

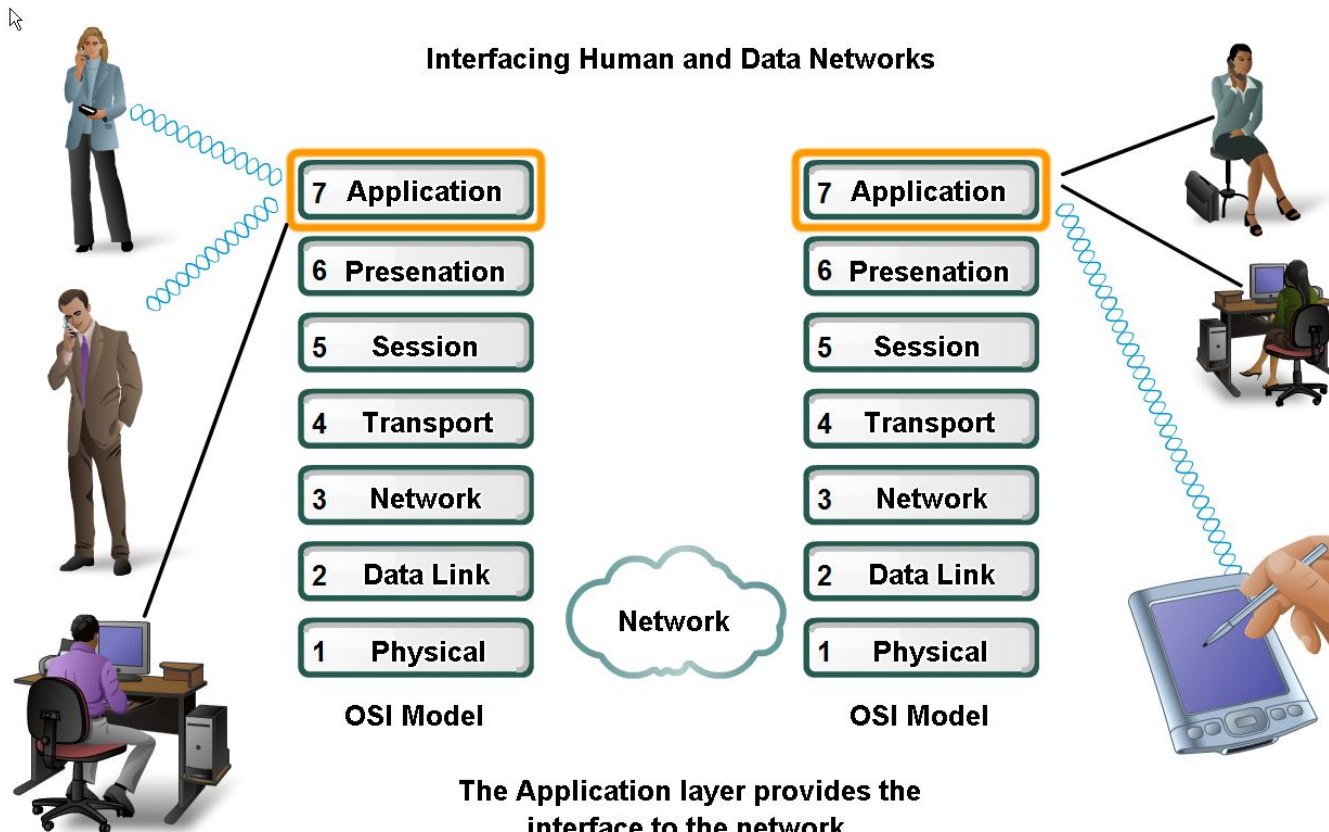
Application Layer I



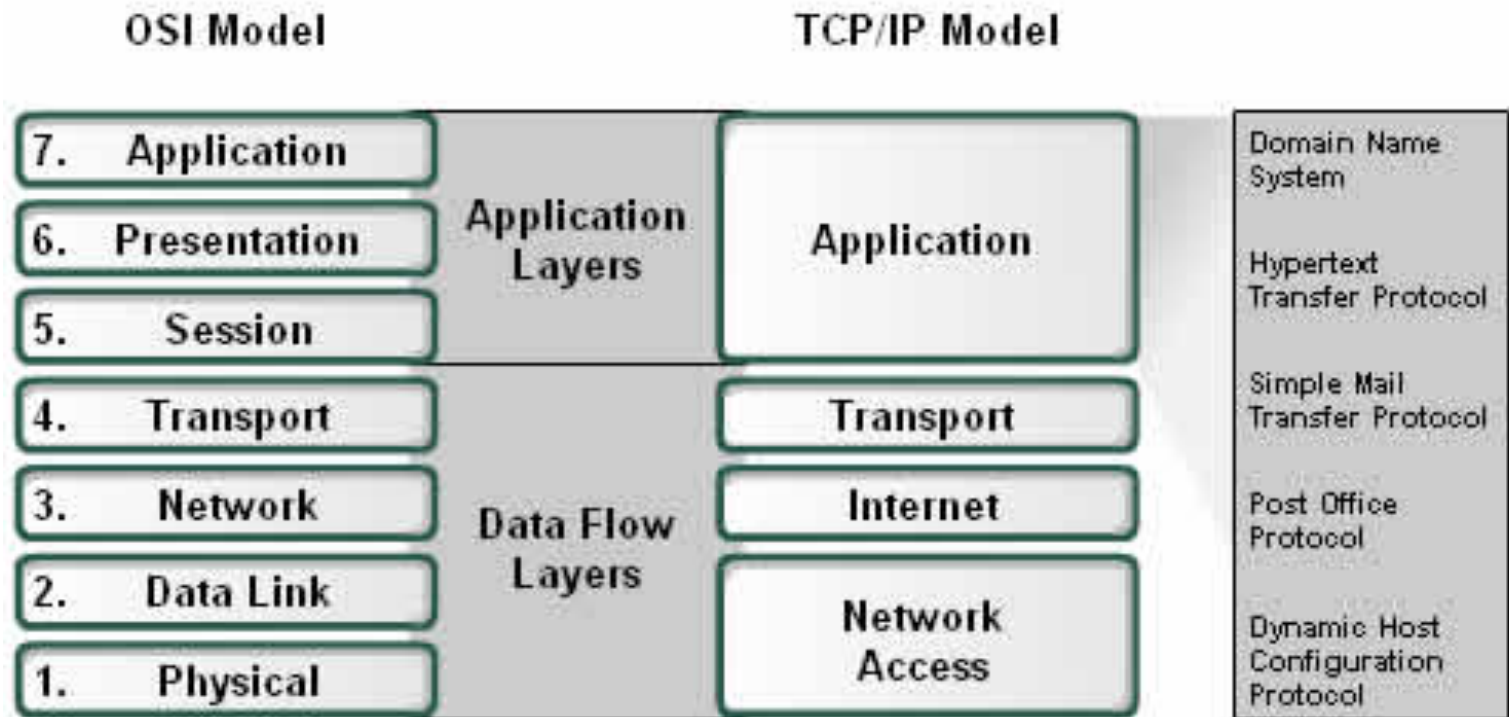
Chapter 3 CCNA Exploration 1

Applications

□ The Interface Between Human and Data Networks



Application Layer



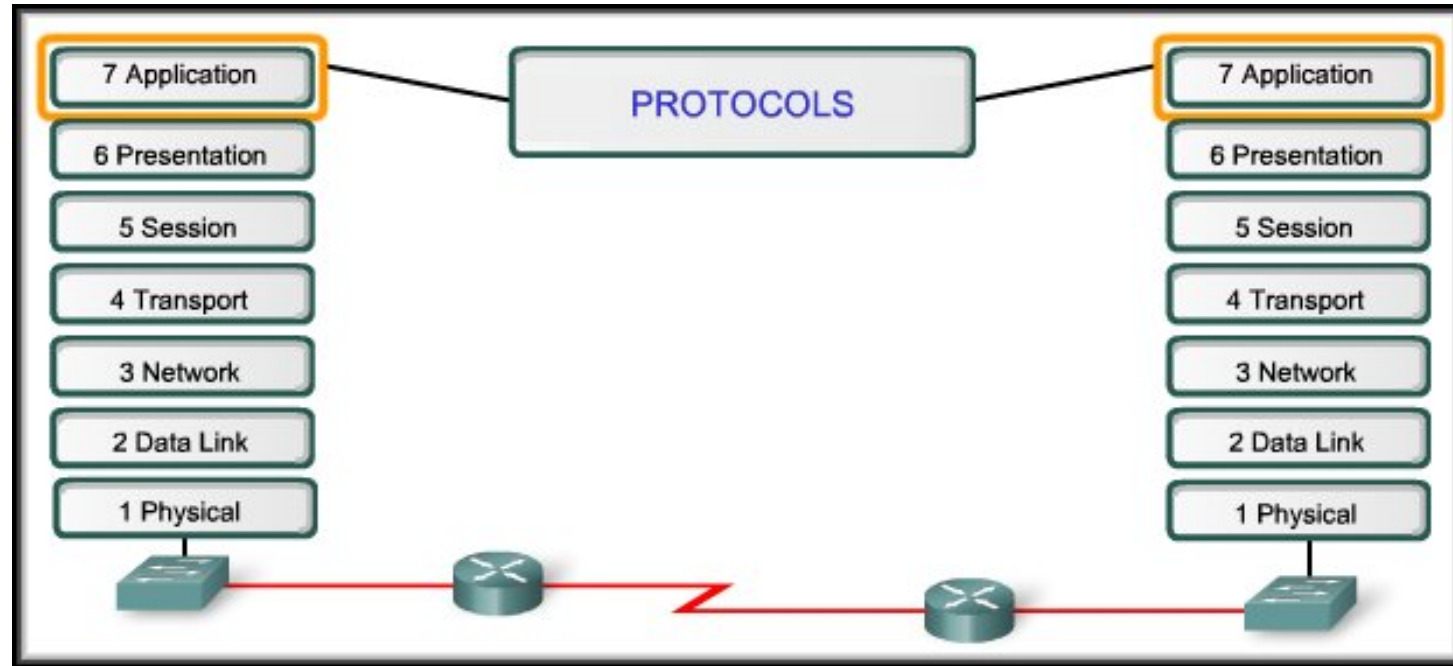
Application Layer Protocols

- ❖ **Application layer is the top most layer of TCP/IP model.**
- ❖ **Application layer is present on the top of the Transport layer.**
- ❖ **Application layer defines TCP/IP application protocols and how host programs interface with Transport layer services to use the network.**
- ❖ **Application layer includes all the higher-level protocols like:**
 - **DNS (Domain Name System),**
 - **HTTP (Hypertext Transfer Protocol),**
 - **Telnet, SSH(Secure Shell)**
 - **FTP (File Transfer Protocol),**
 - **TFTP (Trivial File Transfer Protocol),**
 - **SNMP (Simple Network Management Protocol),**
 - **SMTP (Simple Mail Transfer Protocol) ,**
 - **DHCP (Dynamic Host Configuration Protocol)**
 - **And so on**

Application Layer – OSI and TCP/IP Models

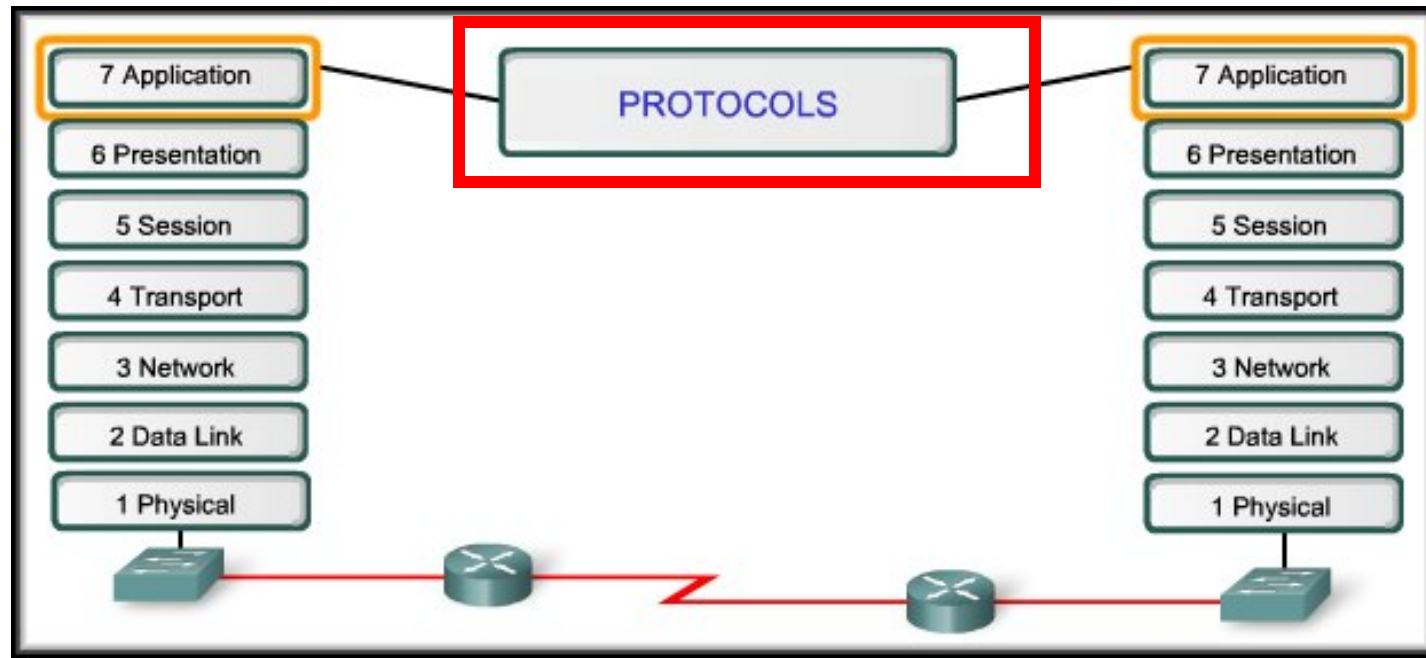
- Two important concepts:
 - **Application Layer Protocols:**
 - Provide the rules and formats that govern how data is treated in the application layer.
 - **Application Software**
 - The programs used to communicate over the network.
- For example:
 - When displaying a web page:
 - The **Application Layer** uses the **HTTP** Protocol.
 - The **Application Software** is your **browser**.

Application Layer Software



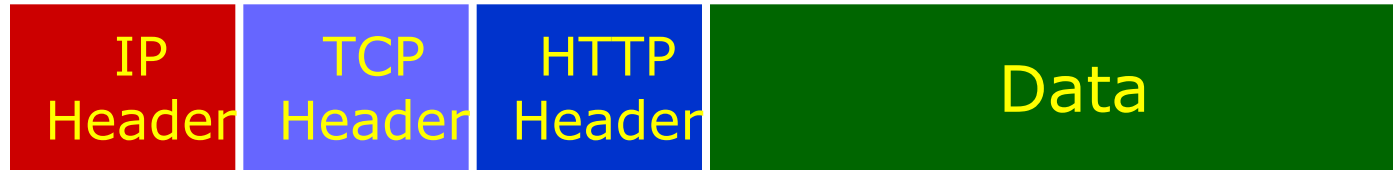
- Application layer protocols are used by **both the source and destination** devices during a communication session.
- The application layer protocols implemented on the source and destination host **must match**.

Application Layer Protocols



- ❑ Establish consistent rules for data exchange.
- ❑ Specify data structure in the message and types of messages.
- ❑ Define message dialogues (appropriate responses).

Application Layer Software



- Applications and services can use multiple protocols.
- For example, using a web browser may invoke:
 - DNS, ARP(Address Resolution Protocol), ICMP(Internet Control Message Protocol)
 - May use TCP, UDP, Ethernet, PPP (*Much More Later*)
 - Definitely uses IP

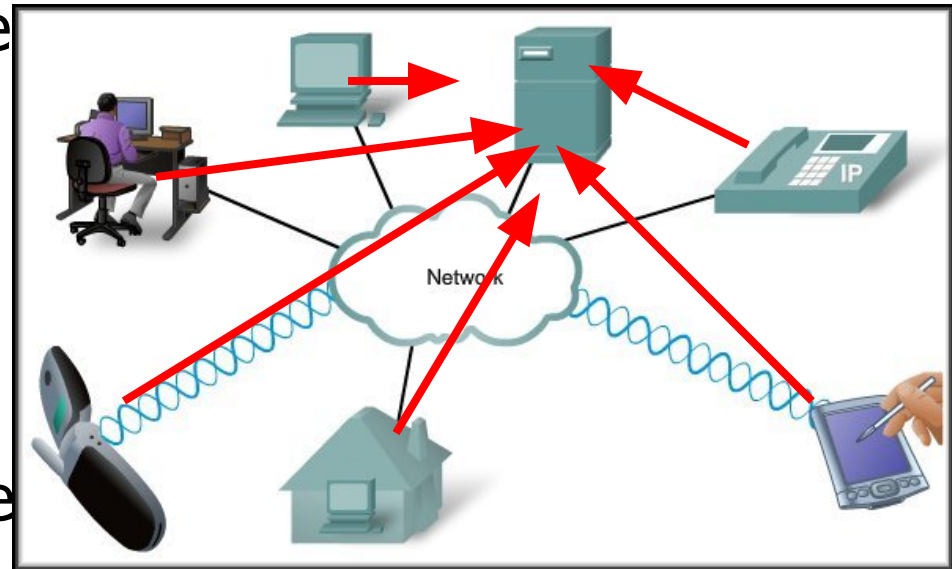
Application Layer



Making Provisions for
Applications and Services

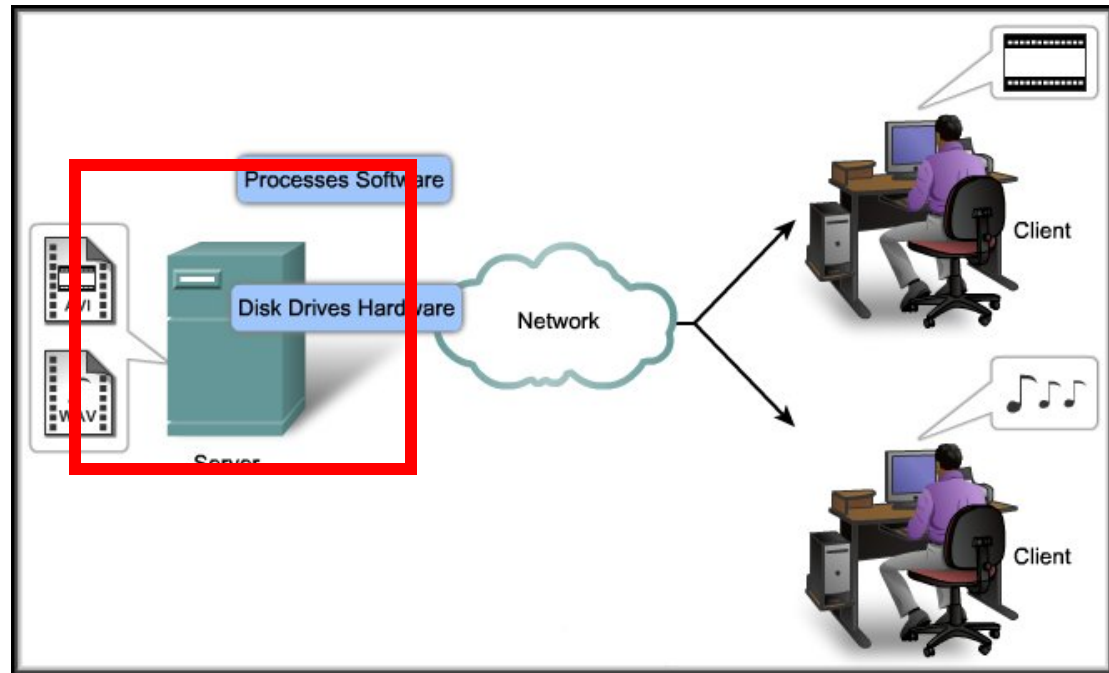
Introduction

- When accessing information on a device the data may not be physically stored on that device.
- If that is the case, a request must be made to the device where the data resides.
- Two methods:
 - Client/Server
 - Peer-to-Peer (P2P)



