows for email messages to be downloaded to the client's device (computer or phone) and removed from the server**
- **A downloaded message resides on the device that triggered the download.**

# Web and Email Protocols

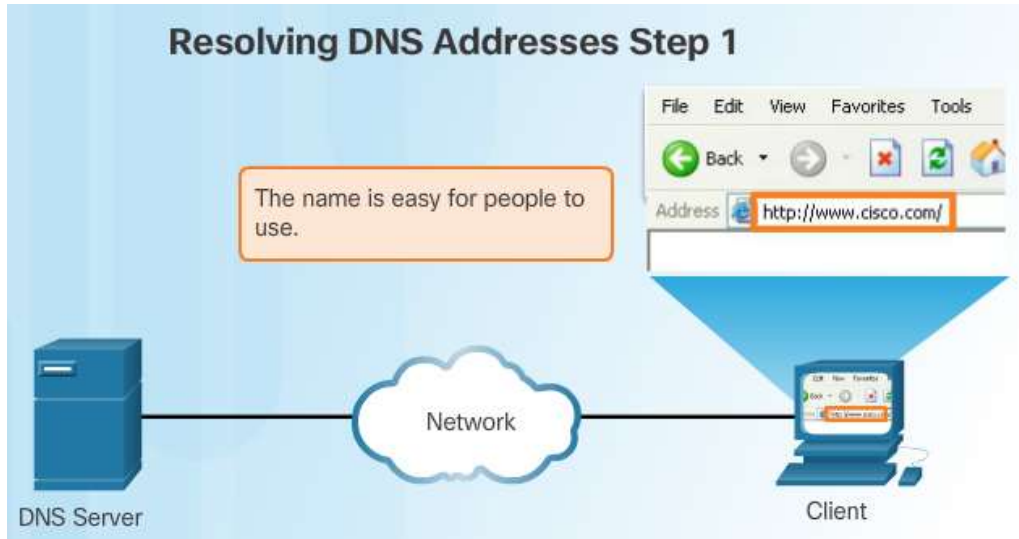


- **IMAP Protocols**

- **IMAP is another protocol used to retrieve email messages**
- **Allows for messages to be displayed to the user rather than downloaded**
- **The original messages reside on the server until manually deleted by the user**
- **Users view copies of the messages in their email client software**
- **Support folder hierarchy to organize and store mail**



# IP Addressing Services



- **Domain Name Service**

- **IP addresses are not easy to memorize**
- **Domain names make server addresses more user-friendly**
- **Computers still need the actual numeric address before they can communicate**
- **The DNS protocol allows for the dynamic translation of a domain name into the associated IP address.**

# IP Addressing Services

DNS uses the same message format for:

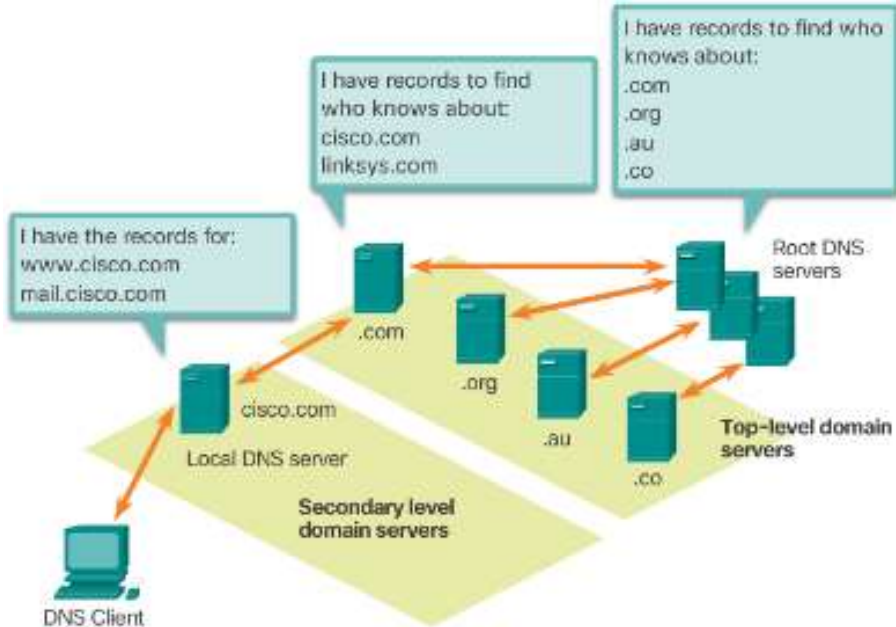
- all types of client queries and server responses
- error messages
- the transfer of resource record information between servers

