

A man in a white shirt and red tie is standing on a green hill, holding a large red cable that arches over a landscape. The background is a textured, yellowish-brown wall. The title "Internetworking Concepts Overview" is written in large white letters across the middle of the image.

Internetworking Concepts Overview



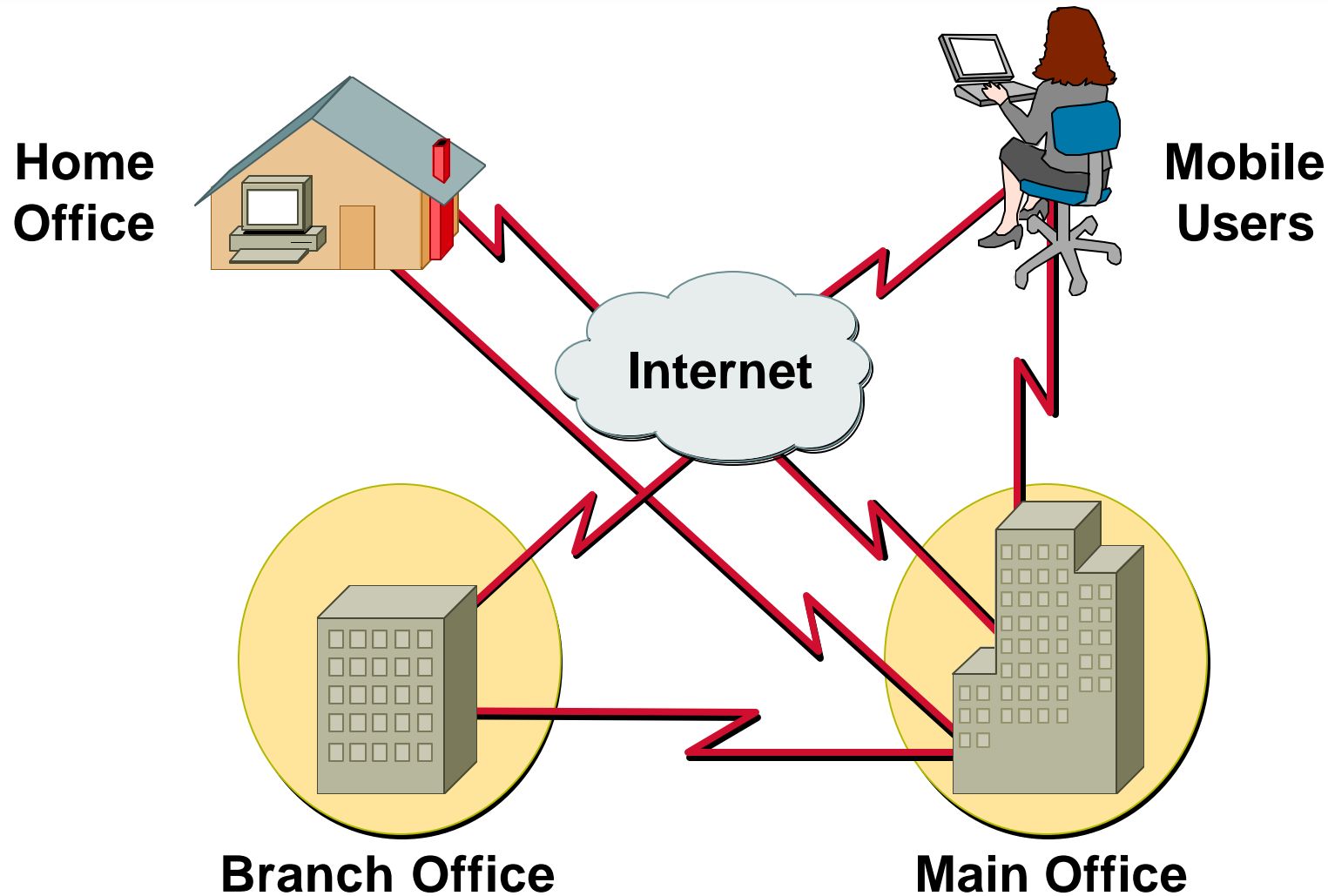


Objectives

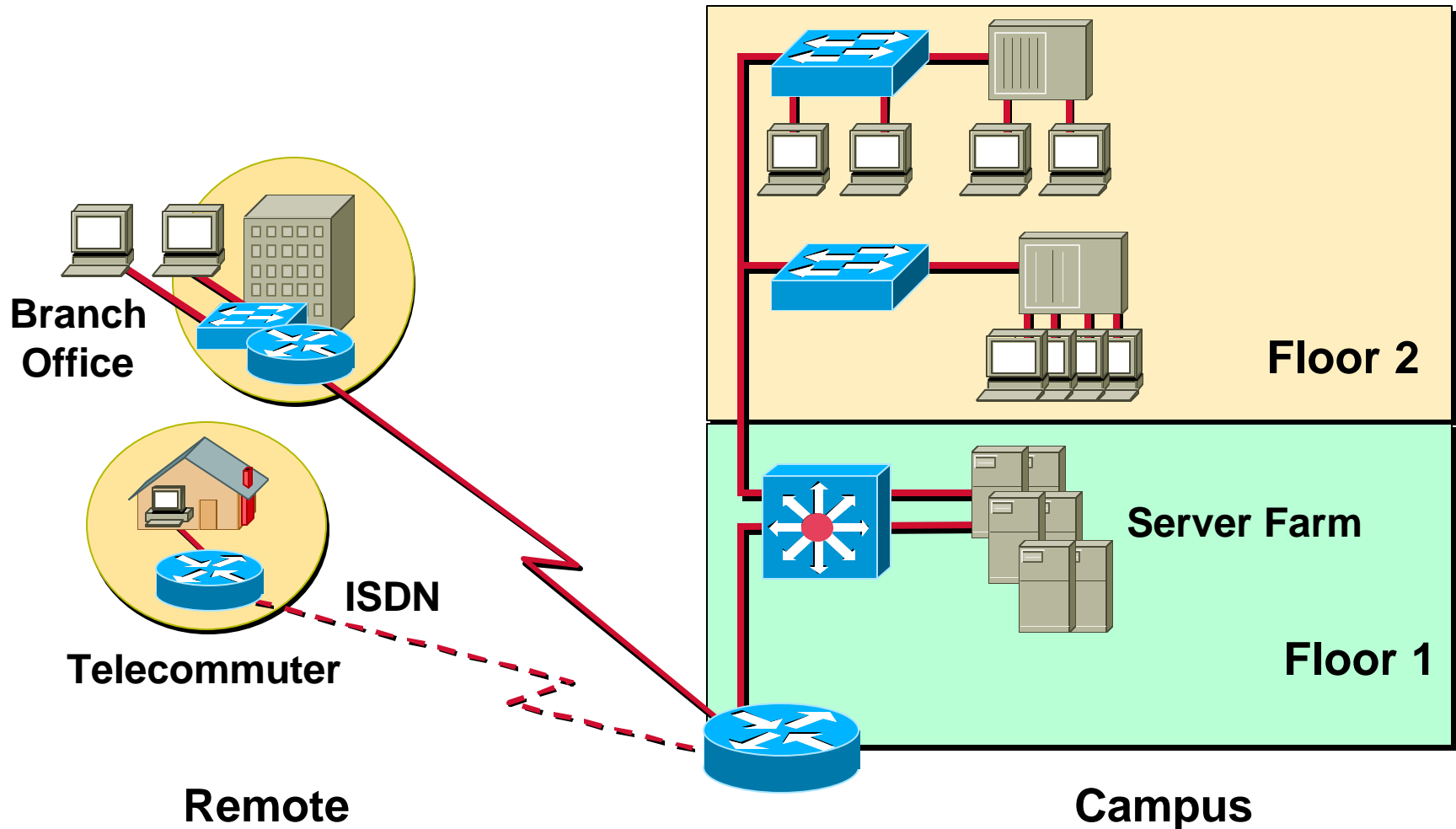
On completion of this chapter, you will be able to perform the following tasks:

- **Describe how data traffic is exchanged between source and destination devices**
- **Identify the roles and functions of a hub, switch, and router, and where they best fit in the network**
- **Select the appropriate Cisco equipment for a given set of network requirements**

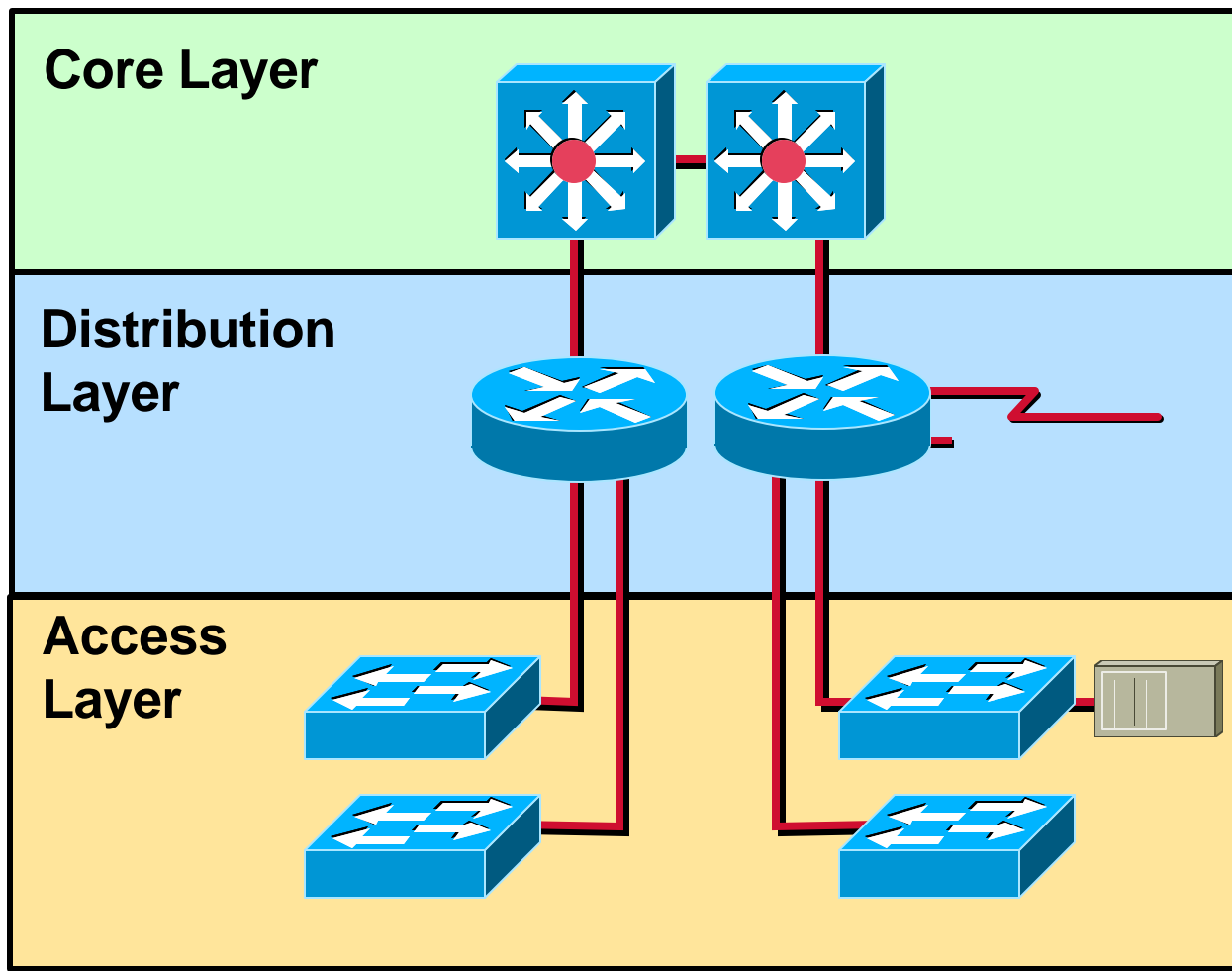
Defining Components of the Network



Defining the Components of a Network (cont.)

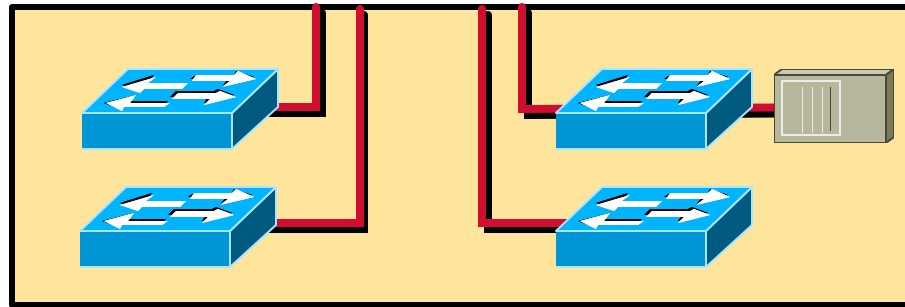


Network Structure Defined by Hierarchy



Access Layer Characteristics

Access Layer

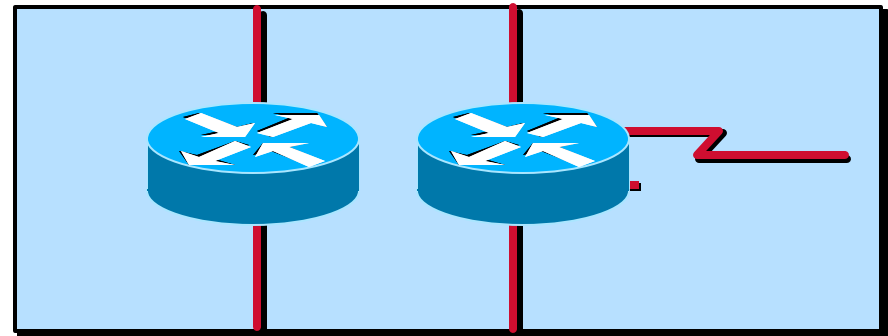


End station entry point to the network

Distribution Layer Characteristics

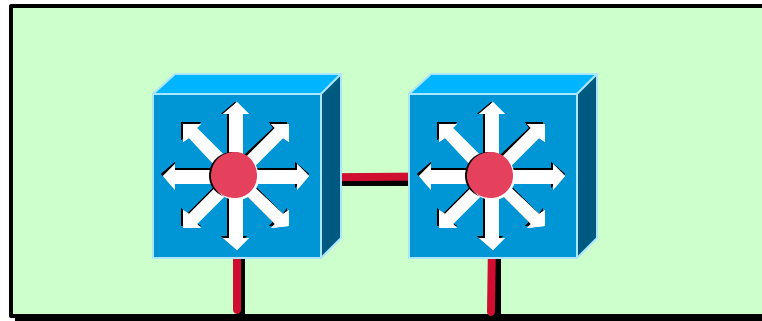
- Access Layer Aggregation Point
- Routes traffic
- Broadcast/Multicast Domains
- Media Translation
- Security
- Possible point for remote access

Distribution Layer



Core Layer Characteristics

Core Layer



- **Fast transport to enterprise services**
- **No packet manipulation**

PROTOCOLS

A protocol is a set of defined rules for communication

Functions of protocols

Functions of protocols can be grouped into the following categories

- Segmentation and Reassembly
- Encapsulation
- Connection Control
- Ordered Delivery
- Error Control
- Multiplexing

SEGMENTATION AND REASSEMBLY

A protocol breaks up the data into smaller blocks. This process is called Segmentation or Fragmentation

At the receiving end, the segmented data must be reassembled. This process is called Reassembly

ENCAPSULATION

A PDU (Protocol Data Unit) usually contains both data and control information (header).