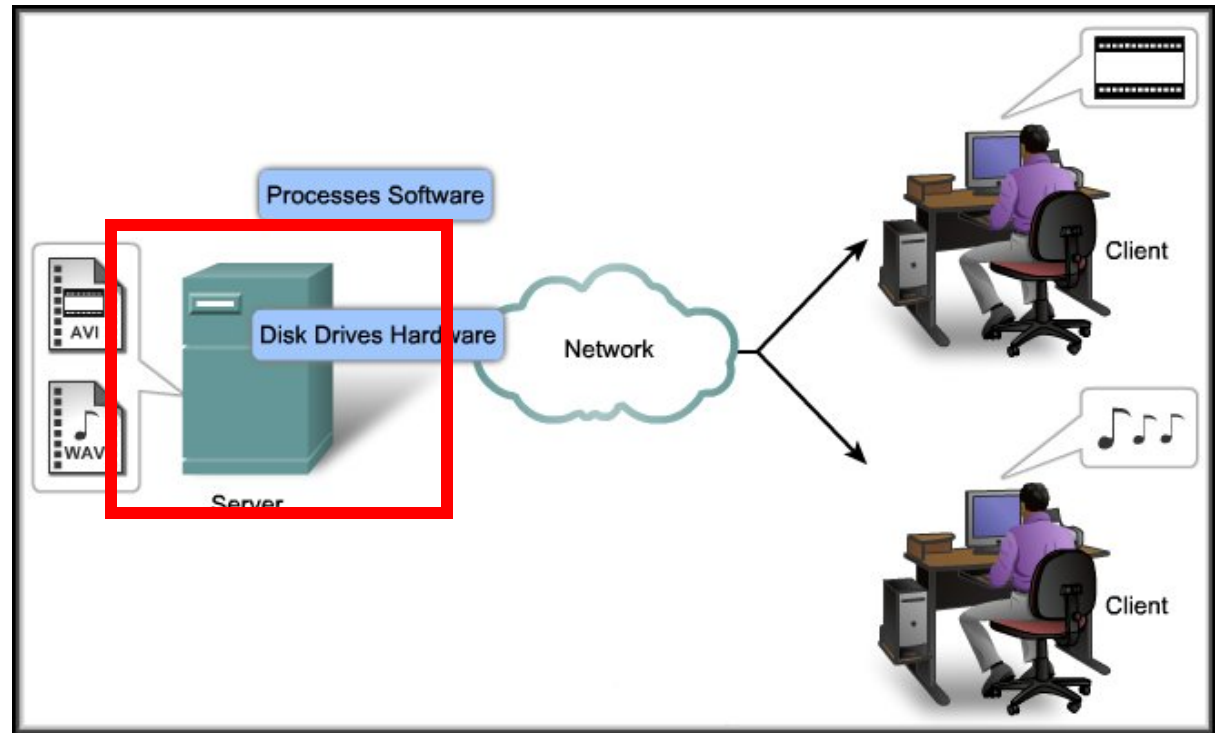
Servers

- Servers are repositories of information.
- Processes on the server control the delivery of information to the client.
- The information is usually shared with multiple clients.
 - Web Server
 - Email Server



Servers

- Some servers may require user authentication to access the data or the network.



- FTP Server:**
May require an account and password before allowing a transfer.

Client/Server Model

May also require control information. User Authentication or identify a file to be transferred.

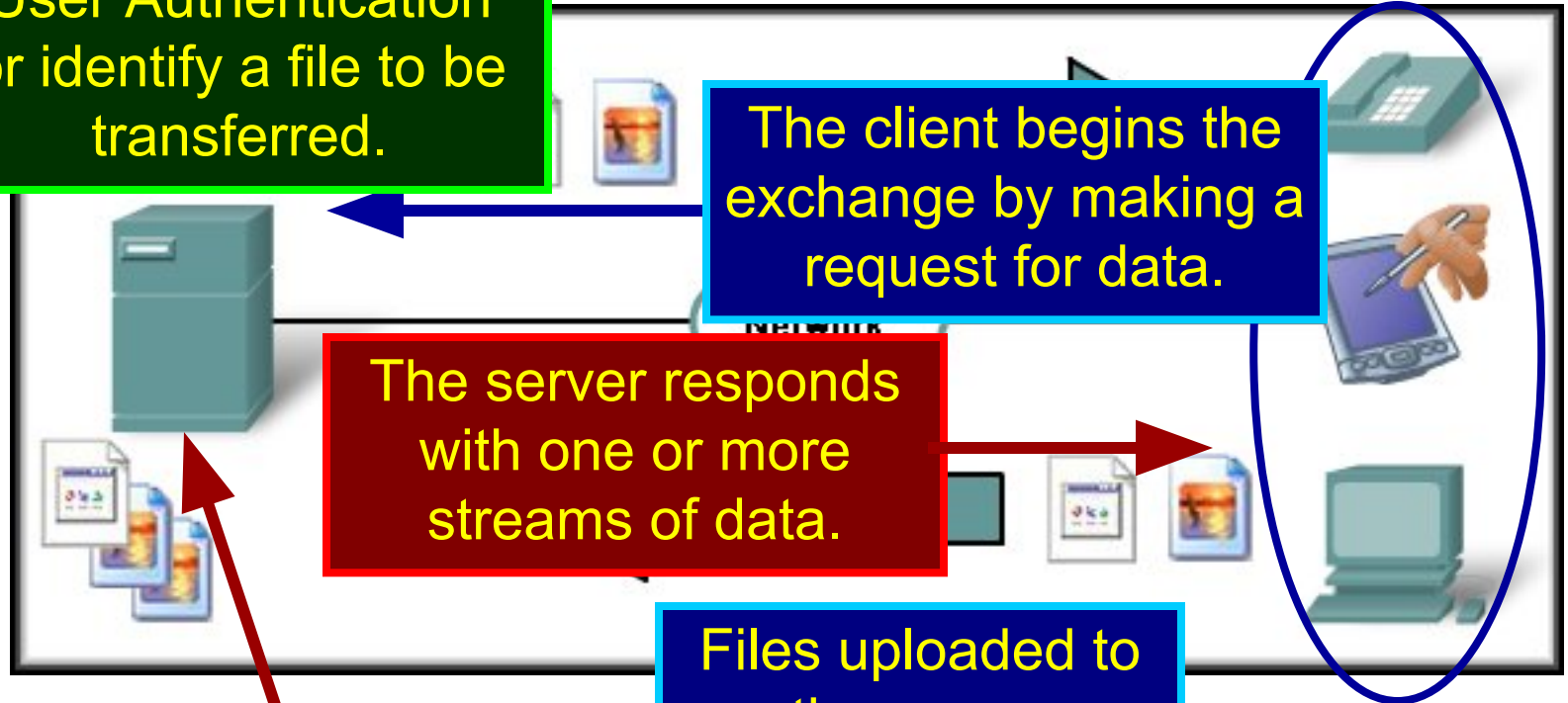
Clients – hardware, software combination

The client begins the exchange by making a request for data.

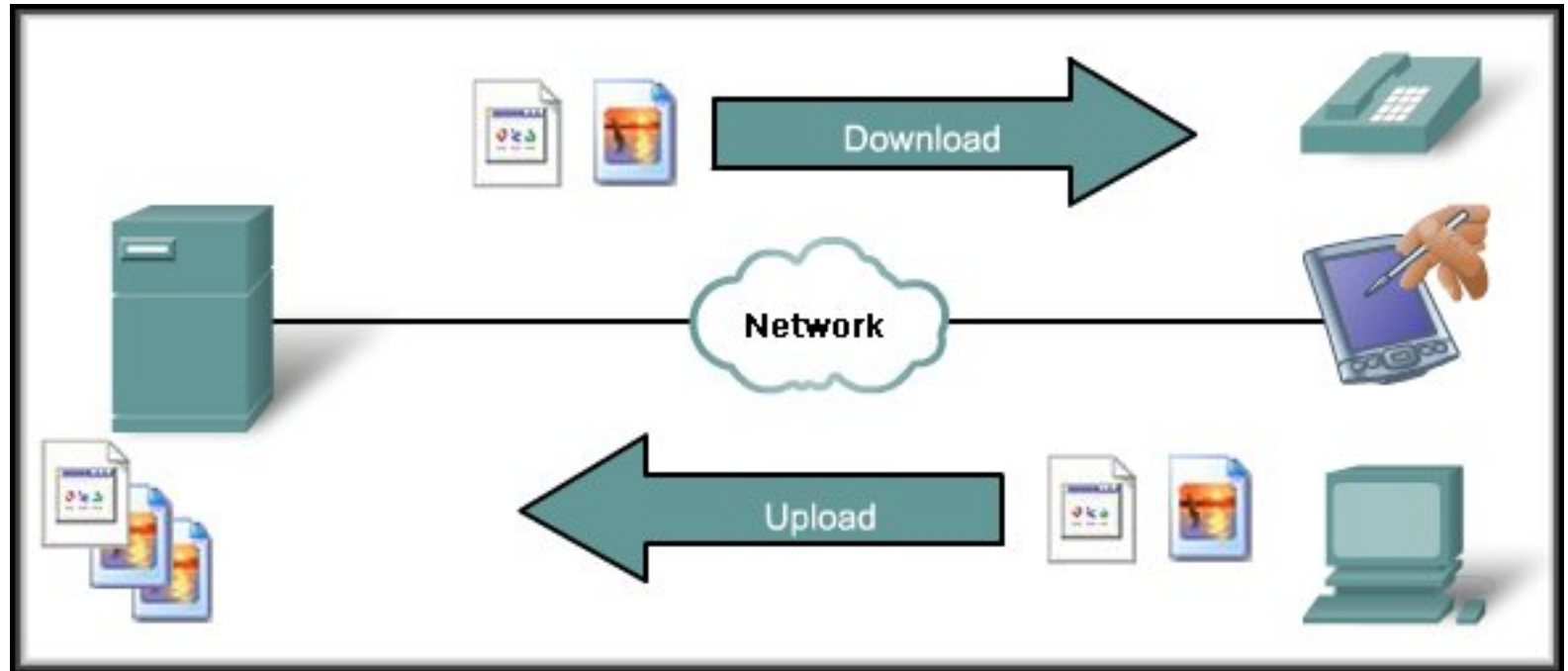
The server responds with one or more streams of data.

Files uploaded to the server

Resources are stored on the server.



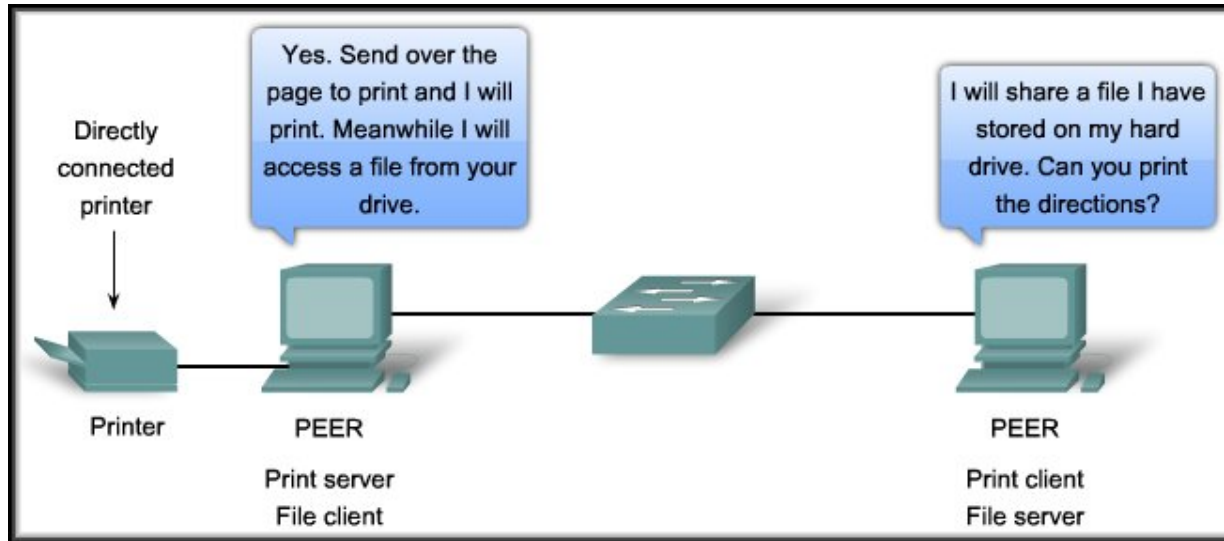
Client/Server Model



The biggest advantage of the client/server model is the centralization of resources.

User Names and Passwords, Files, Databases.

Peer-to-Peer Model: P2P Networking

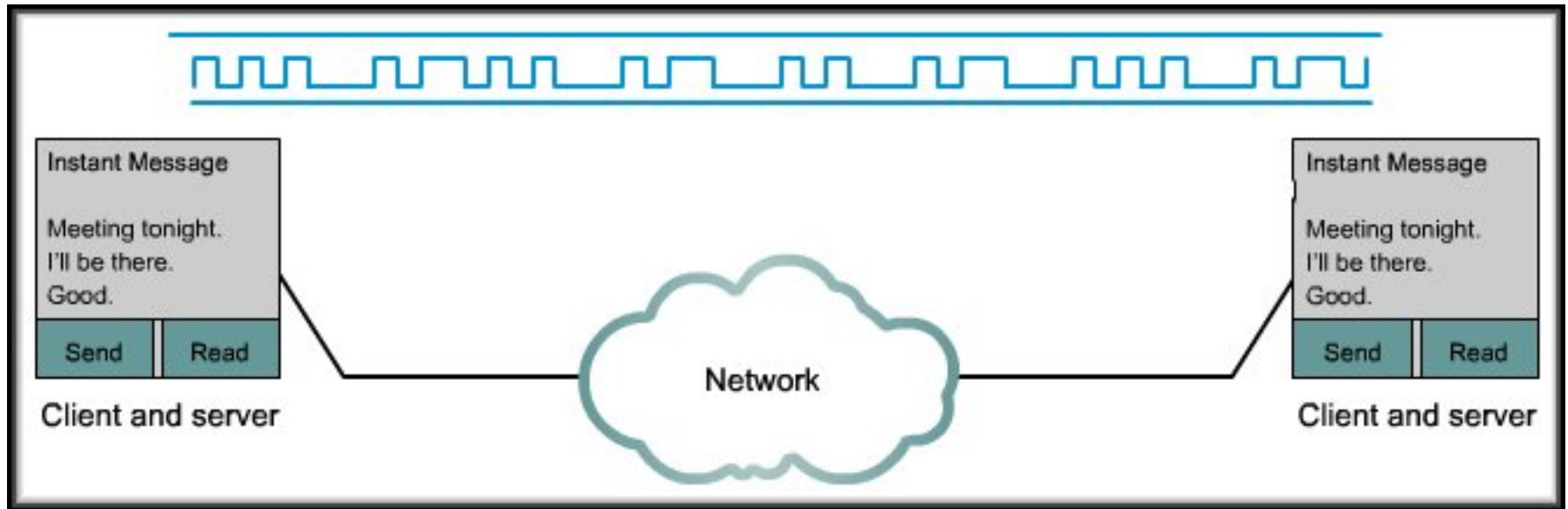


- Two or more computers are connected via a network and can share resources (such as printers and files) *without having a dedicated server*.
- End devices (peers) can function as either a *server* or *client* depending upon the required service.

Peer-to-Peer (P2P) Networking

- ❑ One big disadvantage of P2P networking is that it *decentralizes the services* on a multiuser network.
- ❑ Maintaining security and access policies on a P2P network is definitely a challenge.
- ❑ All **Policies** and **User Names** and **Passwords** must be maintained on each *peer* device.

