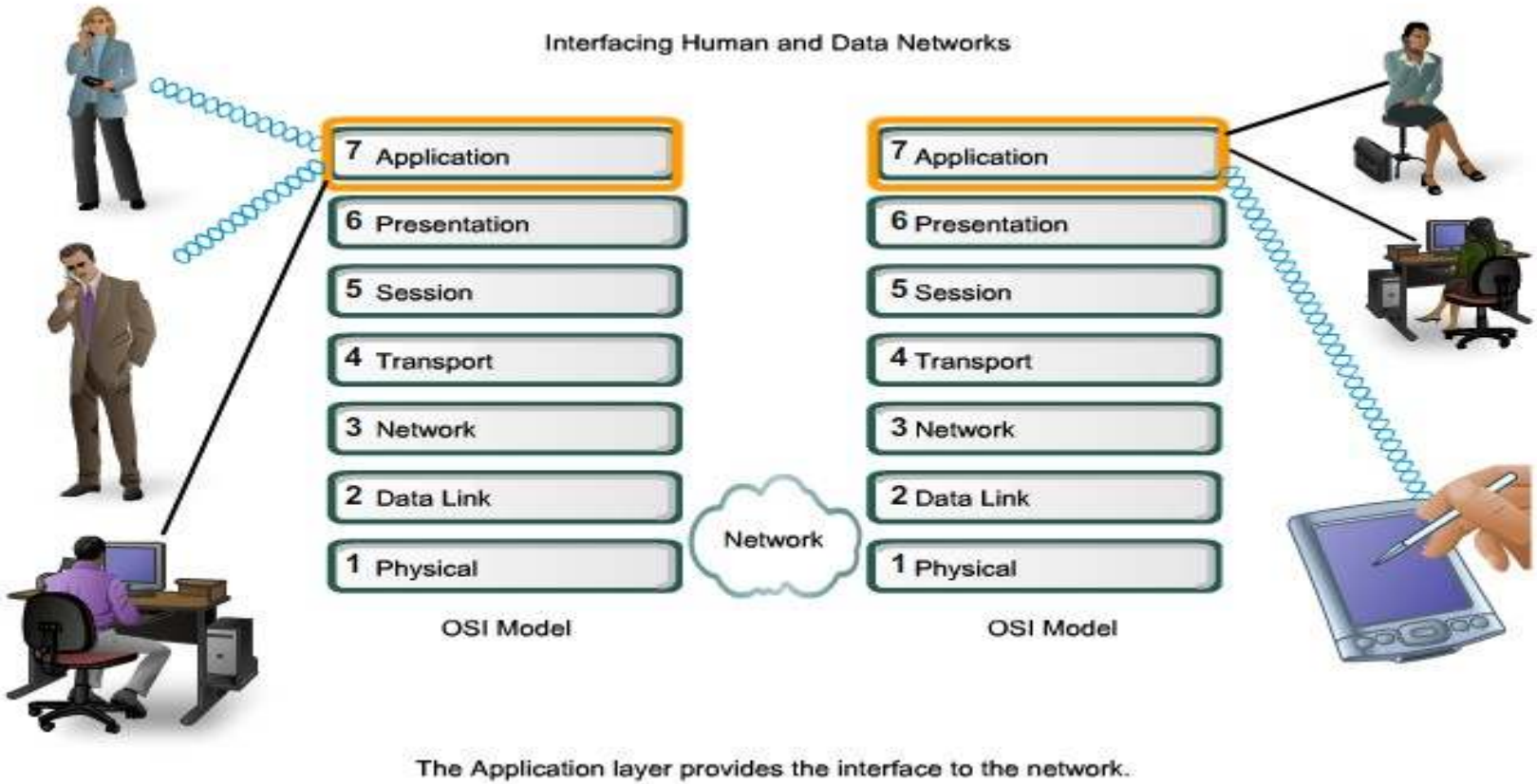


Manajemen Jaringan Komputer

OSI 7 Layer

Abdul Razak Naufal, M.Kom

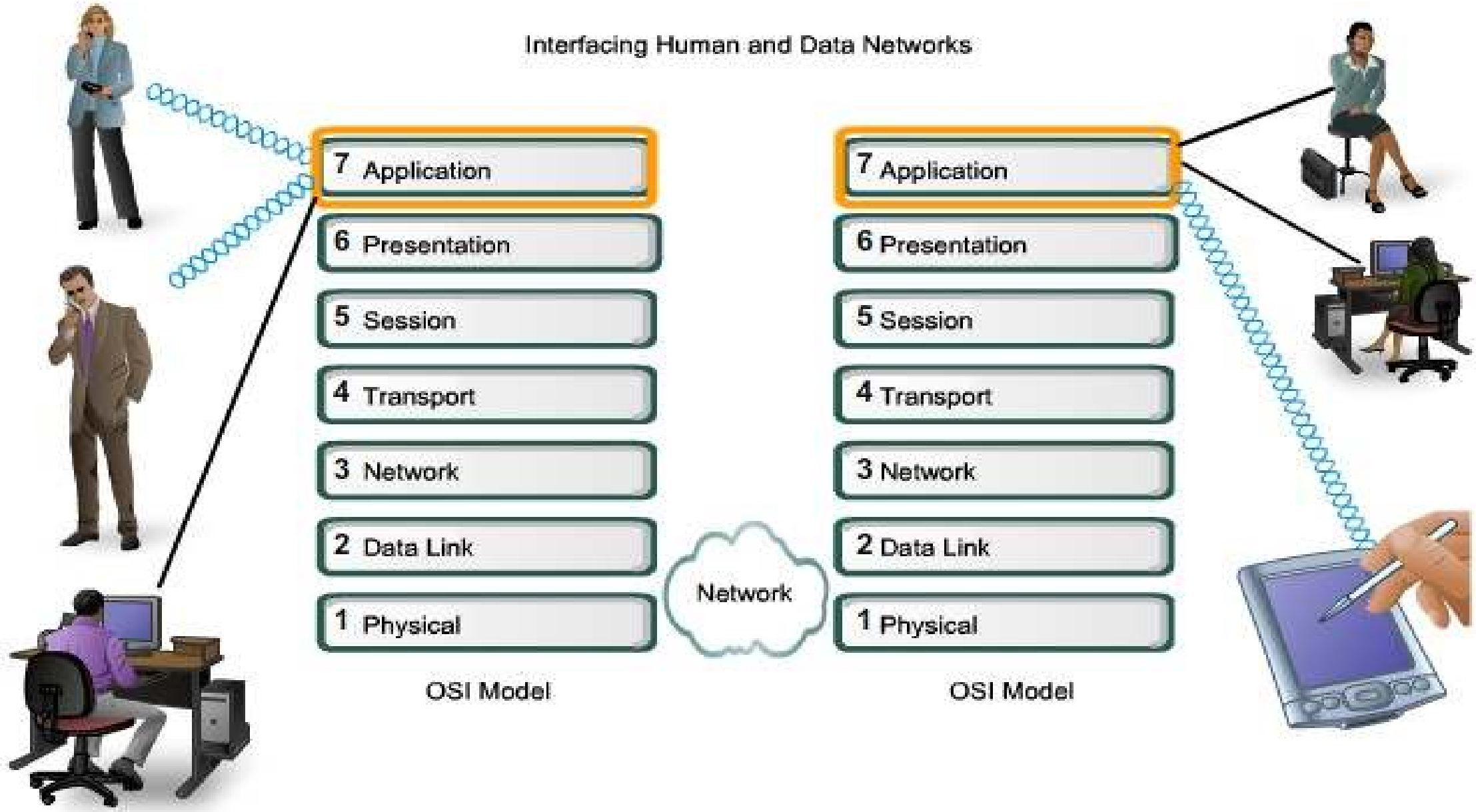
Pendahuluan for Outline

- Most of us experience the Internet through the World Wide Web, e-mail services, and file-sharing programs. These applications, and many others, provide the human interface to the underlying network, enabling us to send and receive information with relative ease.
- Typically the applications that we use are intuitive, meaning we can access and use them without knowing how they work. However, for network professionals, it is important to know how an application is able to format, transmit and interpret messages that are sent and received across the network.
- *Visualizing the mechanisms that enable communication across the network is made easier if we use the layered framework of the* ***Open System Interconnection (OSI) model.***

Focus Outline

- Application Layer Functionally and Protocol
- OSI Transport Layer
- OSI Network Layer
- Data Link Layer
- OSI Physical Layer

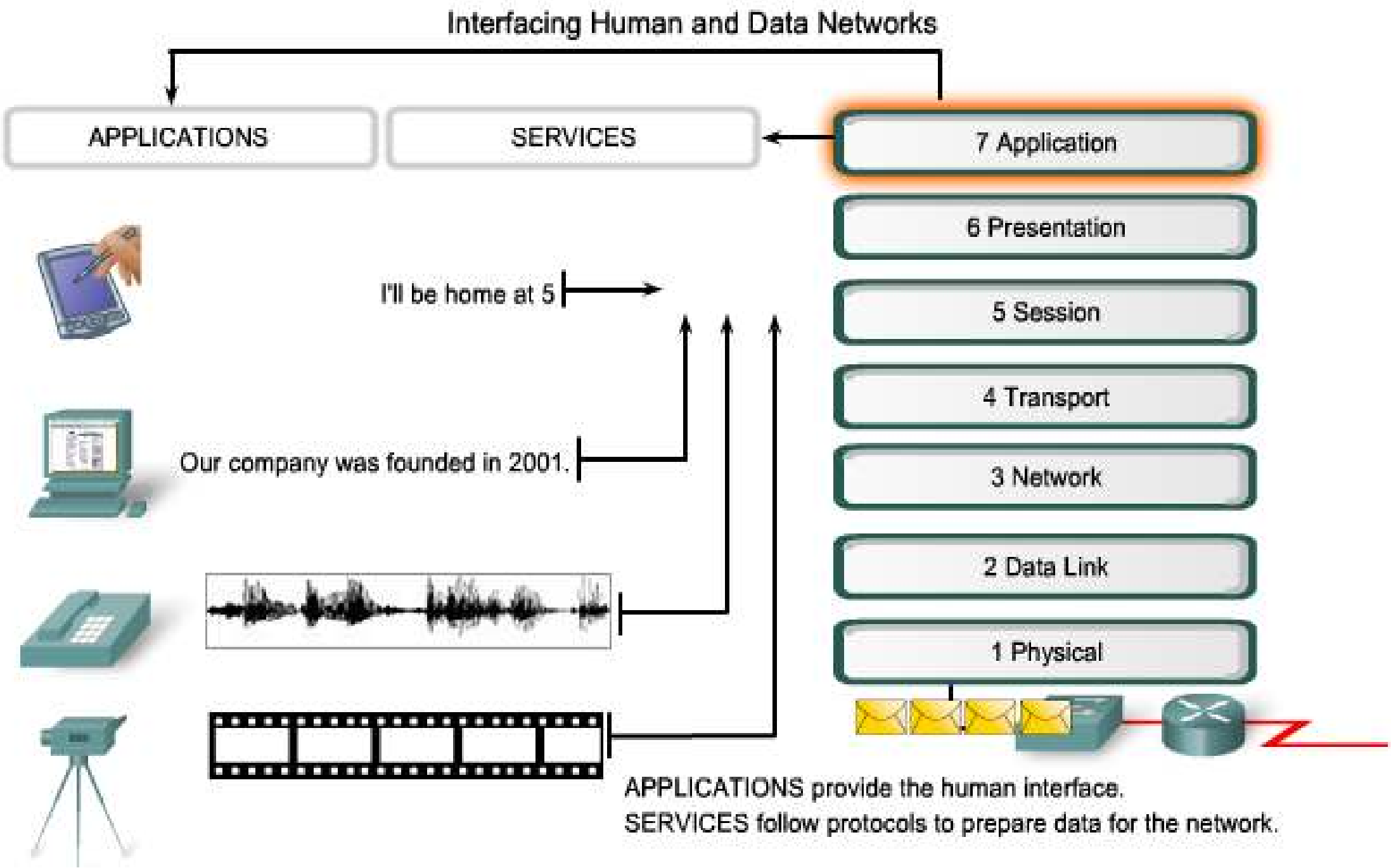
Application Layer Functionally and Protocol



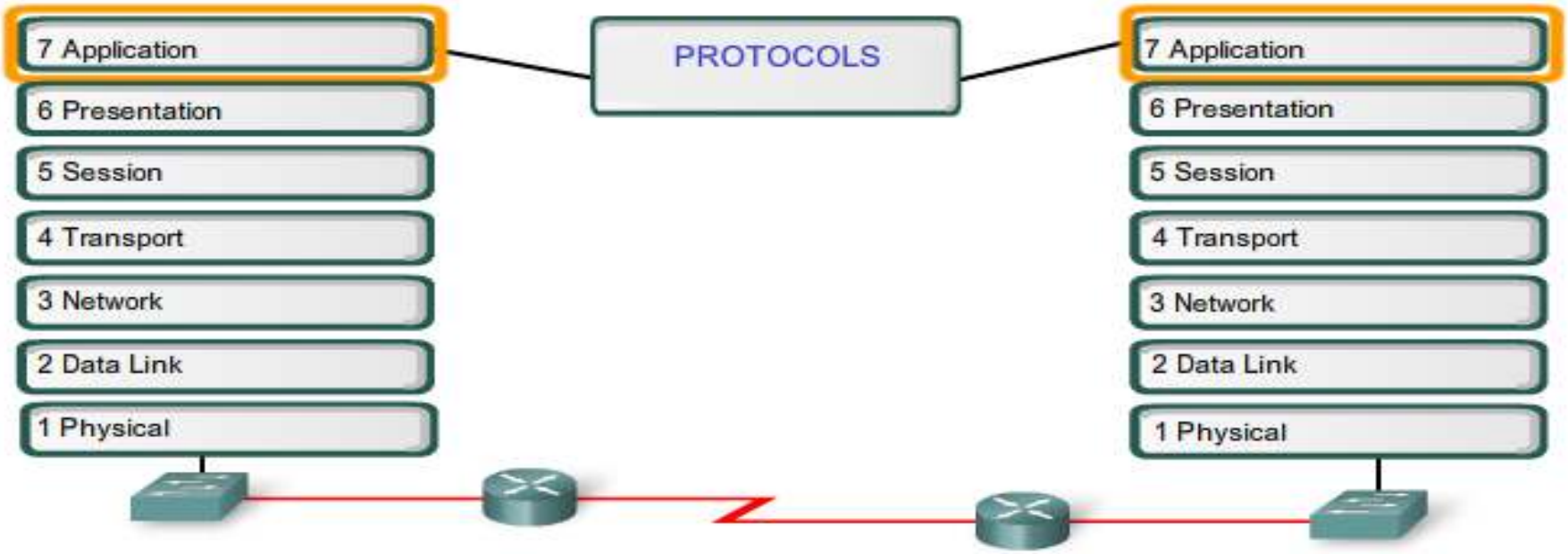
The Application layer provides the interface to the network.

User Application, Services and Application User Protocols

- As mentioned previously, the Application layer uses protocols that are implemented within applications and services. While applications provide people with a way to create messages and Application layer services establish an interface to the network, protocols provide the rules and formats that govern how data is treated. All three components may be used by a single executable program and may even use the same name. For example, when discussing "Telnet" we could be referring to the application, the service, or the protocol.
- In the OSI model, applications that interact directly with people are considered to be at the top of the stack, as are the people themselves. Like all layers within the OSI model, the Application layer relies on the functions of the lower layers in order to complete the communication process. Within the Application layer, protocols specify what messages are exchanged between the source and destination hosts, the syntax of the control commands, the type and format of the data being transmitted, and the appropriate methods for error notification and recovery.


Interfacing Human and Data Networks
APPLICATIONS
SERVICES
7 Application
6 Presentation
5 Session
4 Transport
3 Network
2 Data Link
1 Physical
I'll be home at 5
Our company was founded in 2001.
APPLICATIONS provide the human interface.
SERVICES follow protocols to prepare data for the network.