The addition of control information to data is called Encapsulation

CONNECTION CONTROL

Data transfer between two stations can be connectionless or connection-oriented. In connectionless data transfer, both stations transfer data in an unplanned way

In connection-oriented data transfer, a logical connection is established between the stations before actual transfer of data

ORDERED DELIVERY

PDU's received by the station may not be in the same order as they were sent by the transmitting station because of different paths in network

Each PDU is given a unique sequence number, the receiving station easily rearrange them in the same order they were sent

ERROR CONTROL

Error control is used to recover from lost or damaged PDUs. Sequence numbers are used for error control. A receiving station acknowledges each PDU it receives correctly by sending back its sequence number to the transmitting station

If a sender does not receive a positive acknowledgment within a certain amount of time , the sender assumes that the PDU is either lost or was not received correctly. It then retransmits that PDU

OSI LAYER MODEL OPEN SYSTEMS INTERCONNECTION

The OSI reference model describes how information from a software application in one computer moves through a network medium to a software application in another computer. It was developed by International Standardization ISO in 1984. Model divide in to seven Layers.

LAYERS

Most communication environments separate the communication functions and application processing. This separation of networking functions is called LAYERING. For the OSI model, seven numbered layers indicate distinct functions.

LAYERS

Divide the interrelated aspects of network operation into less complex elements.

Define standard interfaces for " Plug and Plug" Compatibility and multi vender integration.

Divide the complexity of internetworking into Discrete, more easily learned operations.

OSI Model

- OSI (Open Systems Interconnection) model
- a way to understand an internetwork operation.
- Guideline for creating network standards, devices, and internetworking schemes.
- dividing the aspects of network operation into less complex elements.

- **The Term "Open"**
in OSI

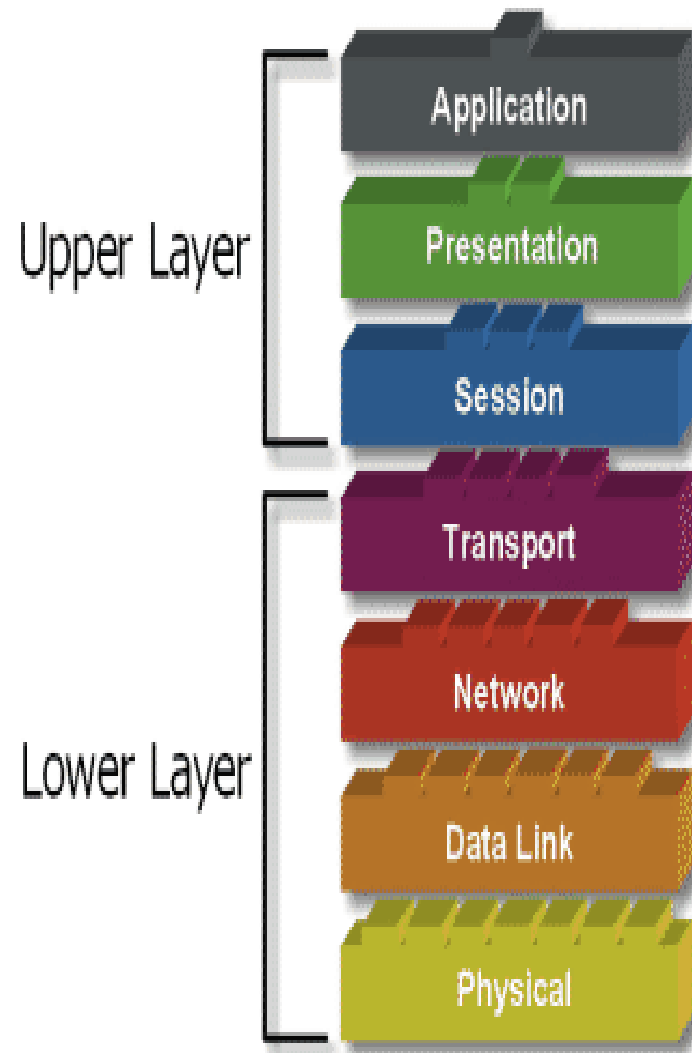


- provides the ability to define standard interfaces for multi-vendor integration.

OSI Model

Seven layer model

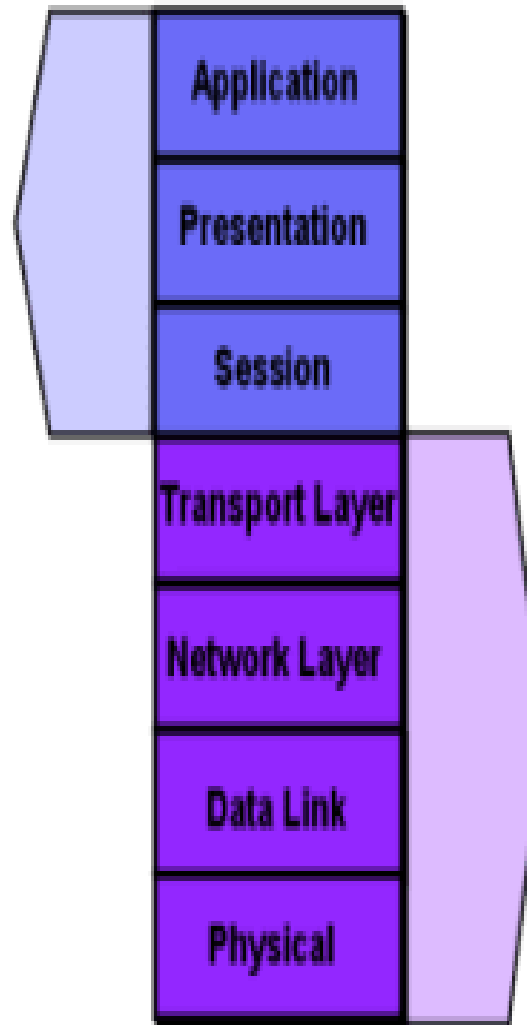
For better understanding
Subdivided into two stacks



OSI Structure Defined by Hierarchy

How the applications within the end stations will communicate with each other and with users

Application
(Upper)
Layers



Ways for end stations to establish connections to each other in order to exchange data.

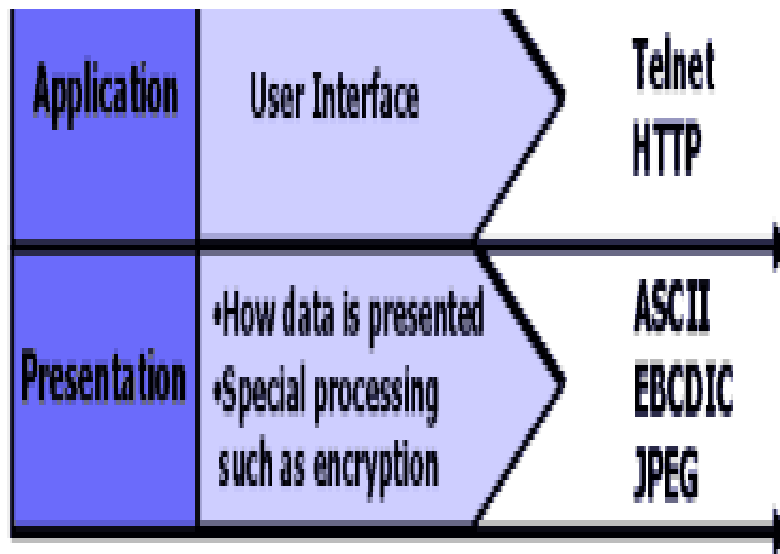
Application Layer

EXAMPLES



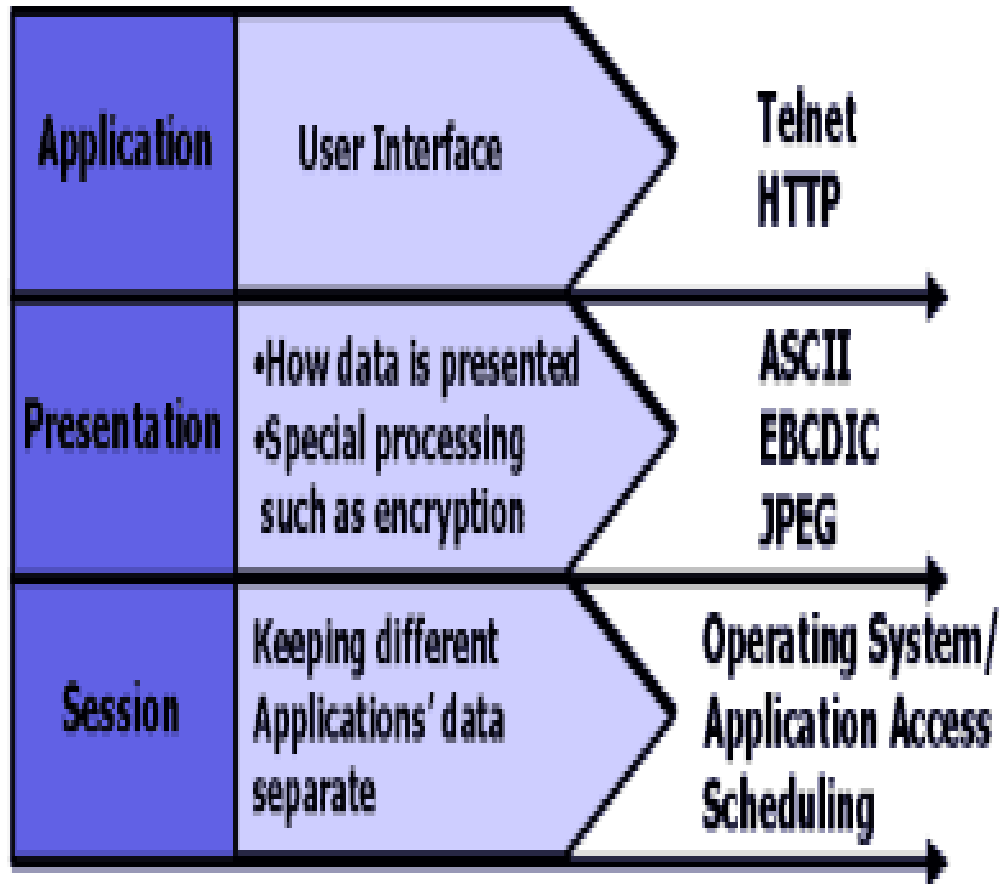
where the user interacts with the computer. For example, a word processing application

Presentation Layer



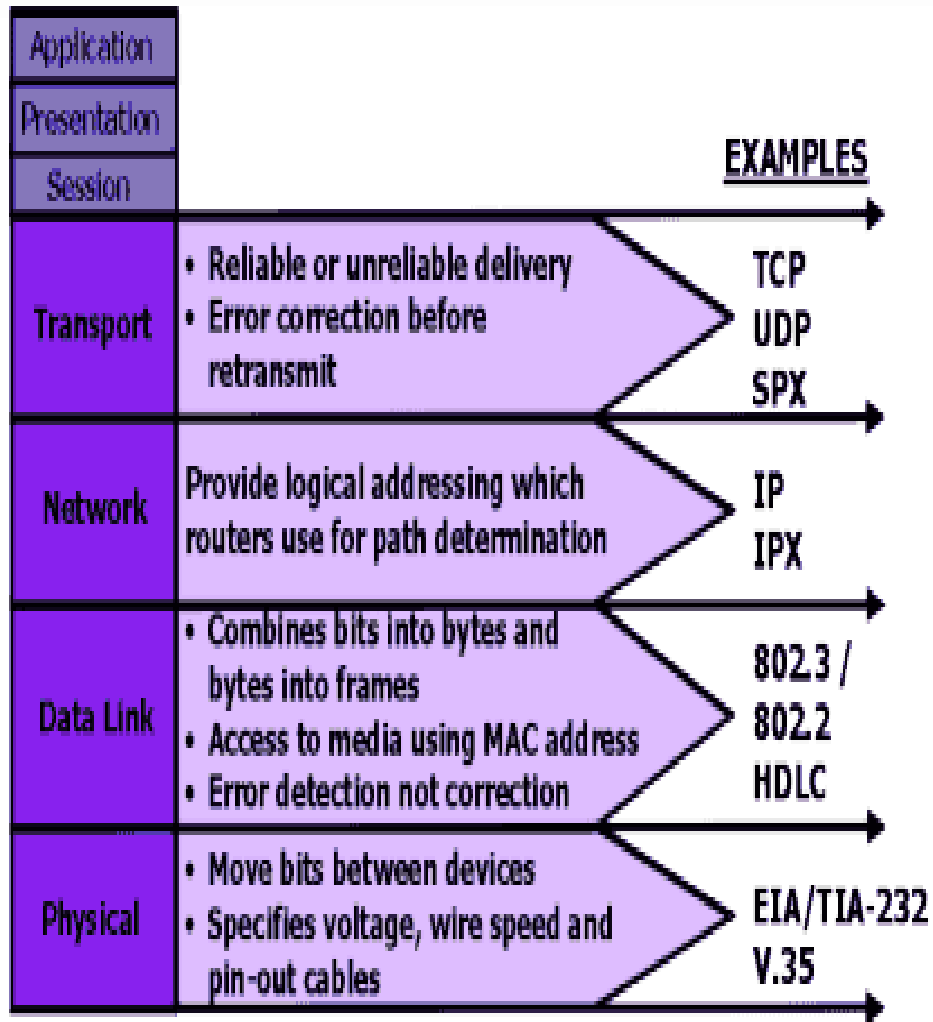
- provides a variety of coding and conversion functions applied to the application layer data. These functions ensure that information sent from the application layer of one system will be readable by the application layer of another system. conversions are done for text, figures, sound, and video.

