



Objectives

- Describe how the functions of the three upper OSI model layers provide network services to end user applications.
- Describe how the TCP/IP Application Layer protocols provide the services specified by the upper layers of the OSI model.
- Define how people use the Application Layer to communicate across the information network.
- Describe the function of well-known TCP/IP applications, such as the World Wide Web and email, and their related services (HTTP, DNS, DHCP, SMTP/POP, and Telnet).



OSI Model

TCP/IP Model

7. Application

6. Presentation

5. Session

4. Transport

3. Network

2. Data Link

1. Physical

Application
Layers

Data Flow
Layers

Application

Transport

Internet

Network
Access

Domain Name
System

Hypertext
Transfer Protocol

Simple Mail
Transfer Protocol

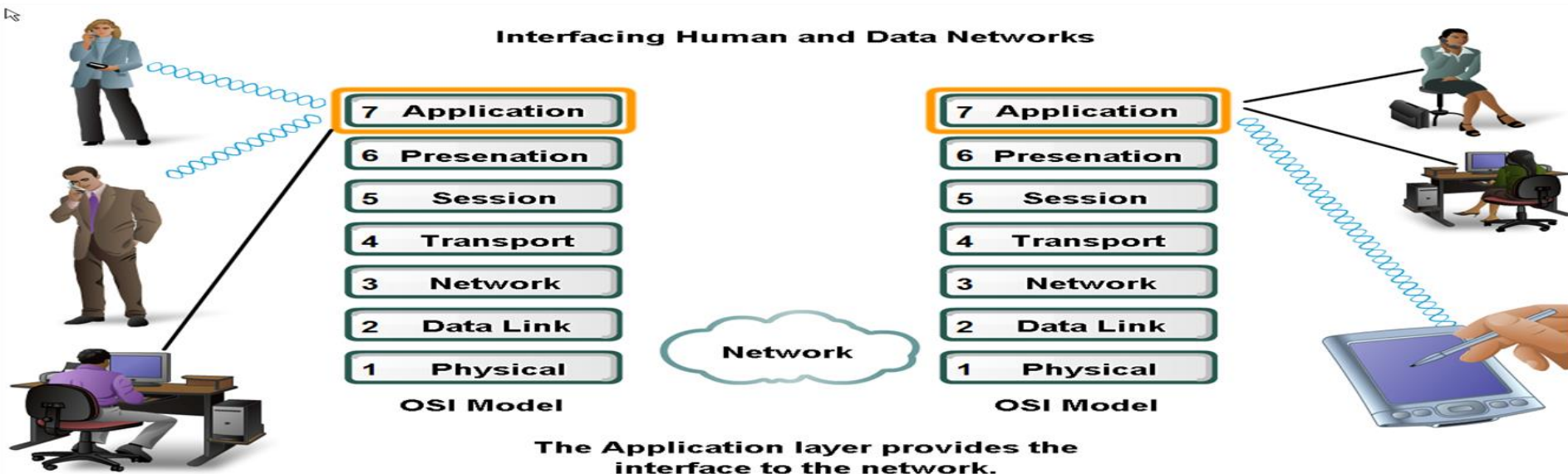
Post Office
Protocol

Dynamic Host
Configuration
Protocol



The OSI Reference Model

As many networking tutorials do, this one begins with an introduction to the **Open Systems Interconnection** (OSI) Reference Model (OSI Model). The OSI model is a layered, abstract description for communication and computer network protocol design, developed as part of the Open Systems Interconnection initiative. It is also called the OSI 7-layer model





Application Layer (Data)

The application layer provides a means for the ***user to access information on the network through an application***. This layer is the ***main interface*** for users to interact with the application and therefore the network.

Presentation Layer (Data)

The presentation layer transforms data to provide a standard interface for the application layer. ***Encoding, data compression, data encryption*** and similar manipulation of the presentation is done at this layer to present the data as a service or protocol developer sees fit.

Session Layer (Data)

The session layer controls the connections (sessions) between computers. It ***establishes, manages and terminates*** the connections between the local and remote application.



Transport Layer (Segments)

The transport layer provides transparent transfer of data between end users, thus relieving the upper layers from transfer concerns while providing reliable data transfer. The transport layer controls the reliability of a given link through flow control, segmentation/ desegmentation, and error control.

Network Layer (packets)

The network layer provides the means of transferring data sequences from a source to a destination by using one or more networks while maintaining the quality of service requested by the Transport layer. The Network layer performs network routing functions, and might also perform segmentation/desegmentation, and report delivery errors.