Application Layer Protocol Functions



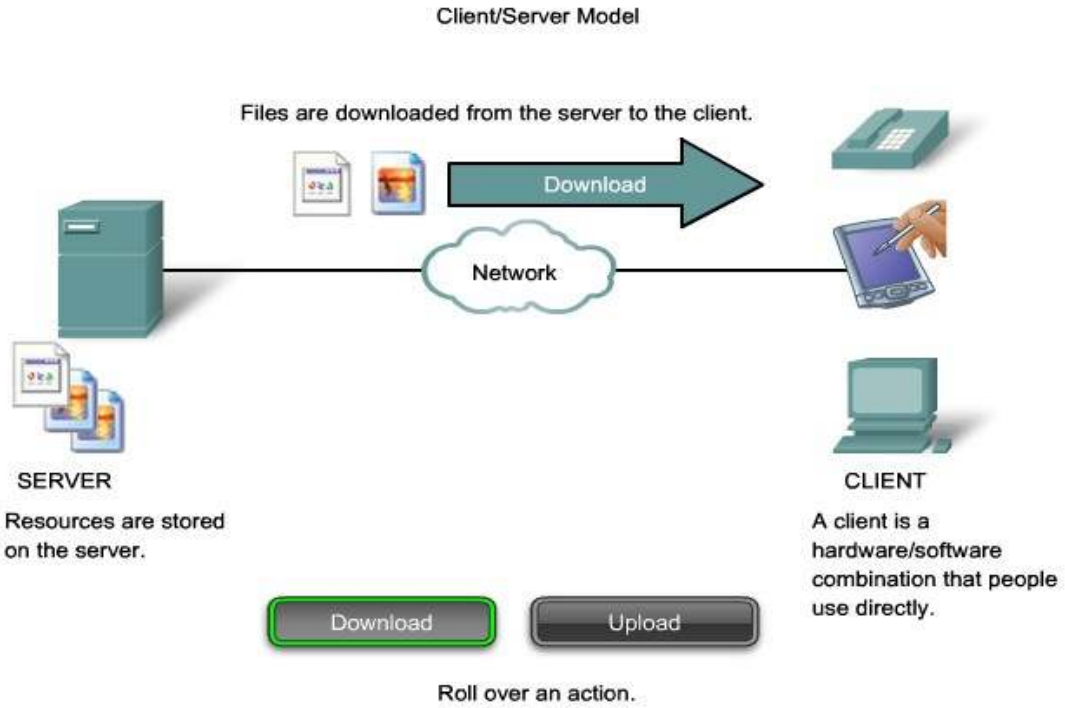
Application layer protocols provide the rules for communication between applications.

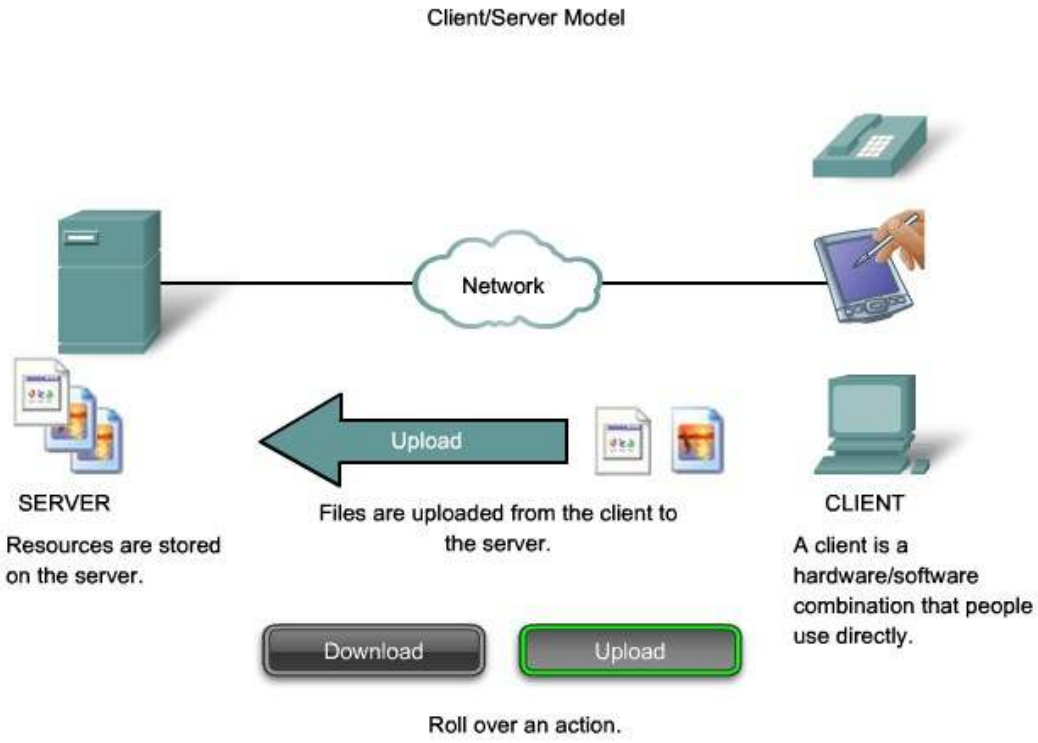
Protocols:

- 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

The Client Server Model

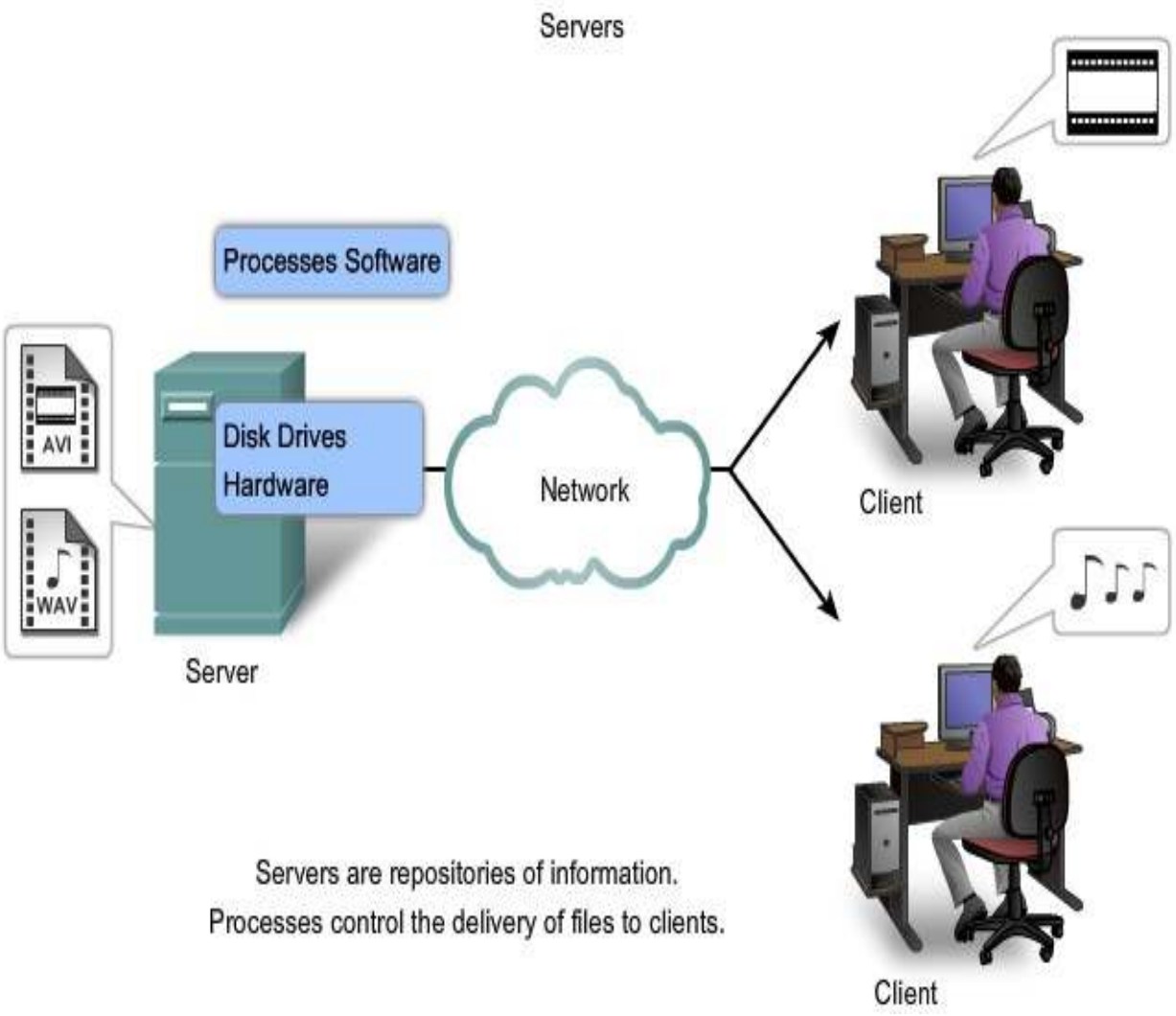
- When people attempt to access information on their device, whether it is a PC, laptop, PDA, cell phone, or some other device connected to a network, the data may not be physically stored on their device.
- If that is the case, a request to access that information must be made to the device where the data resides.



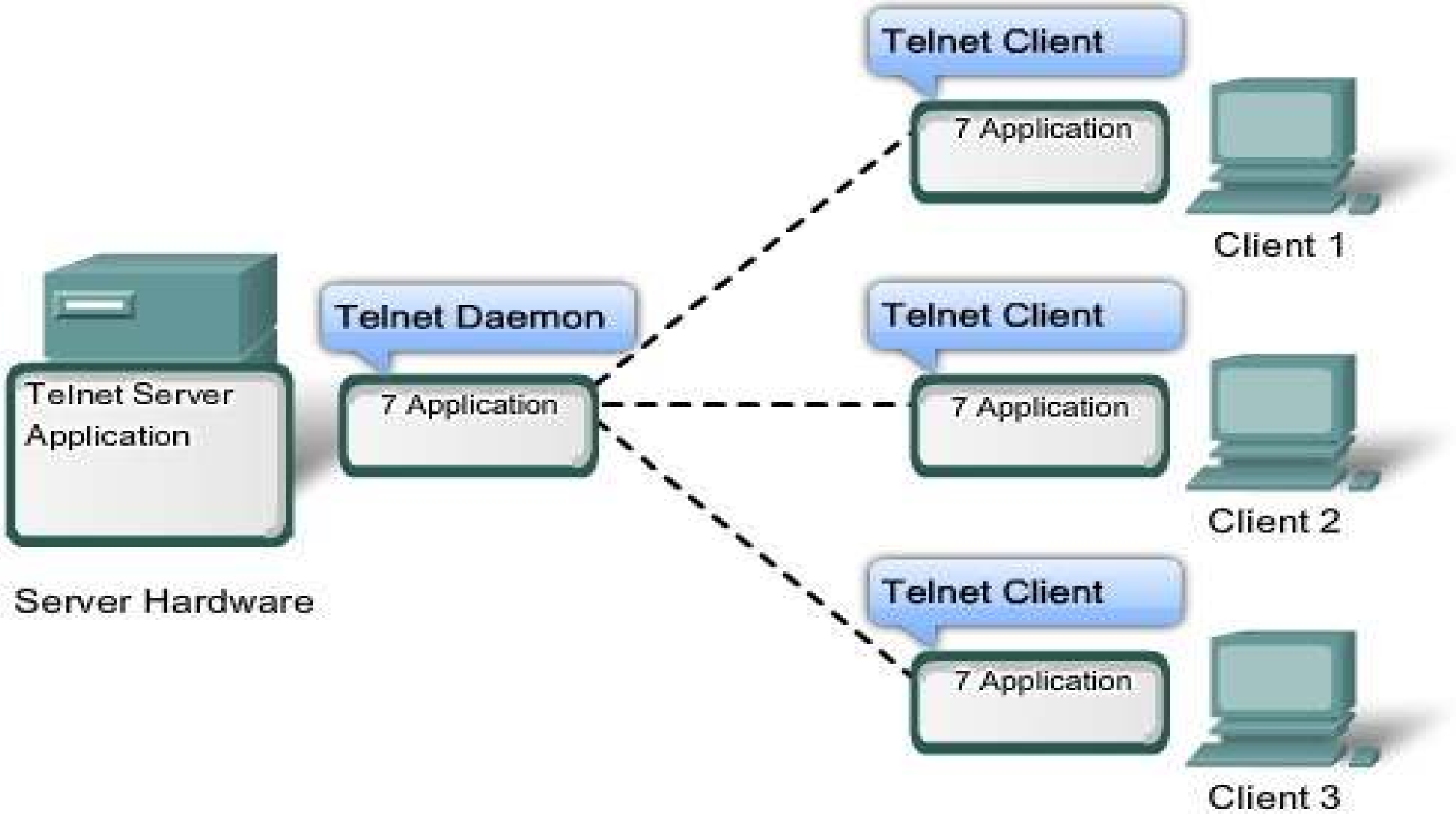


Server

- In a general networking context, any device that responds to requests from client applications is functioning as a server. A server is usually a computer that contains information to be shared with many client systems.
- For example, web pages, documents, databases, pictures, video, and audio files can all be stored on a server and delivered to requesting clients. In other cases, such as a network printer, the print server delivers the client print requests to the specified printer.



Server processes may support multiple clients.



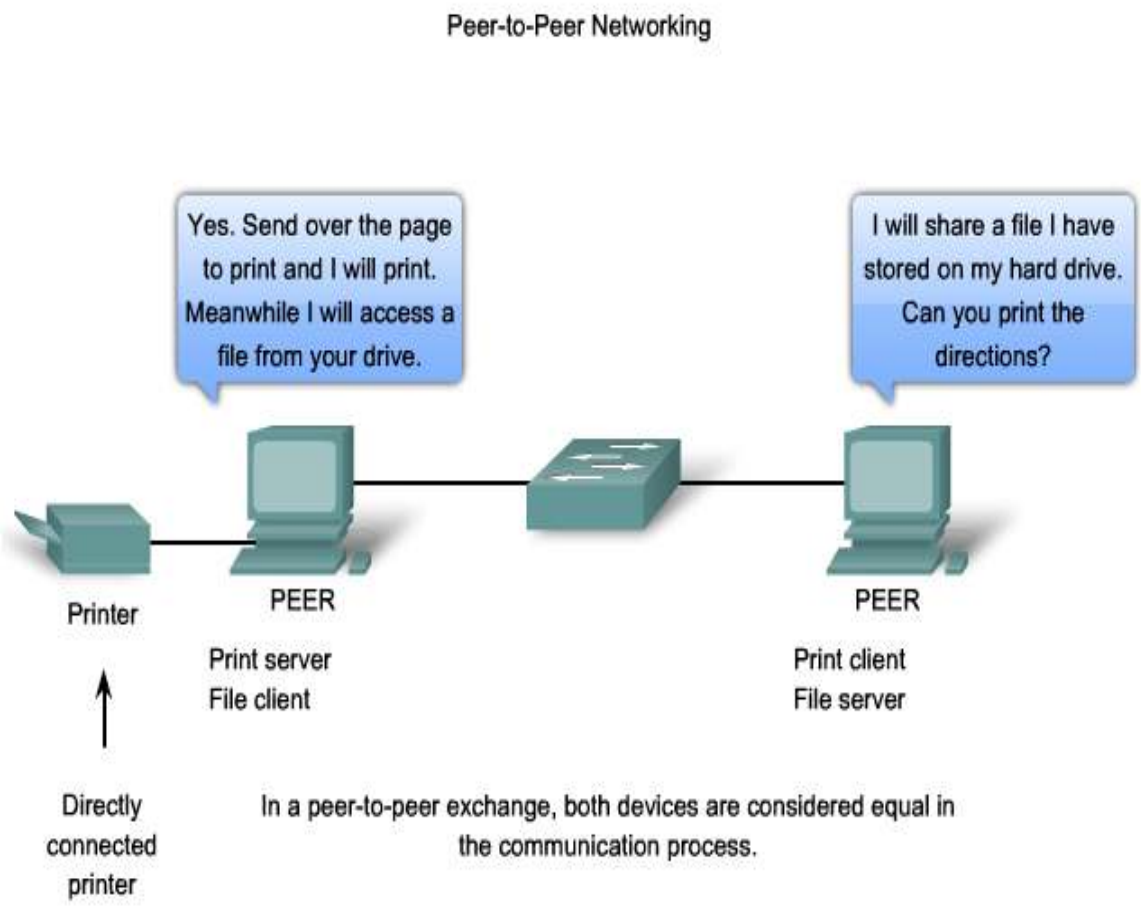
Peer to Peer Networking & Application (P2P)

- **The Peer-to-Peer Model**

  In addition to the client/server model for networking, there is also a peer-to-peer model. Peer-to-peer networking involves two distinct forms: peer-to-peer network design and peer-to-peer applications (P2P). Both forms have similar features but in practice work very differently.