Session Layer



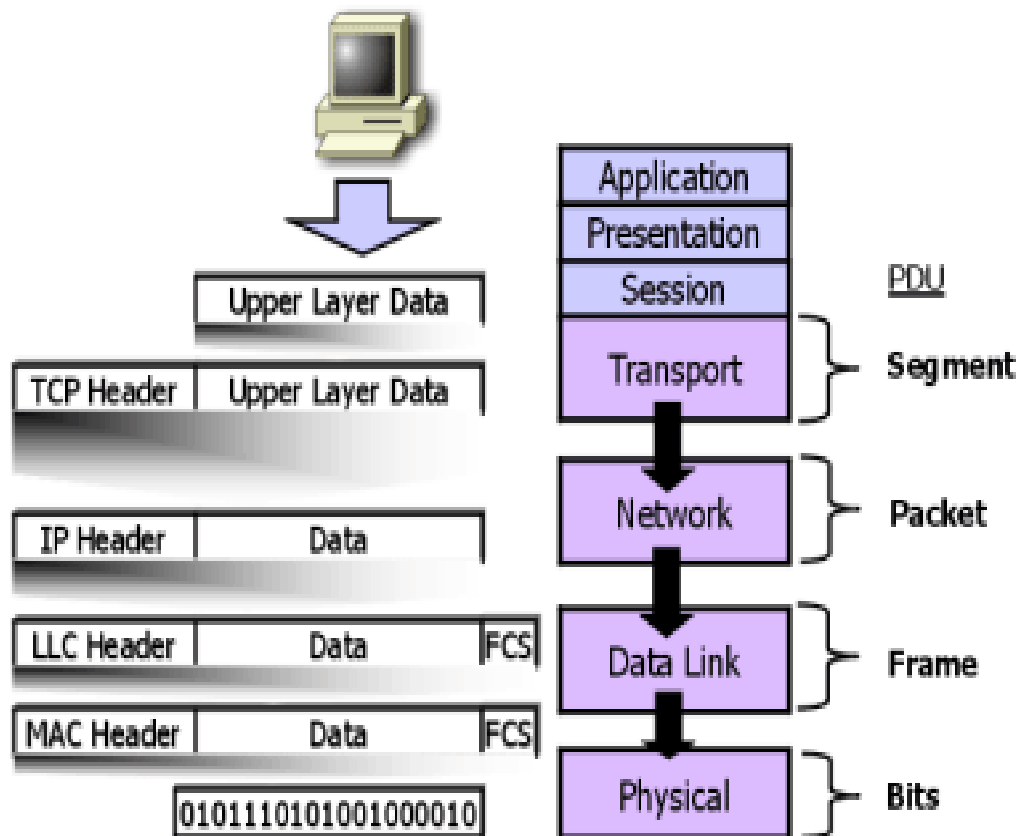
- Establishes, manages, and terminates communication sessions between presentation layer entities.

Data flow layers



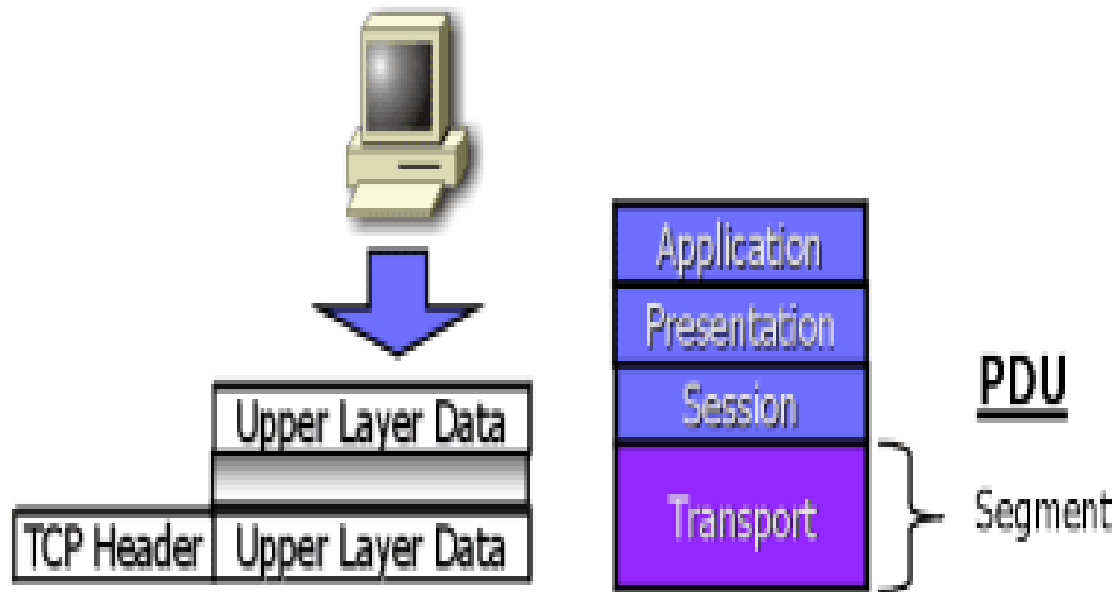
Making data ready for shipping on physical wire

Layers Exchange Information



- protocol data units. Control information are called headers and trailers.
- (FCS) (CRC).
- PDU as it goes up or down the layers, given a more specific name.

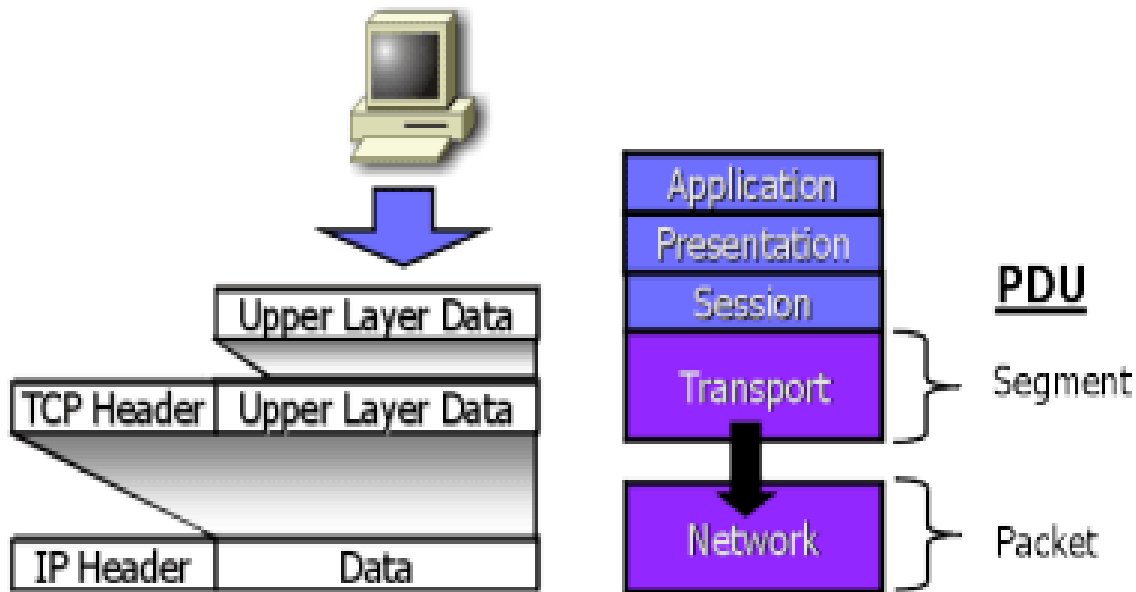
Transport layer



Receives a PDU from the upper layers.

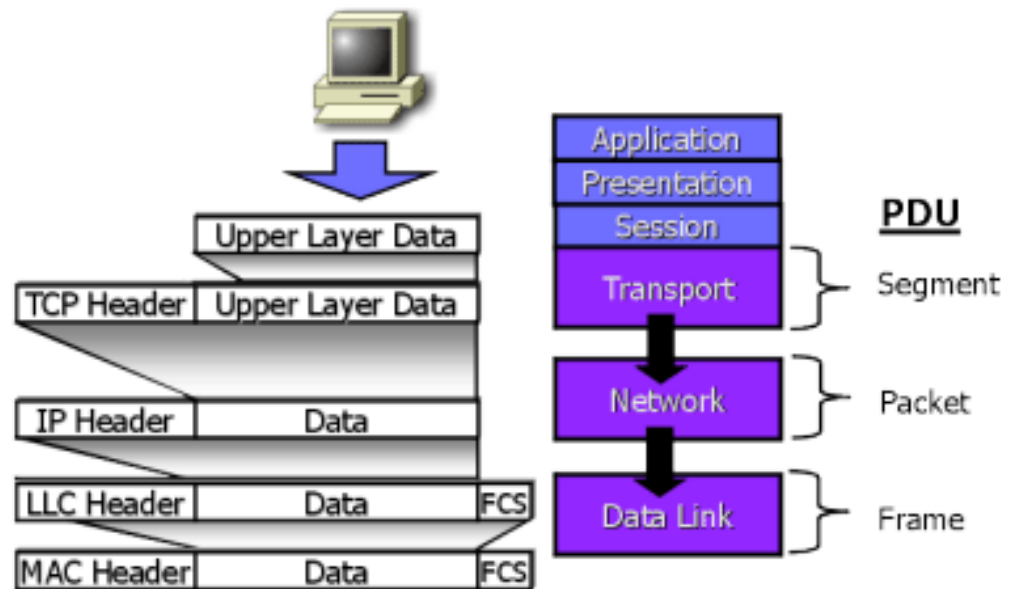
Adds control information then the PDU passes to network layer, known as a **segment**.

Network layer



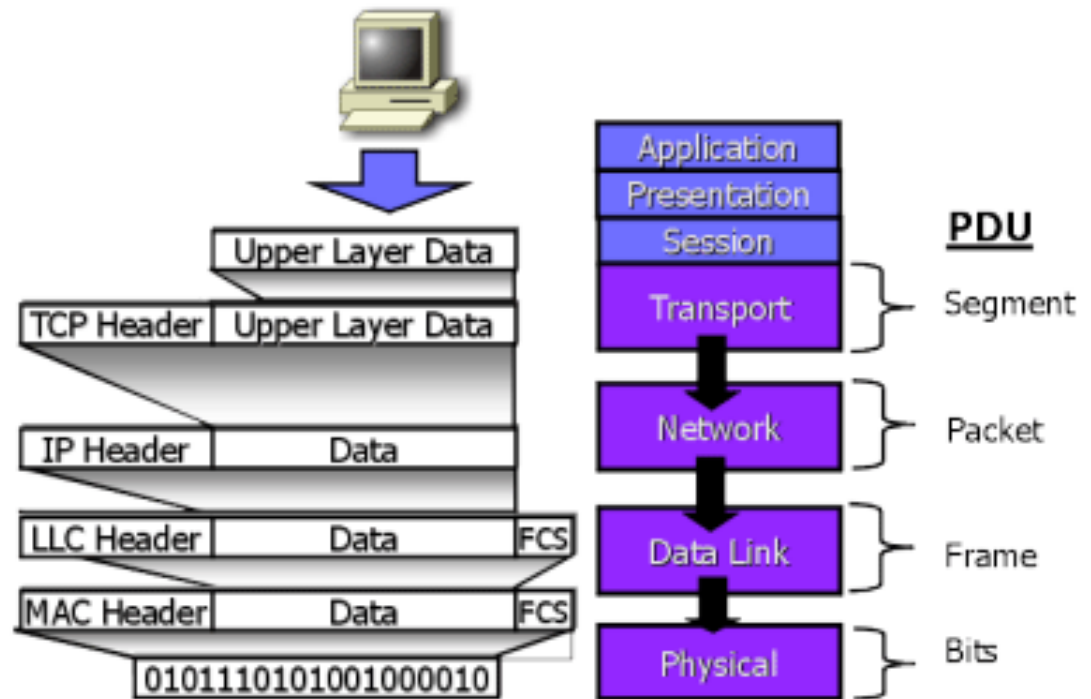
Encapsulates the PDU with its own header . The **packet** is then passed to the data link layer.

Data link layer



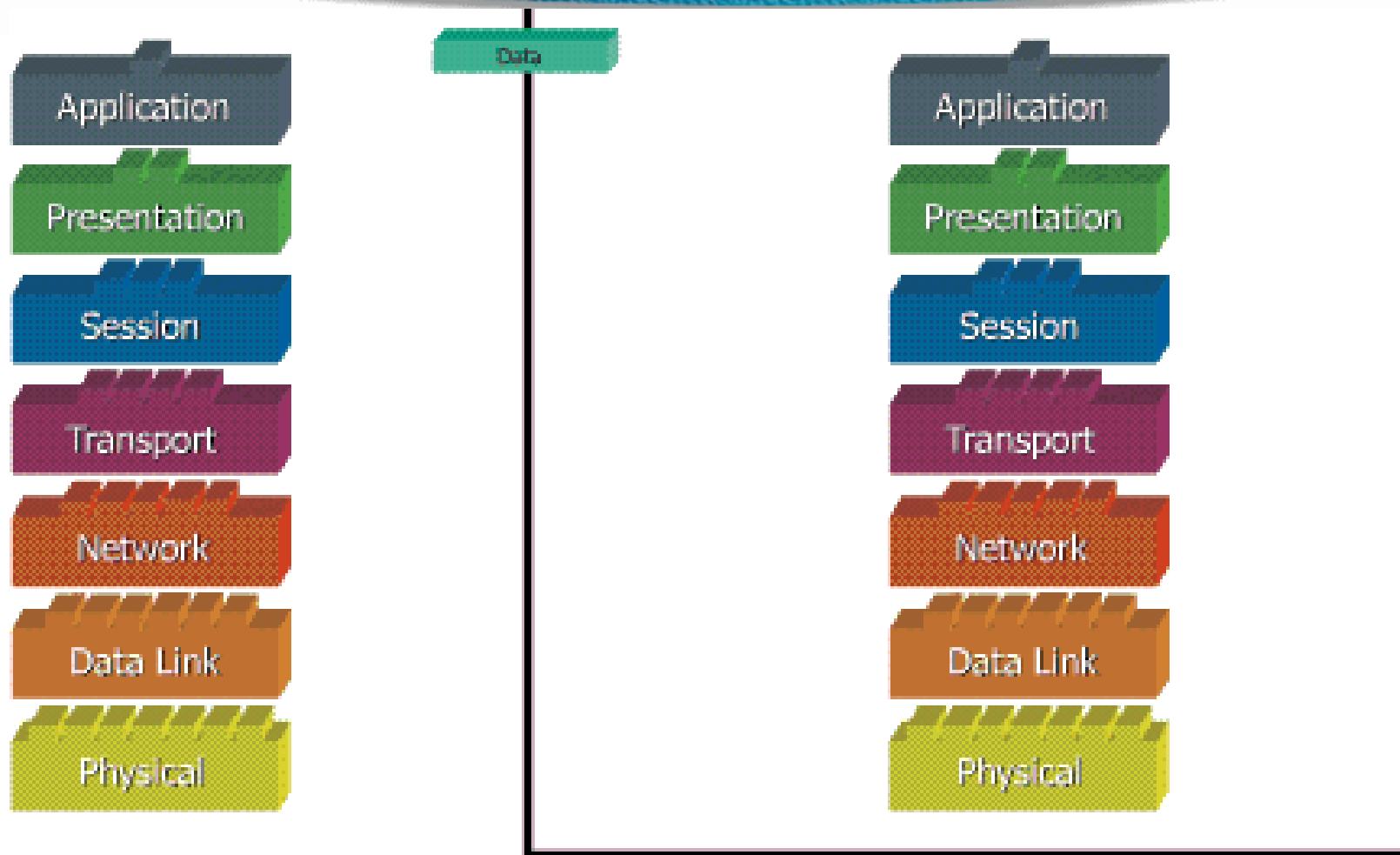
The data link layer encapsulates the network-layer information in a PDU called a **frame**. The frame header contains information required to complete the data link functions.