<b>Header</b>	
<b>Question</b>	The question for the name server
<b>Answer</b>	Resource Records answering the question
<b>Authority</b>	Resource Records pointing toward an authority
<b>Additional</b>	Resource Records holding additional information

- **DNS Message Format**
  - **Common DNS records are A, NS, AAAA and MX**
  - **DNS servers search its own records first, relaying the client's request to other servers if it can't resolve the request**
  - **The response is then forwarded to the client**
  - **The client often stores previous name resolutions**
  - **Use the ipconfig /displaydns to list**

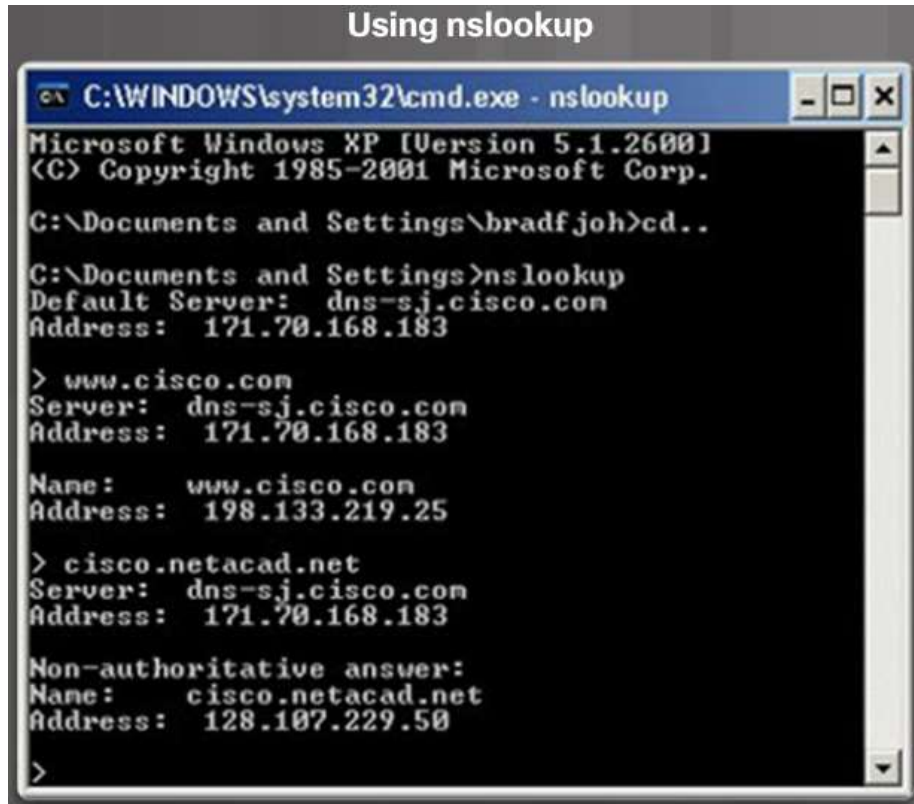
# IP Addressing Services

- **DNS Hierarchy**



- **The DNS protocol uses a hierarchical system**
- **The naming structure is broken down into small, manageable zones**
- **Each DNS server is only responsible for managing name-to-IP mappings for a small portion of the DNS structure**
- **Requests for zones not stored in a specific DNS server are forwarded to other servers for translation**