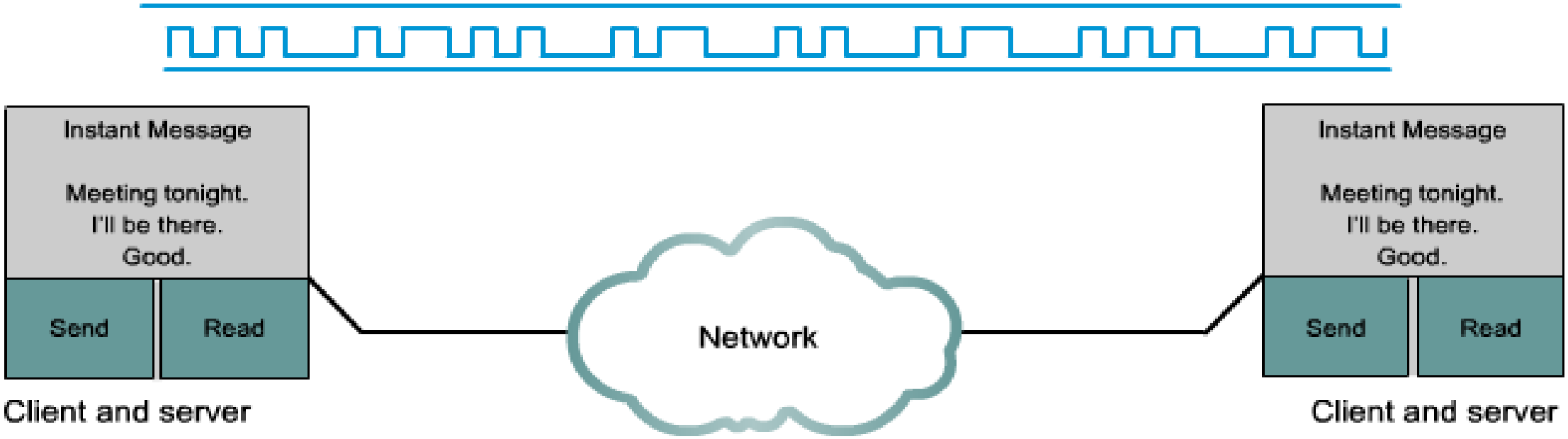
- **Peer-to-Peer Networks**

  In a peer-to-peer network, two or more computers are connected via a network and can share resources (such as printers and files) without having a dedicated server. Every connected end device (known as a peer) can function as either a server or a client. One computer might assume the role of server for one transaction while simultaneously serving as a client for another. The roles of client and server are set on a per request basis.



Peer-to-Peer Applications

Client and server in the same communication



Both clients:

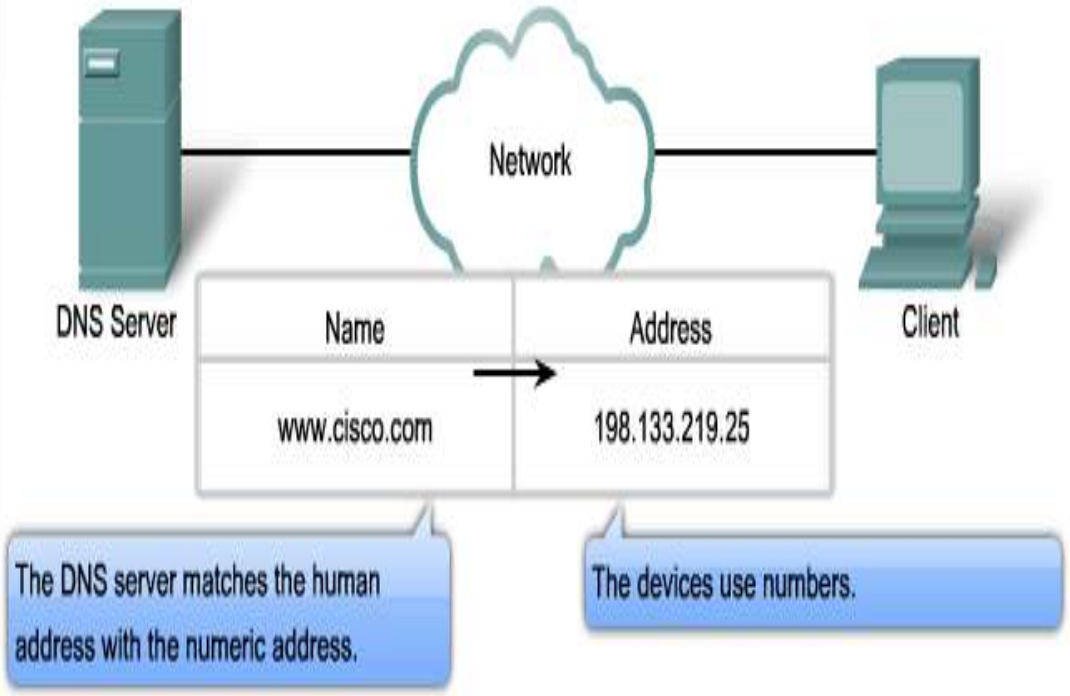
- Initiate a message
- Receive a message

Both clients simultaneously:

- Send
- Receive

DNS & Services Protocol

- 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 Internet these domain names, such as www.cisco.com, are much easier for people to remember than 198.133.219.25, which is the actual numeric address for this server

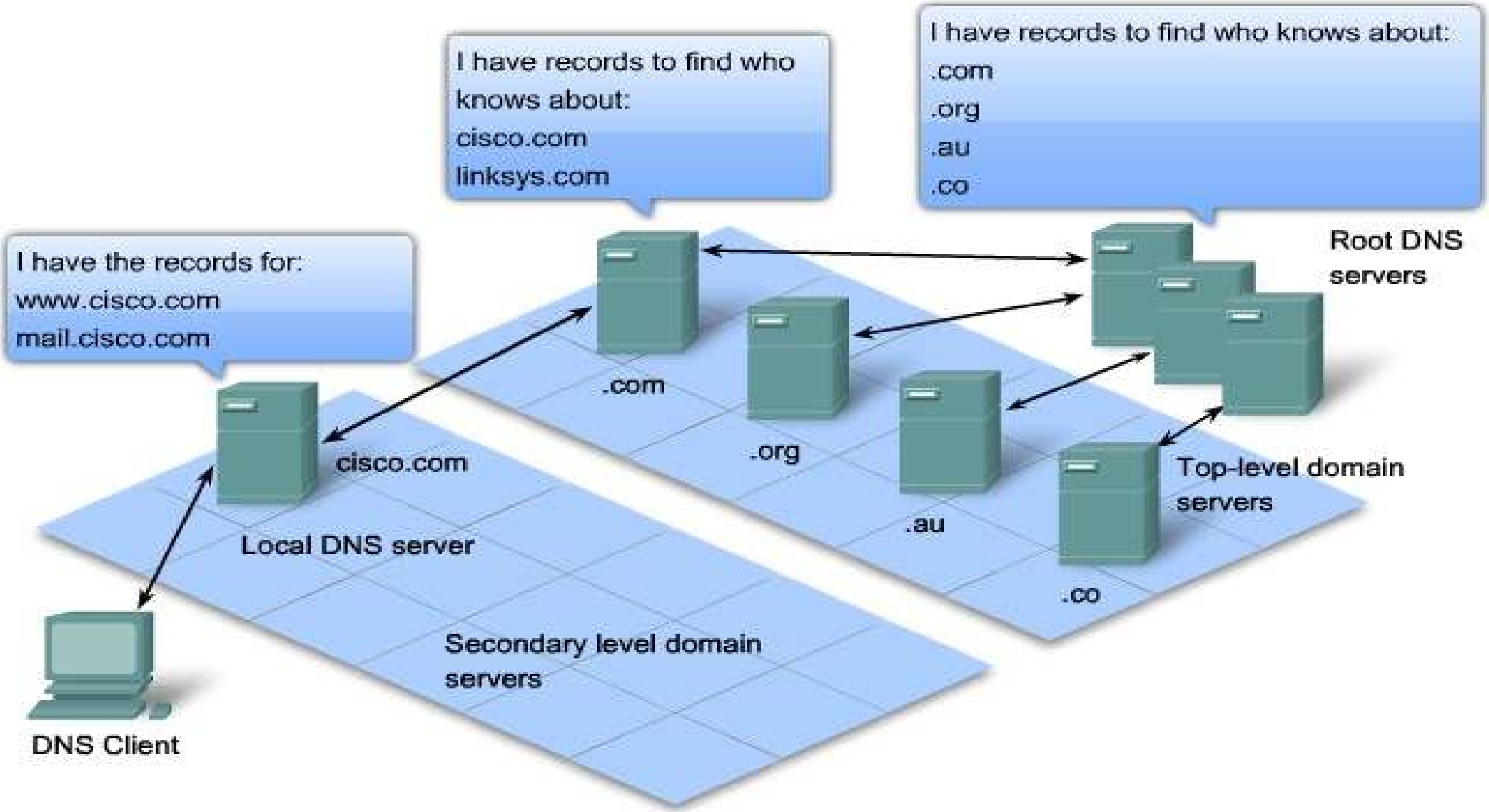


DNS Message Format

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

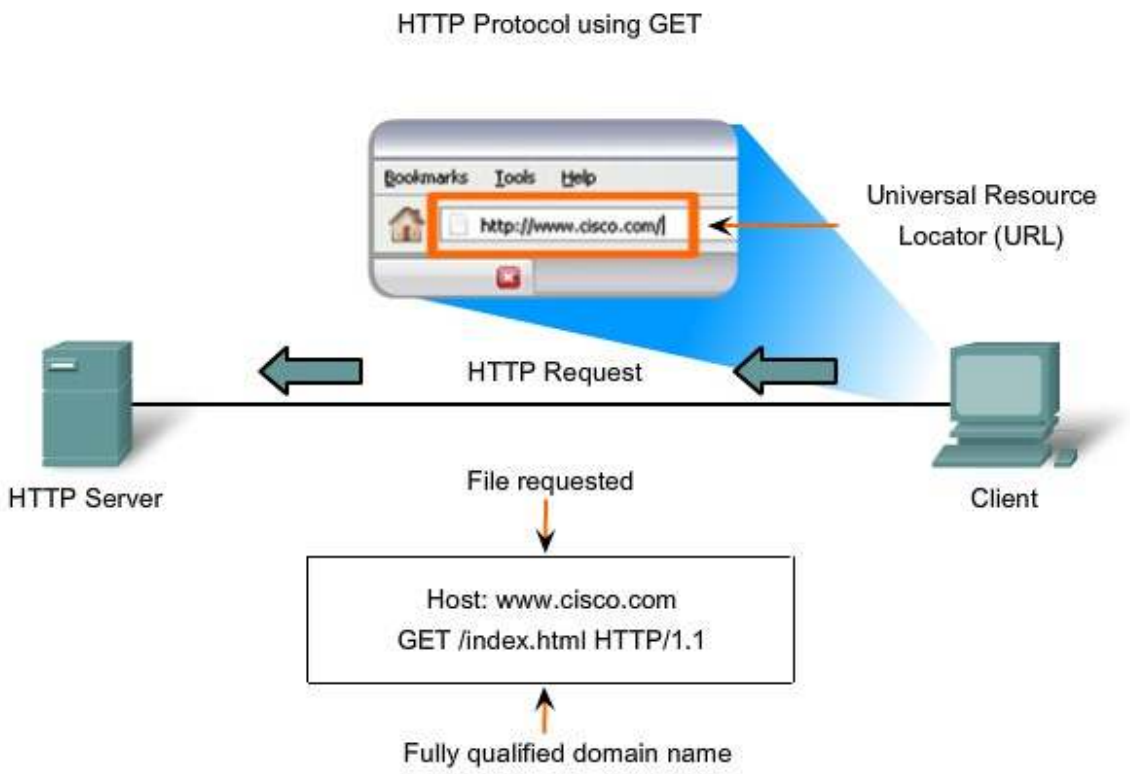
Header	
Question	The question for the name server
Answer	Resource Records answering the question
Authority	Resource Records pointing toward an authority
Additional	Resource Records holding additional information



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

www dan http

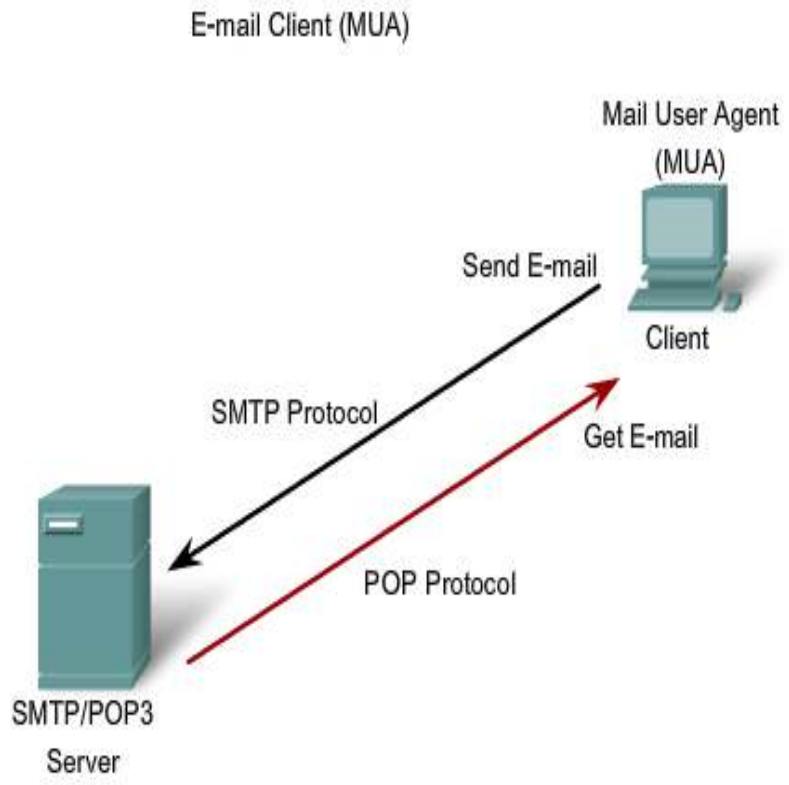
- When a web address (or URL) is typed into a web browser, the web browser establishes a connection to the web service running on the server using the HTTP protocol. URLs (or Uniform Resource Locator) and URIs (Uniform Resource Identifier) are the names most people associate with web addresses.
- The URL http://www.cisco.com/index.html is an example of a URL that refers to a specific resource - a web page named index.html on a server identified as cisco.com (click the tabs in the figure to see the steps used by HTTP).



Entering 'http://www.cisco.com' in the address bar of a web browser generates the HTTP 'GET' Message.

E-Mail Services & SMTP/POP Protocol

- E-mail, the most popular network service, has revolutionized how people communicate through its simplicity and speed. Yet to run on a computer or other end device, 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.