Peer-to-Peer (P2P) Applications



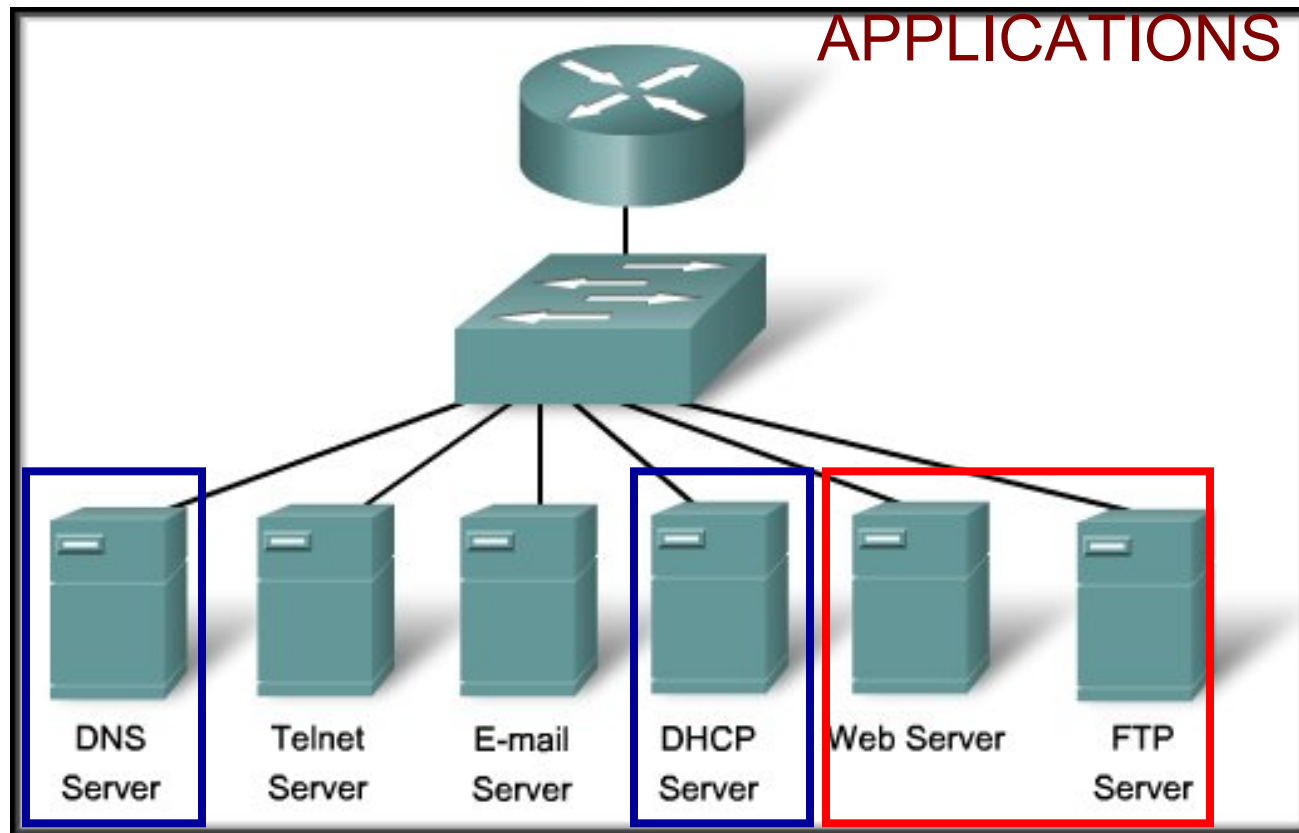
- A peer-to-peer *application*, unlike a peer-to-peer network, allows a device to act as *both a client and a server within the same communication*.

Application Layer



Application Layer Protocols
and Services Examples

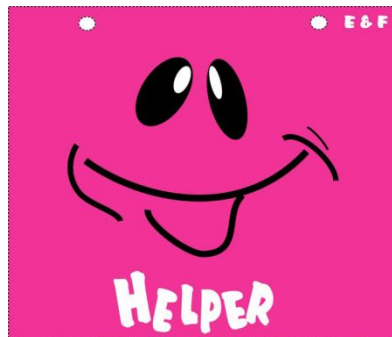
Applications



Usually, a single server will function as a server for multiple application protocols.

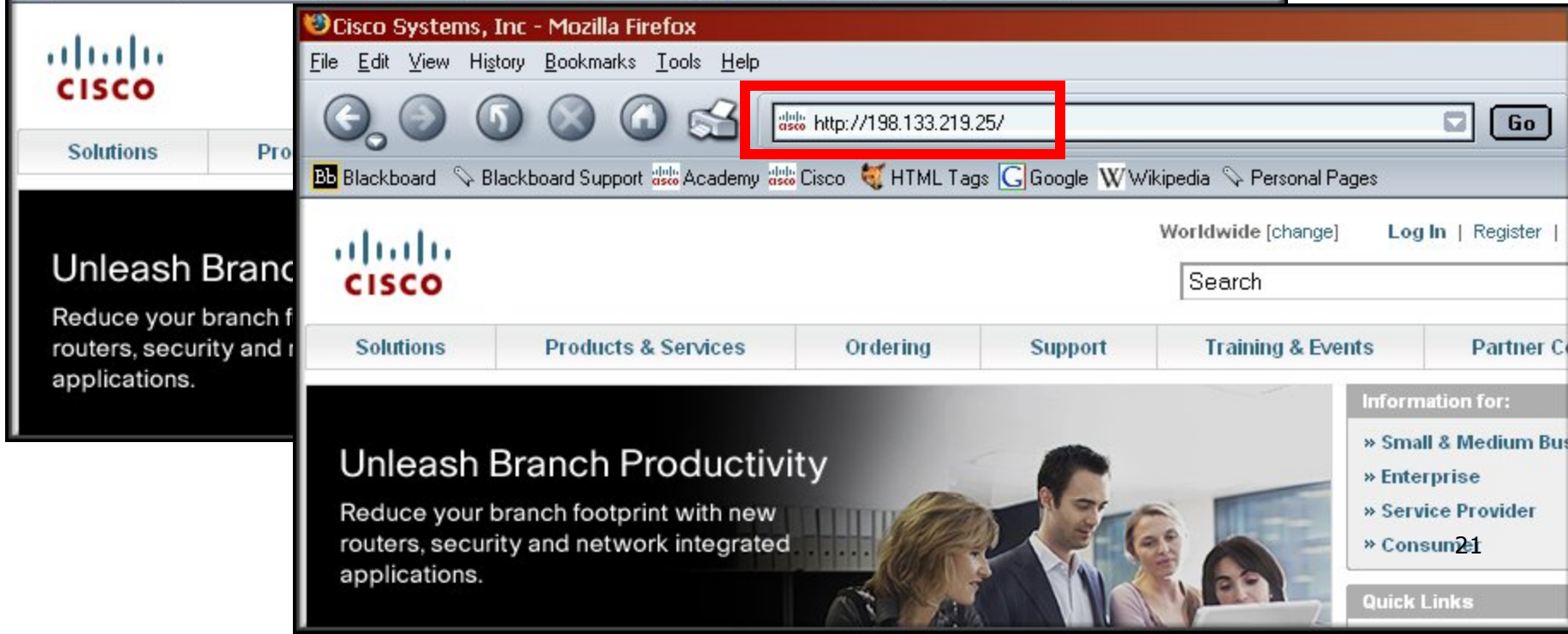
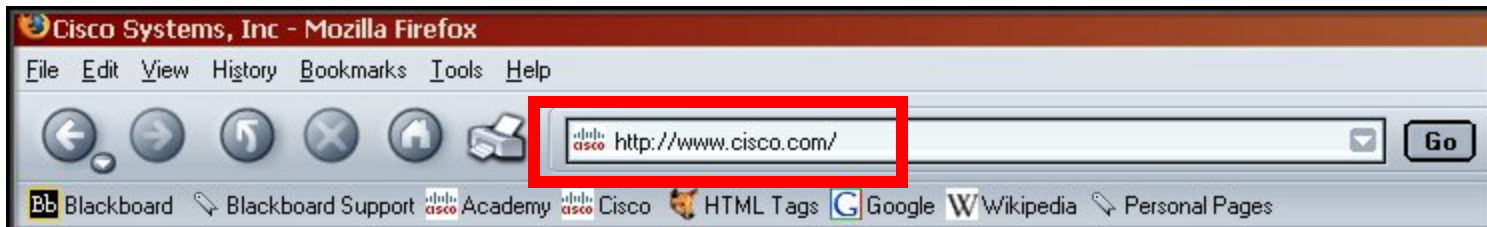
DNS

Domain Name System Helping Protocol



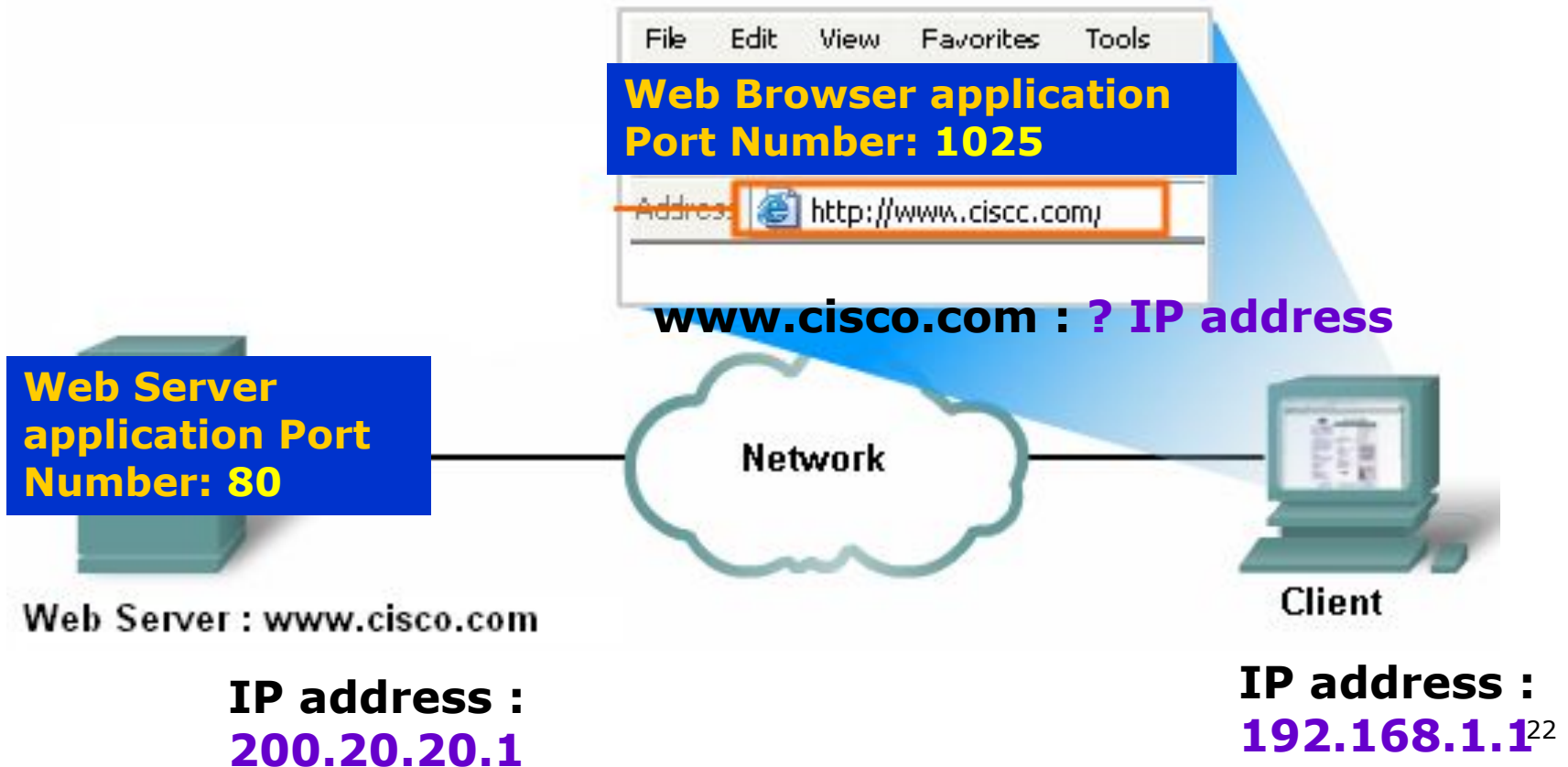
Domain Name System (DNS)

- DNS allows us to use simple, recognizable names instead of an IP Address.

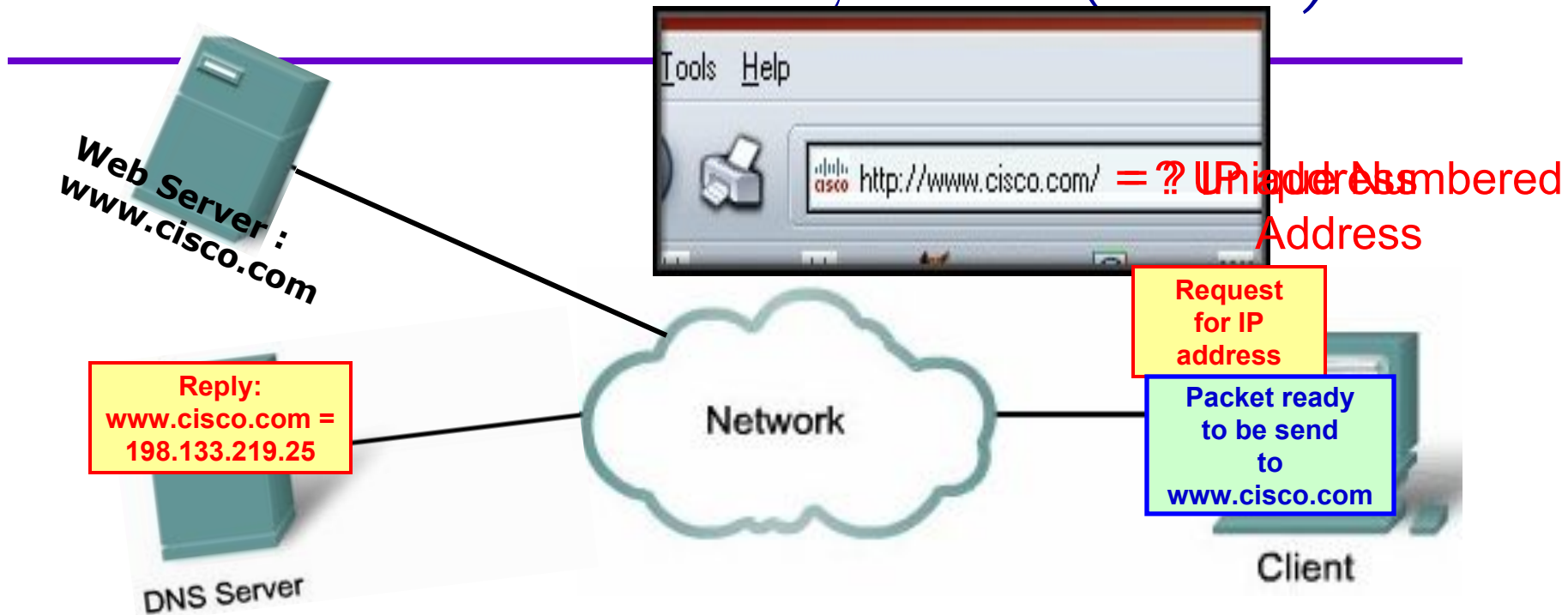


Domain Name System (DNS)

		?	192.168.1.1	80	1025	Data: Request for web page	Trailer
--	--	---	-------------	----	------	----------------------------------	---------



Domain Name System (DNS)

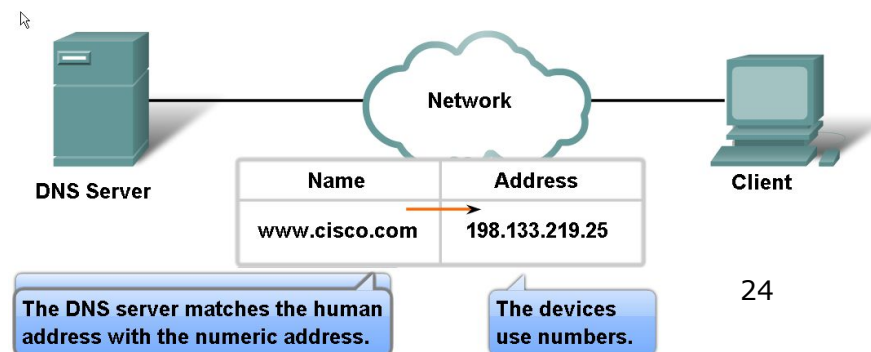
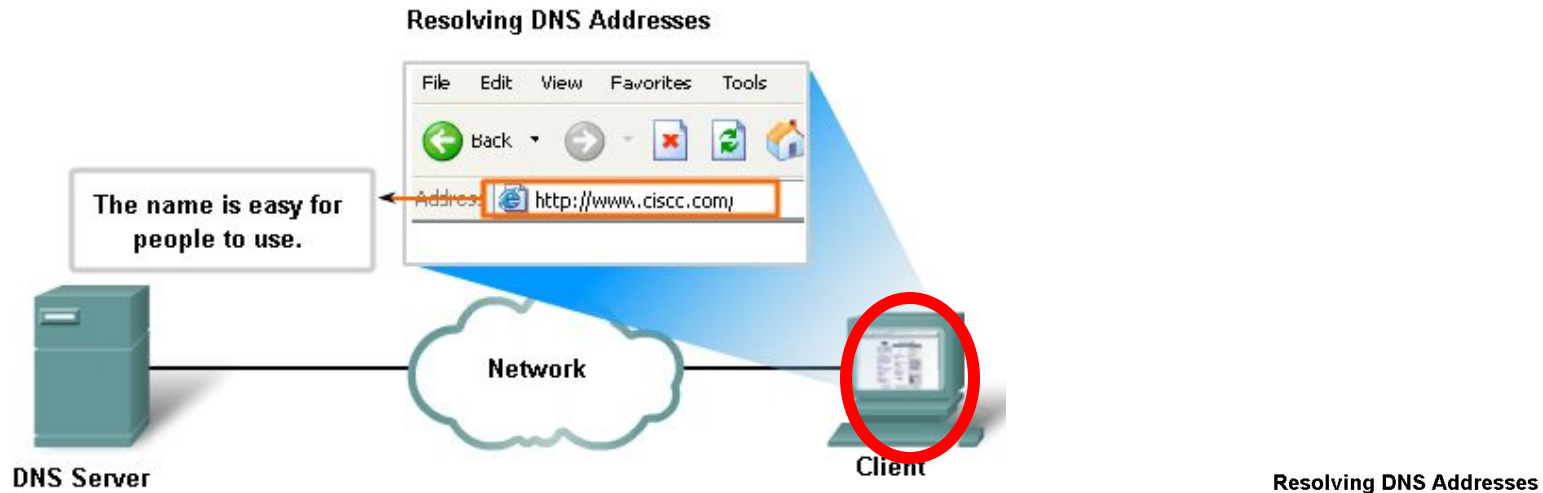