# IP Addressing Services



```
Using nslookup
C:\WINDOWS\system32\cmd.exe - nslookup
Microsoft Windows XP [Version 5.1.2600]
(C) Copyright 1985-2001 Microsoft Corp.

C:\Documents and Settings\bradfjoh>cd..

C:\Documents and Settings>nslookup
Default Server:  dns-sj.cisco.com
Address:  171.70.168.183

> www.cisco.com
Server:  dns-sj.cisco.com
Address:  171.70.168.183

Name:    www.cisco.com
Address:  198.133.219.25

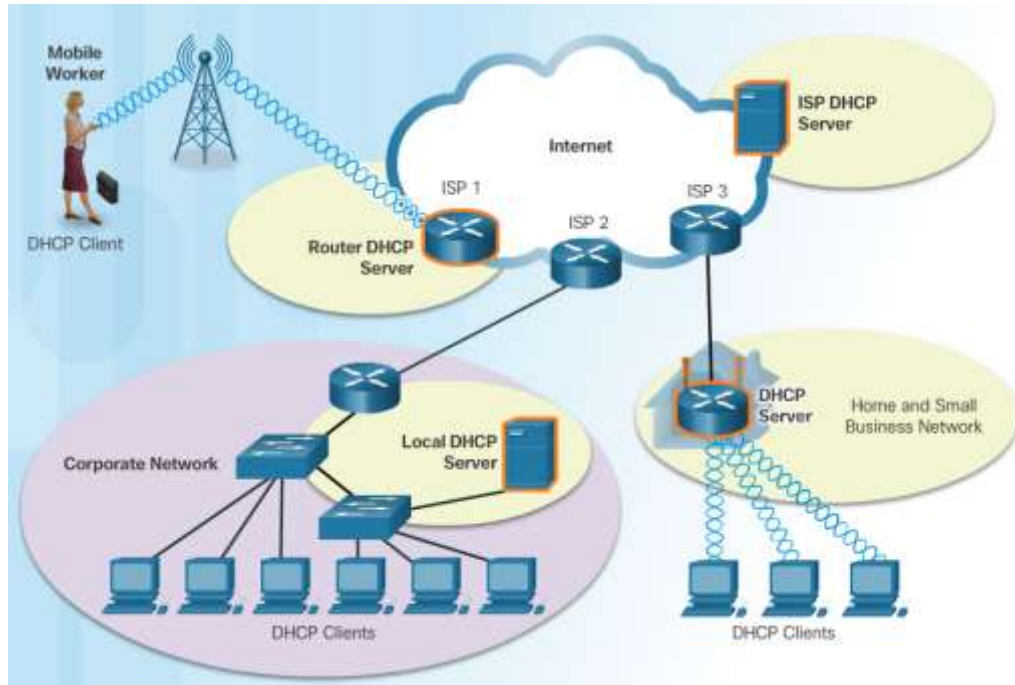
> cisco.netacad.net
Server:  dns-sj.cisco.com
Address:  171.70.168.183

Non-authoritative answer:
Name:    cisco.netacad.net
Address:  128.107.229.50

>
```

- **The nslookup Command**
  - Use nslookup to place DNS queries
  - Useful for DNS troubleshooting.

# IP Addressing Services



- **Dynamic Host Configuration Protocol**
  - **Computers need network IP information to communicate over a network**
  - **IP information include host and gateway addresses, mask, and DNS server**
  - **DHCP allows for automated and scalable distribution of IP information**
  - **DHCP-distributed addresses are leased for a set period of time**
  - **Addresses are returned to the pool for reuse when no longer in use**