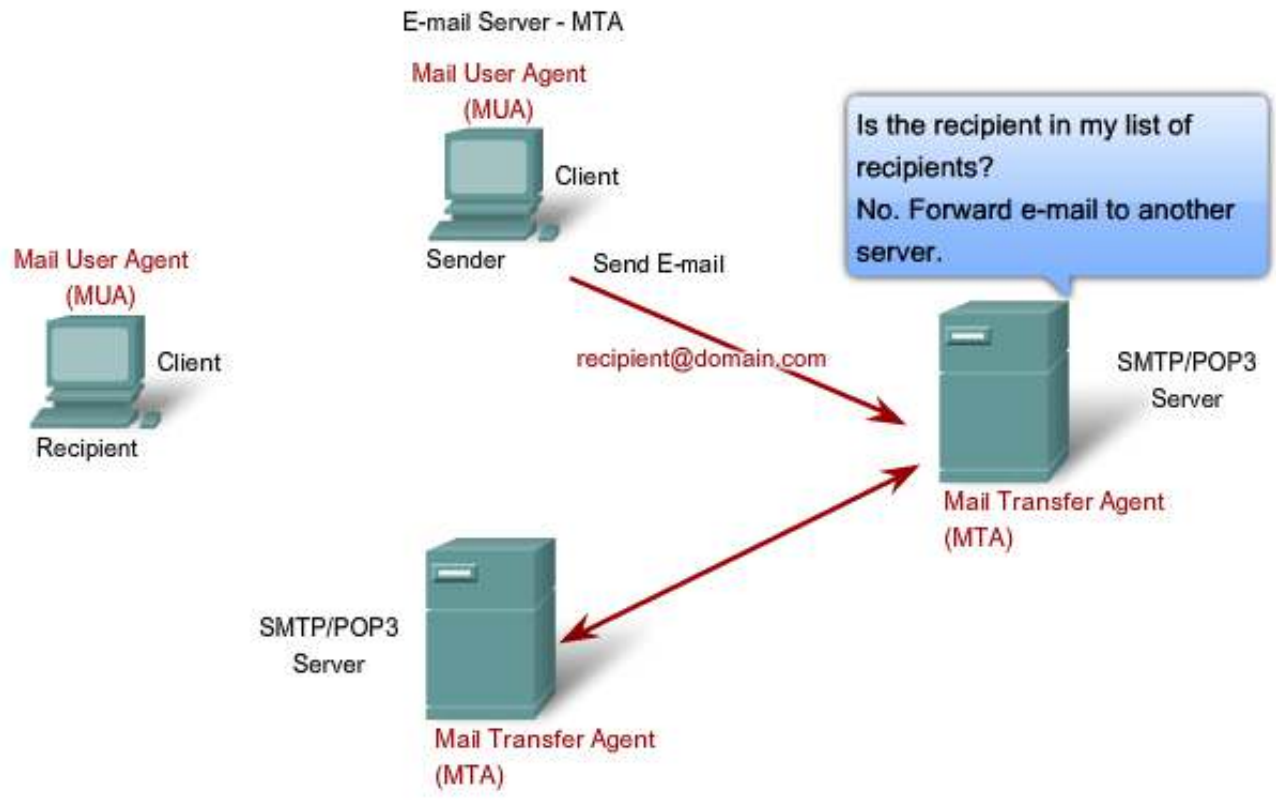


Clients send e-mails to a server using SMTP and receive e-mails using POP3.

E-Mail Services & SMTP/POP Protocol

The e-mail server operates two separate processes:

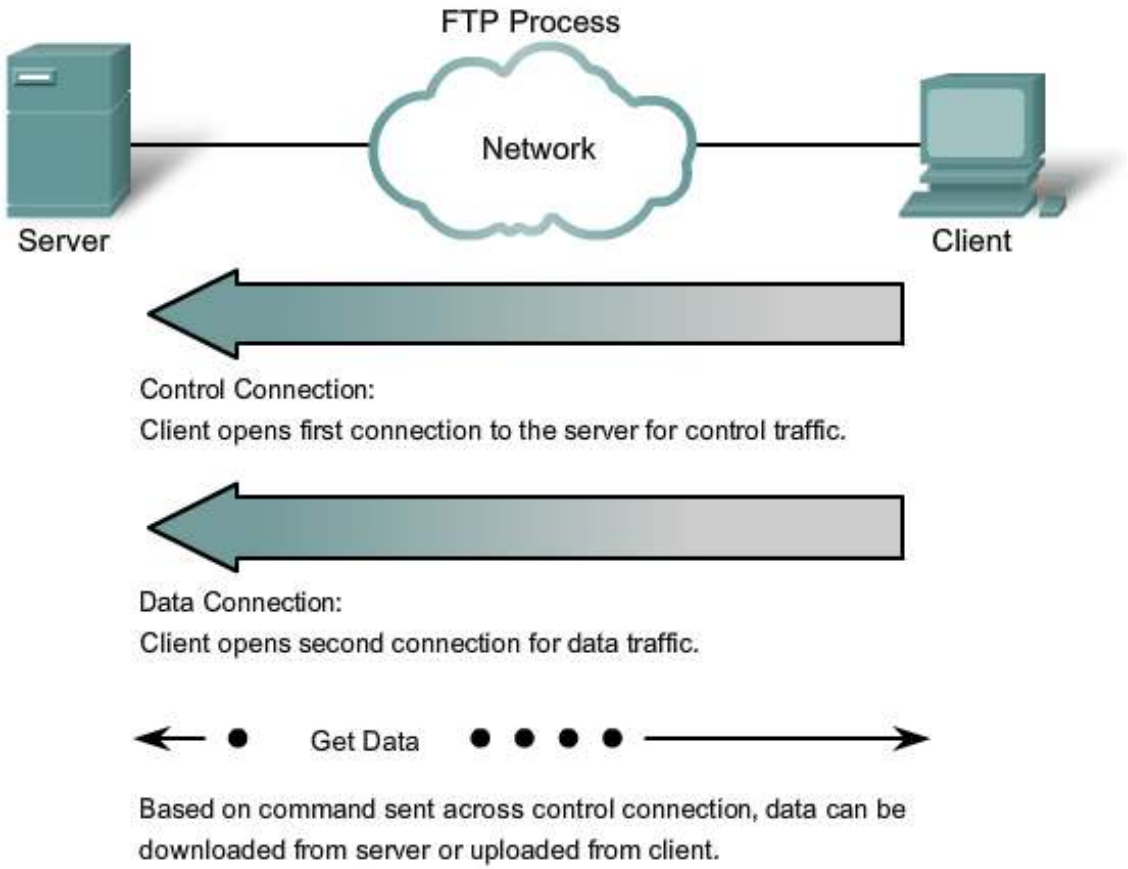
- Mail Transfer Agent (MTA)
- Mail Delivery Agent (MDA)



The Mail Transfer Agent process governs e-mail handling between servers and servers.

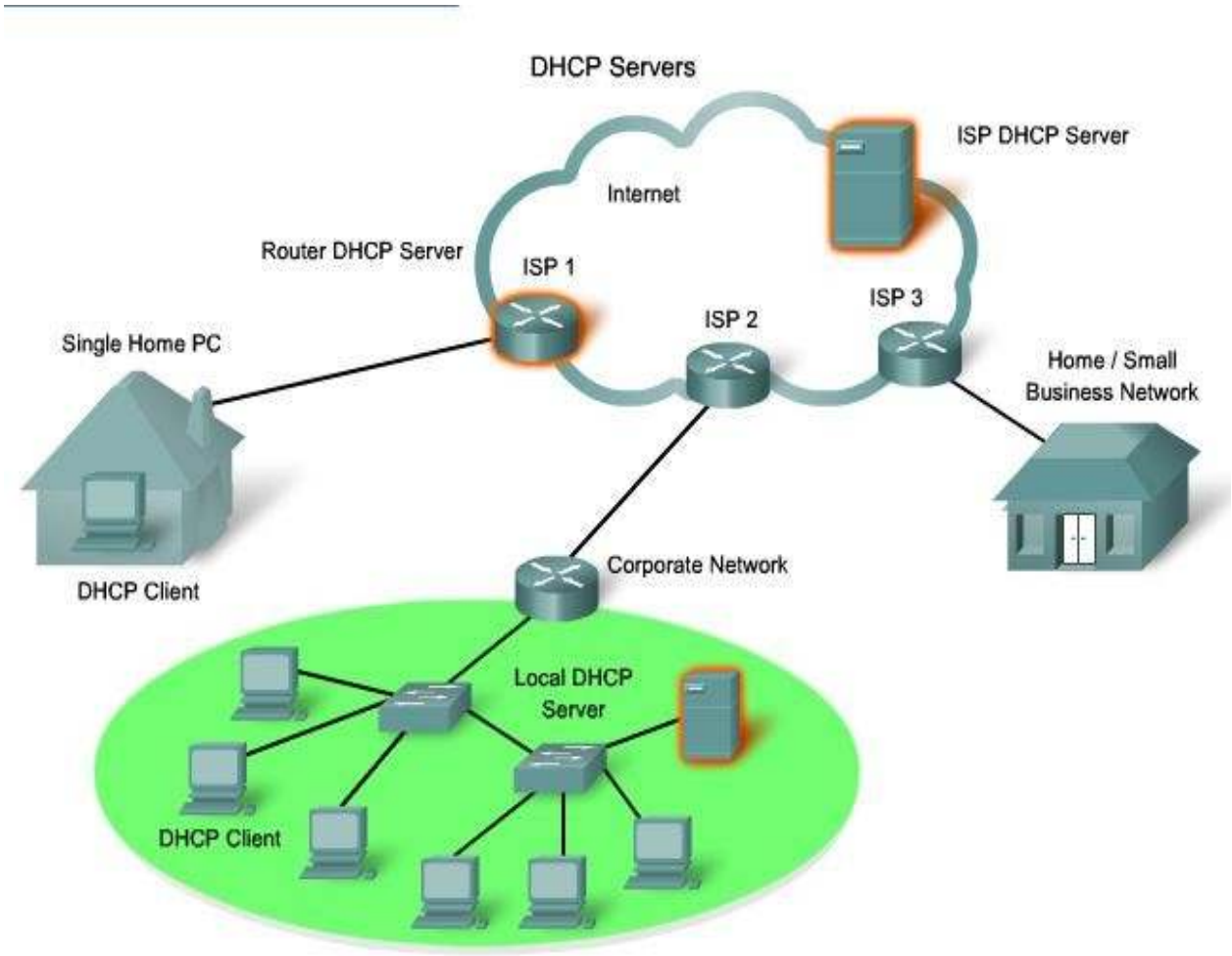
FTP

- The File Transfer Protocol (FTP) is another commonly used Application layer protocol. FTP was developed to allow for file transfers between a client and a server. An FTP client is an application that runs on a computer that is used to push and pull files from a server running the FTP daemon (FTPd).
- To successfully transfer files, FTP requires two connections between the client and the server: one for commands and replies, the other for the actual file transfer.
- The client establishes the first connection to the server on TCP port 21. This connection is used for control traffic, consisting of client commands and server replies.



DHCP

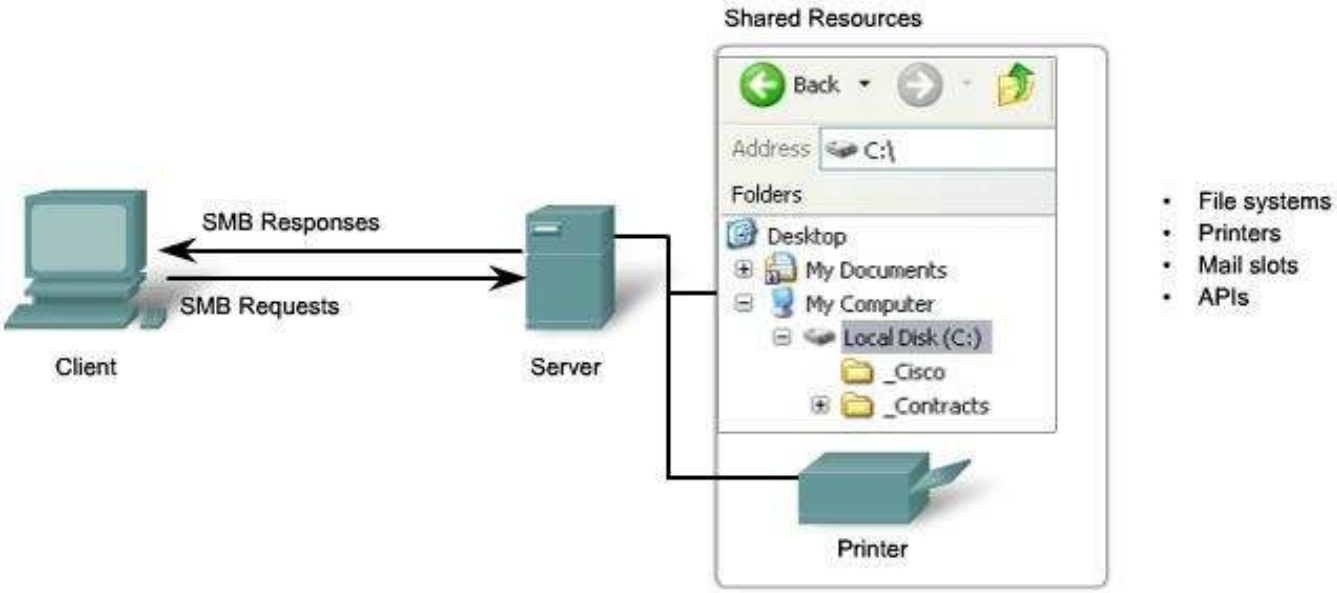
- The Dynamic Host Configuration Protocol (DHCP) service enables devices on a network to obtain IP addresses and other information from a DHCP server. This service automates the assignment of IP addresses, subnet masks, gateway and other IP networking parameters.
- DHCP allows a host to obtain an IP address dynamically when it connects to the network. The DHCP server is contacted and an address requested. The DHCP server chooses an address from a configured range of addresses called a pool and assigns ("leases") it to the host for a set period.



File Sharing Services and SMB Protocol

- The Server Message Block (SMB) is a client/server file sharing protocol. IBM developed Server Message Block (SMB) in the late 1980s to describe the structure of shared network resources, such as directories, files, printers, and serial ports. It is a request-response protocol.
- Unlike the file sharing supported by FTP, clients establish a long term connection to servers. Once the connection is established, the user of the client can access the resources on the server as if the resource is local to the client host.