Physical layer



When the physical layer receives the frame, it encodes the frame into a pattern of ones and zeros, or **bits**, for transmission usually on a wire.

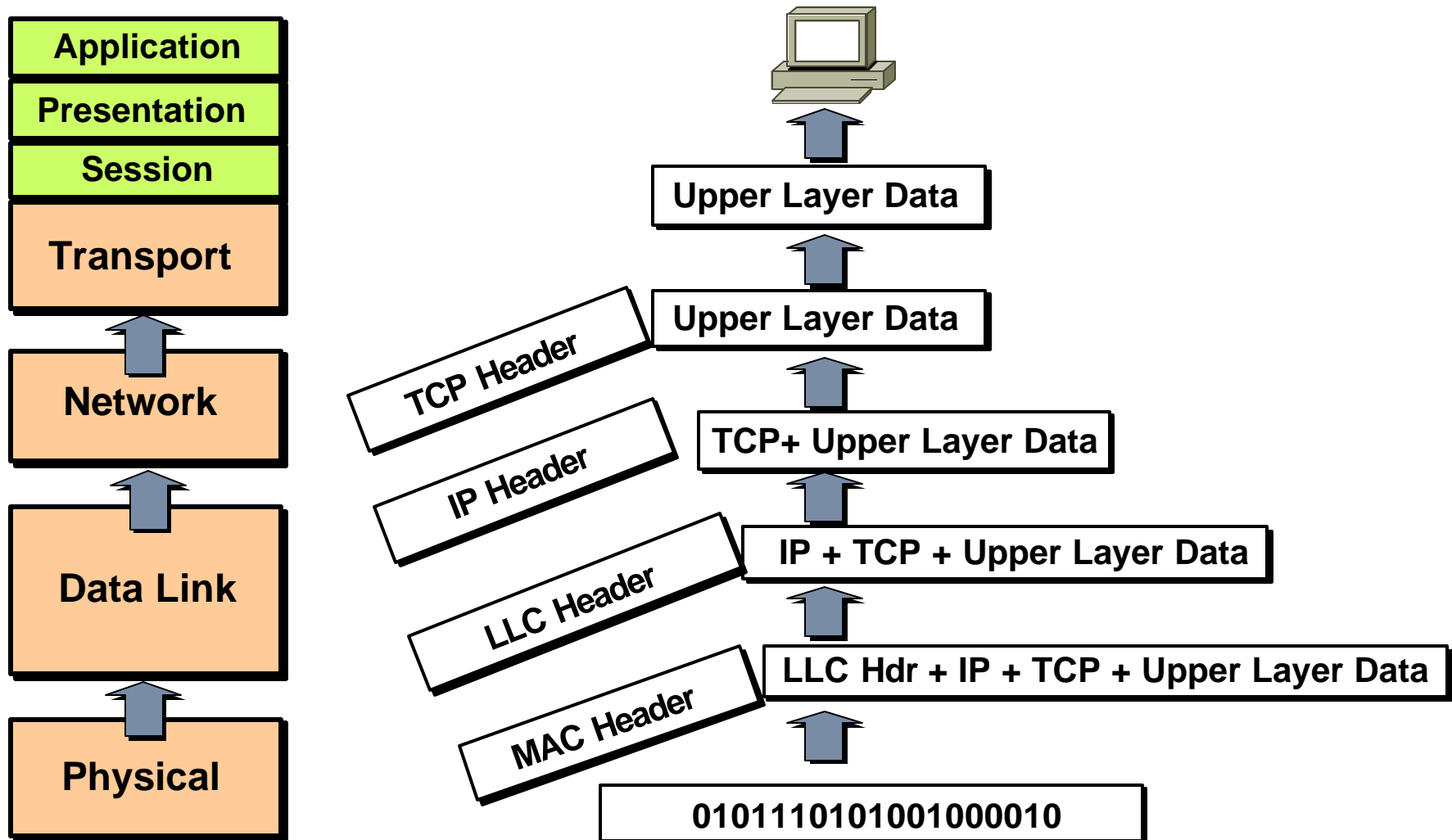
Encapsulation /De-Encapsulation



Encapsulation

De-Encapsulation

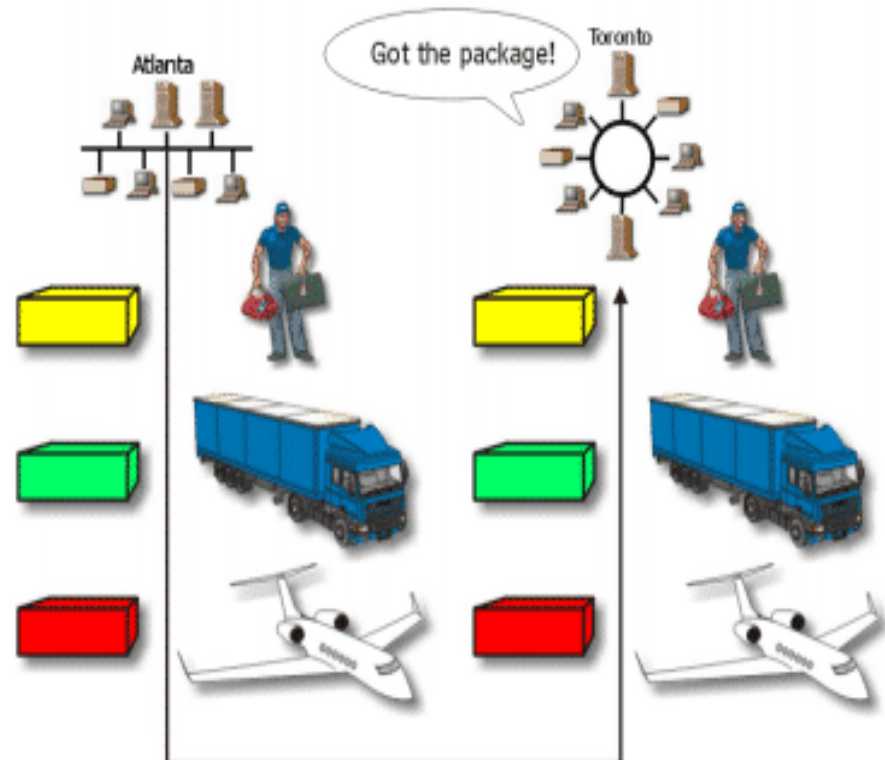
De-encapsulating Data



OSI courier service



Atlanta tells Toronto that he is going to send a package through the OSI Courier Service.



Toronto acknowledges to Atlanta that the package is received

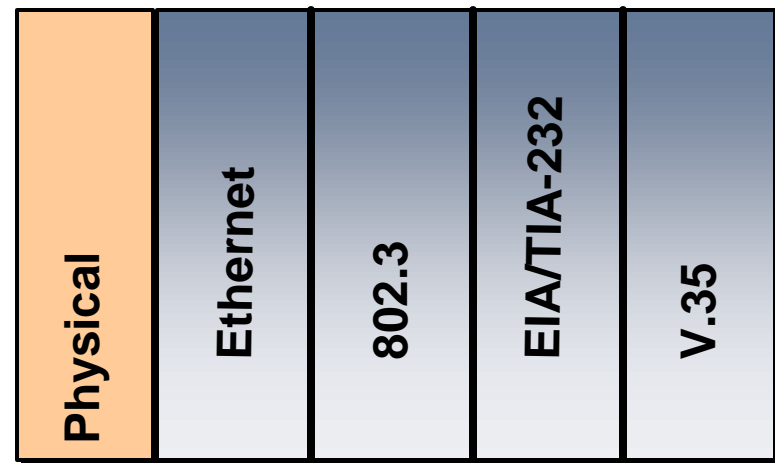
Written Exercise: OSI Model

OSI Model	PDU	Functional Responsibilities	Examples
Application			
Presentation			
Session			
Transport			
Network			
Data Link			
Physical			

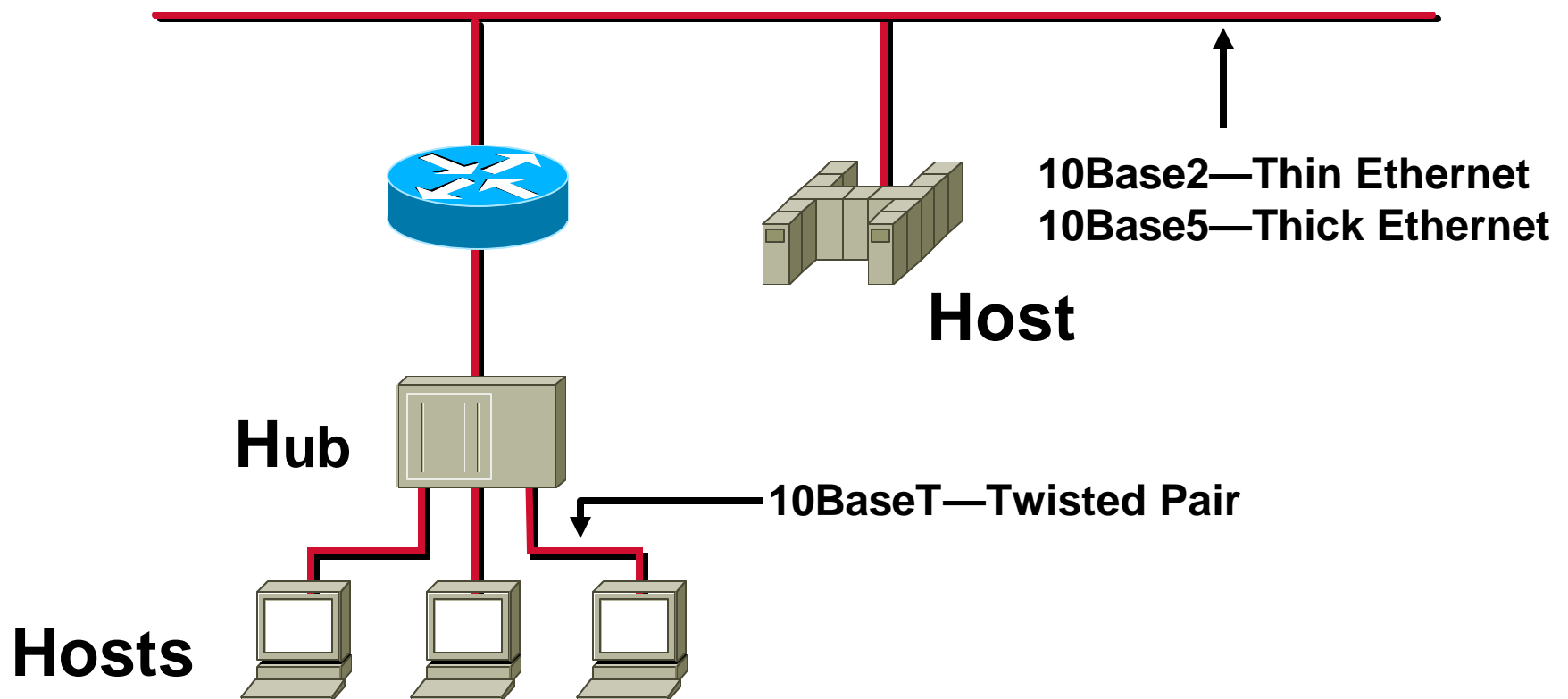
Physical Layer Functions

Defines

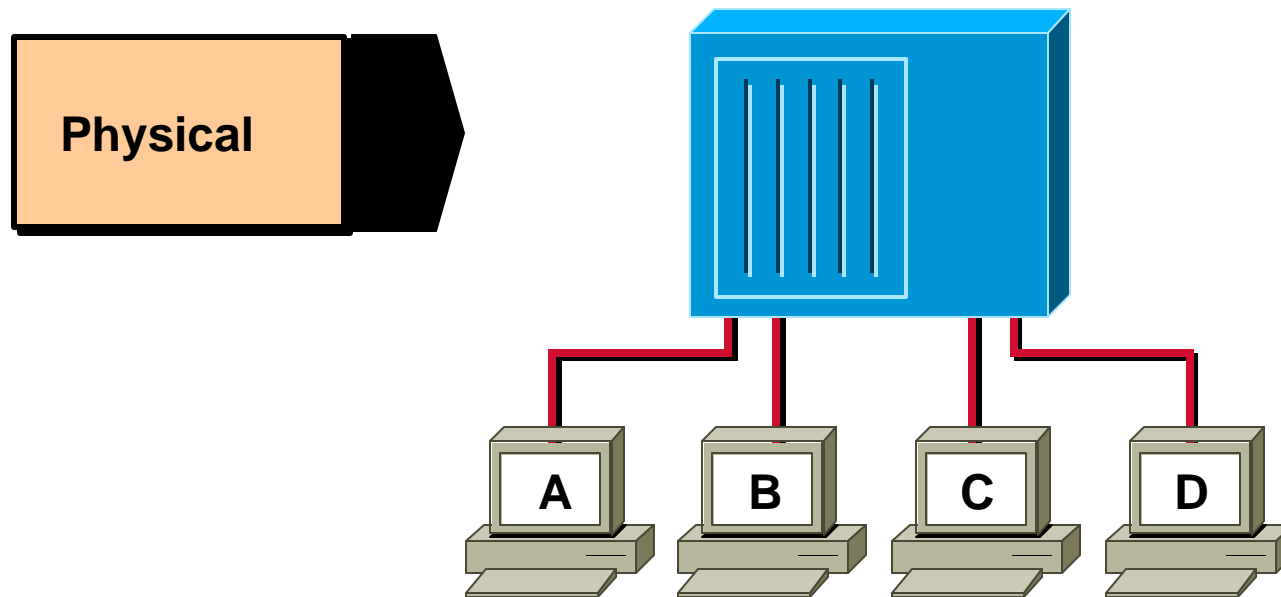
- Media type
- Connector type
- Signaling type