DNS Address Book:

www.cisco.com = 198.133.219.25

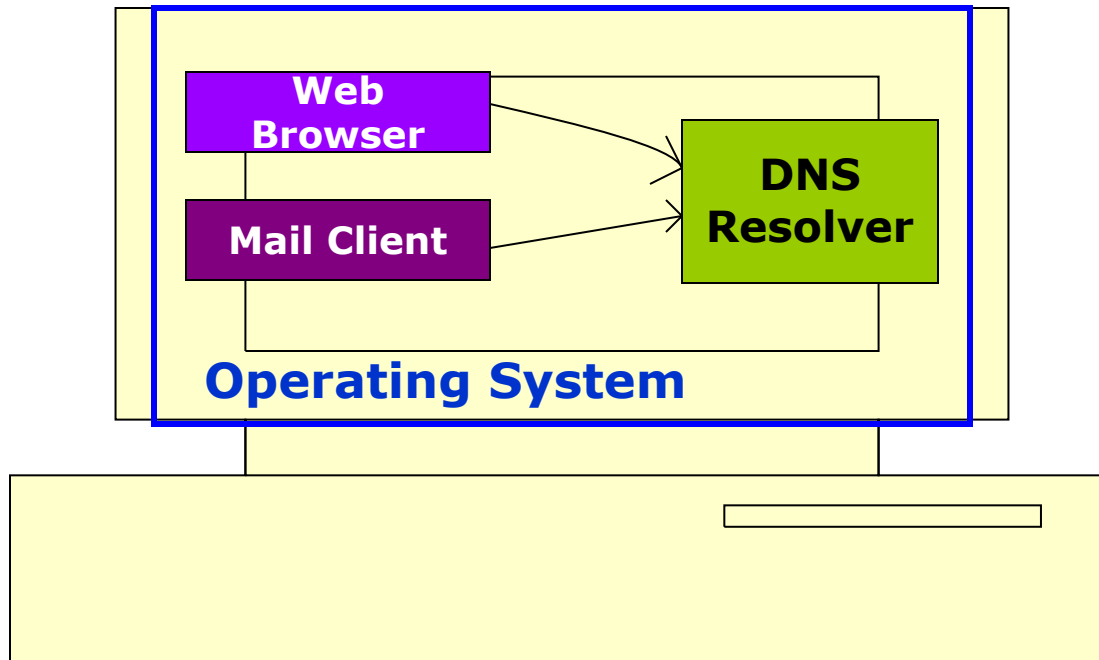
www.yahoo.com = 200.133.2.56

DNS-Domain Name System

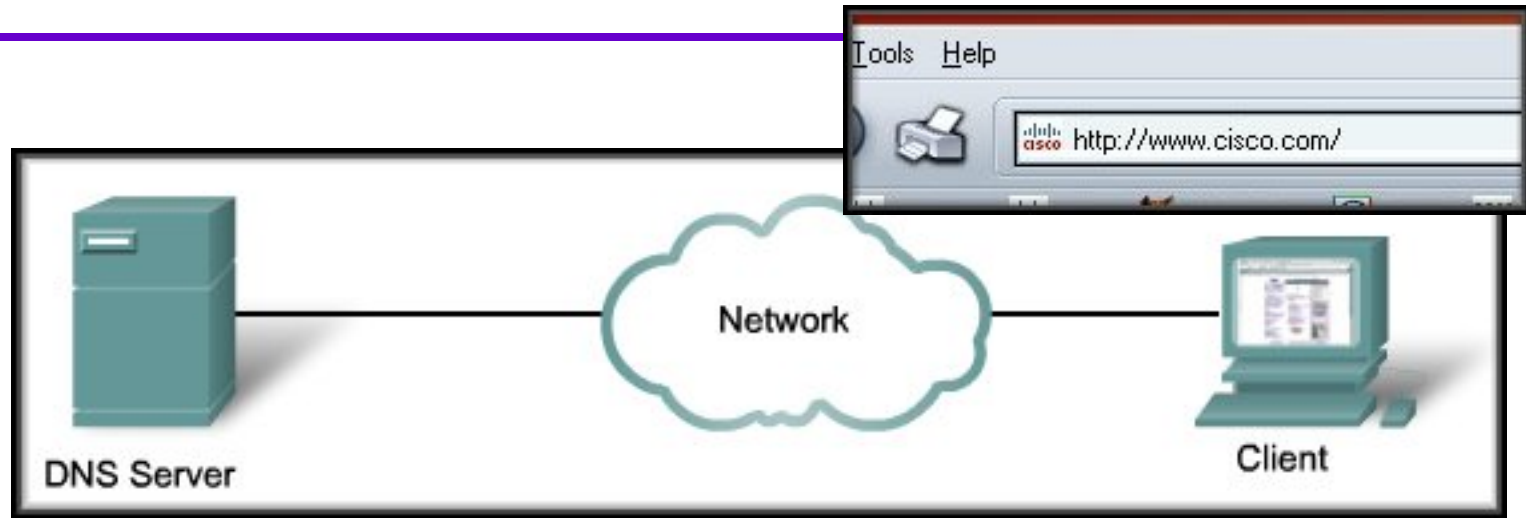


Domain Name System (DNS)

- DNS is an **automated client/server** service.
- Internet programs requiring domain name look up send a resolution request to the **DNS resolver** (Client side of DNS) in the local operating system
- The resolver in turn handles the communications required.



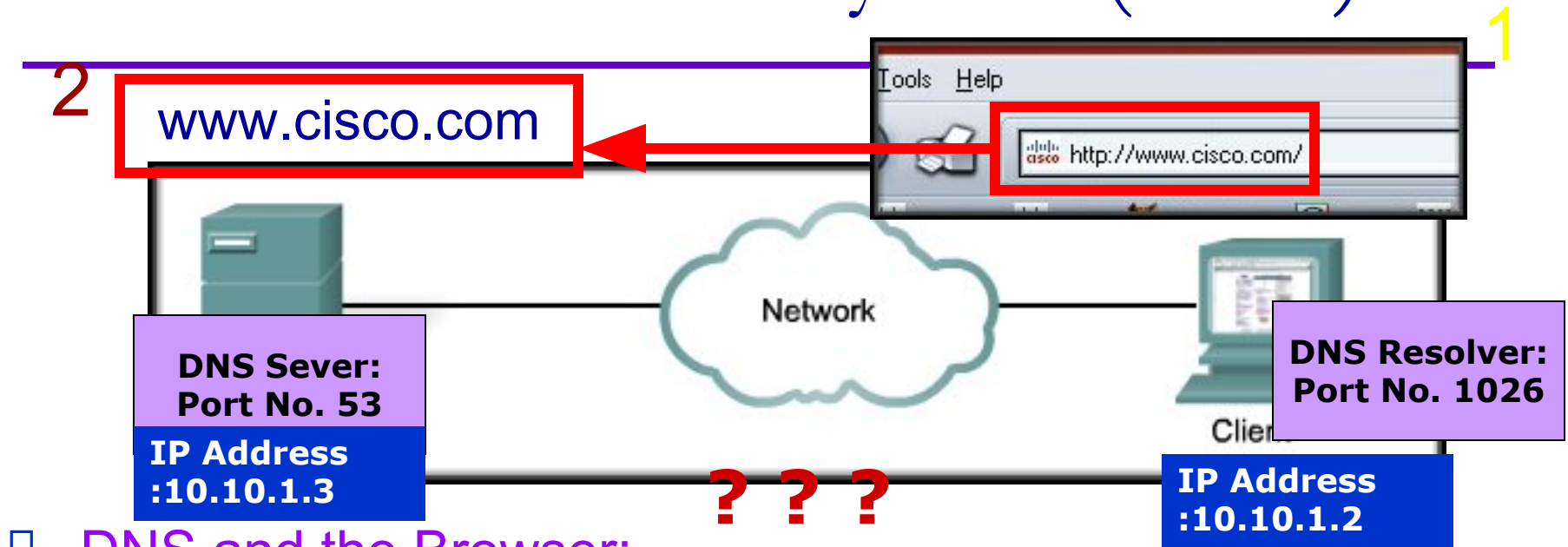
Domain Name System (DNS)



□ DNS and the Browser:

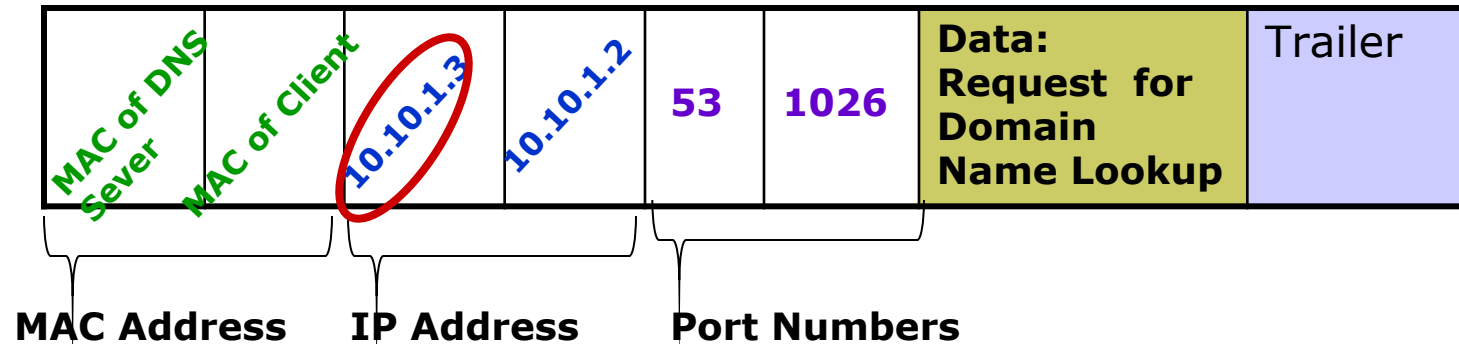
1. First, a domain name or URL is entered in the address field of the browser. The browser passes the name to the resolver.

Domain Name System (DNS)

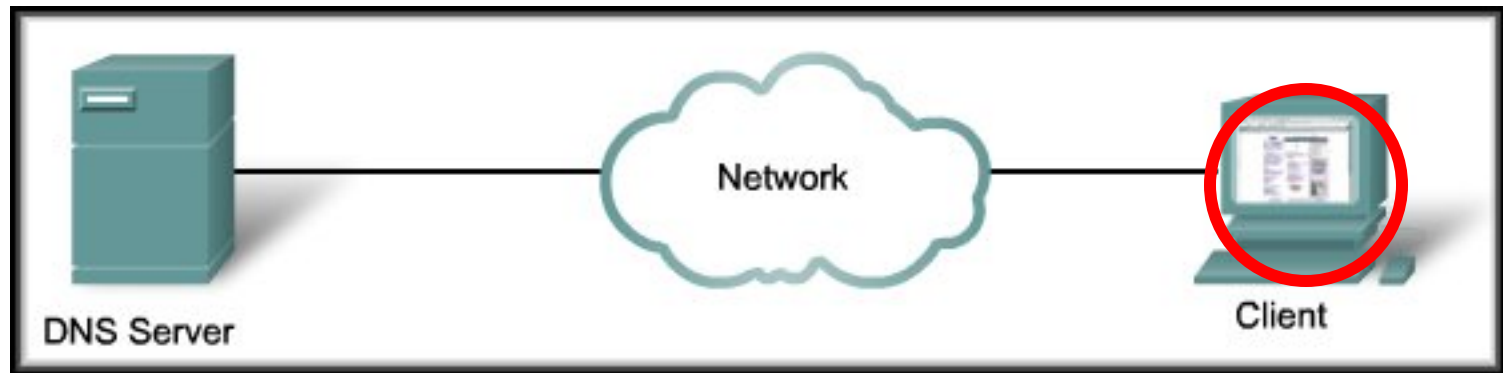


□ DNS and the Browser:

2. The resolver sends the DNS request to the DNS Server.



Domain Name System (DNS)



□ How does the resolver know where to send the requests?

- From the IP configuration on the device.

IP Address 192.168.25.25

Subnet Mask 255.255.255.0

Default Gateway 192.168.25.1

DNS Server 208.67.222.222

DNS: Client Settings

The screenshot displays the Windows Network Connections window, which is titled "Network Connections". The "LAN or High-Speed Internet" tab is selected. In the "Network Tasks" pane on the left, the "Other Places" section is expanded, showing "Control Panel", "My Network Places", "My Documents", and "My Computer". The "Local Area Connection 4" icon is circled in red. Below it, the "Local Area Connection 4 Status" window is open, showing the connection is "Connected" with a speed of "100.0 Mbps". The "Properties" button is circled in red. The "Local Area Connection 4 Properties" window is also open, showing the "General" tab. The "Connect using:" section lists "Intel(R) PRO/100 VE Network Connection". The "This connection uses the following items:" list includes "File and Printer Sharing for Microsoft Networks", "QoS Packet Scheduler", and "Internet Protocol (TCP/IP)". The "Properties" button for "Internet Protocol (TCP/IP)" is circled in red. The "Internet Protocol (TCP/IP) Properties" window is open, showing the "General" tab. The "Use the following IP address:" option is selected, with the IP address "137.189.91.29", subnet mask "255.255.252.0", and default gateway "137.189.91.254". The "Use the following DNS server addresses:" option is also selected, with the preferred DNS server "137.189.91.187" and alternate DNS server "137.189.91.188". The "Advanced..." button is visible at the bottom right of the "Internet Protocol (TCP/IP) Properties" window.

Network Connections

File Edit View Favorites Tools Advanced Help

Back Forward Stop Search Folders

Address Network Connections

Network Tasks

- Create a new connection
- Disable this network device
- Repair this connection
- Rename this connection
- View status of this connection
- Change settings of this connection

Other Places

- Control Panel
- My Network Places
- My Documents
- My Computer

Details

Local Area Connection 4

LAN or High-Speed Internet

Enabled

Intel(R) PRO/100 VE Network Connection

IP Address: 137.189.91.29

Subnet Mask: 255.255.252.0

Manually Configured

LAN or High-Speed Internet

Local Area Connection 4

Local Area Connection 4 Status

General Support

Connection

Status: Connected

Duration: 1 day 05:21:33

Speed: 100.0 Mbps

Activity

Sent Received

Packets: 1,662,171 827,894

Properties Disable

Local Area Connection 4 Properties

General Authentication Advanced

Connect using:

Intel(R) PRO/100 VE Network Connection

This connection uses the following items:

- File and Printer Sharing for Microsoft Networks
- QoS Packet Scheduler
- Internet Protocol (TCP/IP)

Install... Uninstall Properties

Description

Transmission Control Protocol/Internet Protocol. The default wide area network protocol that provides communication across diverse interconnected networks.

Show icon in notification area when connected

Internet Protocol (TCP/IP) Properties

General

You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.

Obtain an IP address automatically

Use the following IP address:

IP address: 137.189.91.29

Subnet mask: 255.255.252.0

Default gateway: 137.189.91.254

Obtain DNS server address automatically

Use the following DNS server addresses:

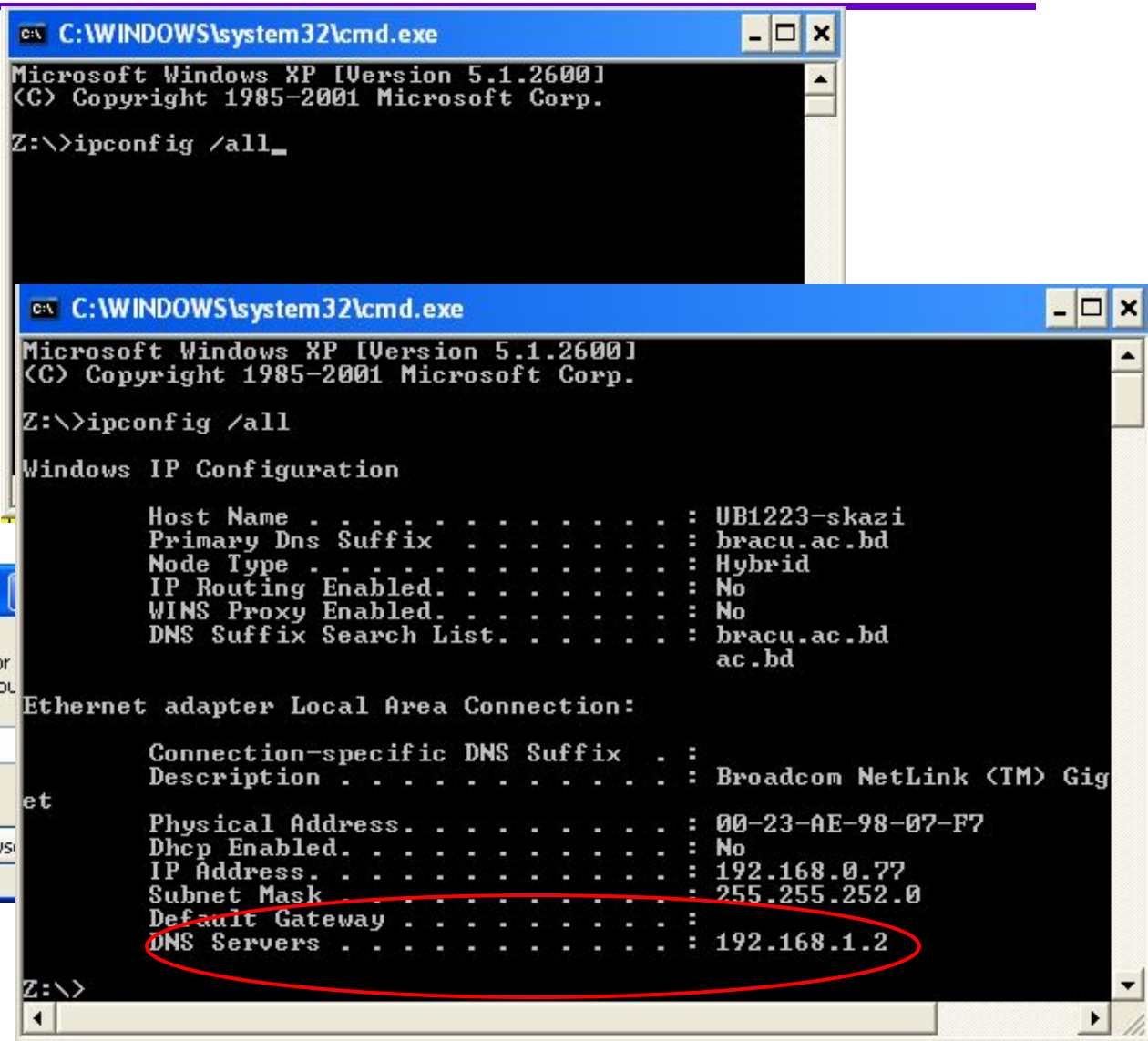
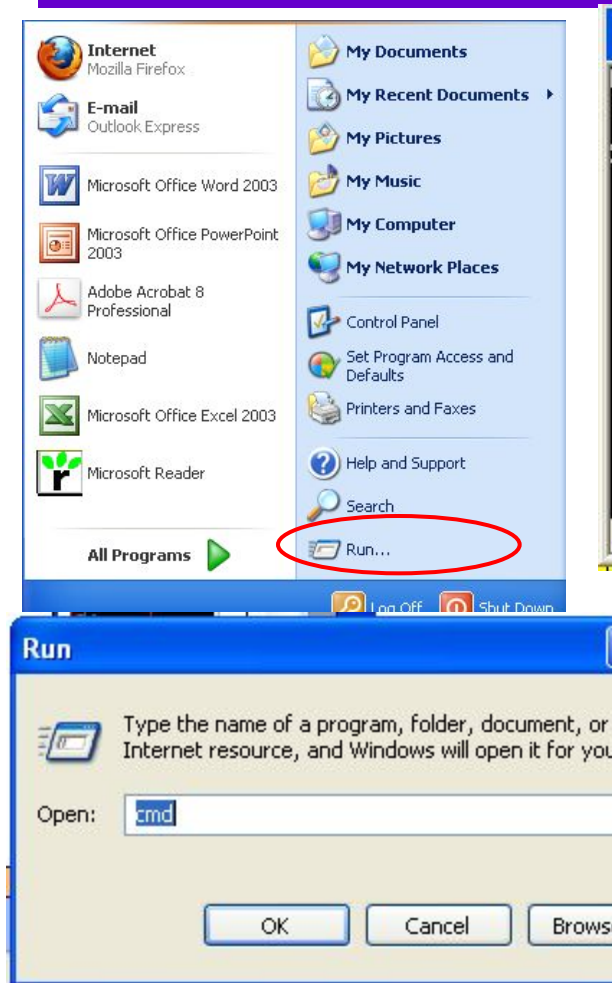
Preferred DNS server: 137.189.91.187

Alternate DNS server: 137.189.91.188

Advanced...