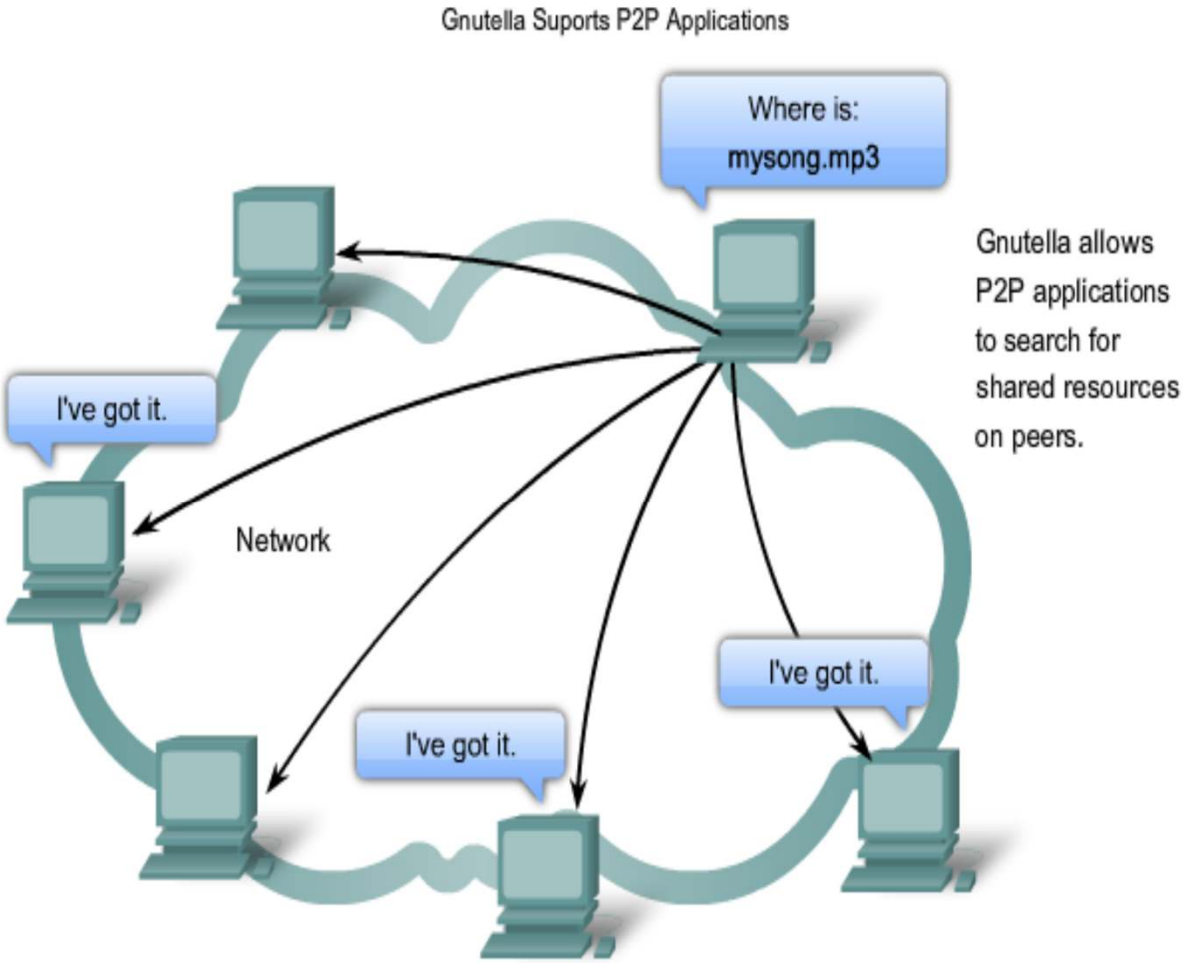
File Sharing Using the SMB Protocol



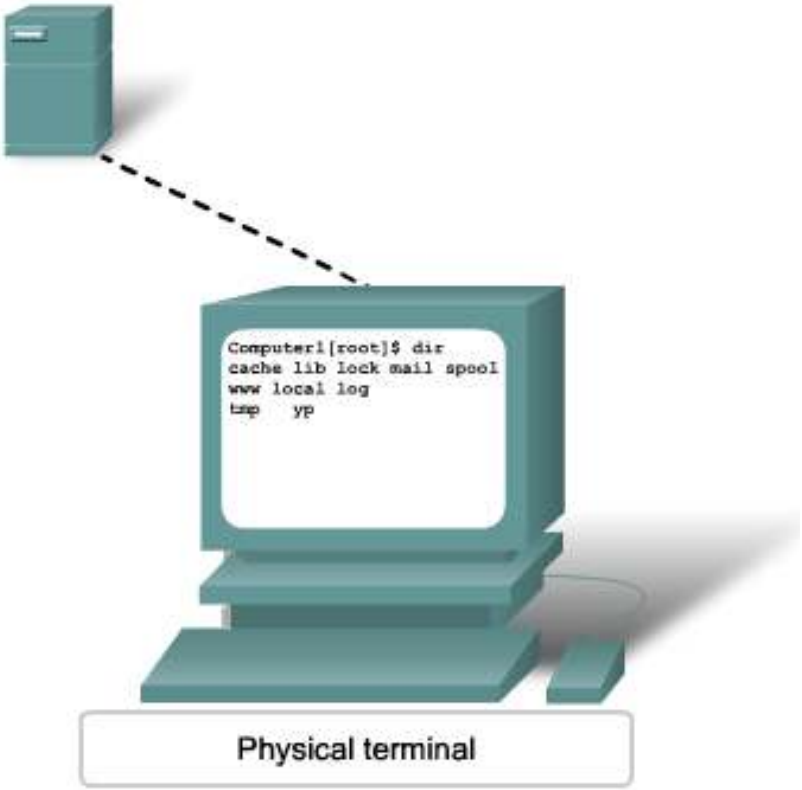
SMB is a client-server, request-response protocol. Servers can make their resources available to clients on the network.

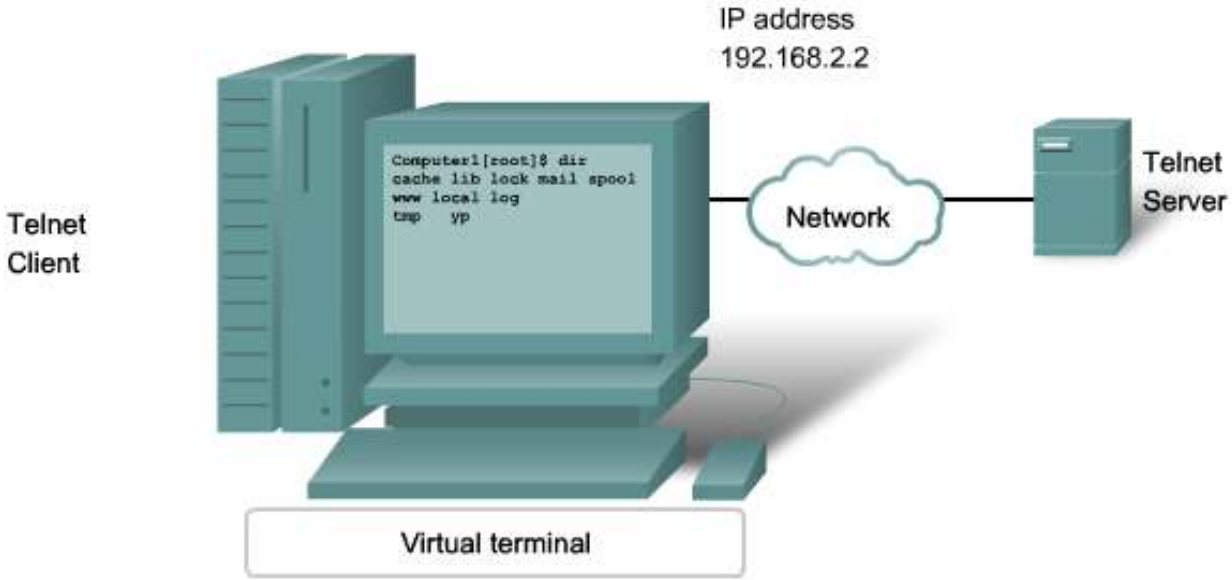
P2P Services and Gnutella Protocol

- Many P2P applications do not use a central database to record all the files available on the peers.
- Instead, the devices on the network each tell the other what files are available when queried and use the Gnutella protocol and services to support locating resources. See the figure.



Telnet





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.

Begin

Telnet

Click to see Telnet.

Begin

Click to Reset.

Telnet

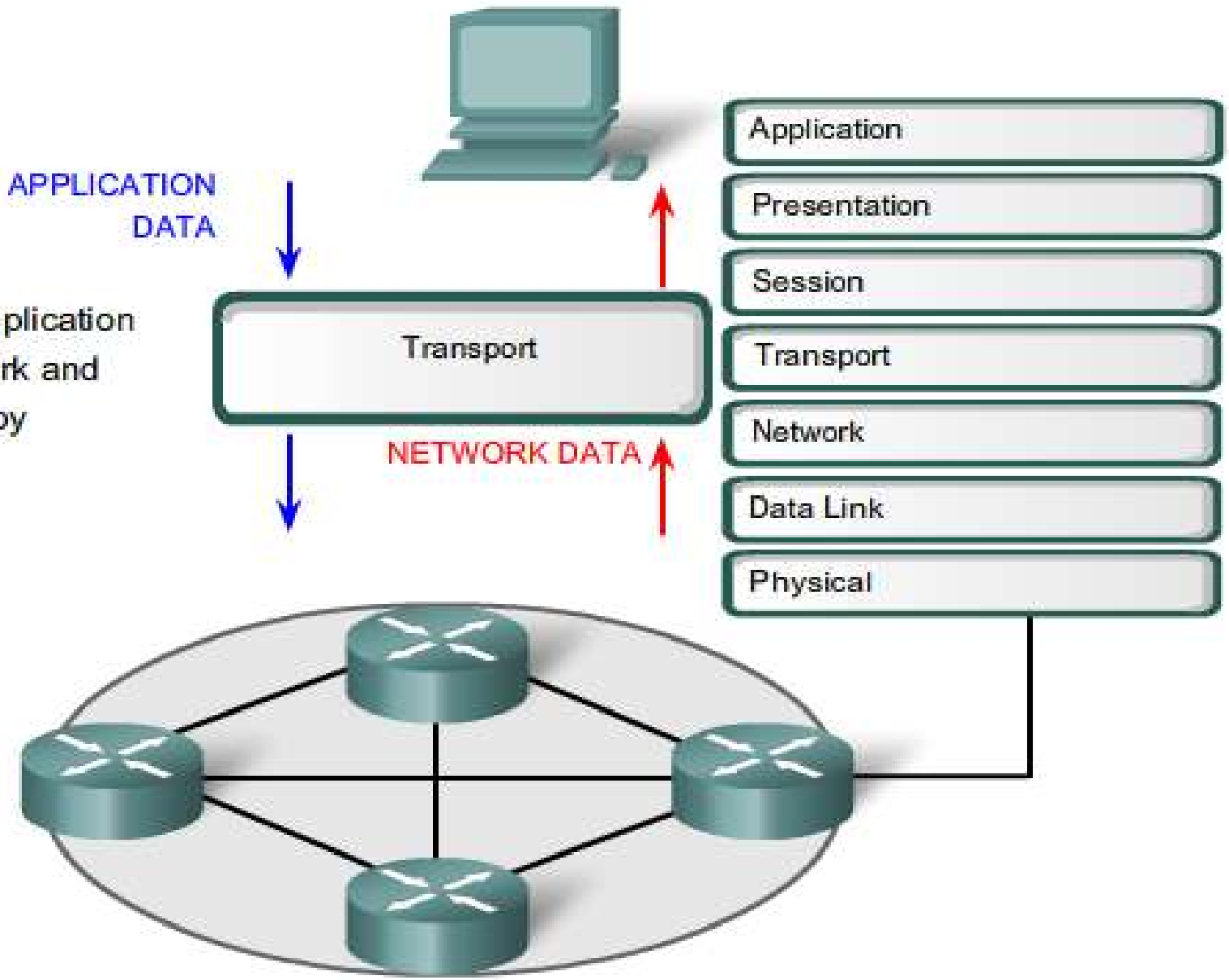
OSI Transport Layer

Pendahuluan

- Data networks and the Internet support the human network by supplying seamless, reliable communication between people - both locally and around the globe. On a single device, people can use multiple services such as e-mail, the web, and instant messaging to send messages or retrieve information. Applications such as e-mail clients, web browsers, and instant messaging clients allow people to use computers and networks to send messages and find information.
- Data from each of these applications is packaged, transported, and delivered to the appropriate server daemon or application on the destination device. The processes described in the OSI Transport layer accept data from the Application layer and prepare it for addressing at the Network layer. The Transport layer is responsible for the overall end-to-end transfer of application data.

The OSI Transport Layer

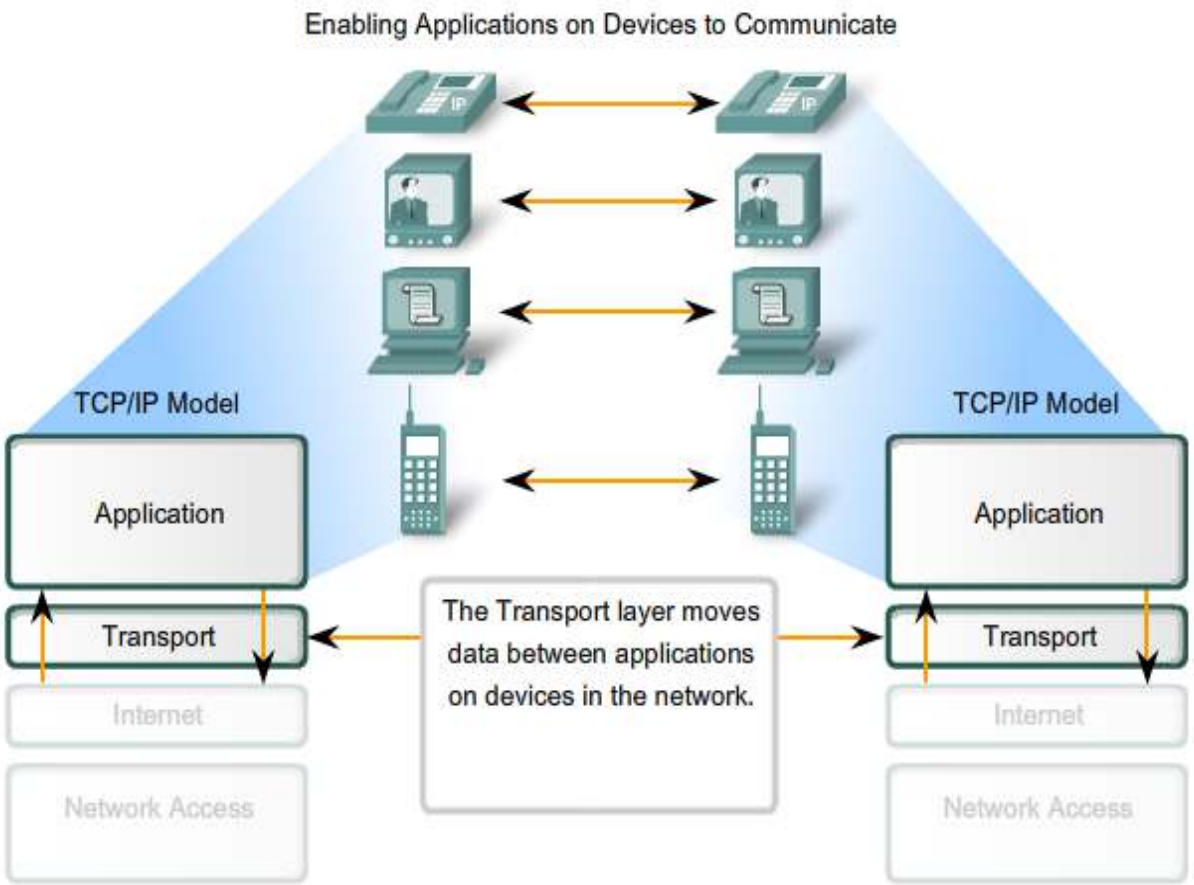
The Transport layer prepares application data for transport over the network and processes network data for use by applications.



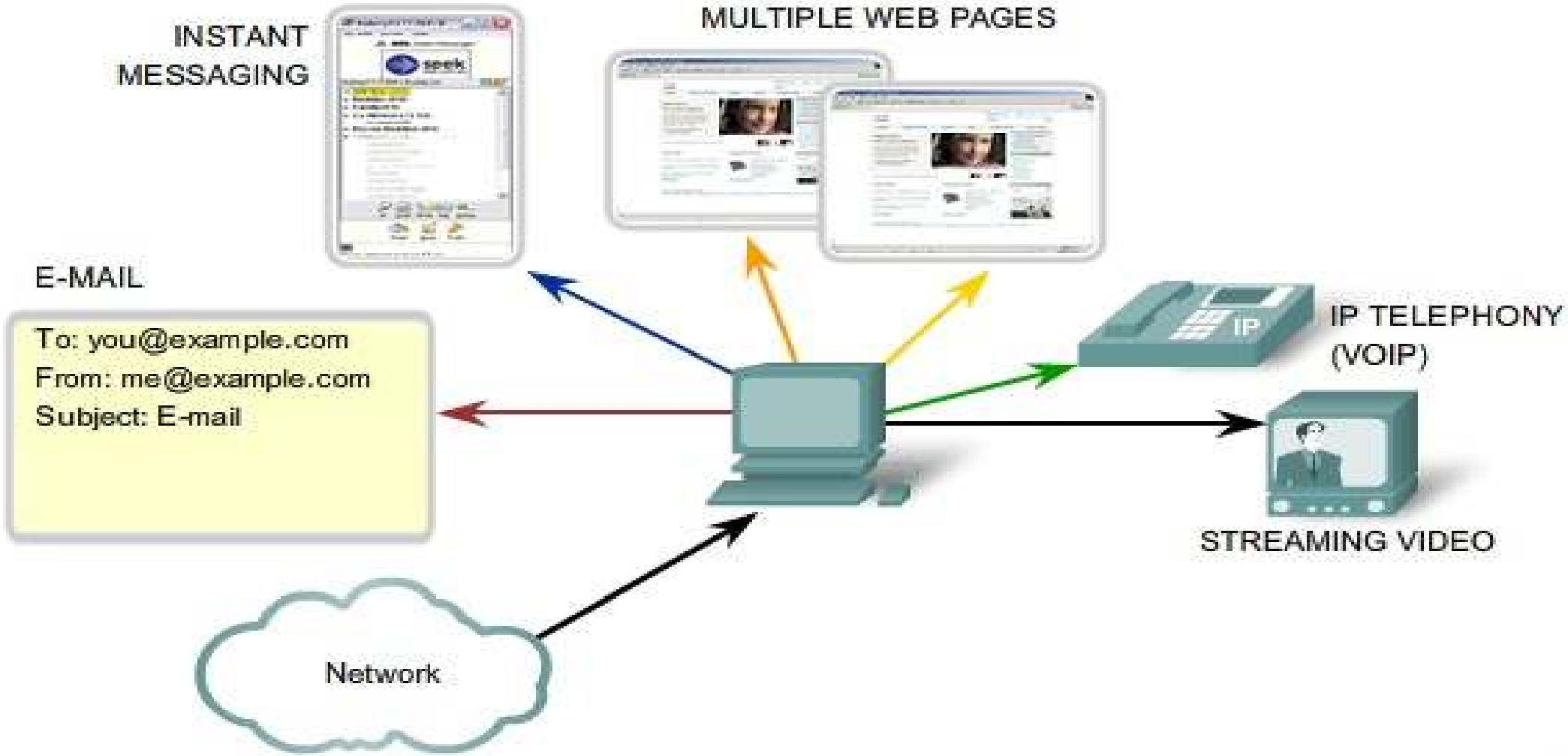
Purpose Of Transport Layer

The Transport layer provides for the segmentation of data and the control necessary to reassemble these pieces into the various communication streams. Its primary responsibilities to accomplish this are:

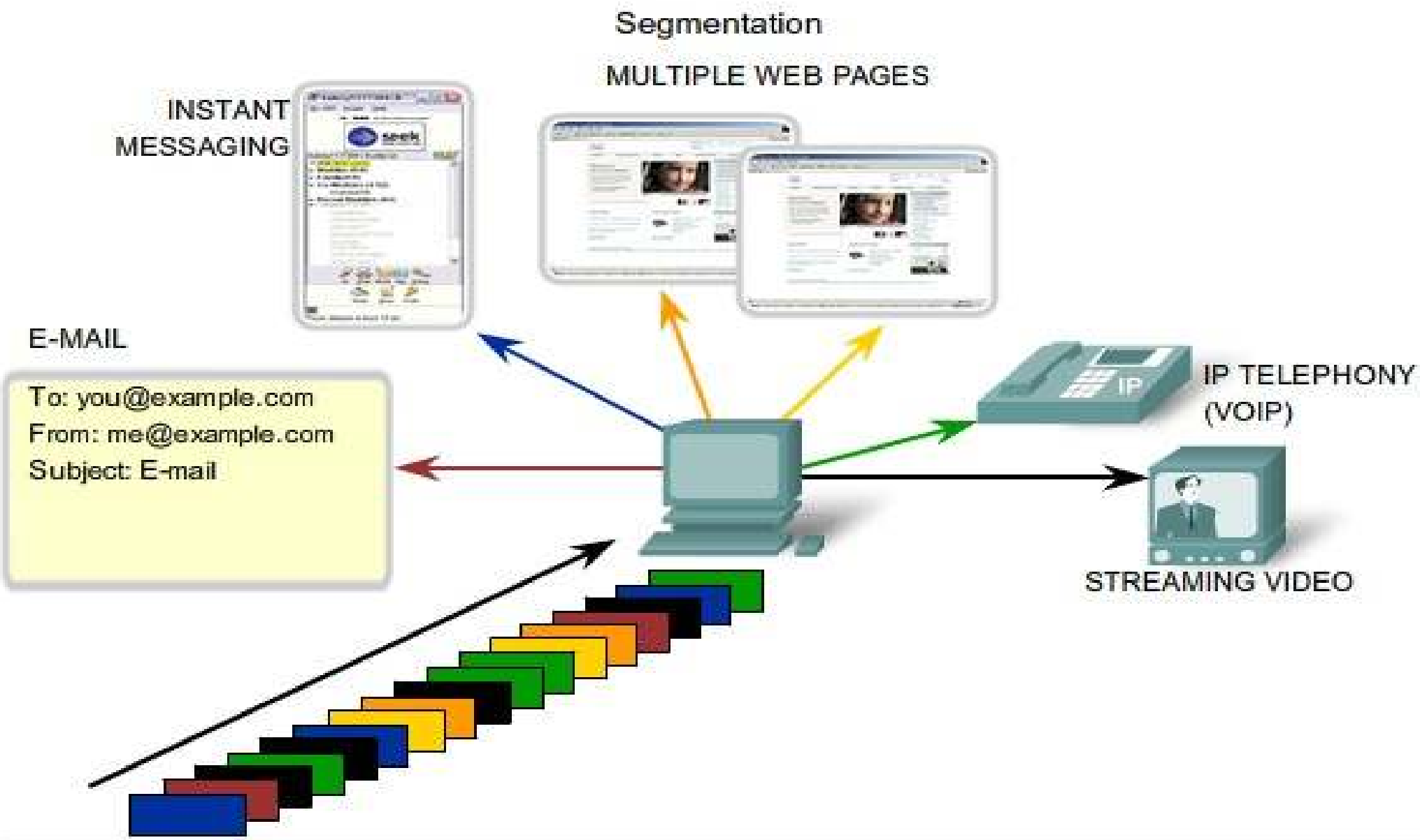
- Tracking the individual communication between applications on the source and destination hosts
- Segmenting data and managing each piece
- Reassembling the segments into streams of application data
- Identifying the different applications



Tracking the Conversations

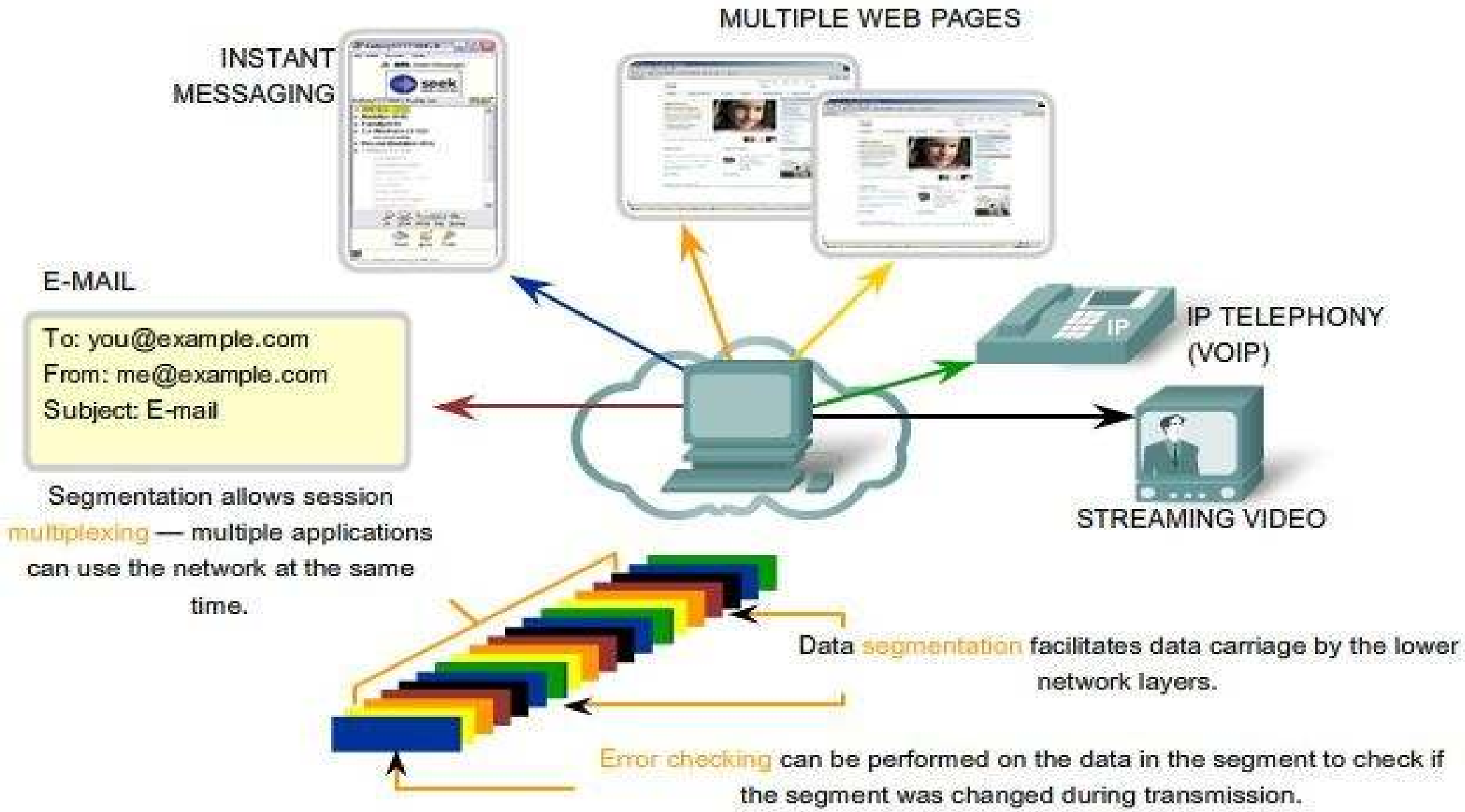


The Transport layer segments the data and manages the separation of data for different applications. Multiple applications running on a device receive the correct data.

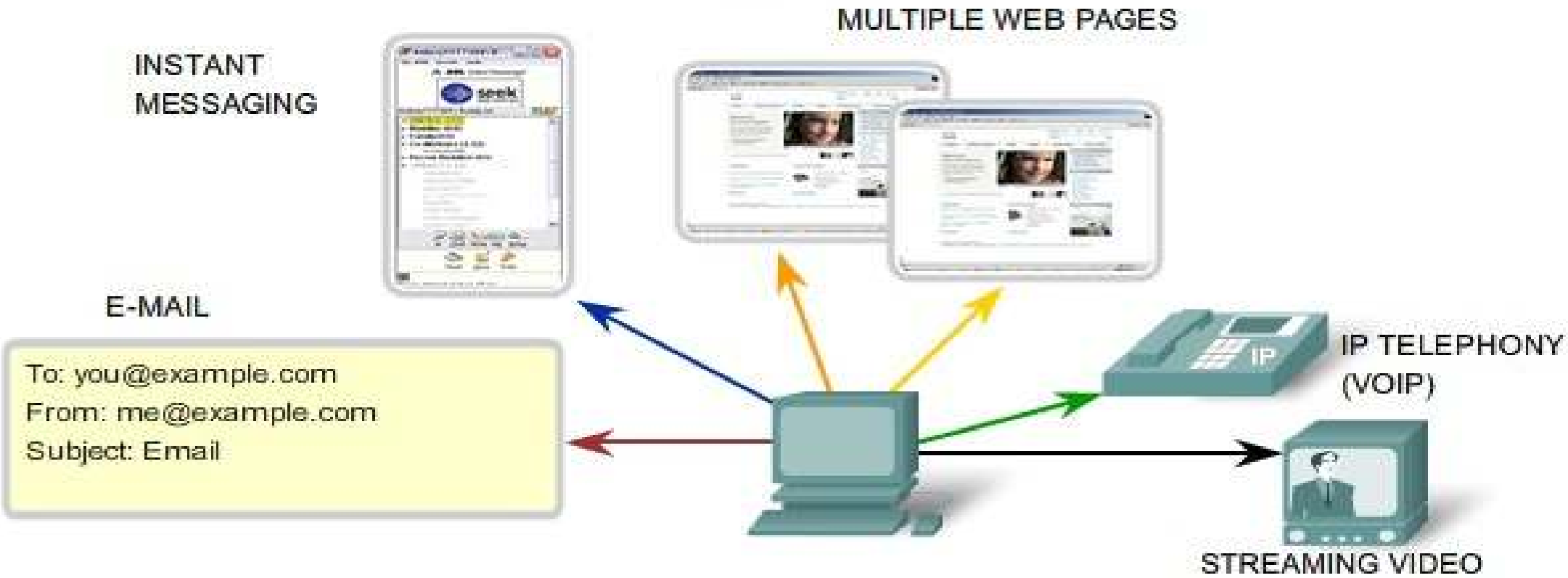


The Transport layer divides the data into segments that are easier to manage and transport.

Transport Layer Services



Transport Layer Services



Establishing a Session ensures the application is ready to receive the data.

Reliable delivery means lost segments are resent so the data is received complete.

Same order delivery ensures that the segments are reassembled into the proper order.

Flow Control manages data delivery if there is congestion on the host.

Transport Layer Protocols

- IP Telephony
- Streaming Video

- SMTP/POP (Email)
- HTTP

Required Protocol Properties

- Fast
- Low overhead
- Does not require acknowledgements
- Does not resend lost data
- Delivers data as it arrives

OSI Model	TCP/IP Model
Application	Application
Presentation	
Session	
Transport	Transport
Network	Internet
Data Link	Network Access
Physical	

Required Protocol Properties

- Reliable
- Acknowledge data
- Resend lost data
- Delivers data in order sent

Application developers choose the appropriate Transport Layer protocol based on the nature of the application.

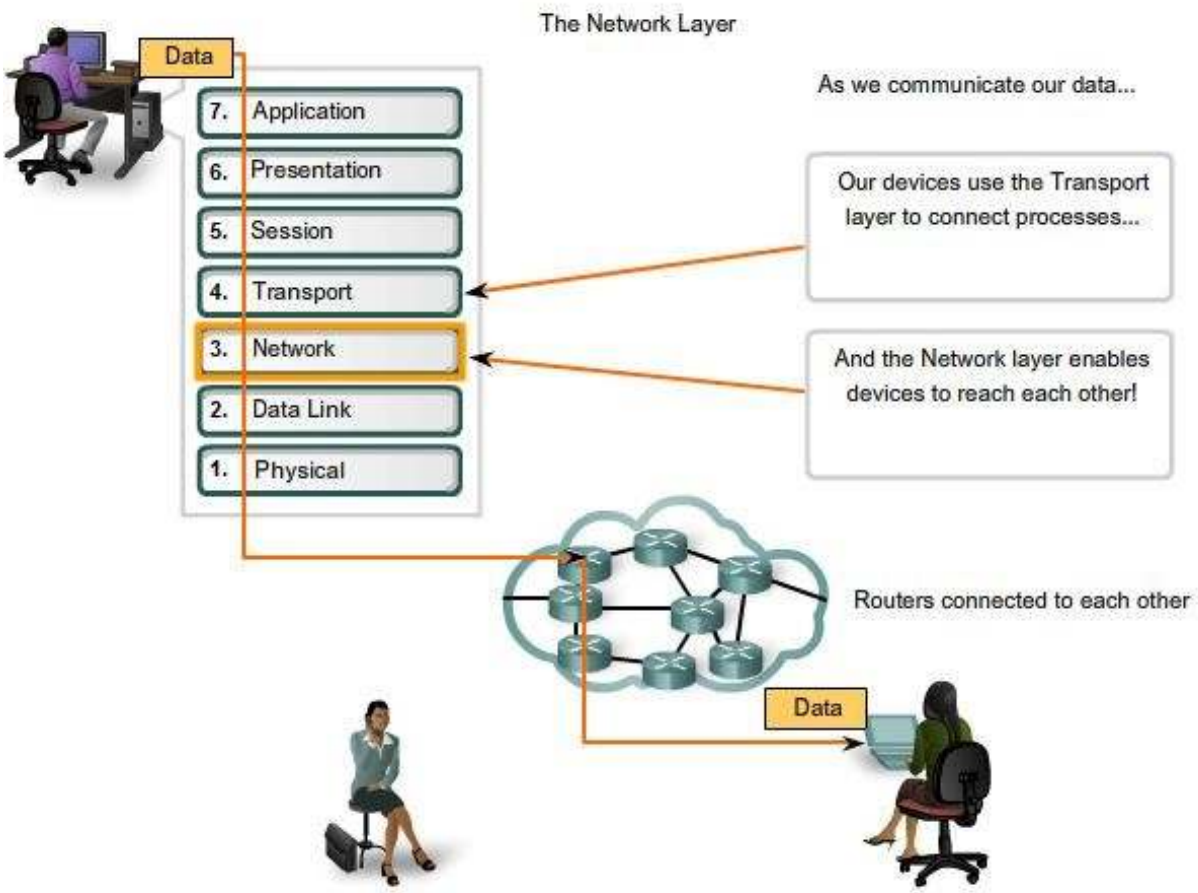
More..OSI Transport Layer

- TCP dan UDP
  - TCP ☞ Web Browser, Email & File Transfer
  - UDP ☞ DNS, Telephone, Video Streaming & VoIP
- Port Adressing &
- Segmentation and Reassembly (Devide Concueror)