Physical Layer: Ethernet/802.3



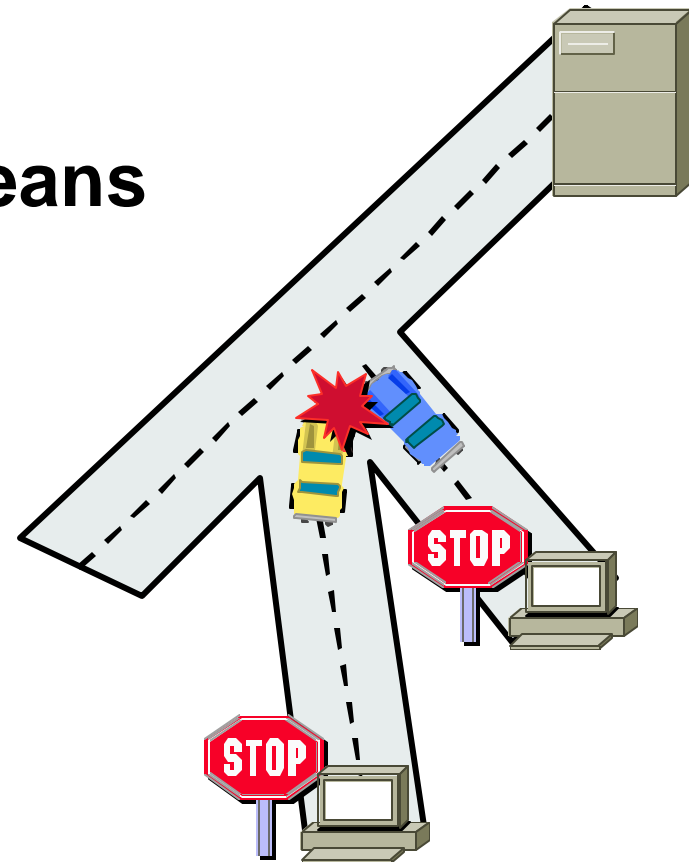
Hubs Operate at Physical layer



- All devices in the same collision domain
- All devices in the same broadcast domain
- Devices share the same bandwidth

Hubs: One Collision Domain

- More end stations means more collisions
- CSMA/CD is used



Data Link layer Functions

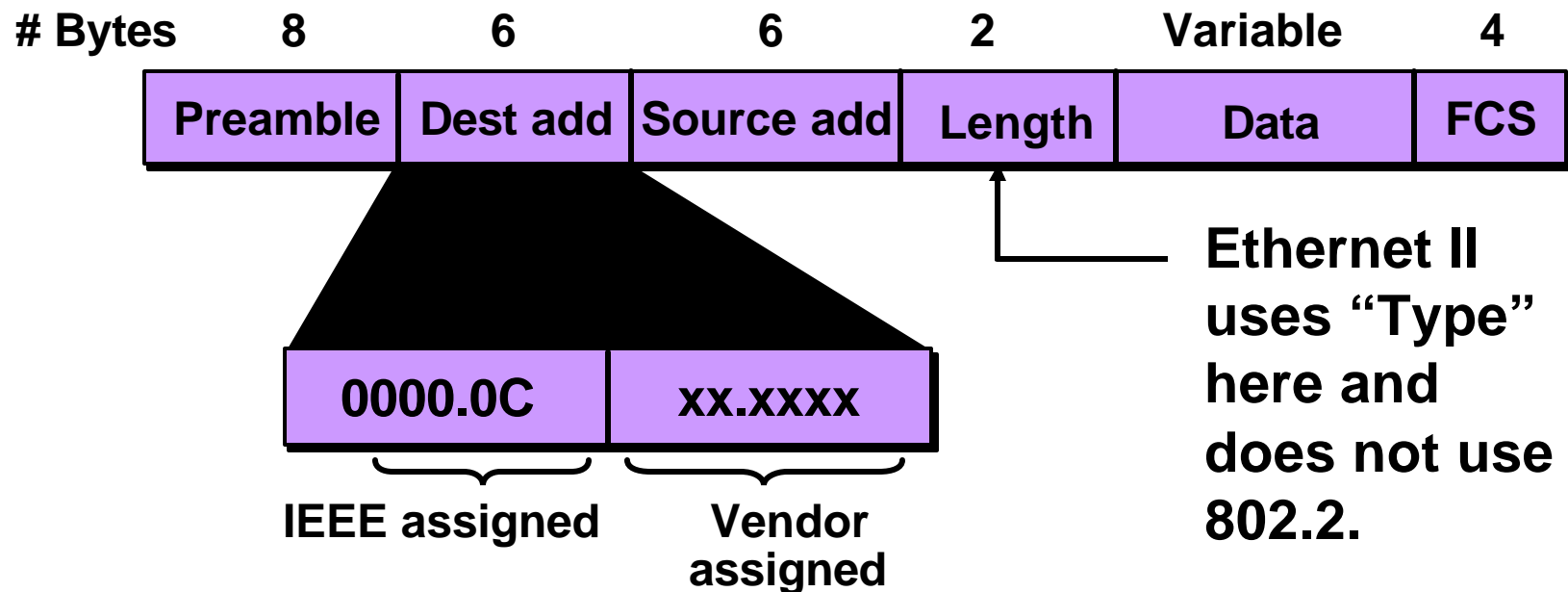
Defines

- Physical source and destination addresses
- Higher layer protocol (Service Access Point) associated with frame
- Network topology
- Frame sequencing
- Flow control
- Connection-oriented or connectionless

Physical	Data Link	Ethernet	802.2	HDLC	Frame Relay
			802.3		
EIA/TIA-232 v.35					

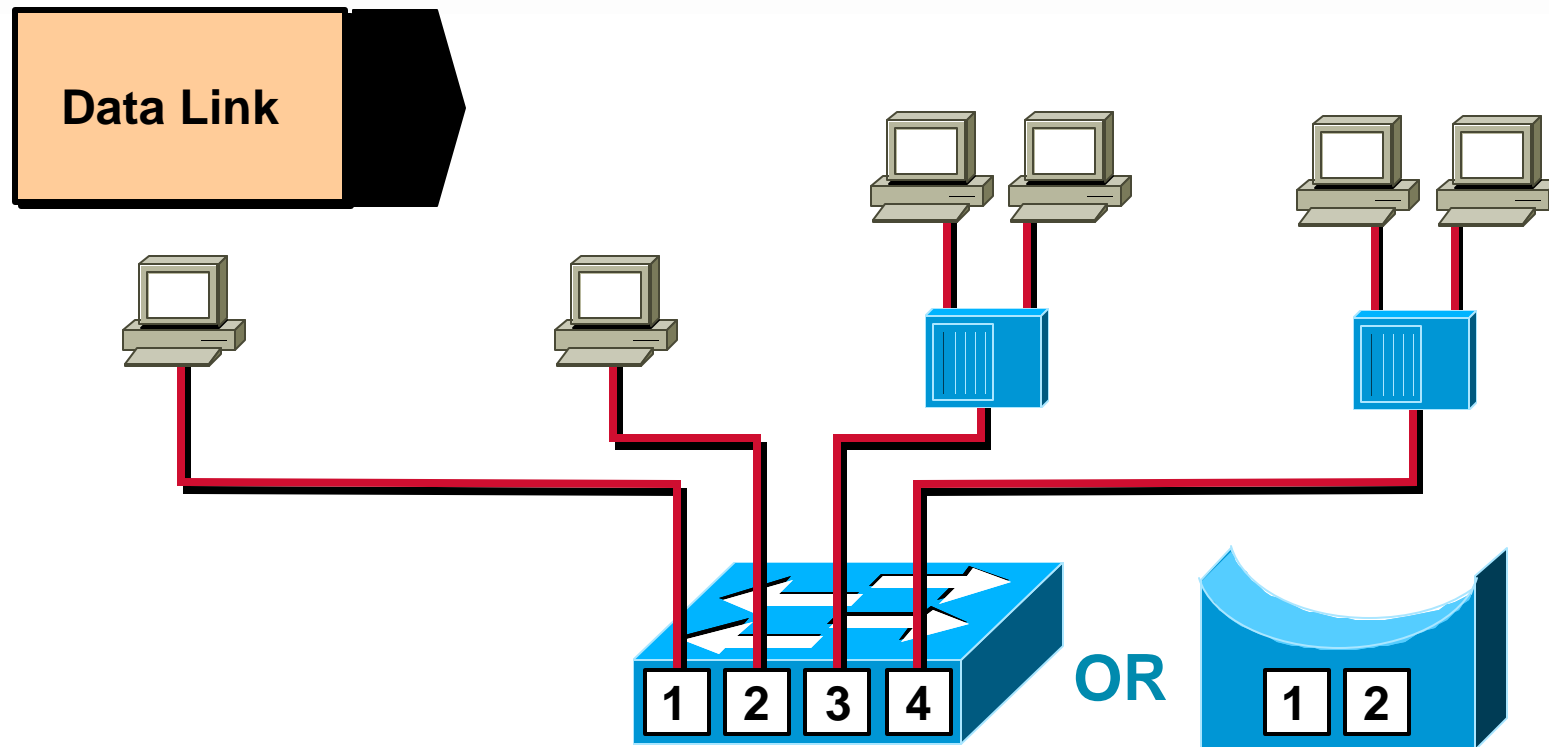
Data Link Layer Functions (cont.)

MAC Layer - 802.3



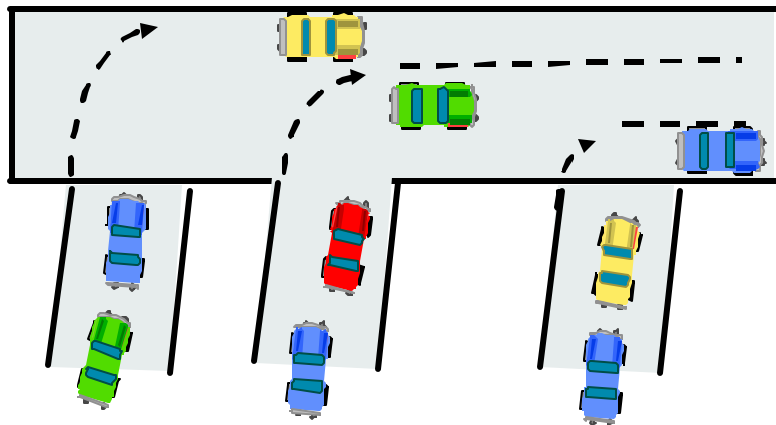
MAC Address

Switches and Bridges Operate at Data Link Layer

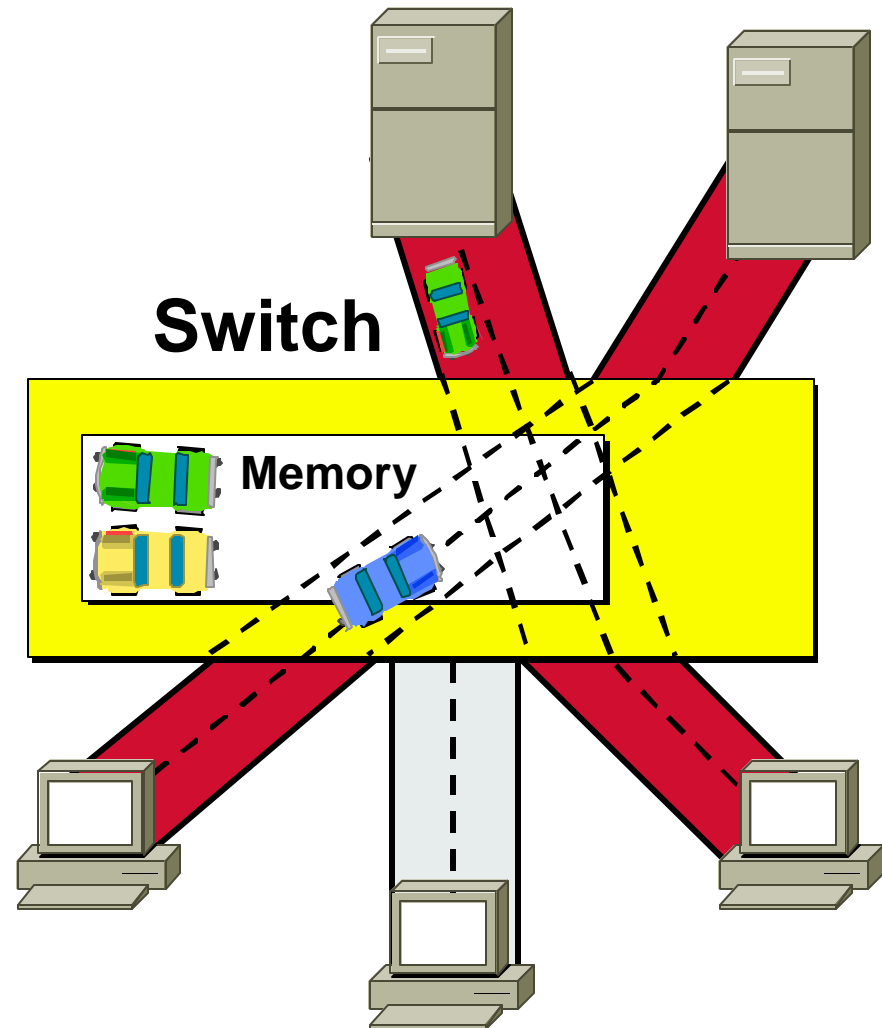


- Each segment has its own collision domain
- All segments are in the same broadcast domain

Switches



- Each segment has its own collision domain
- Broadcasts are forwarded to all segments



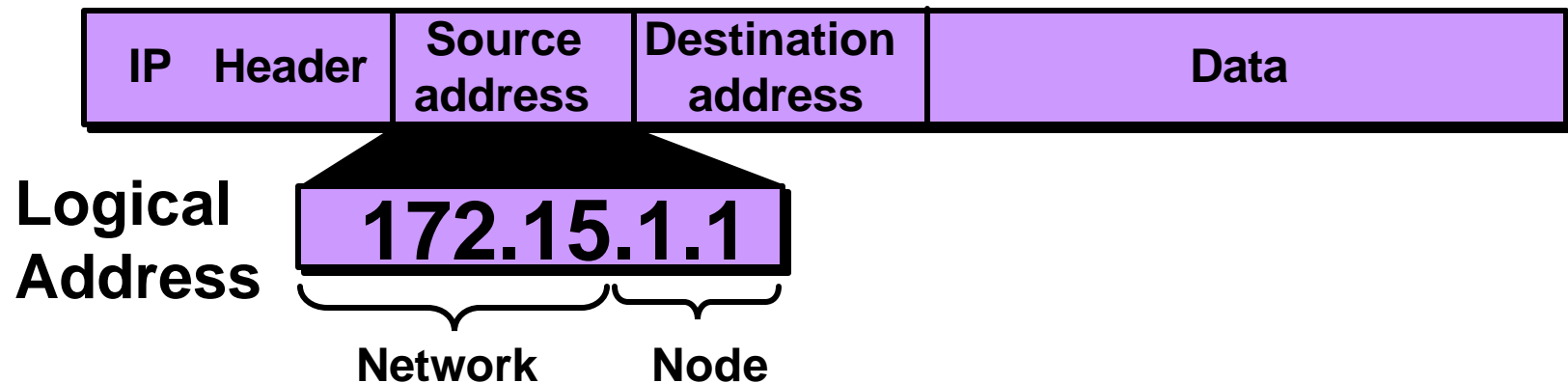
Network Layer Functions

- Defines logical source and destination addresses associated with a specific protocol
- Defines paths through network
- Interconnects multiple data links

Network	IP, IPX			
Data Link	Ethernet	802.2	HDLC	Frame Relay
Physical		802.3		
			EIA/TIA-232 v.35	

Network Layer Functions (cont.)