Data Link Layer (Frames)

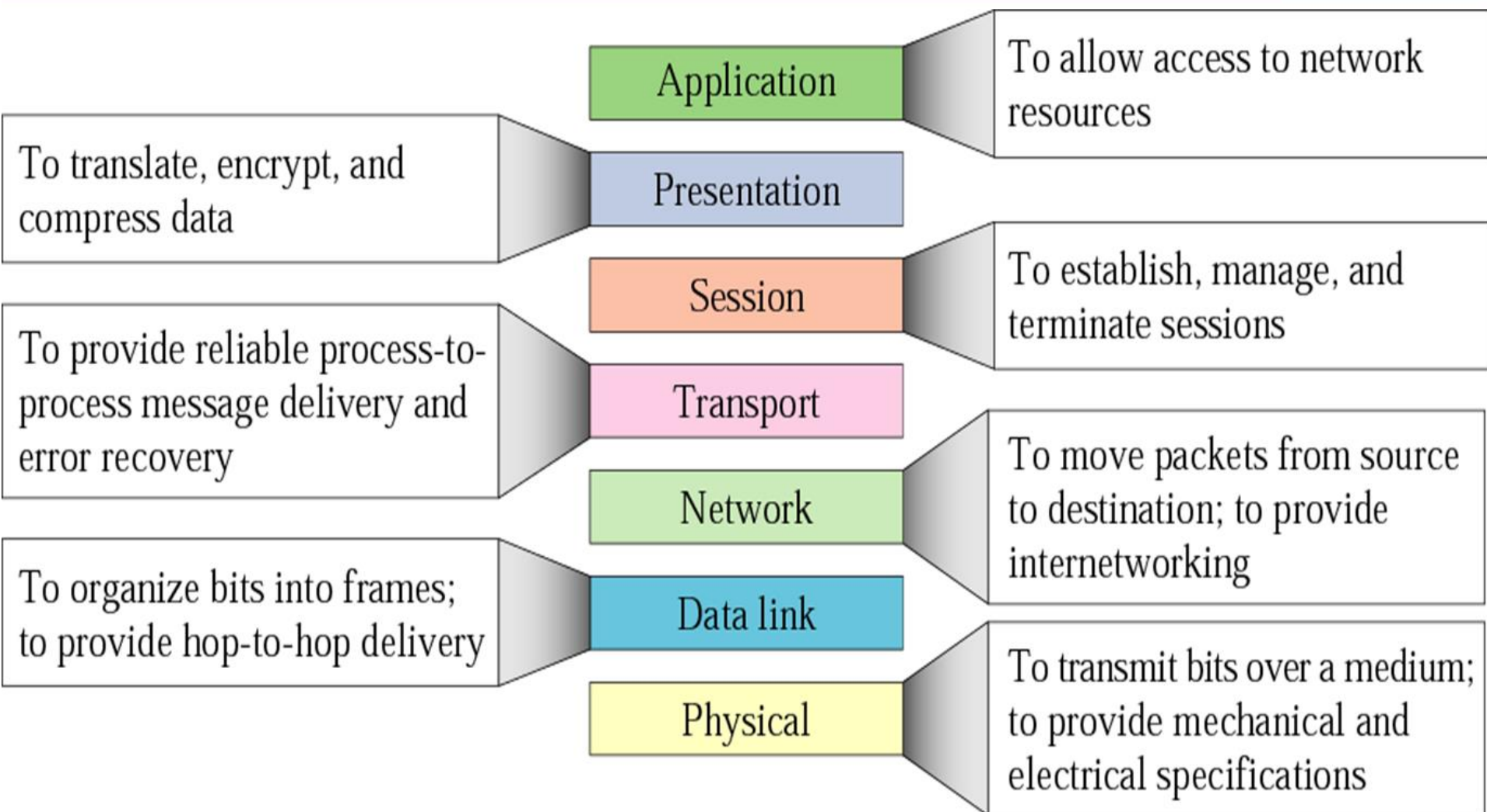
The data link layer provides the means to transfer data between network entities and to detect and possibly correct errors that may occur in the Physical layer. It arranges bits from the physical layer into logical chunks of data, known as frames.

Physical Layer (Bits)

The physical layer defines all the electrical and physical specifications for devices. This includes the layout of pins, voltages, and cable specifications.