OSI Network Layer

Pendahuluan

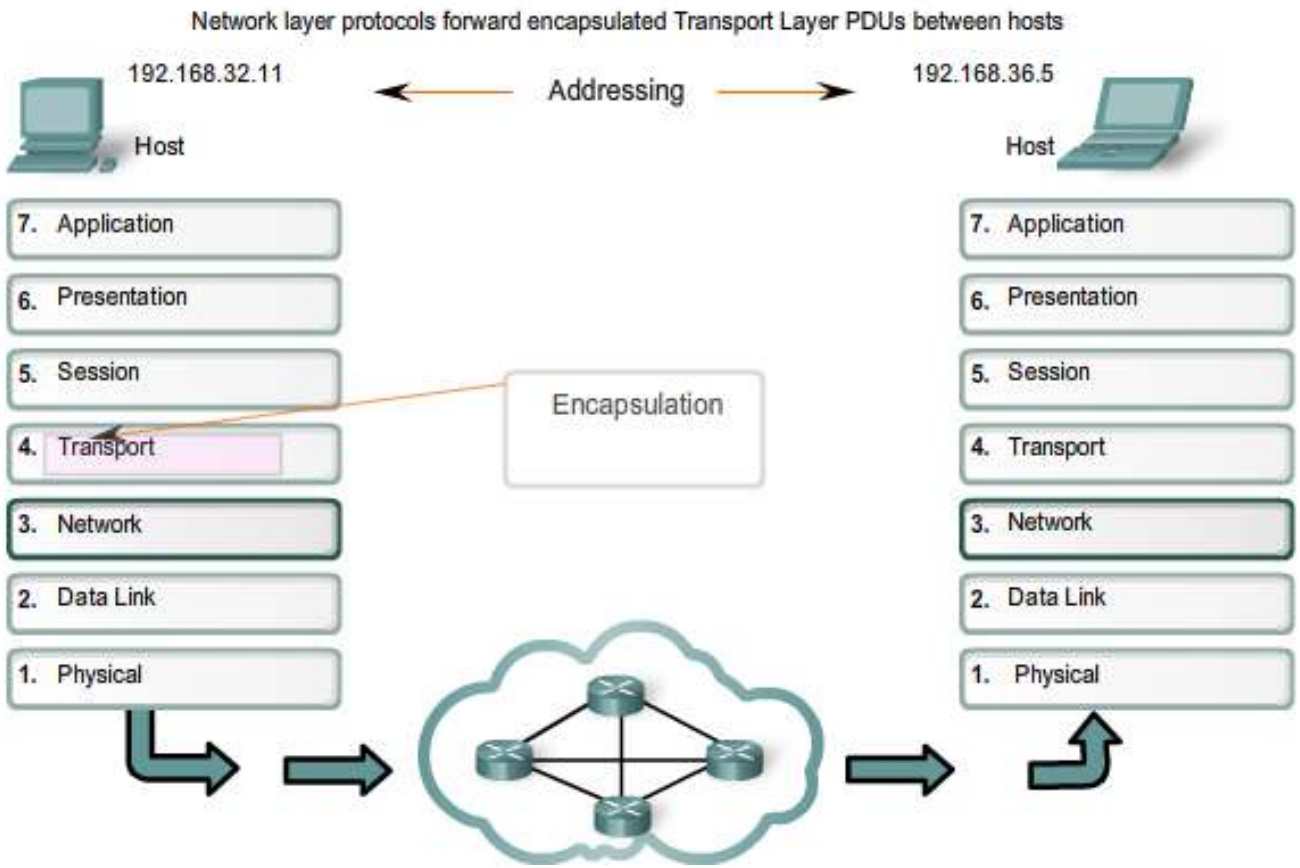
- The protocols of the OSI model Network layer specify addressing and processes that enable Transport layer data to be packaged and transported.
- The Network layer encapsulation allows its contents to be passed to the destination within a network or on another network with minimum overhead.



Communication From Host to Host

The Network layer, or OSI Layer 3, provides services to exchange the individual pieces of data over the network between identified end devices. To accomplish this end-to-end transport, Layer 3 uses four basic processes:

- Addressing
- Encapsulation
- Routing
- Decapsulation



Addressing

- First, the Network layer must provide a mechanism for addressing these end devices. If individual pieces of data are to be directed to an end device, that device must have a unique address.
- In an IPv4 network, when this address is added to a device, the device is then referred to as a host.

Encapsulation

- The Network layer must provide encapsulation. Not only must the devices be identified with an address, the individual pieces - the Network layer PDUs - must also contain these addresses. During the encapsulation process, Layer 3 receives the Layer 4 PDU and adds a Layer 3 header, or label, to create the Layer 3 PDU. When referring to the Network layer, we call this PDU a packet. When a packet is created, the header must contain, among other information, the address of the host to which it is being sent. This address is referred to as the destination address. The Layer 3 header also contains the address of the originating host. This address is called the source address.
- After the Network layer completes its encapsulation process, the packet is sent down to the Data Link layer to be prepared for transportation over the media.

Routing

- Next, the Network layer must provide services to direct these packets to their destination host. The source and destination hosts are not always connected to the same network. In fact, the packet might have to travel through many different networks. Along the way, each packet must be guided through the network to reach its final destination. Intermediary devices that connect the networks are called routers.
- The role of the router is to select paths for and direct packets toward their destination. This process is known as routing.

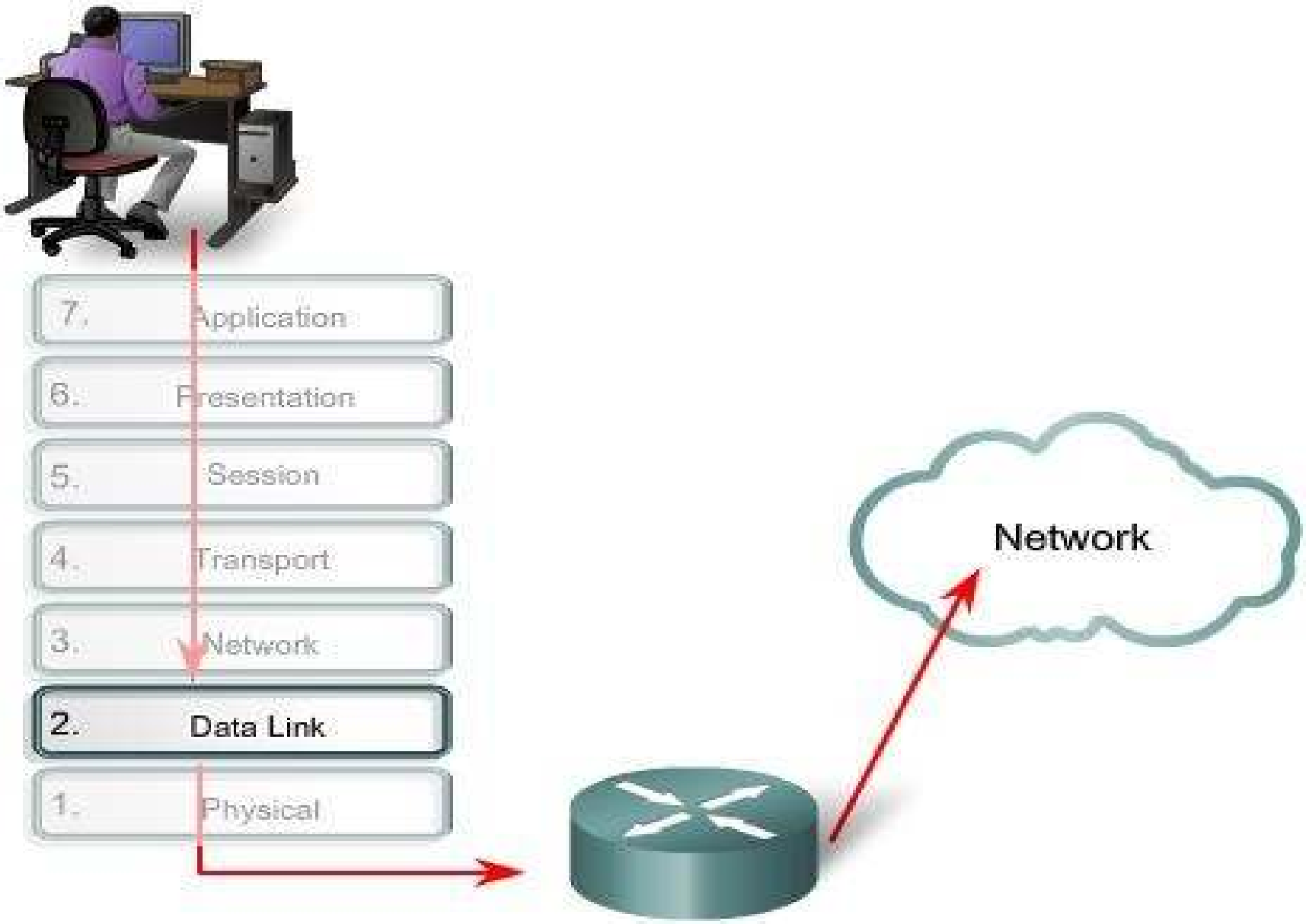
Decapsulation

- Finally, the packet arrives at the destination host and is processed at Layer 3.
- The host examines the destination address to verify that the packet was addressed to this device.
- If the address is correct, the packet is decapsulated by the Network layer and the Layer 4 PDU contained in the packet is passed up to the appropriate service at Transport layer.

Data Link Layer

Pendahuluan

- To support our communication, the OSI model divides the functions of a data network into layers.
- To recap:
  - The Application layer provides the interface to the user.
  - The Transport layer is responsible for dividing and managing communications between the processes running in the two end systems.
  - The Network layer protocols organize our communication data so that it can travel across internetworks from the originating host to a destination host.



The Data Link layer prepares network data for the physical network.

Puprpose of Data Link Layer

- The Data Link layer provides a means for exchanging data over a common local media.
- The Data Link layer performs two basic services:
  - Allows the upper layers to access the media using techniques such as framing
  - Controls how data is placed onto the media and is received from the media using techniques such as media access control and error detection

Data Link Layer Terms

- Application
- Presentation
- Session
- Transport
- Network
- **Data Link**
- Physical

Frame

PDU

A PDU at the Data Link layer is called a frame.

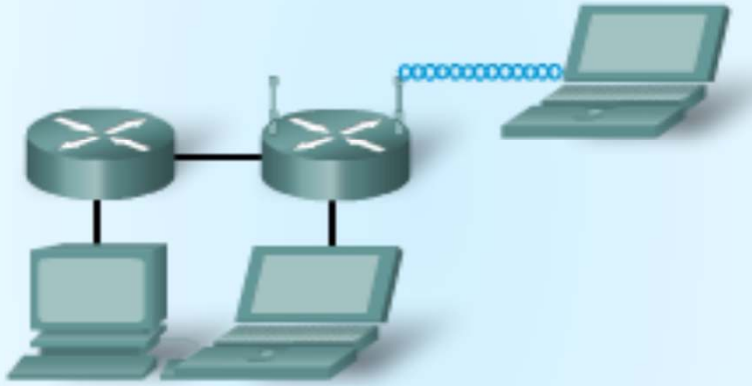
Node

A node is a device on a network.

Media

The media are the physical means used to carry data signals.

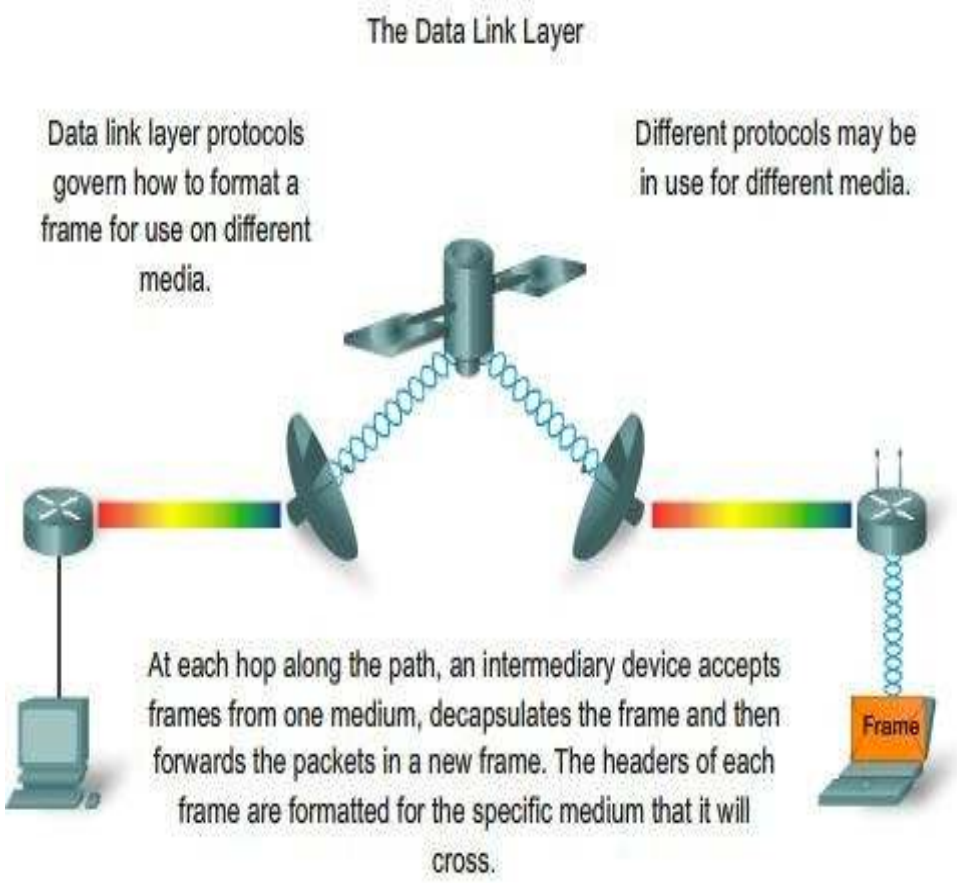
Network



A network is two or more devices connected to a common medium.

Supporting & Connecting to Upper Layer

- As we have discussed, a network model allows each layer to function with minimal concern for the roles of the other layers. The Data Link layer relieves the upper layers from the responsibility of putting data on the network and receiving data from the network. This layer provides services to support the communication processes for each medium over which data is to be transmitted.
- In any given exchange of Network layer packets, there may be numerous Data Link layer and media transitions. At each hop along the path, an intermediary device - usually a router - accepts frames from a medium, decapsulates the frame, and then forwards the packet in a new frame appropriate to the medium of that segment of the physical network.