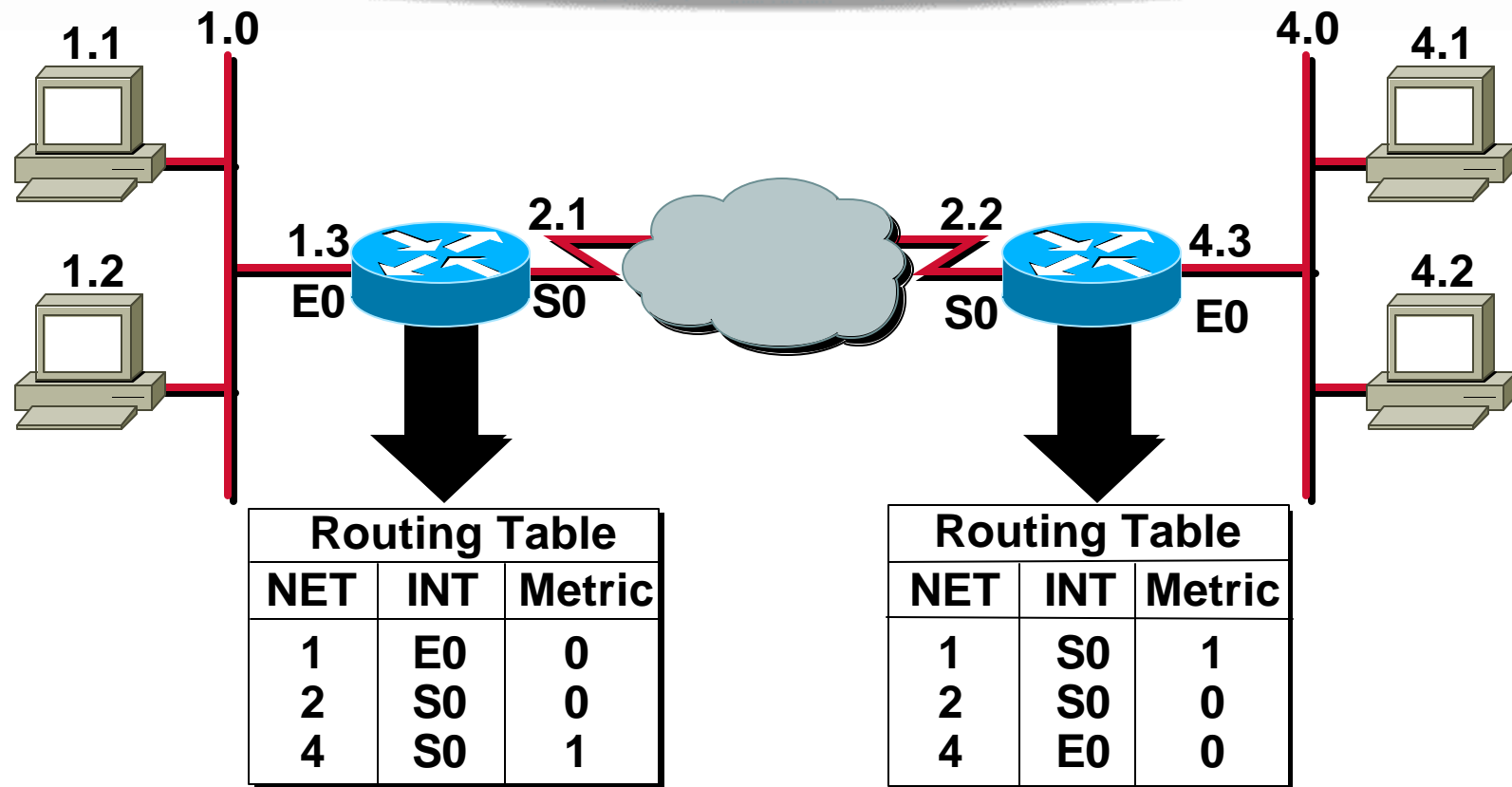
Network Layer End Station Packet



Network Layer Functions (cont.)

	Address		Mask	
	172.16.122.204		255.255.0.0	
	172	16	122	204
Binary Address	10101100	00010000	01111010	11001100
	255	255	0	0
Binary Mask	11111111	11111111	00000000	00000000
	Network		Host	

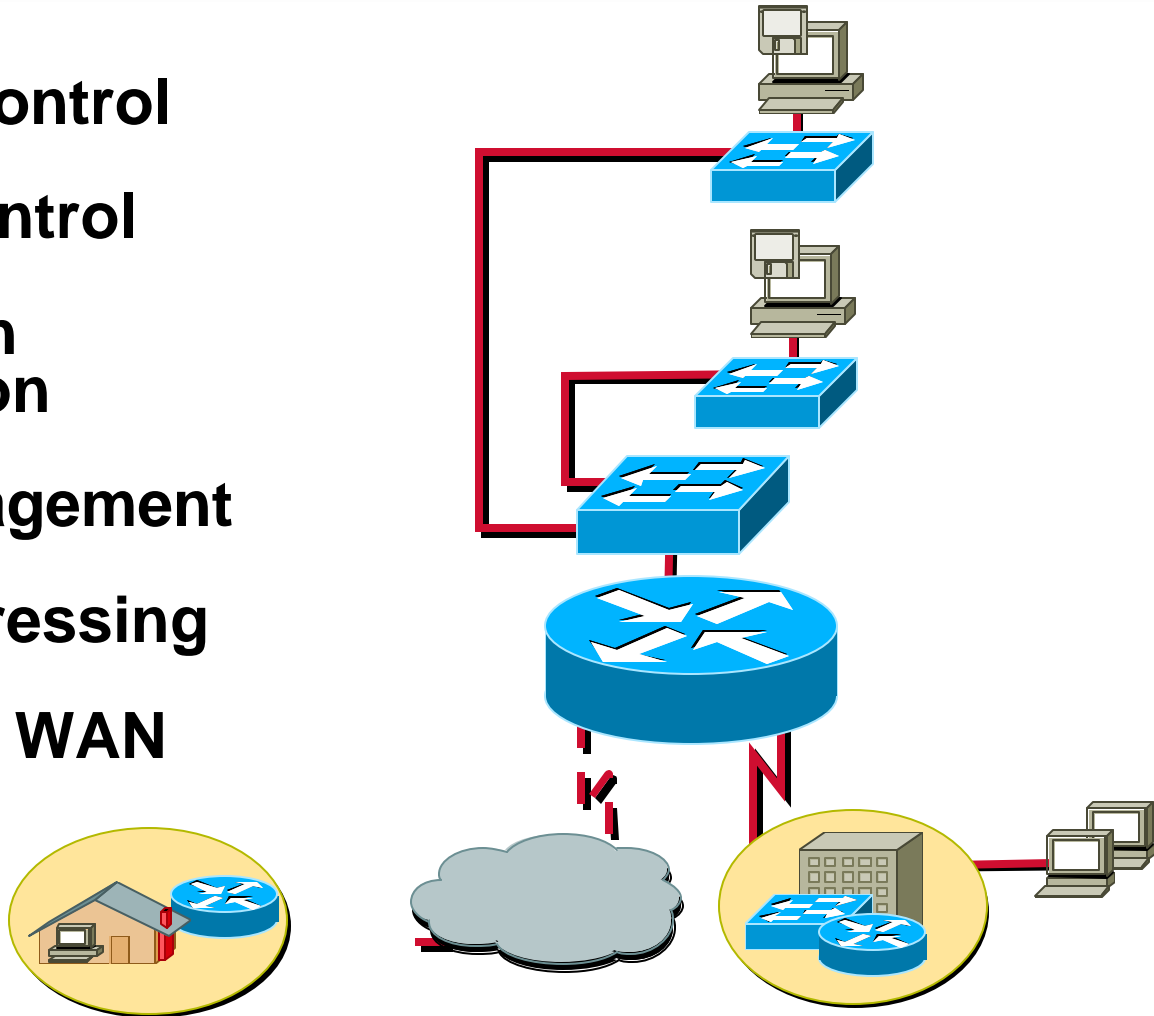
Network Layer Functions (cont.)



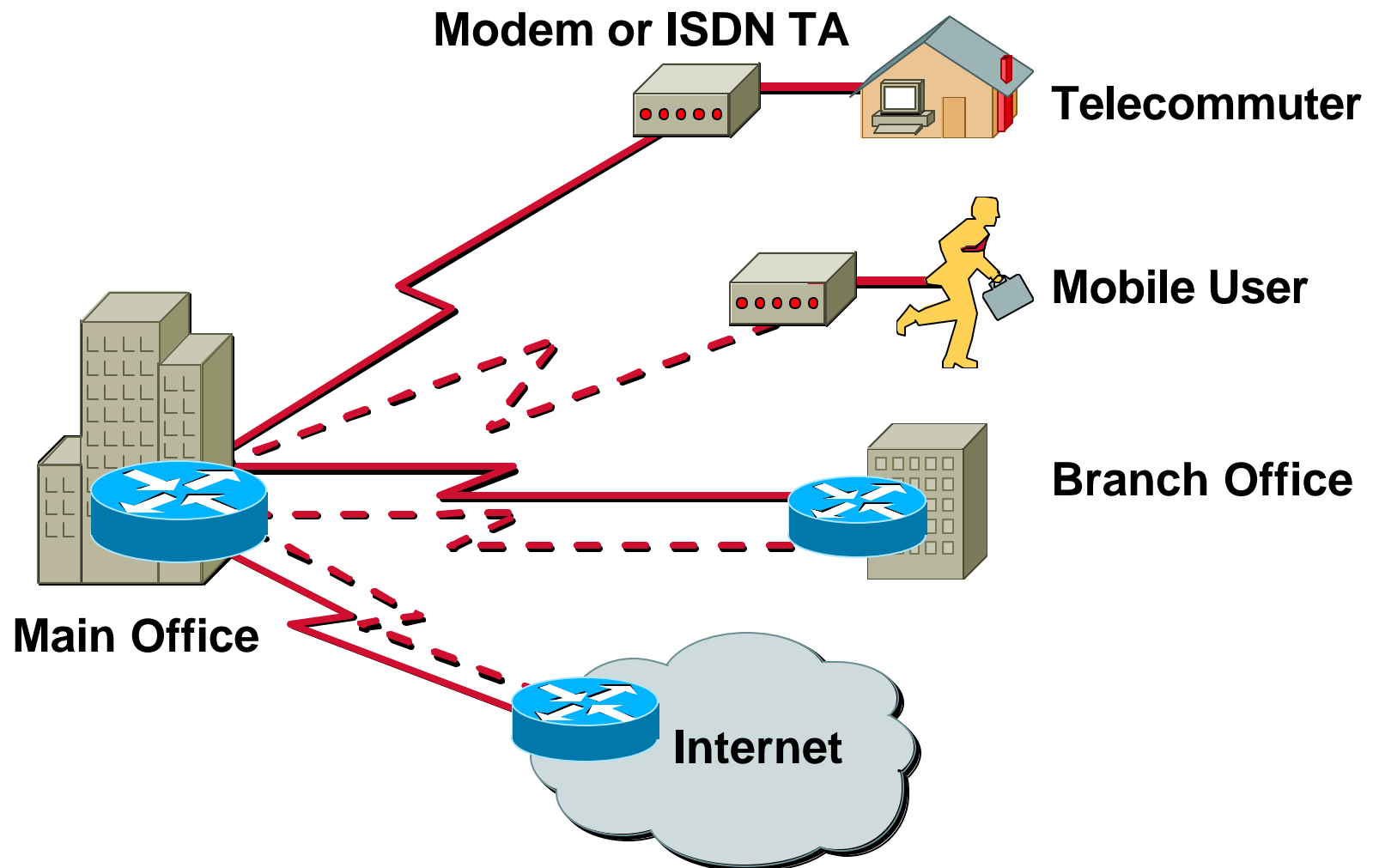
- Logical addressing allows for hierarchical network
- Configuration required
- Uses configured information to identify paths to networks

Routers: Operate at the Network Layer

- Broadcast control
- Multicast control
- Optimal path determination
- Traffic management
- Logical addressing
- Connects to WAN services