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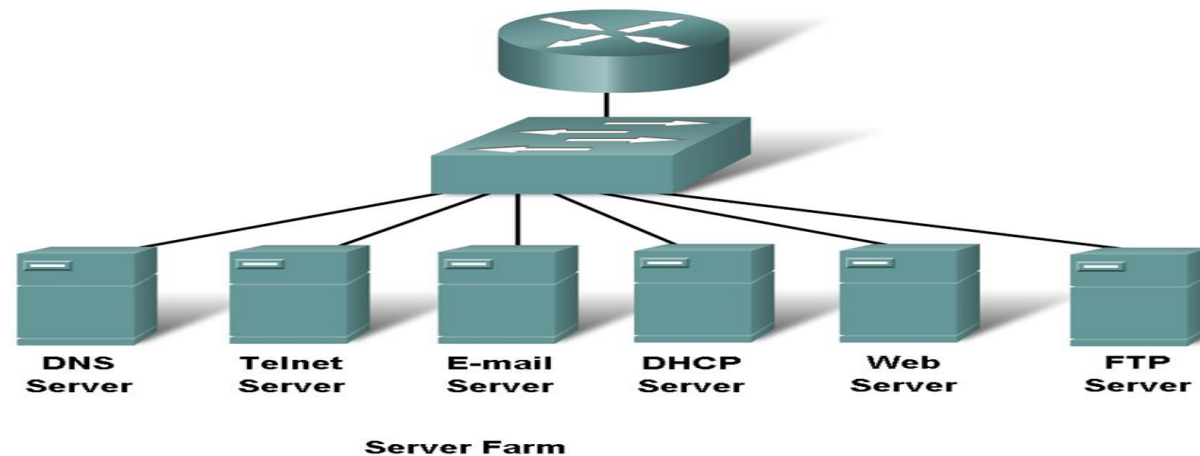




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- Describe the role protocols play in networking and be able to identify several message properties that can be defined by a protocol



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



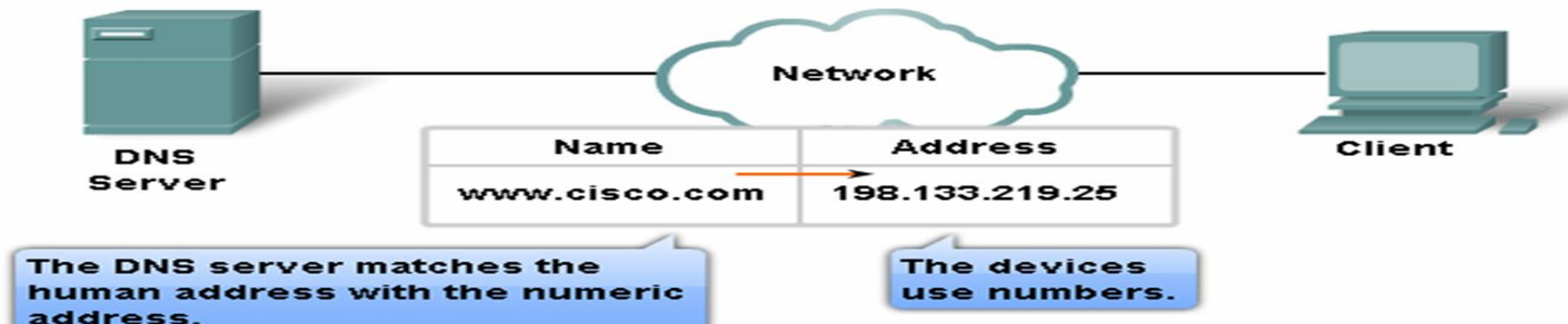
The most widely-known TCP/IP Application layer protocols are those that provide for the exchange of user information. These protocols specify the format and control information necessary for many of the common Internet communication functions. Among these TCP/IP protocols are:

- **Domain Name Service Protocol (DNS)** is used to resolve Internet names to IP addresses.
- **Hypertext Transfer Protocol (HTTP)** is used to transfer files that make up the Web pages of the World Wide Web.
- **Simple Mail Transfer Protocol (SMTP)** is used for the transfer of mail messages and attachments.
- **Telnet, a terminal emulation protocol**, is used to provide remote access to servers and networking devices.
- **File Transfer Protocol (FTP)** is used for interactive file transfer between systems.