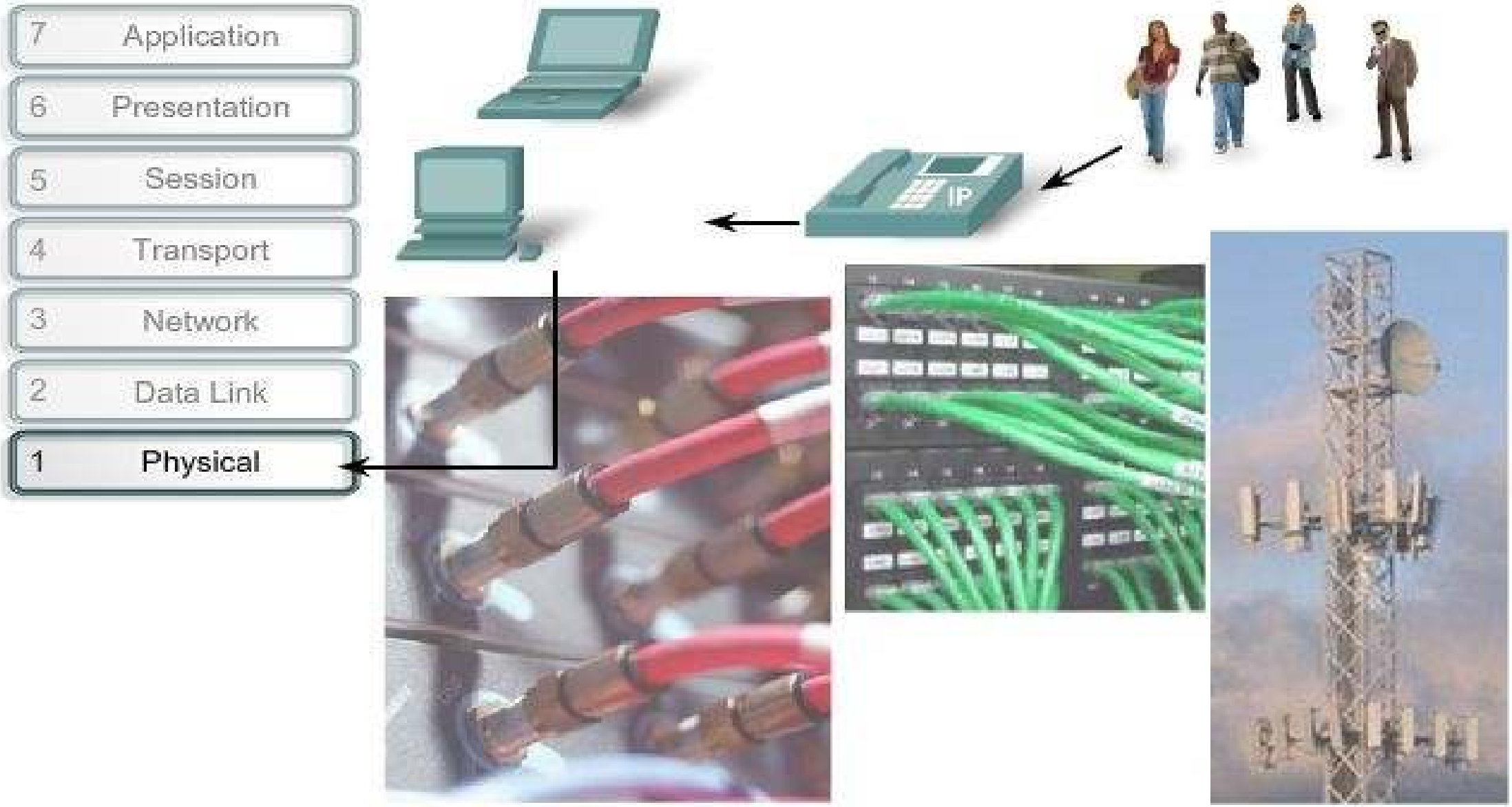
More..Data Link Layer

- Media Acces Control Technique
  - Placing Data on Media
  - MAC for Share Media
  - MAC for Non-Share Media
  - Topology
- MAC Adressing and Framing Data
  - The Frame
  - Framing-Role of Header
  - Adressing
  - Framing-Role of Trailer

OSI Physical Layer

Overview

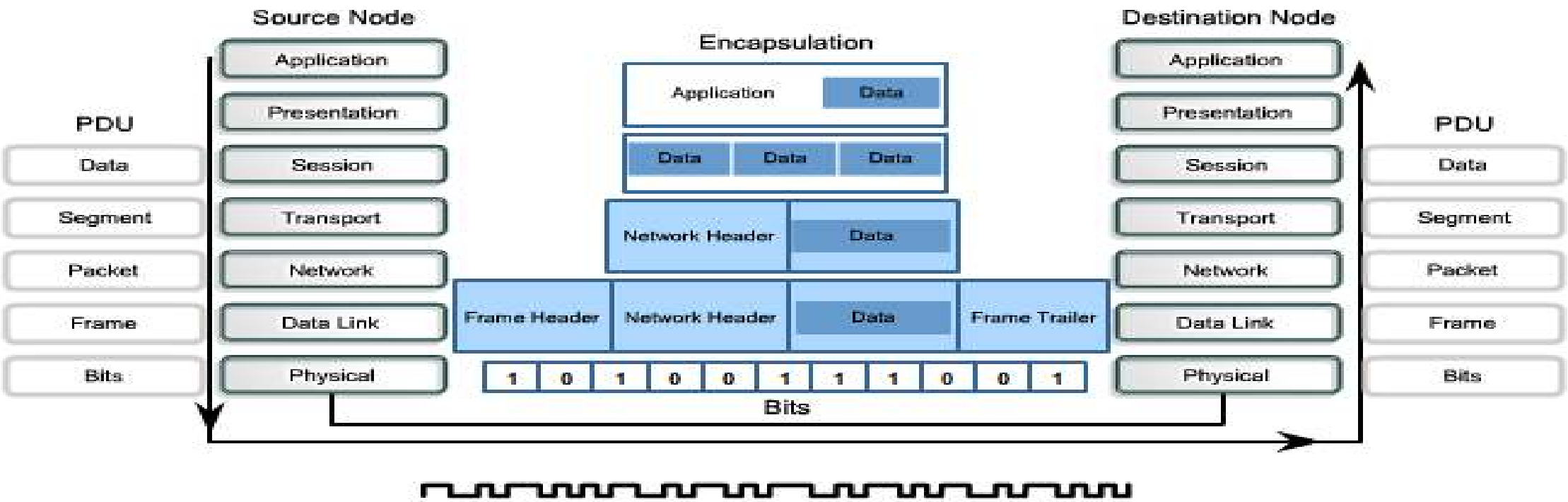
- Upper OSI layer protocols prepare data from the human network for transmission to its destination. The Physical layer controls how data is transmitted on the communication media.
- The role of the OSI Physical layer is to encode the binary digits that represent Data Link layer frames into signals and to transmit and receive these signals across the physical media - copper wires, optical fiber, and wireless - that connect network devices.



The Physical layer interconnects our data networks.

Physical Layer Purpose

Transforming Human Network Communications to Bits



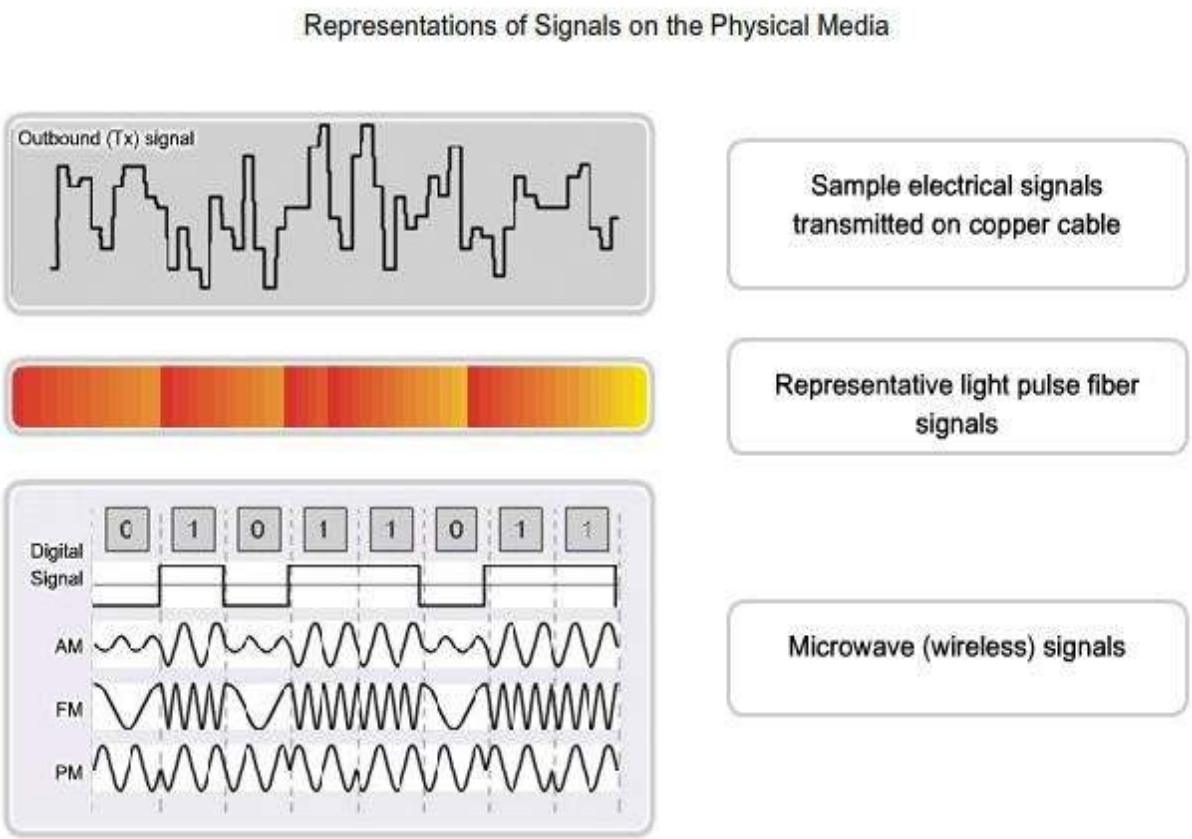
In diagrams, signals on the physical media are depicted by this line symbol.

Physical Layer Purpose

- The OSI Physical layer provides the means to transport across the network media the bits that make up a Data Link layer frame. This layer accepts a complete frame from the Data Link layer and encodes it as a series of signals that are transmitted onto the local media. The encoded bits that comprise a frame are received by either an end device or an intermediate device.
- The delivery of frames across the local media requires the following Physical layer elements:
  - The physical media and associated connectors
  - A representation of bits on the media
  - Encoding of data and control information
  - Transmitter and receiver circuitry on the network devices

Operation

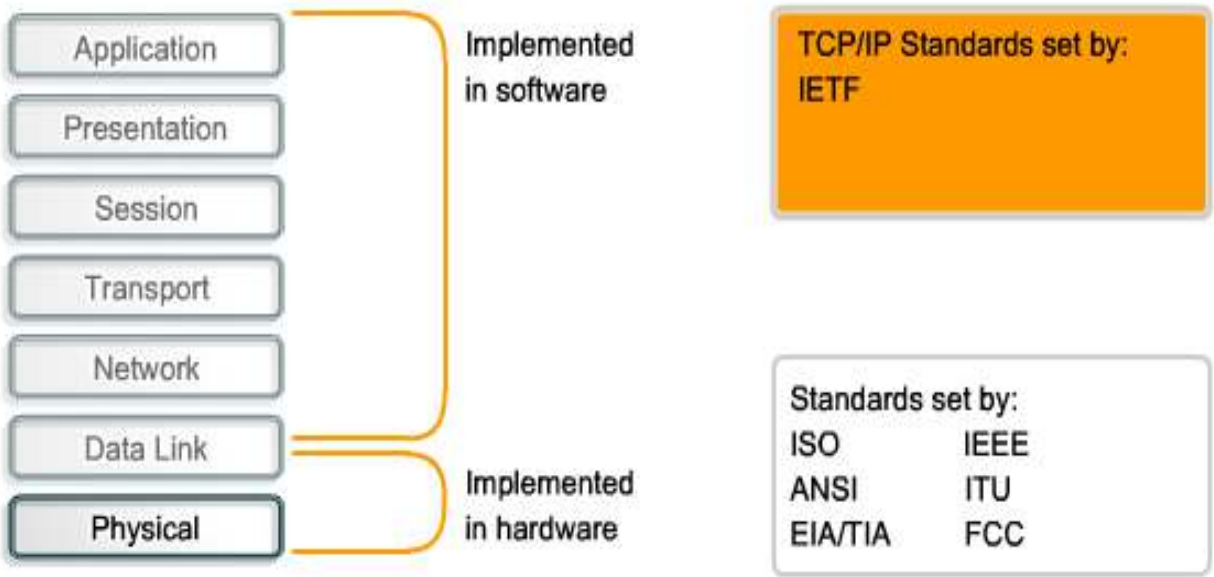
- The media does not carry the frame as a single entity. The media carries signals, one at a time, to represent the bits that make up the frame.
- There are three basic forms of network media on which data is represented:
  - Copper cable
  - Fiber
  - Wireless



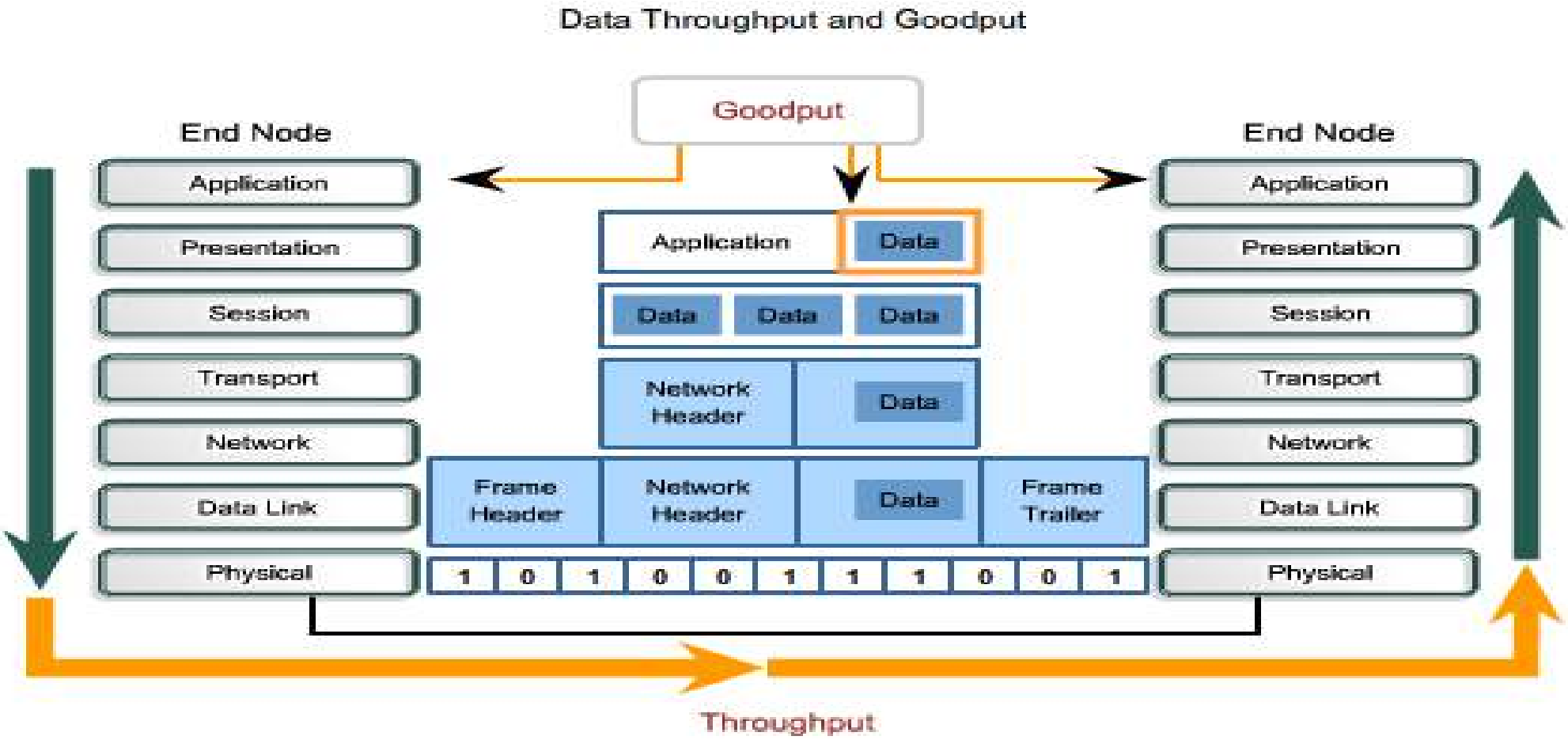
Standard

- Similar to technologies associated with the Data Link layer, the Physical layer technologies are defined by organizations such as:
  - The International Organization for Standardization (ISO)
  - The Institute of Electrical and Electronics Engineers (IEEE)
  - The American National Standards Institute (ANSI)
  - The International Telecommunication Union (ITU)

Comparison of Physical Layer Standards and Upper Layer Standards



Data Carrying Capacity



Data throughput is actual network performance. Goodput is a measure of the transfer of usable data after protocol overhead traffic has been removed.

More..OSI Physical Layer

- Communication Signal
- Signaling & Encoding
- Representing Bits
- Signaling Bits for Media
- Grouping Bits
- Data Carrying Capacity
- Physical Media

Tugas

Bahas kembali secara detail setiap masing-masing Layer secara general, kemudian bahas secara detail 1 subtopik dari tugas setiap layer tersebut;

1. Application Layer
2. Presentation Layer
3. Session Layer
4. OSI Transport Layer
5. OSI Network Layer
6. Data Link Layer
7. OSI Physical Layer

Any Question...??

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