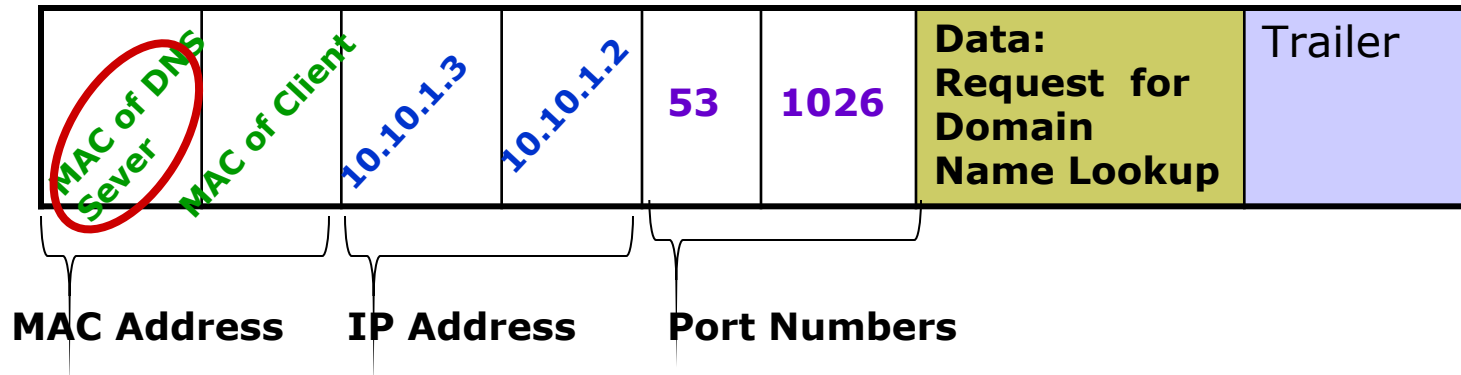
OK Cancel

DNS: Client Settings



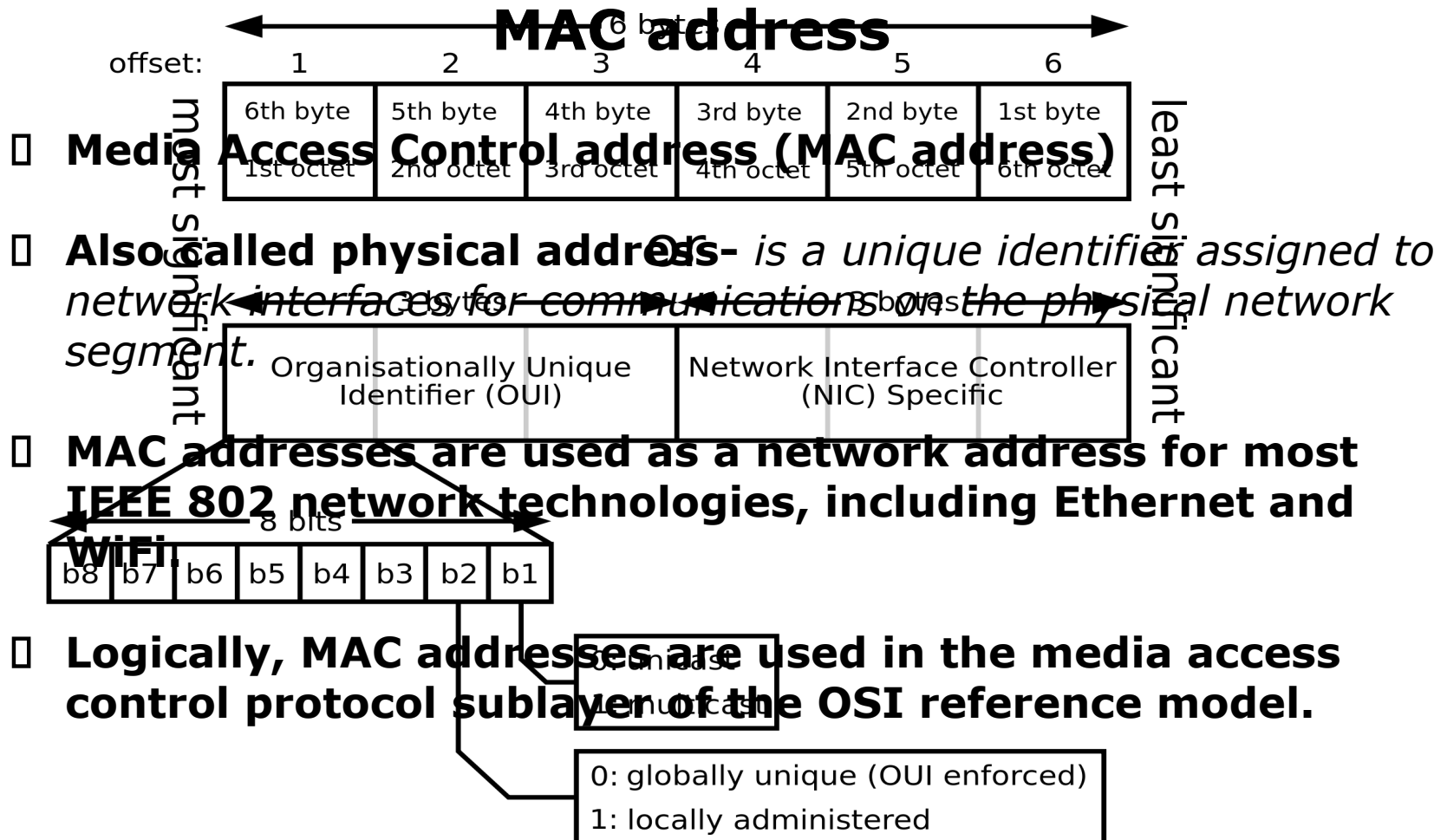
Domain Name System (DNS)

- What about the MAC address of DNS of the server?

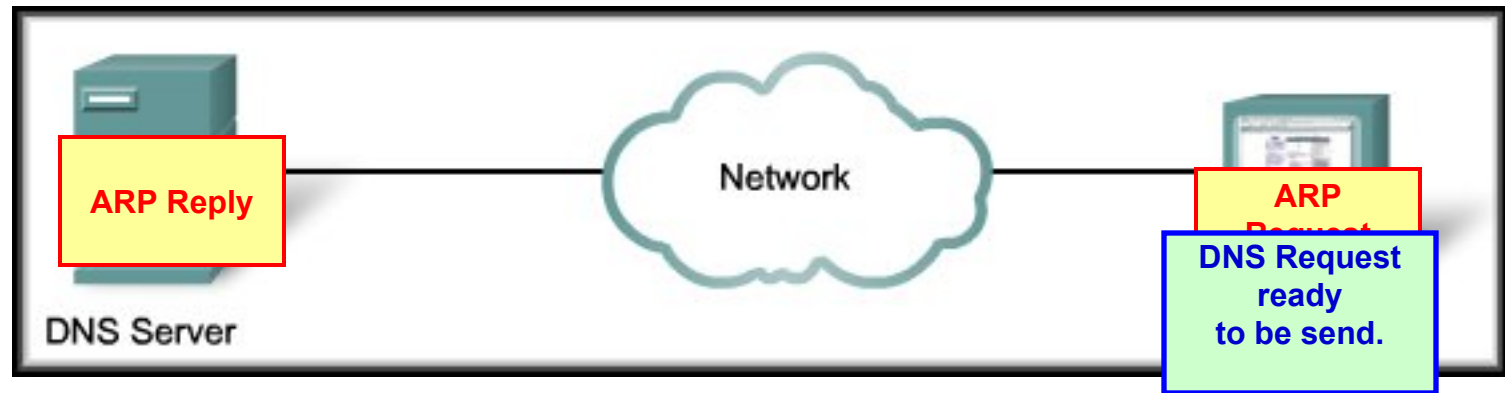


- How does the resolver know the **MAC Address** of the DNS Server?

Domain Name System (DNS)

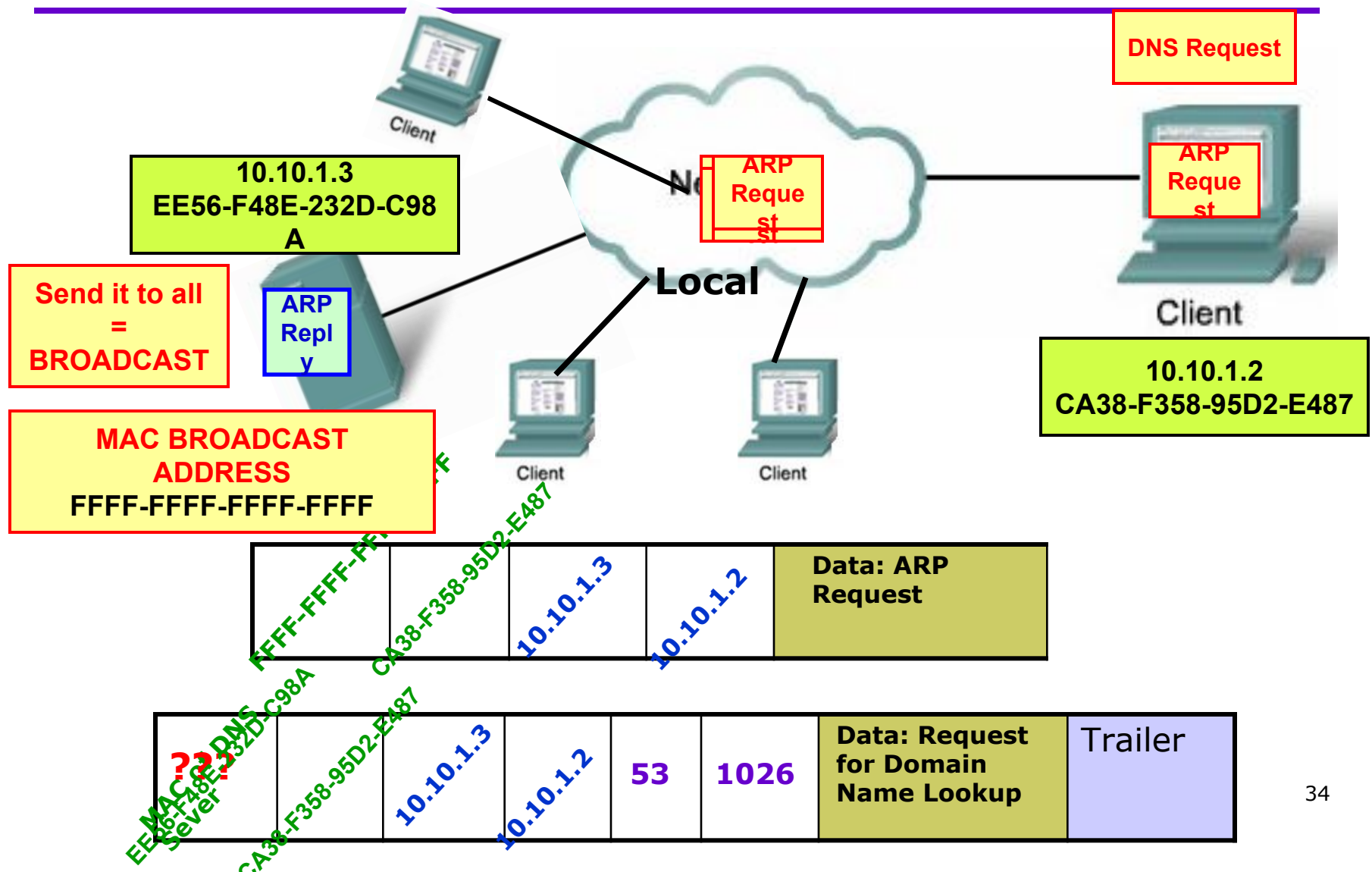


Domain Name System (DNS)

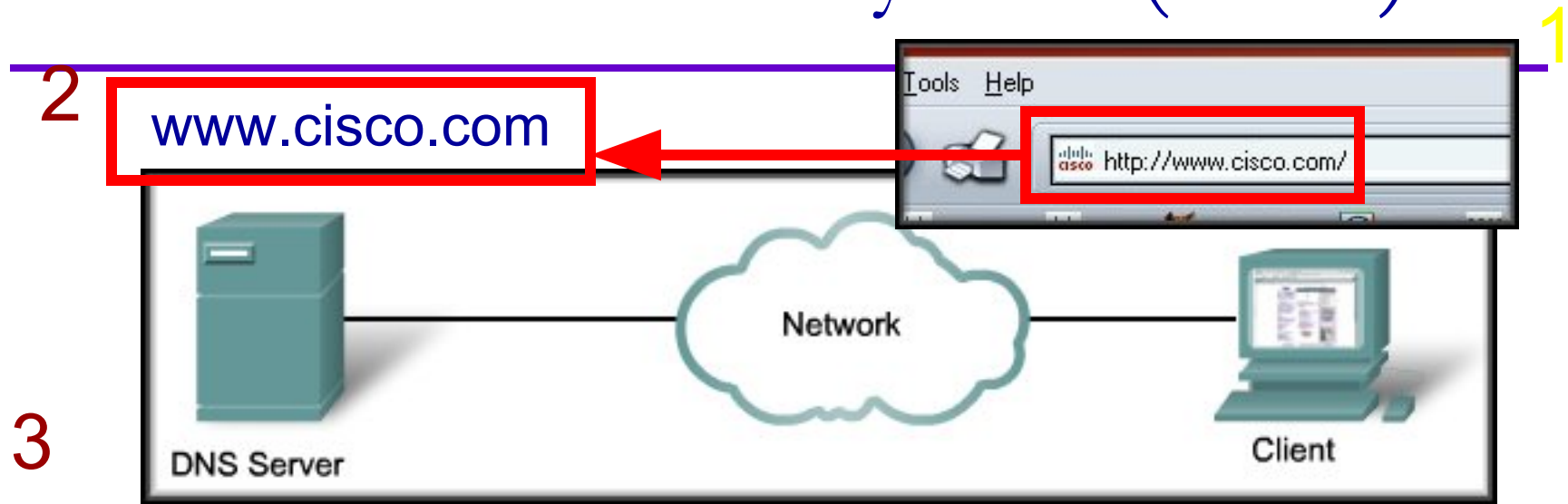


- By the help of **ARP** (Address Resolution Protocol)
- Resolves Known IP address = Unknown MAC Address.
- Where to send the ARP request?
 - To All Devices in the Network - **BROADCAST**

Domain Name System (DNS)



Domain Name System (DNS)

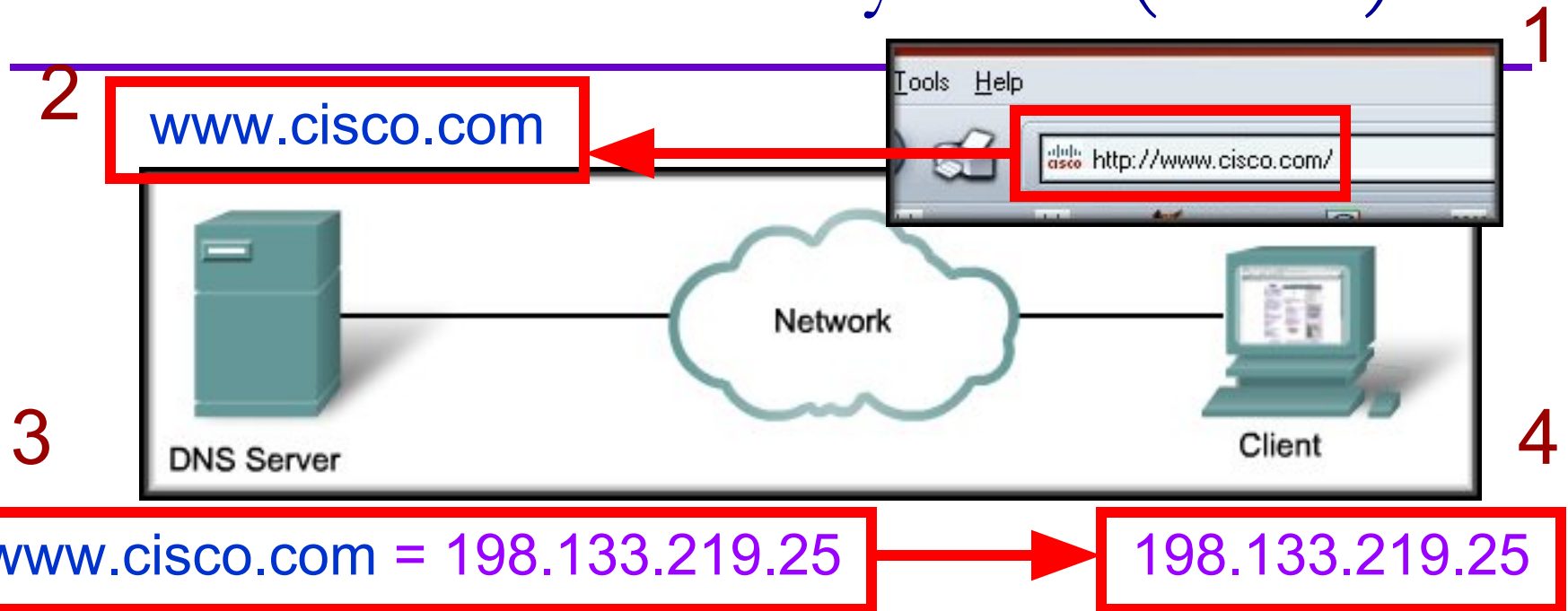


`www.cisco.com = 198.133.219.25`

□ DNS and the Browser:

2. The resolver sends the DNS request to the DNS Server.
3. The server then searches its records and resolves the name with to a corresponding IP Address.