# IP Addressing Services

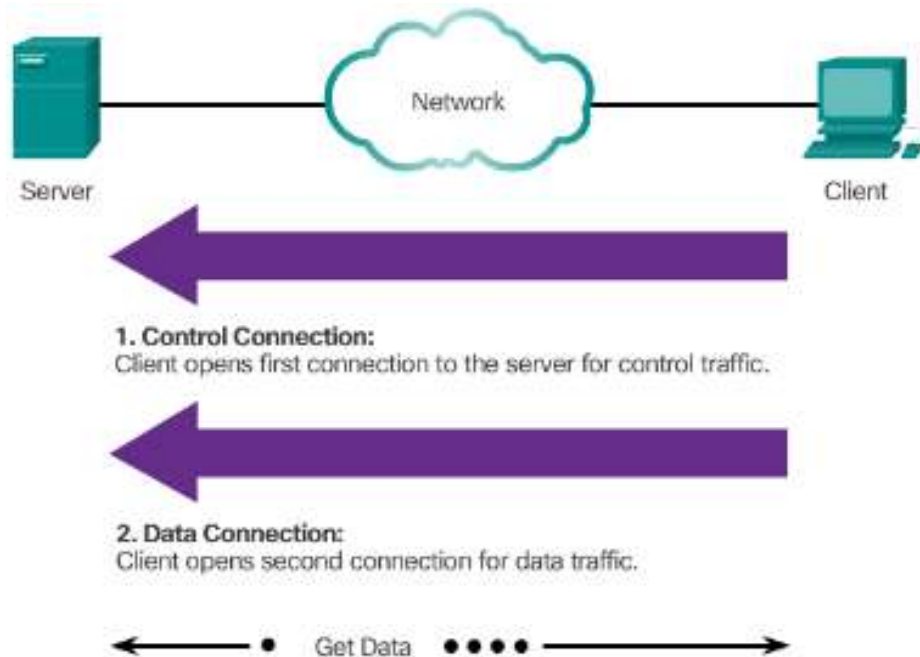


- **DHCP Operation**

- **The client broadcasts a DHCPDISCOVER**
- **A DHCP server replies with DHCPOFFER**
- **The client sends a DHCPREQUEST message to the server it wants to use (in case of multiple offers)**
- **A client may also request an address previously been allocated by the server**
- **The server returns a DHCPACK to confirm the lease has been finalized.**

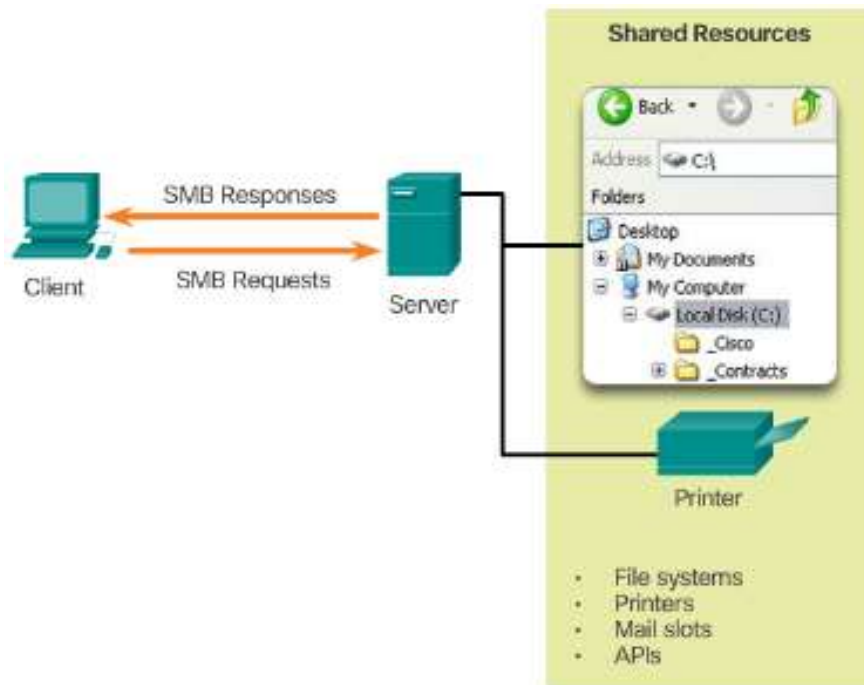
# File Sharing Services

- **File Transfer Protocol**



- An FTP client is an application that runs on a client computer used to push and pull data from an FTP server
- FTP requires two connections between the client and the server: one connection for commands and replies and another connection for the actual file transfer
- The client initiates and establishes the first connection to the server for control traffic on TCP port 21

# File Sharing Services



- **Server Message Block**

- **SMB is a client/server file sharing protocol**
- **All SMB messages share a common format**
- **SMB file-sharing and print services have become the mainstay of Windows networking**
- **Microsoft products now support TCP/IP protocols to directly support SMB resource sharing**



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