Domain Name Service (DNS) :In data networks, devices are labeled with numeric IP addresses, so that they can participate in sending and receiving messages over the network. However, most people have a hard time remembering this numeric address. Hence, domain names were created to convert the numeric address into a simple, recognizable name. on the other hand **DNS protocol is used to resolve Internet names to IP addresses.**

Resolving DNS Addresses





DNS The Domain Name System uses a hierarchical system to create a name database to provide name resolution. The hierarchy looks like an inverted tree with the root at the top and branches below.

At the top of the hierarchy, the root servers maintain records about how to reach the top-level domain servers, which in turn have records that point to the secondary level domain servers and so on.

The different top-level domains represent either the type of organization or the country or origin. Examples of top-level domains are:

.au – Australia

.co - Colombia

.com - a business or industry

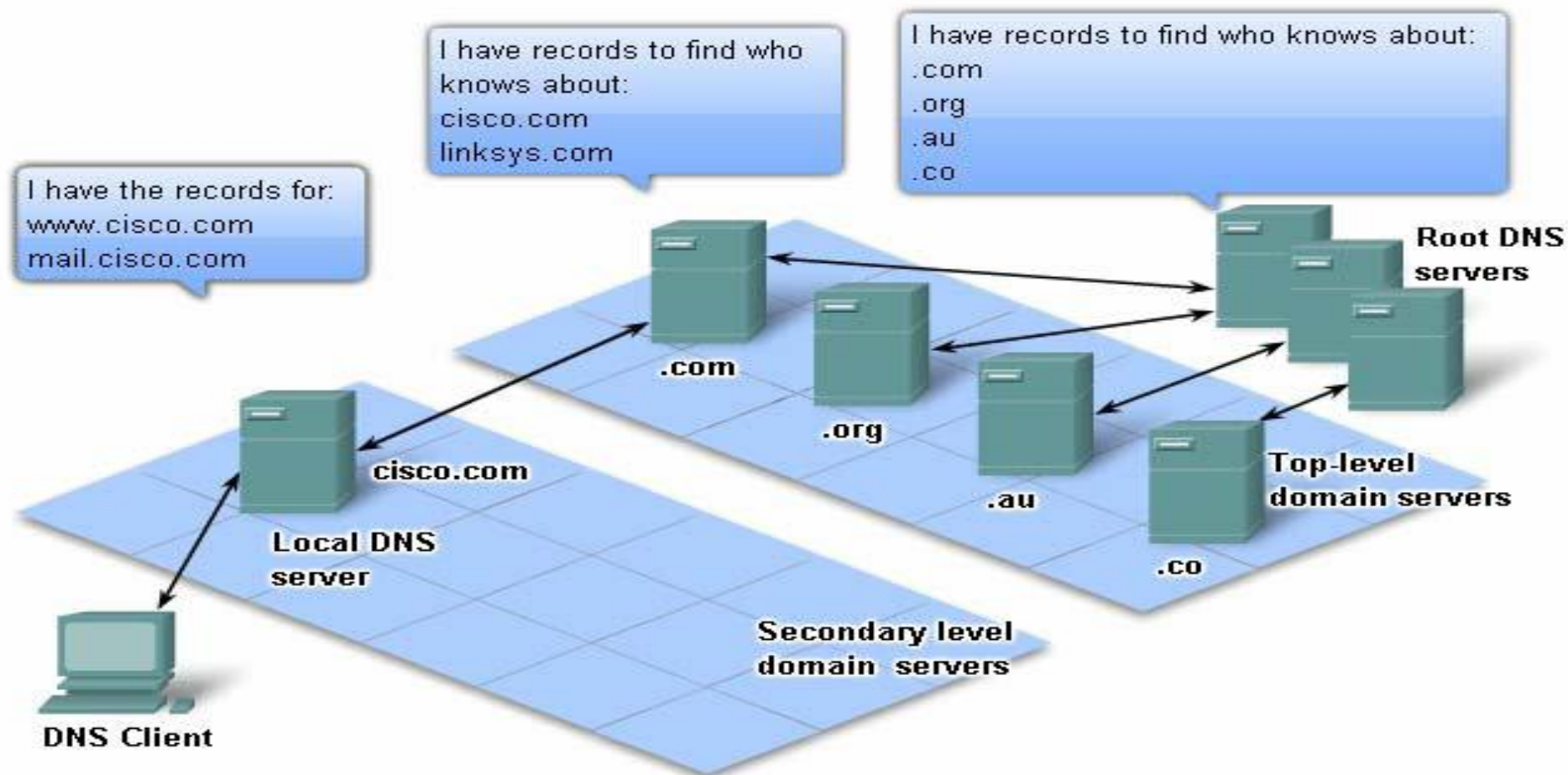
.jp - Japan

.org - a non-profit organization

After top-level domains are second-level domain names, and below them are other lower level domains.