Domain Name System (DNS)



□ DNS and the Browser:

4. The DNS server then sends the IP Address back to the client that made the request. The IP Address will be used in the encapsulation process as the destination address for packets going to `www.cisco.com`.

DNS Name Servers

Centralized DNS? **NO**

- ❑ Single point of failure

- ❑ Traffic volume

REASONS ?

- ❑ Distance centralized database

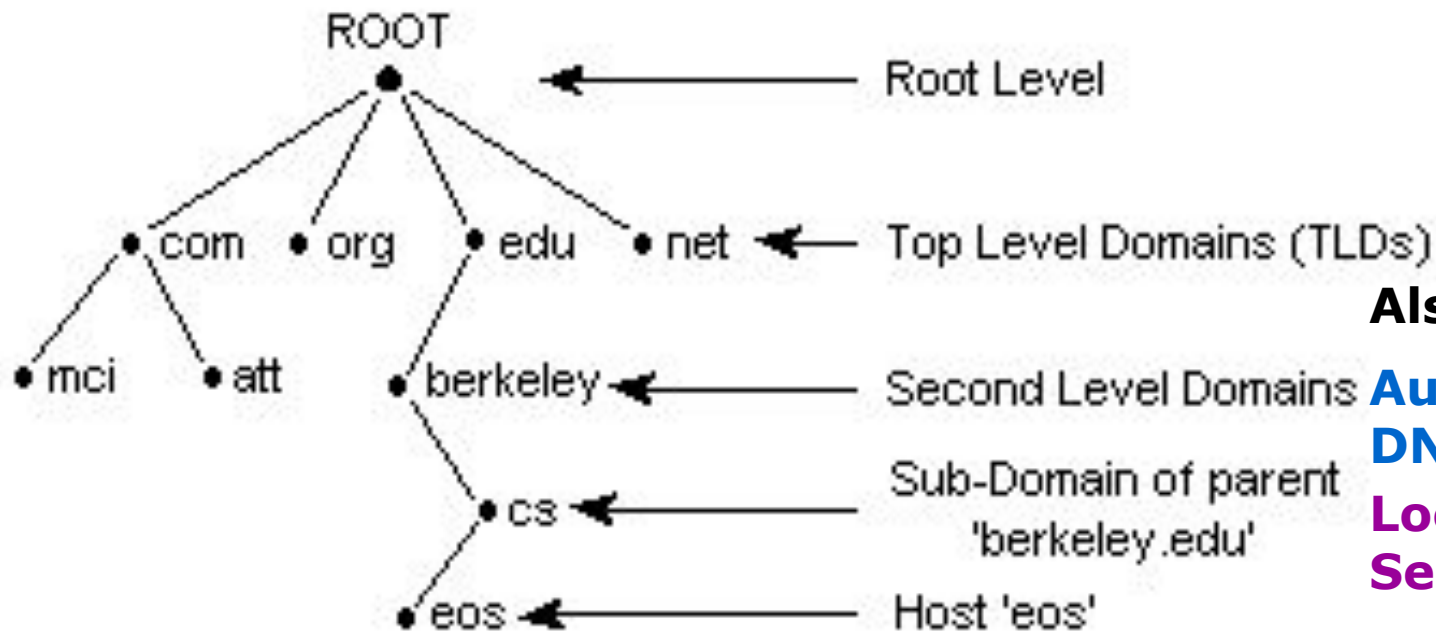
- ❑ Maintenance

- ❑ Doesn't *scale!*

- ❑ *Solution: Distributed Database*

DNS Heirarchy

DNS Hierarchy



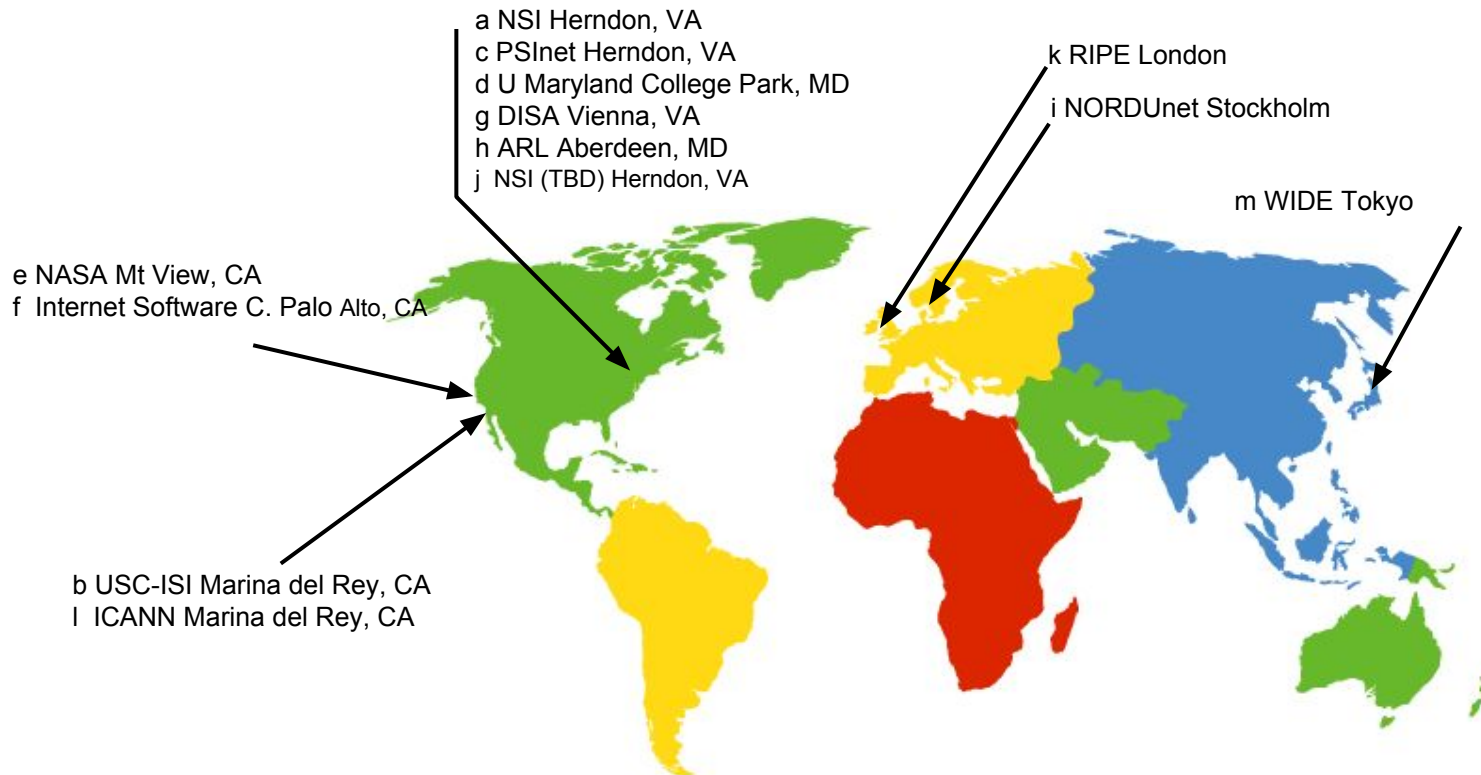
Also Known as

**Authoritative
DNS Servers**

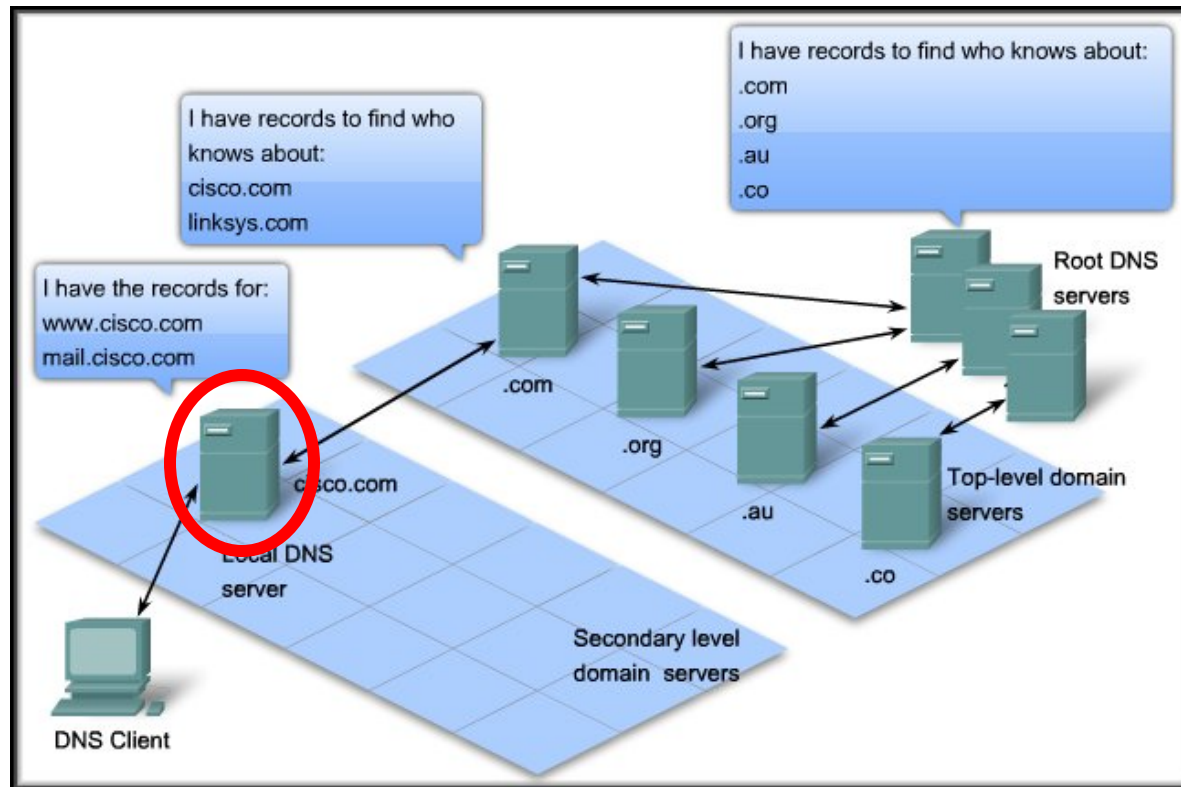
**Local DNS
Servers**

DNS: Root name servers

- 13 root name servers worldwide
- Contacted by local name server that can not resolve name.

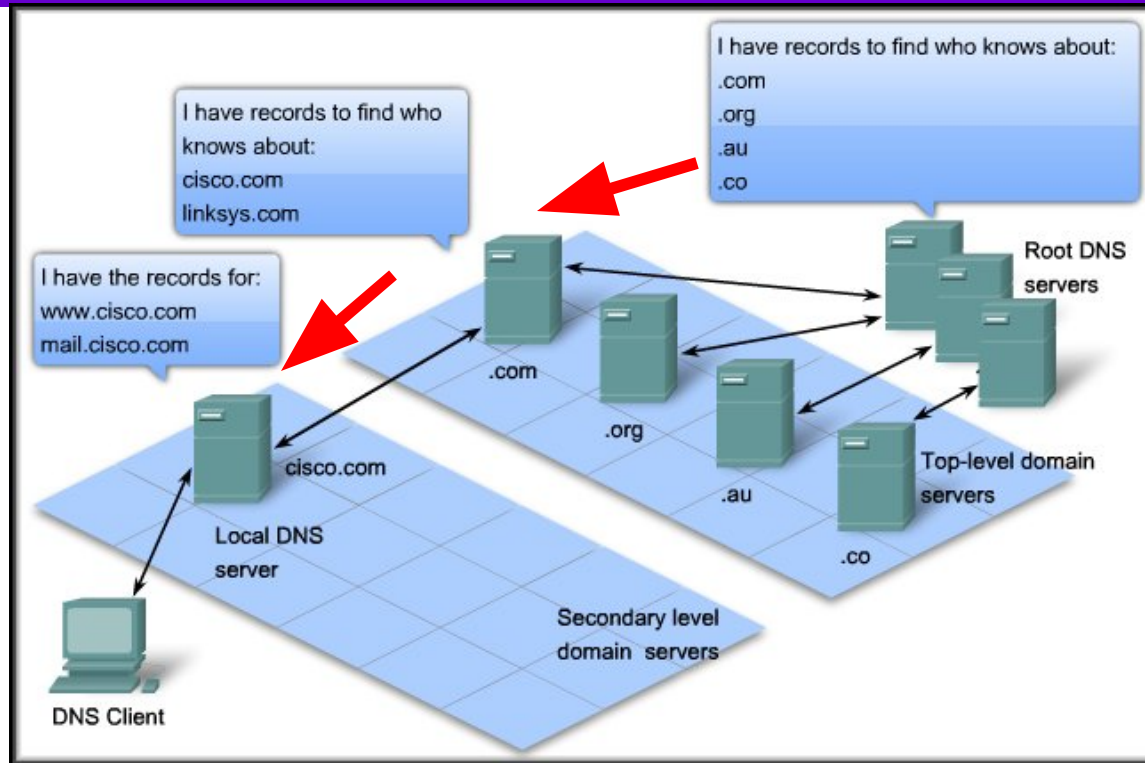


Domain Name System (DNS)



- For access to the Internet, DNS servers are arranged in a hierarchy.
- References to the hierarchy are included when a local DNS server is installed.

Domain Name System (DNS)



- The servers at the "Root" know how to reach the "Top-level" domain servers.
- The top-level servers know how to reach the secondary level servers and so on.....

Domain Name System (DNS)

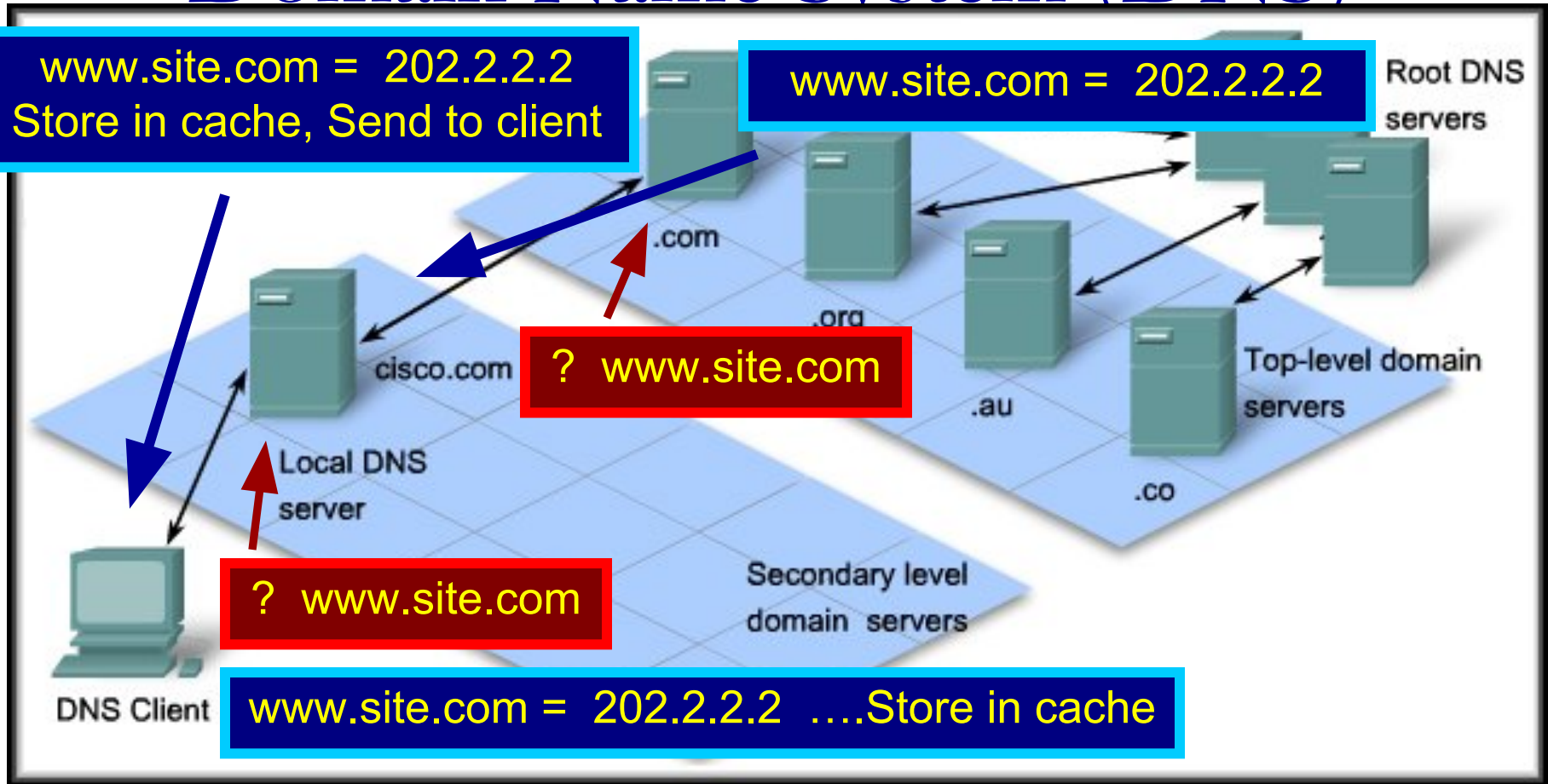
www.site.com = 202.2.2.2
Store in cache, Send to client

www.site.com = 202.2.2.2

? www.site.com

? www.site.com

www.site.com = 202.2.2.2Store in cache

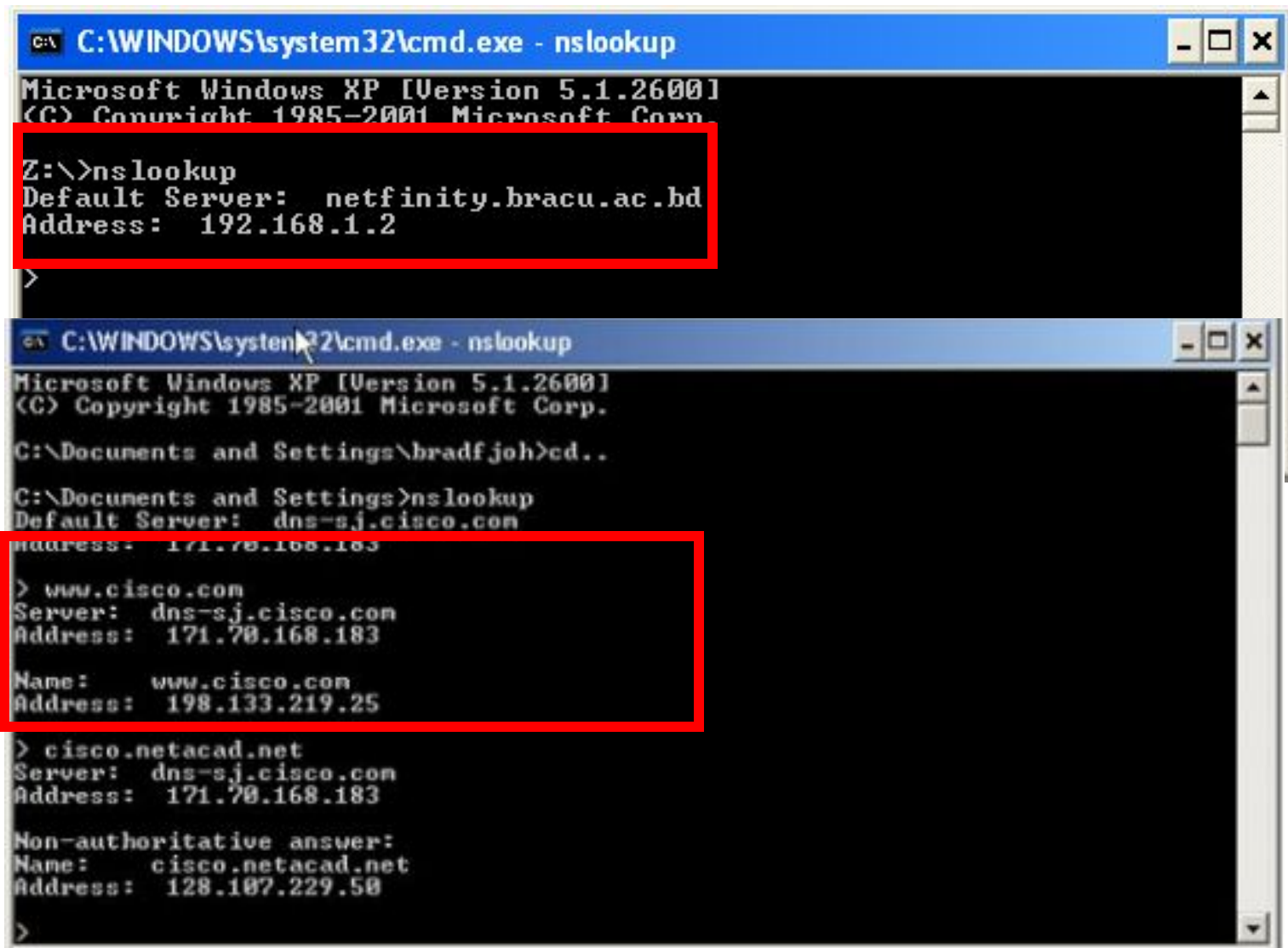


- DNS Cache : Storing DNS Information in Local memory

nslookup

- Windows operating systems provide the *nslookup* utility.
- Use to query a domain name and get the IP Address.
- Can also be used to troubleshoot DNS resolution issues.

nslookup



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

Z:\>nslookup
Default Server:  netfinity.bracu.ac.bd
Address:  192.168.1.2

>

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

>
```

Domain Name System (DNS)

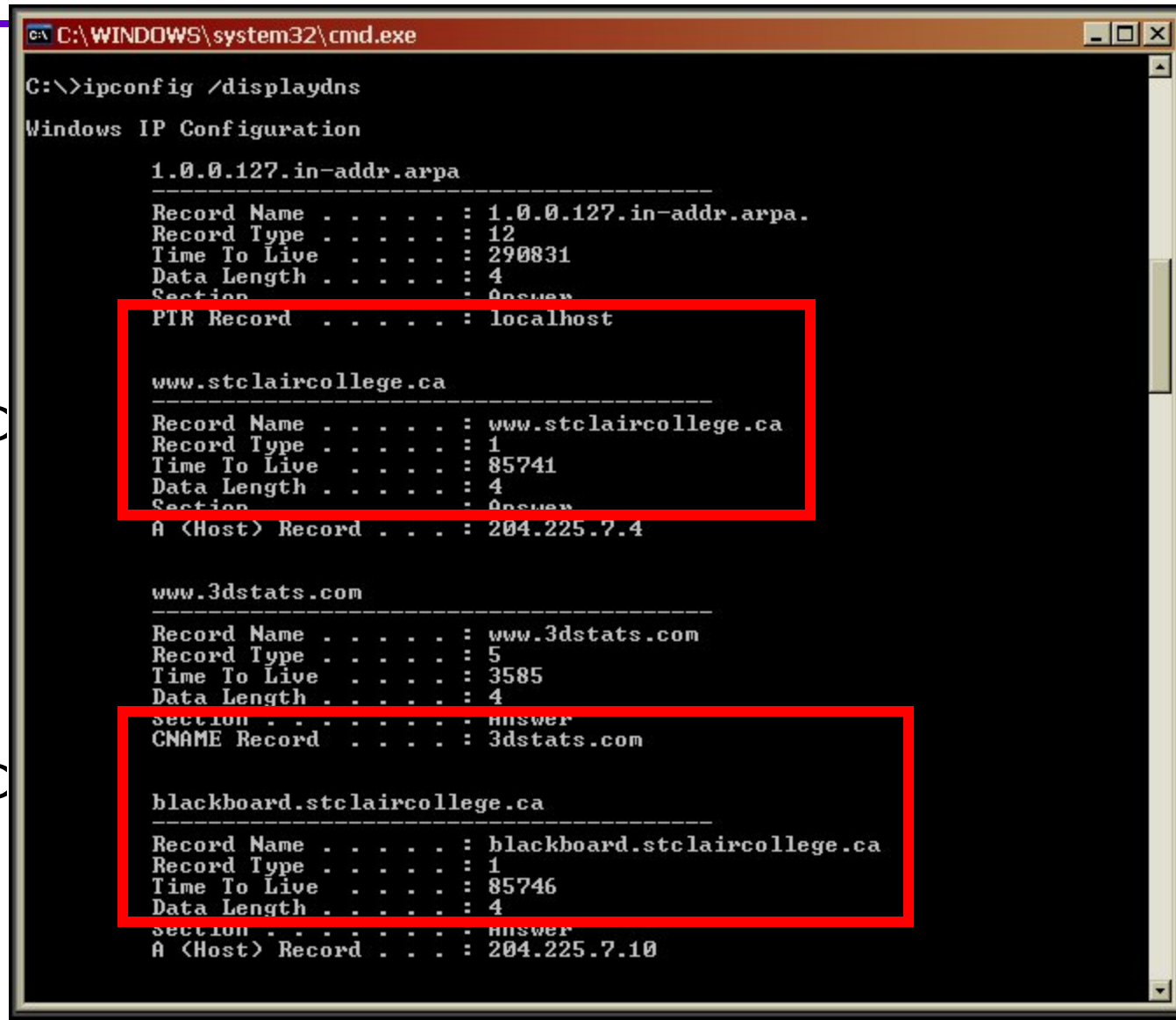
Utility:

`ipconfig
/displaydns`

Displays the
contents of the PC
cache.

`ipconfig /flushdns`

Clears the
contents of the PC
cache.



```
C:\WINDOWS\system32\cmd.exe
C:\>ipconfig /displaydns

Windows IP Configuration


1.0.0.127.in-addr.arpa
-----
Record Name . . . . . : 1.0.0.127.in-addr.arpa.
Record Type . . . . . : 12
Time To Live . . . . . : 290831
Data Length . . . . . : 4
Section . . . . . : Answer
PTR Record . . . . . : localhost

www.stclaircollege.ca
-----
Record Name . . . . . : www.stclaircollege.ca
Record Type . . . . . : 1
Time To Live . . . . . : 85741
Data Length . . . . . : 4
Section . . . . . : Answer
A (Host) Record . . . : 204.225.7.4

www.3dstats.com
-----
Record Name . . . . . : www.3dstats.com
Record Type . . . . . : 5
Time To Live . . . . . : 3585
Data Length . . . . . : 4
Section . . . . . : Answer
CNAME Record . . . . . : 3dstats.com