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A hierarchy of DNS servers contains the resource records that match names with addresses.



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HTTP: When a web address (or URL) is typed into a web browser, the web browser establishes a connection to the web service running on the server using the HTTP protocol. URLs (or Uniform Resource Locator) and URIs (Uniform Resource Identifier) are the names most people associate with web addresses. **Hypertext Transfer Protocol (HTTP)** : The (HTTP) is one of the protocols in the TCP/IP suite, was originally developed to publish and retrieve HTML pages and is now used for distributed, collaborative information systems. HTTP is used across the WWW for data transfer and is one of the most used application protocols. **(HTTP) is used to transfer files that make up the Web pages of the World Wide Web.**

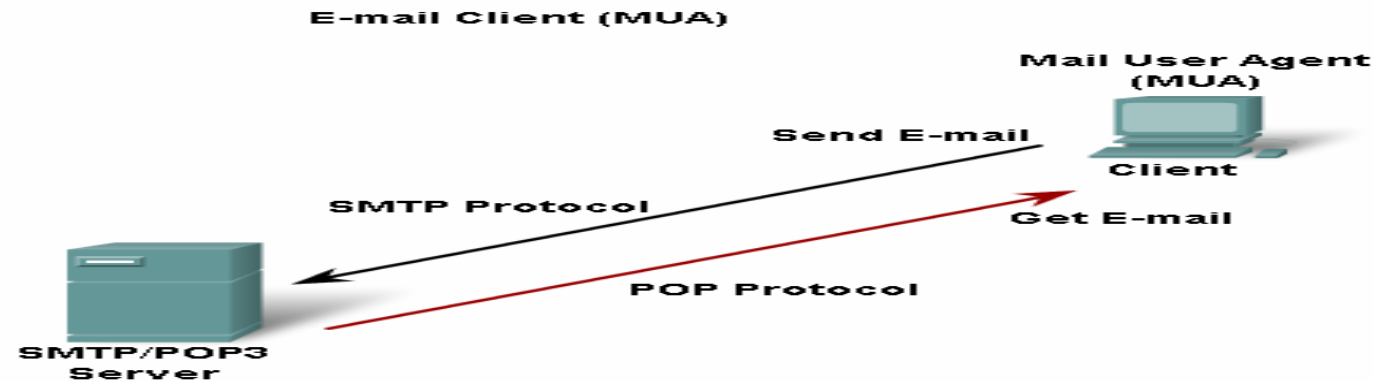
SMTP and POP (E-mail services) : e-mail requires several applications and services. Two example Application layer protocols are Post Office Protocol (POP) and Simple Mail Transfer Protocol (SMTP), shown in the figure. As with HTTP, these protocols define client/server processes.

When people compose e-mail messages, they typically use an application called a Mail User Agent (MUA), or e-mail client. The MUA allows messages to be sent and places received messages into the client's mailbox, both of which are distinct processes.

In order to receive e-mail messages from an e-mail server, the e-mail client can use POP.



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Clients send e-mails to a server using SMTP and receive e-mails using POP3.

E-mail Server Processes - MTA and MDA

The e-mail server operates two separate processes:

1. Mail Transfer Agent (MTA)
2. Mail Delivery Agent (MDA)

The Mail Transfer Agent (MTA) process is used to forward e-mail. As shown in the figure, the MTA receives messages from the MUA or from another MTA on another e-mail server. Based on the message header, it determines how a message has to be forwarded to reach its destination. If the mail is addressed to a user whose mailbox is on the local server, the mail is passed to the MDA. If the mail is for a user not on the local server, the MTA routes the e-mail to the MTA on the appropriate server.



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E-mail Server - MDA

**Mail User Agent
(MUA)**



Client

Sender

Send e-mail

recipient@domain.com

**Mail User Agent
(MUA)**



Client

Recipient

Is the recipient in my list of recipients?
No. Forward e-mail to another server.

**SMTP/POP3
Server**

**Mail Transfer Agent
(MTA)**

**SMTP/POP3
Server**



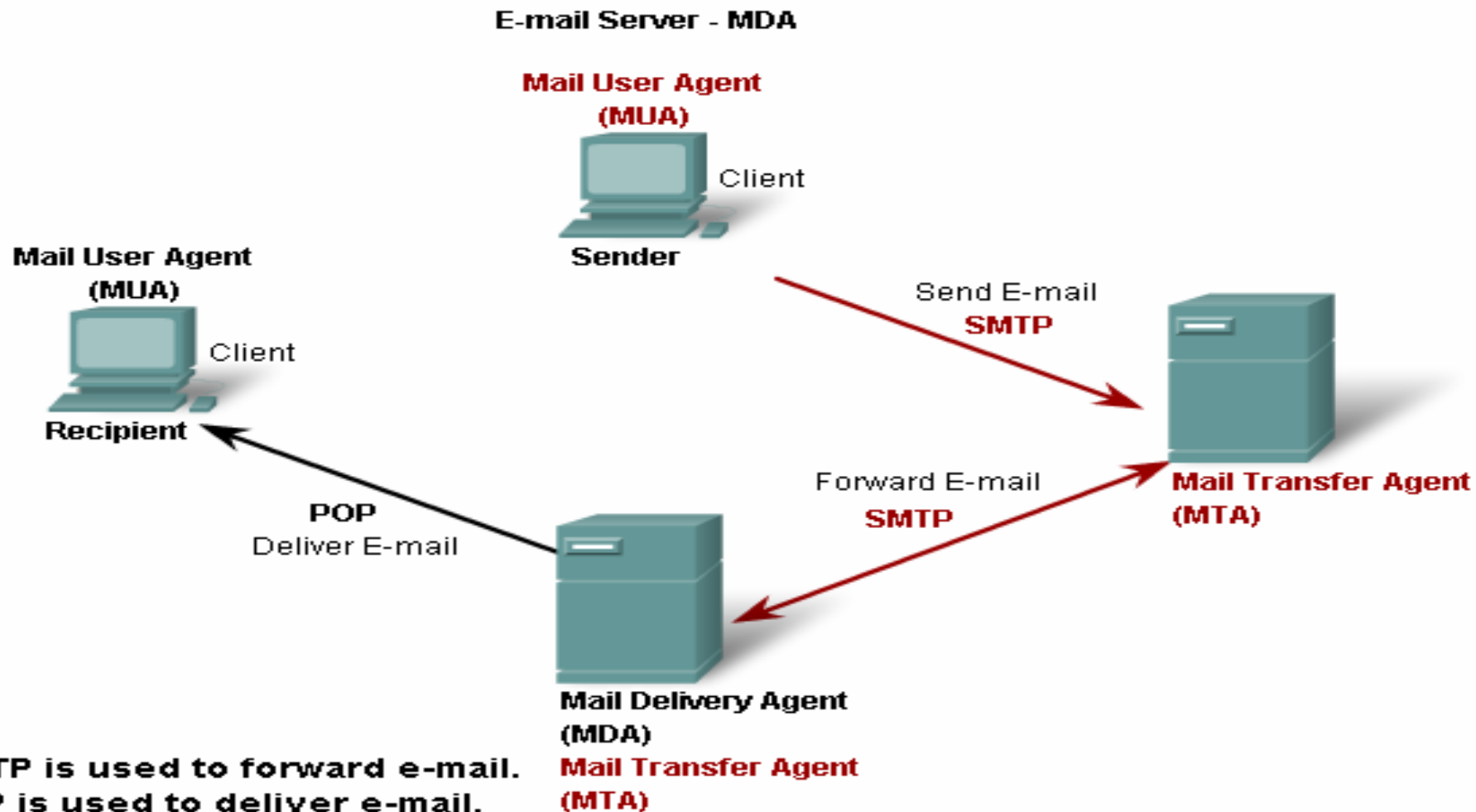
**Mail Delivery Agent
(MDA)**

Is the recipient in my list of recipients?
Yes. Place e-mail in recipient's mailbox .

The Mail Delivery Agent process governs delivery of e-mail between servers and clients.



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Application layer Protocols examples include:

- **Dynamic Host Configuration Protocol (DHCP)** : Enables devices on a network to obtain IP addresses and other information from a DHCP server. DHCP allows a host to obtain an IP address dynamically when it connects to the network.
- **File Transfer Protocol (FTP)** : FTP was developed to allow for file transfers between a client and a server . (FTP) Protocol is used for interactive file transfer between systems.
- **Terminal Emulation Protocol (Telnet)**: is used to provide remote access to servers and networking devices. Internet Message Access Protocol (IMAP).
- **Internet Relay Chat (IRC).**
- **Simple Network Management Protocol (SNMP)**



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