blackboard.stclaircollege.ca
-----
Record Name . . . . . : blackboard.stclaircollege.ca
Record Type . . . . . : 1
Time To Live . . . . . : 85746
Data Length . . . . . : 4
Section . . . . . : Answer
A (Host) Record . . . : 204.225.7.10
```

HTTP



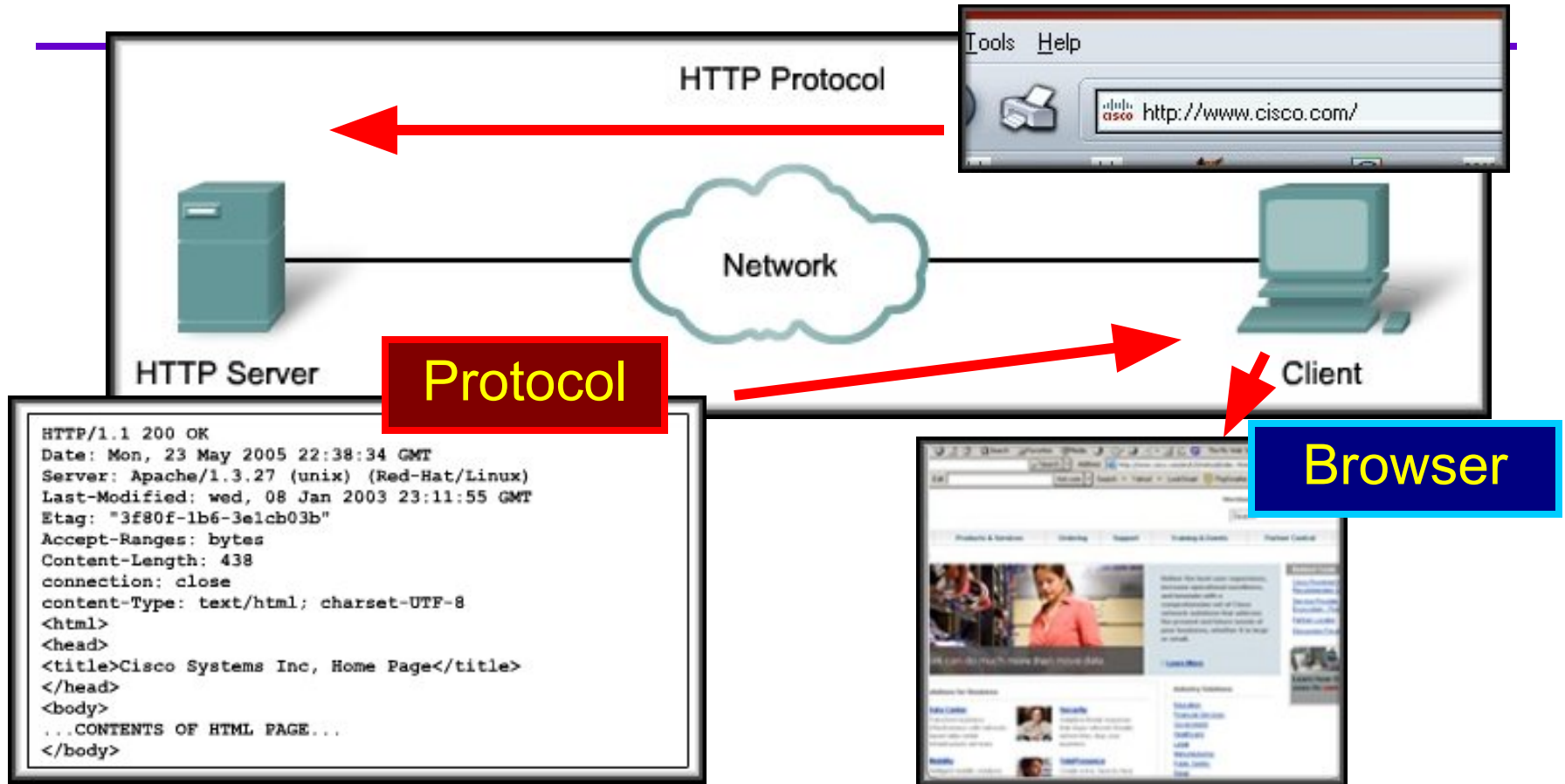
Hypertext Transfer Protocol And WWW Services

HTTP Components

- Client
 - Web browser
- Server
 - Web Server
- Protocol
 - HTTP, HTTPS
- Content
 - Web Documents

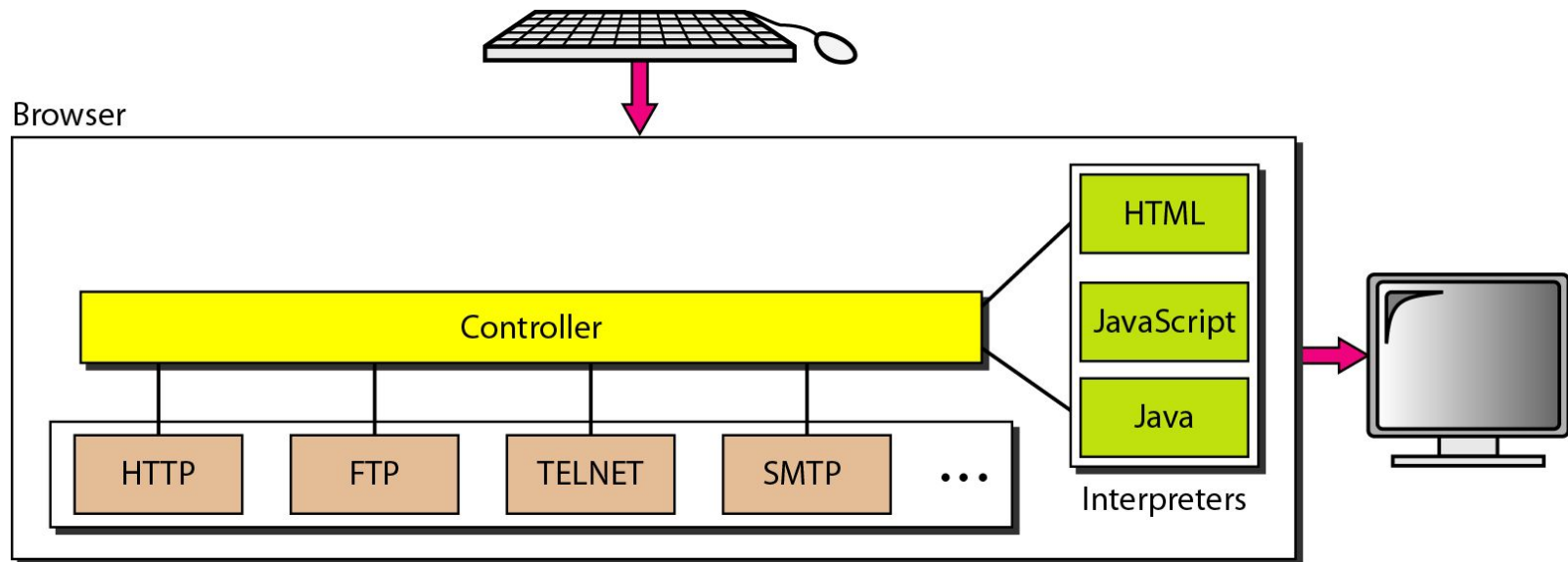


WWW Service and HTTP

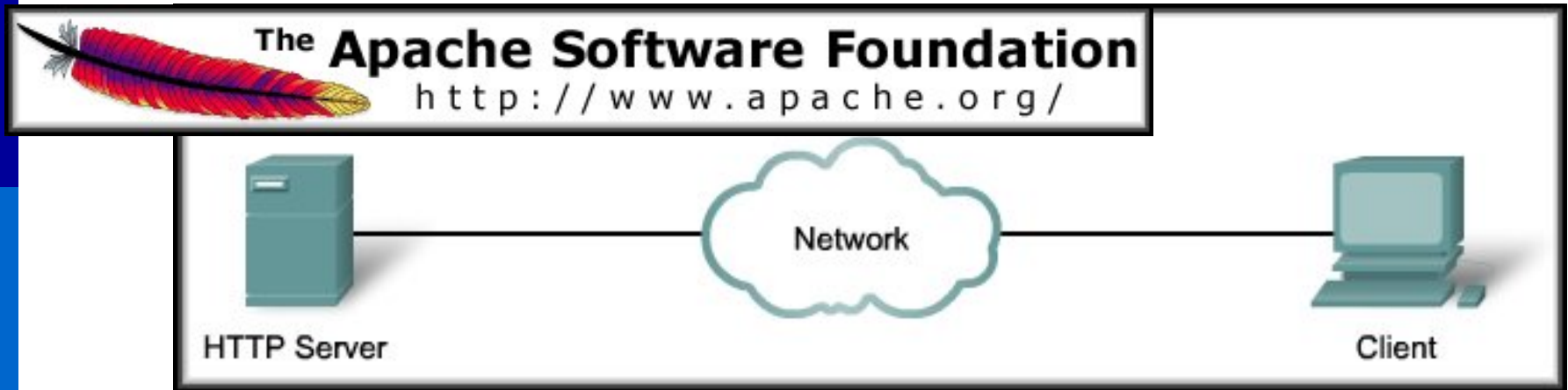


- Web browsers are the client applications used to interpret the HTTP application protocol received from a web server.

Web Browser



WWW Service and HTTP



□ Web Server:

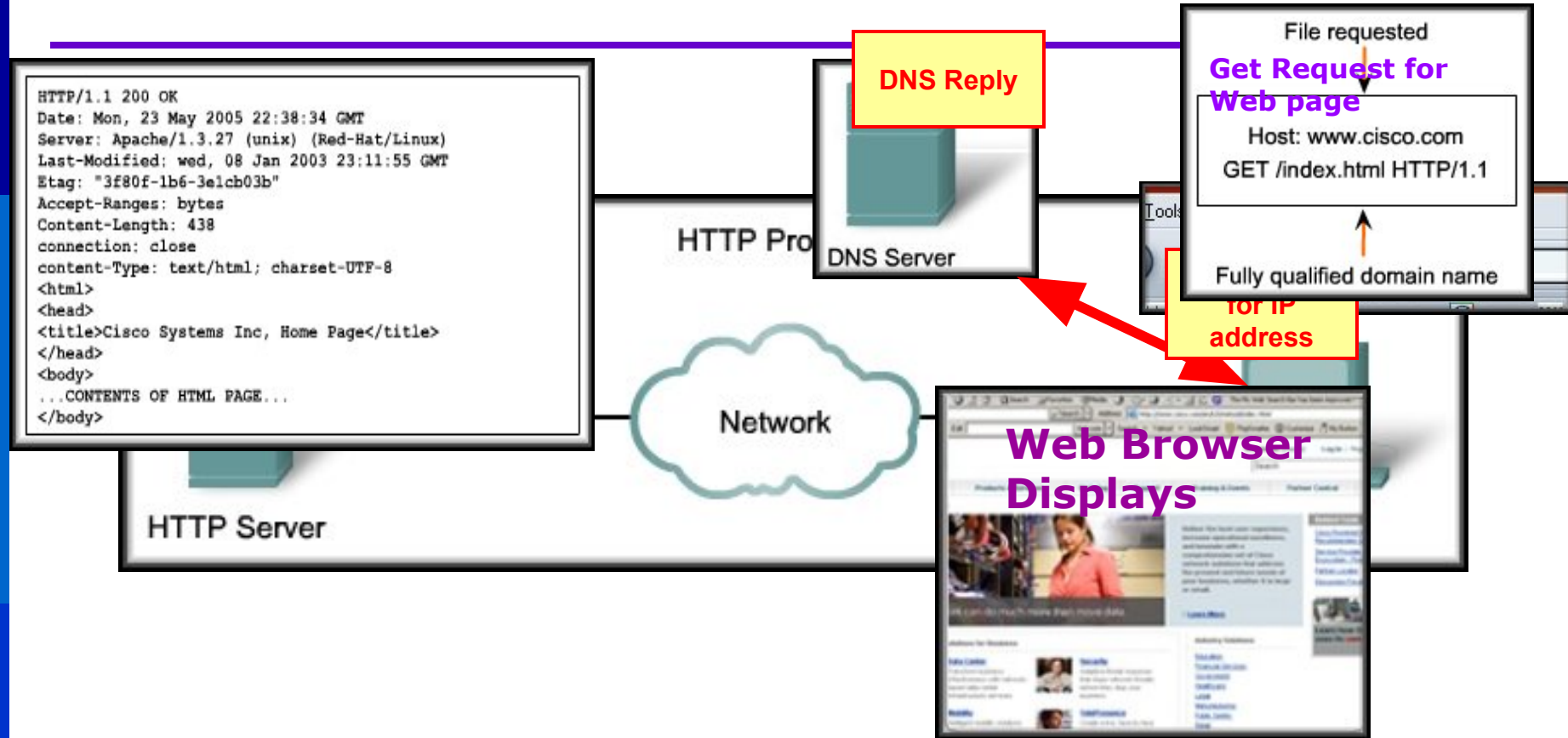
- Stores the web objects (HTML, Pictures, Video, Files).
- Each accessible by a **URL**.
- Implements the **server side of HTTP**.
- Examples:
 - Apache, Microsoft Internet Information Server (IIS)

URL

- The browser interprets the **3** parts of the URL:
 1. **http** (the protocol or scheme)
 2. **www.cisco.com** (the server name)
 3. **web-server.html** (the specific file name requested).



HTTP – How does it work?

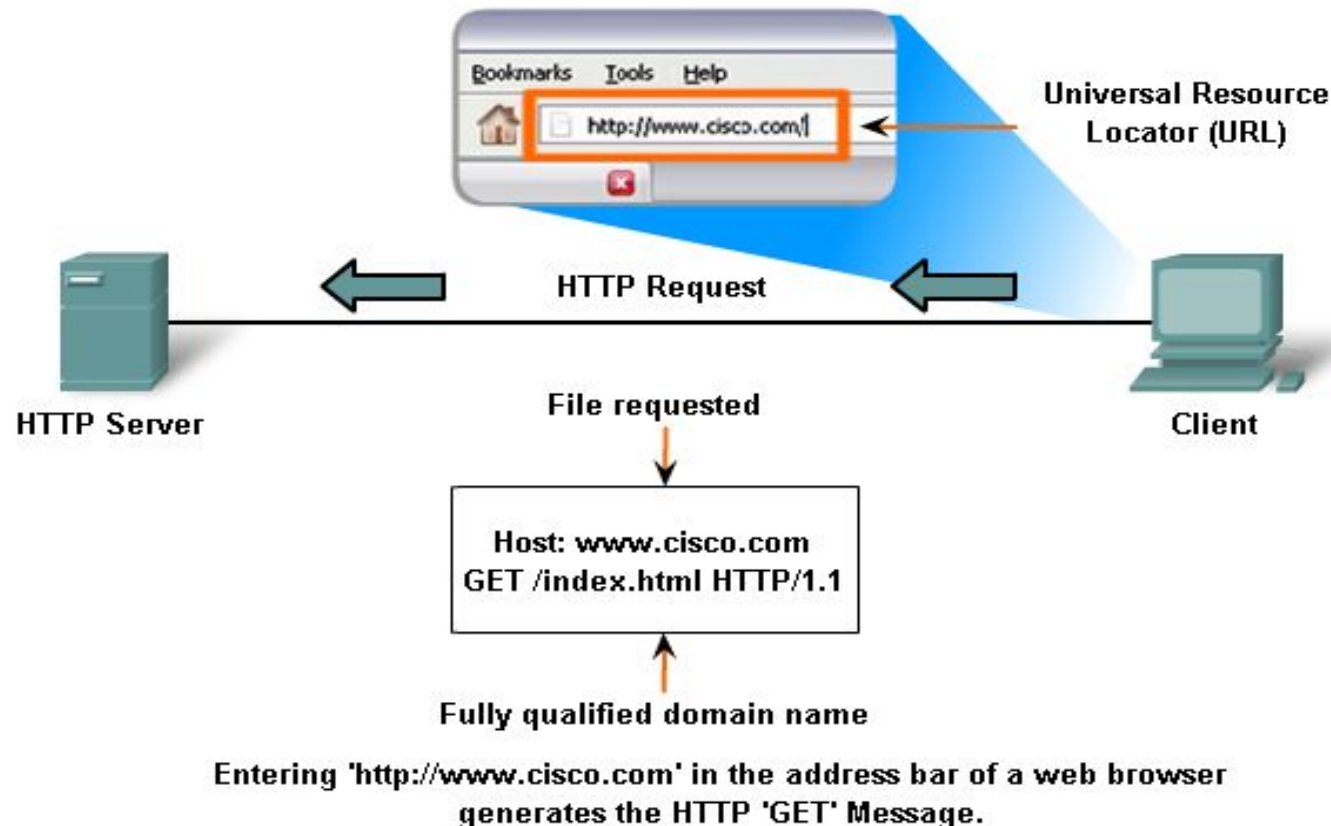


□ HTTP is a **request/response** type of protocol.

- HTTP 1.0: RFC 1945
- HTTP 1.1: RFC 2068

HTTP Request Message

HTTP Protocol using GET



Method/Message types

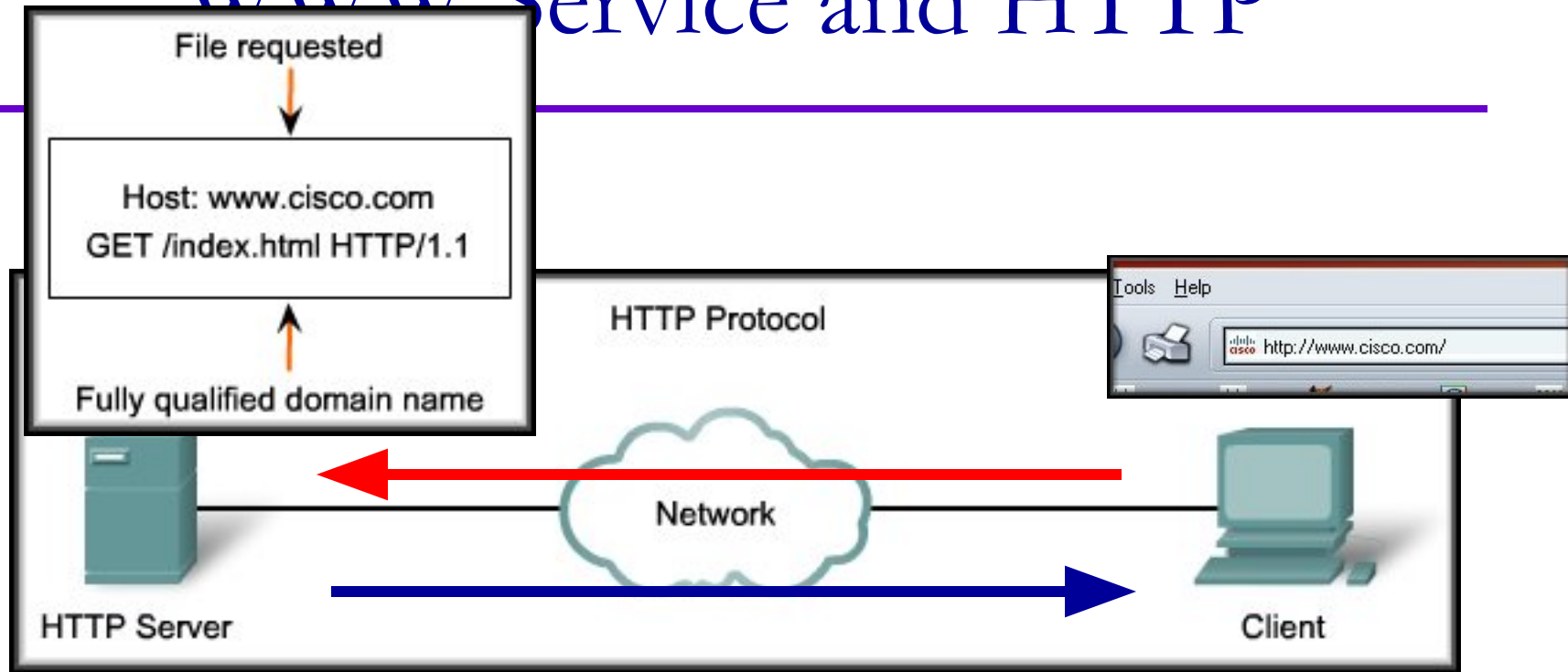
HTTP/1.0

- GET
- POST
- HEAD
 - asks server to leave requested object out of response
 - debugging

HTTP/1.1

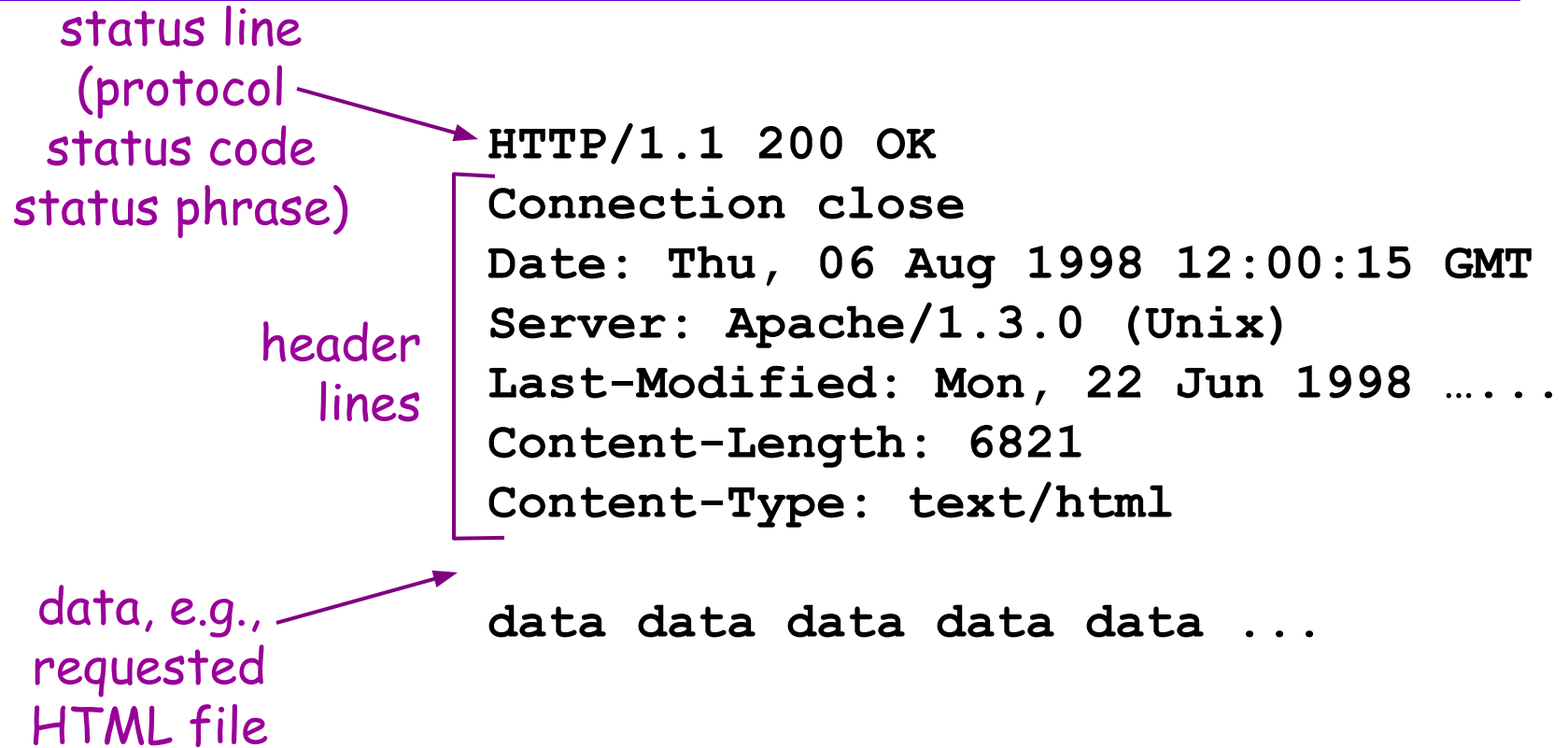
- GET, POST, HEAD
- PUT
 - uploads file in entity body to path specified in URL field
- DELETE
 - deletes file specified in the URL field

WWW Service and HTTP



- The server responds with either:
 - The requested object.
 - An error message, if necessary.
 - Or other status messages.

HTTP Response Message



HTTP response status codes

A few sample codes:

200 OK

- request succeeded, requested object later in this message

301 Moved Permanently

- requested object moved, new location specified later in this message (Location:)

400 Bad Request

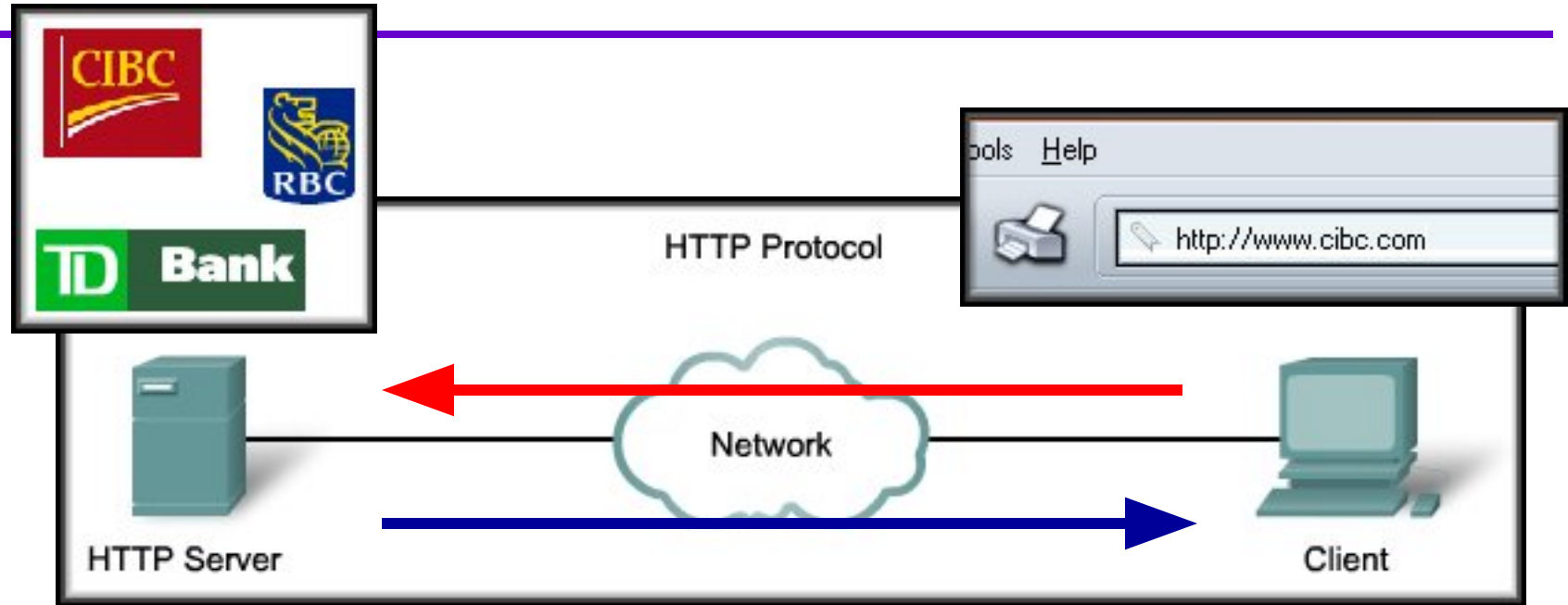
- request message not understood by server

404 Not Found

- requested document not found on this server

505 HTTP Version Not Supported

WWW Service and HTTP



- For secure communications, Secure HTTP (**HTTPS**) is used:
 - Allows servers and clients to exchange information securely over the Internet.