Using Routers to Provide Remote Access

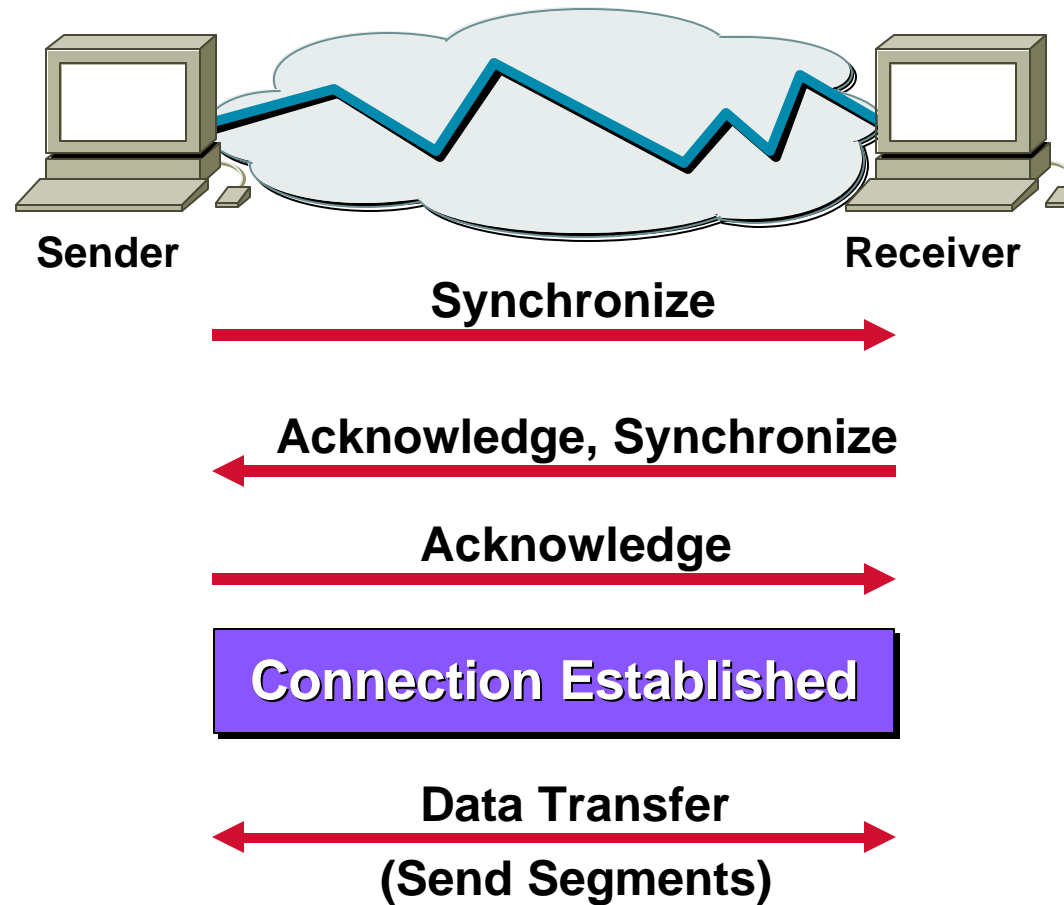


Transport Layer Functions

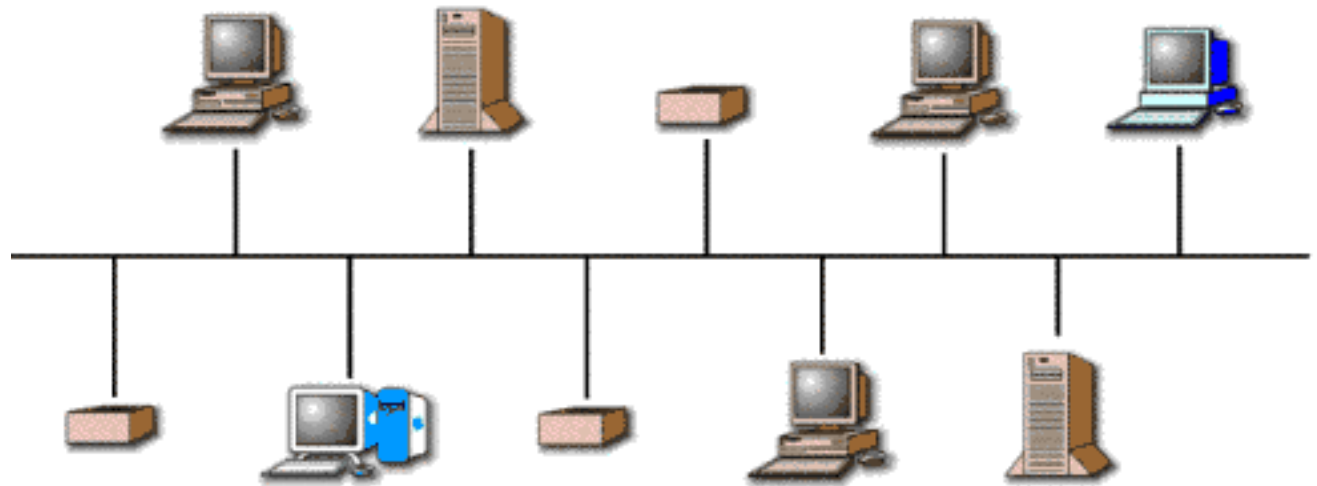
- Distinguishes between upper layer applications
- Establishes end-to-end connectivity between applications
- Defines flow control
- Provides reliable or unreliable services for data transfer

Transport	TCP	UDP	SPX
Network	IP		IPX

Reliable Transport Layer Functions



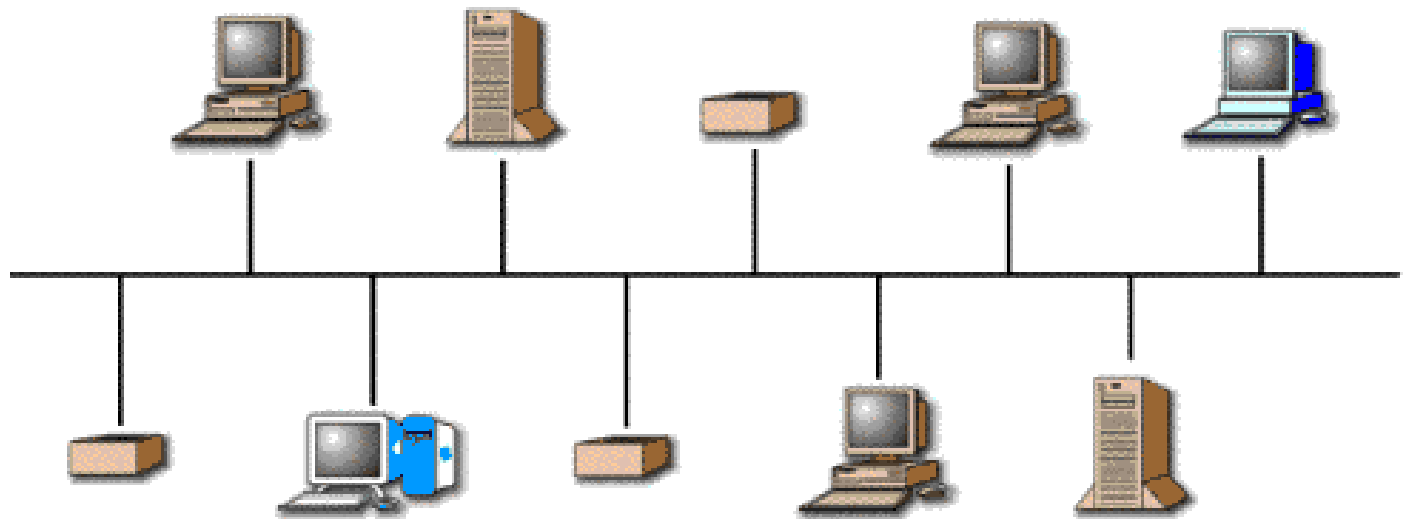
Broadcast Domain



Broadcast Domain

Set of devices which receives the same broadcast message

Collision Domain

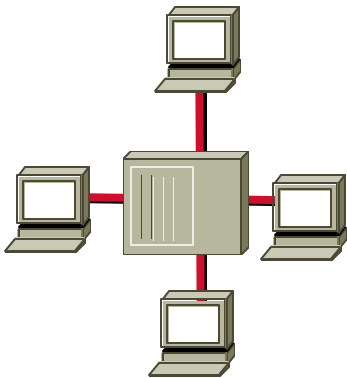


COLLISION DOMAIN

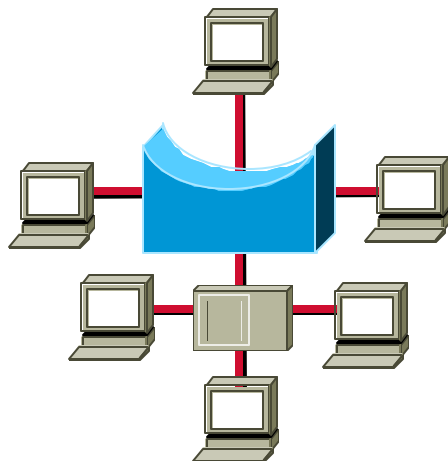
a domain in which all the devices hear the same collision called Collision domain

Network Device Domains

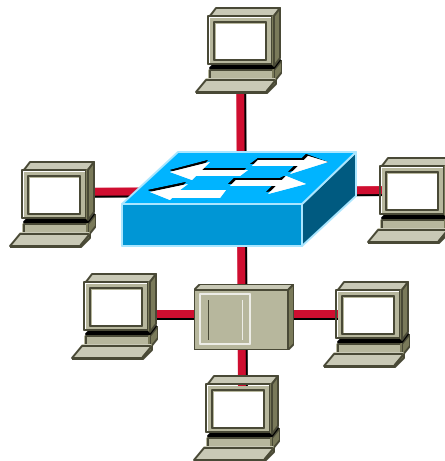
Hub



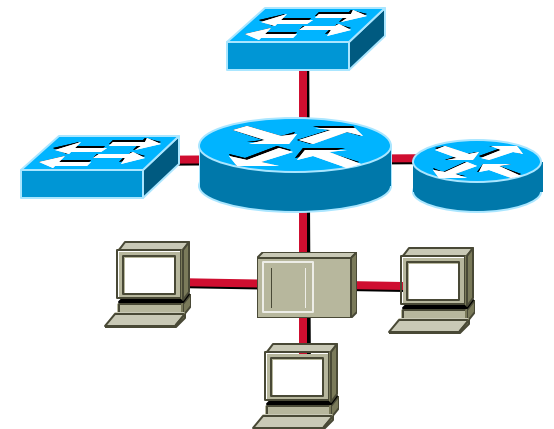
Bridge



Switch



Router



Collision Domains:

1

4

4

4

Broadcast Domains:

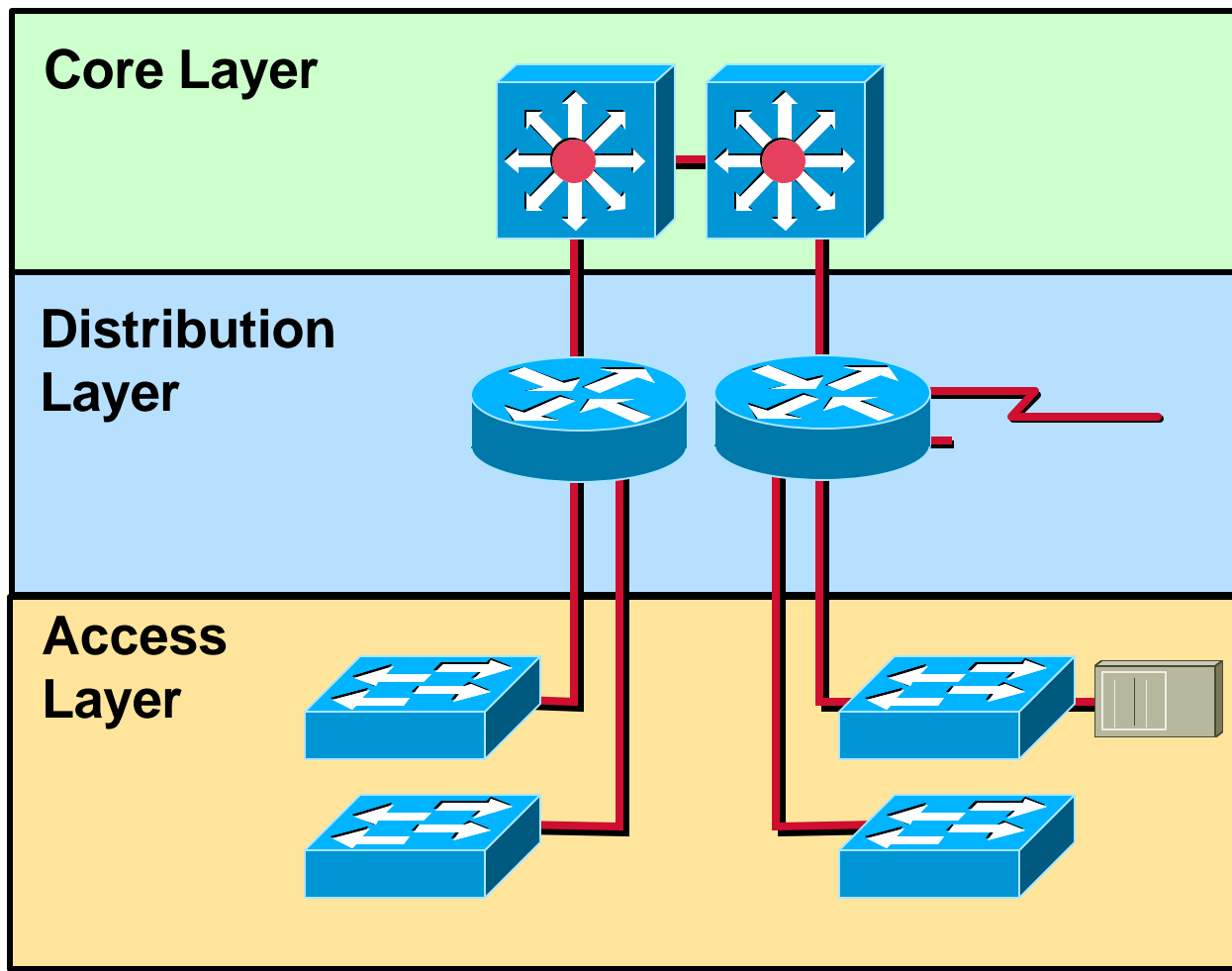
1

1

1

4

Choosing a Cisco Product

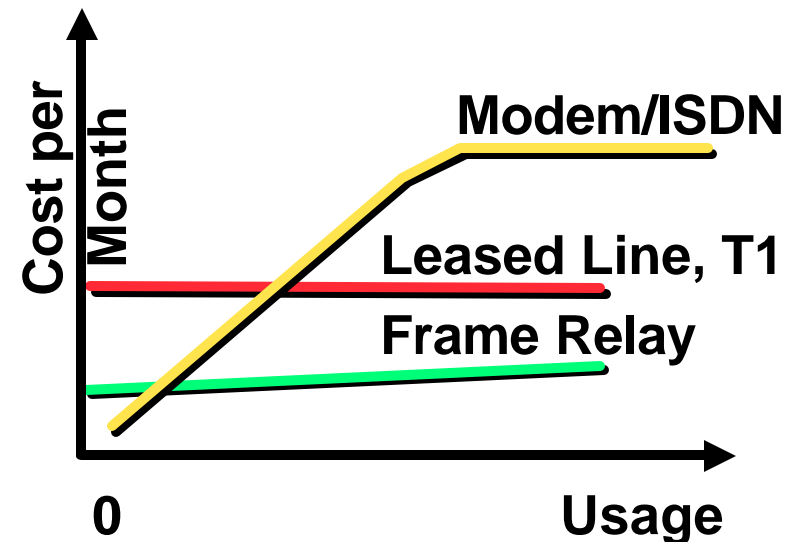


Product Selection Considerations

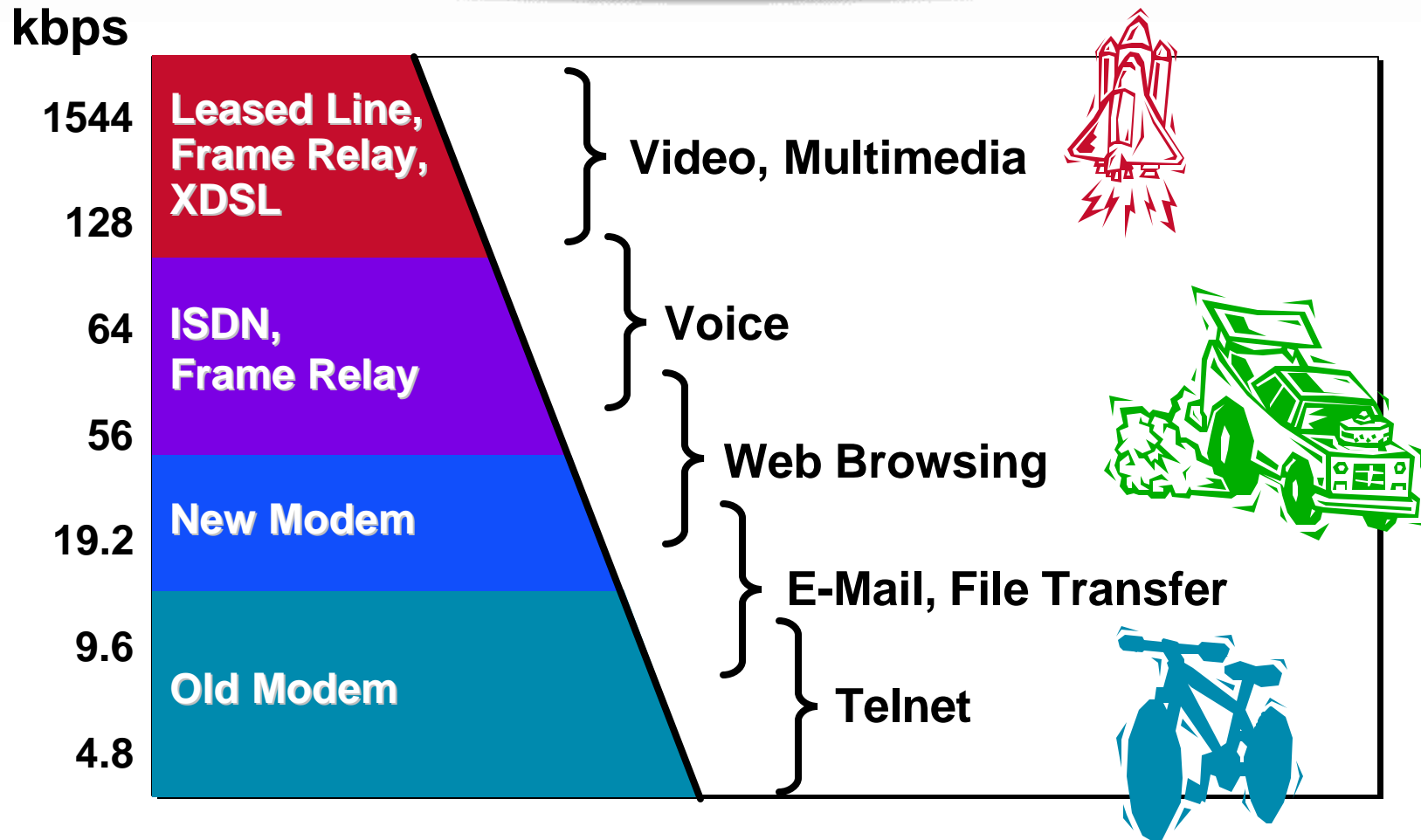
- **Provides functionality and features you need today**
- **Capacity and performance**
- **Easy installation and centralized management**
- **Provides network resiliency**
- **Investment protection in existing infrastructure**
- **Migration path for change and growth**
- **Seamless access for mobile users and branch offices**

Product Selection Considerations (cont.)

- First select WAN technology solutions based on the following:
 - Availability of service
 - Bandwidth requirement
 - Cost
- Second, choose products that support selected WAN solutions



Product Selection Considerations (cont.)

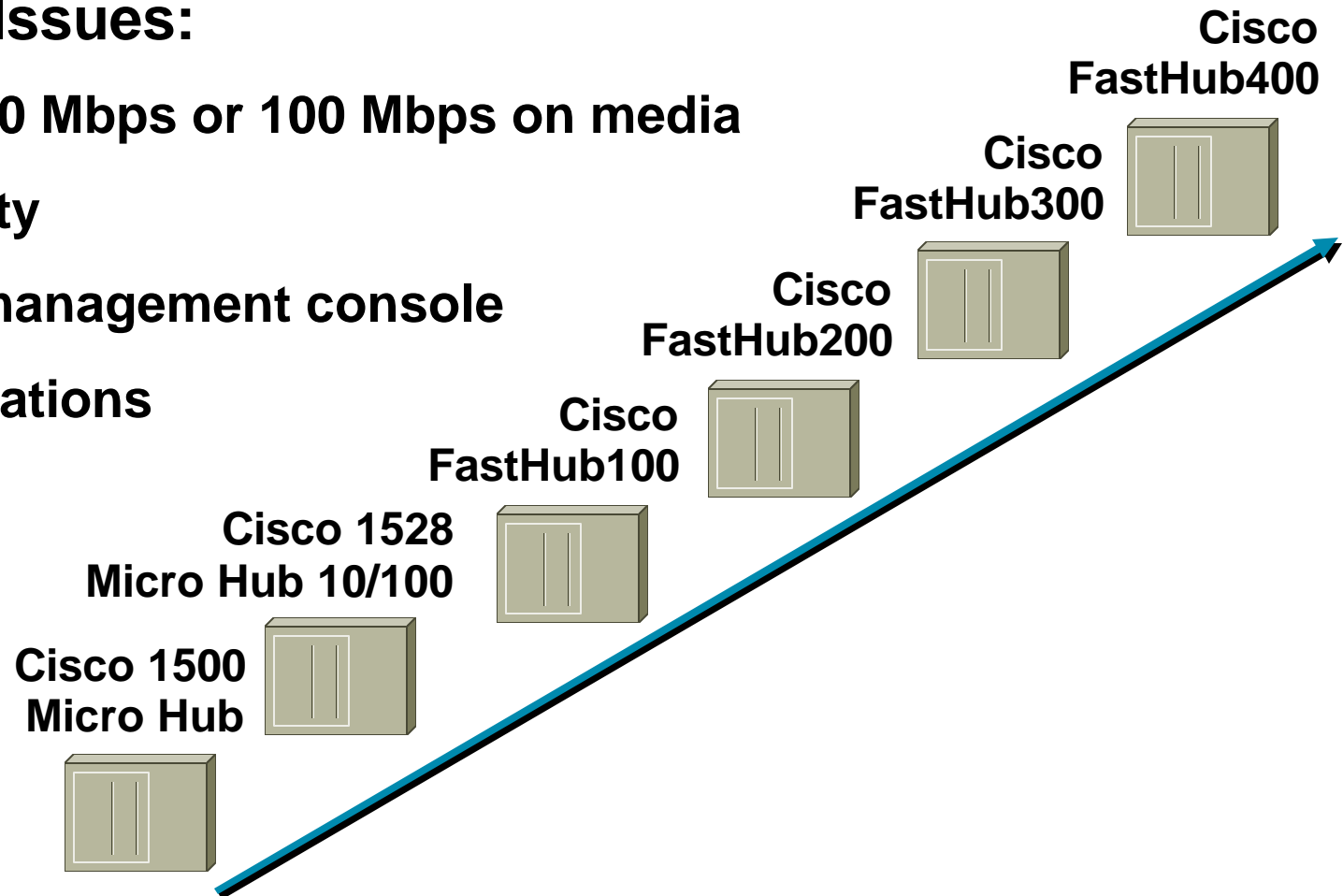


Determine applications that you want to run

Cisco Hub Products

Selection Issues:

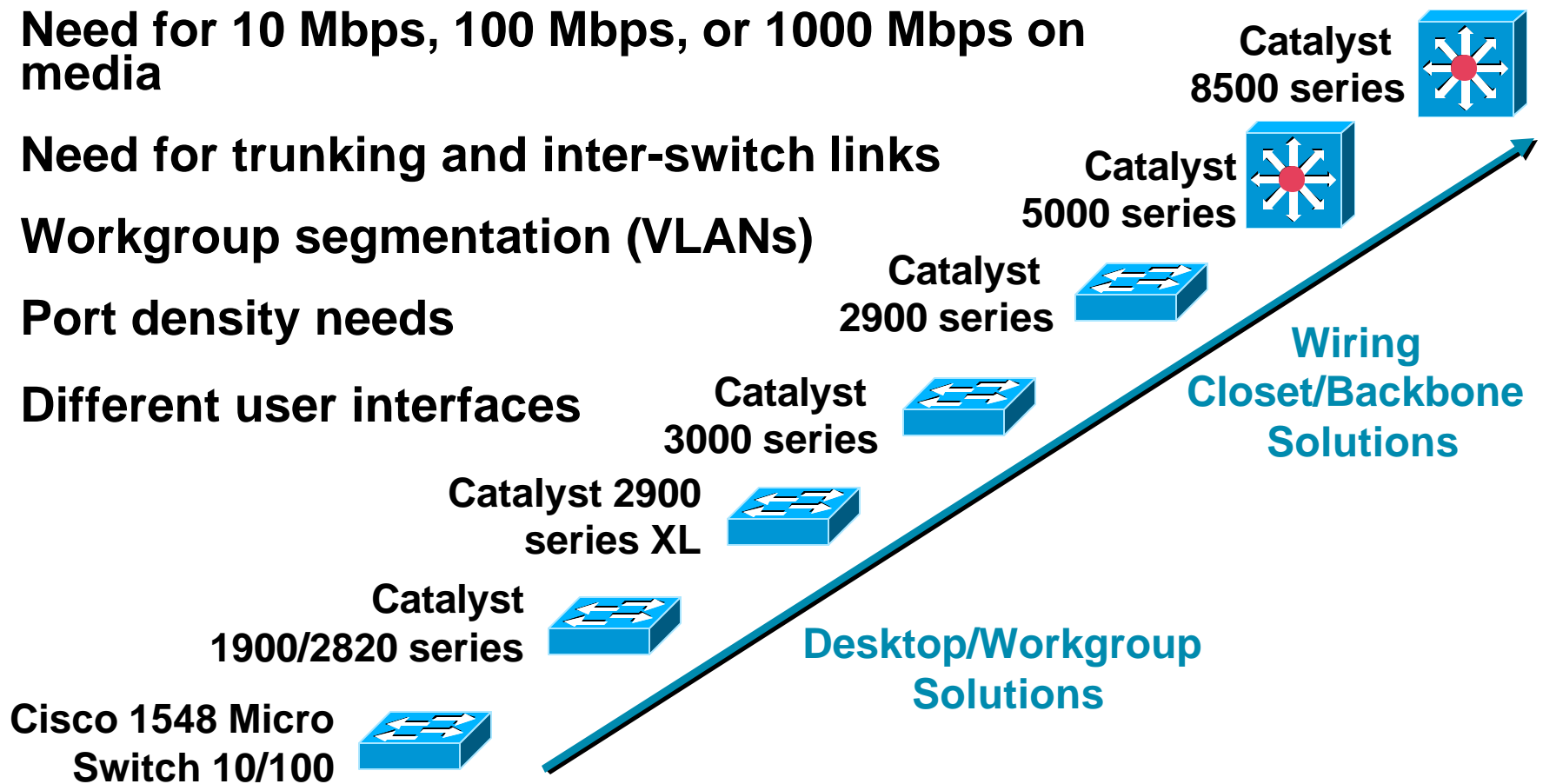
- Need for 10 Mbps or 100 Mbps on media
- Port density
- Need for management console
- Easy Operations



Catalyst Switch Products

Selection Issues:

- Need for 10 Mbps, 100 Mbps, or 1000 Mbps on media
- Need for trunking and inter-switch links
- Workgroup segmentation (VLANs)
- Port density needs
- Different user interfaces

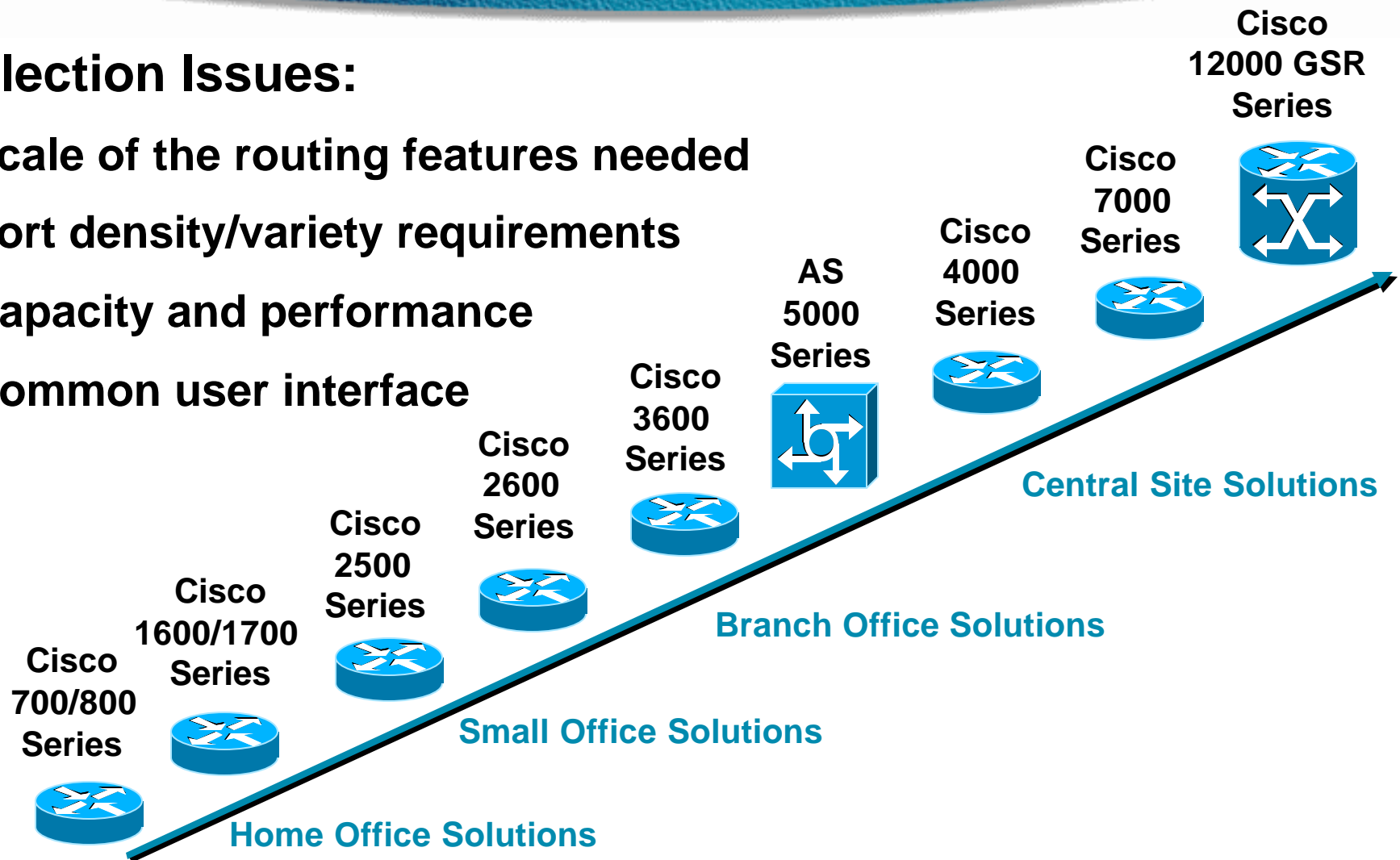


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Cisco Router Products

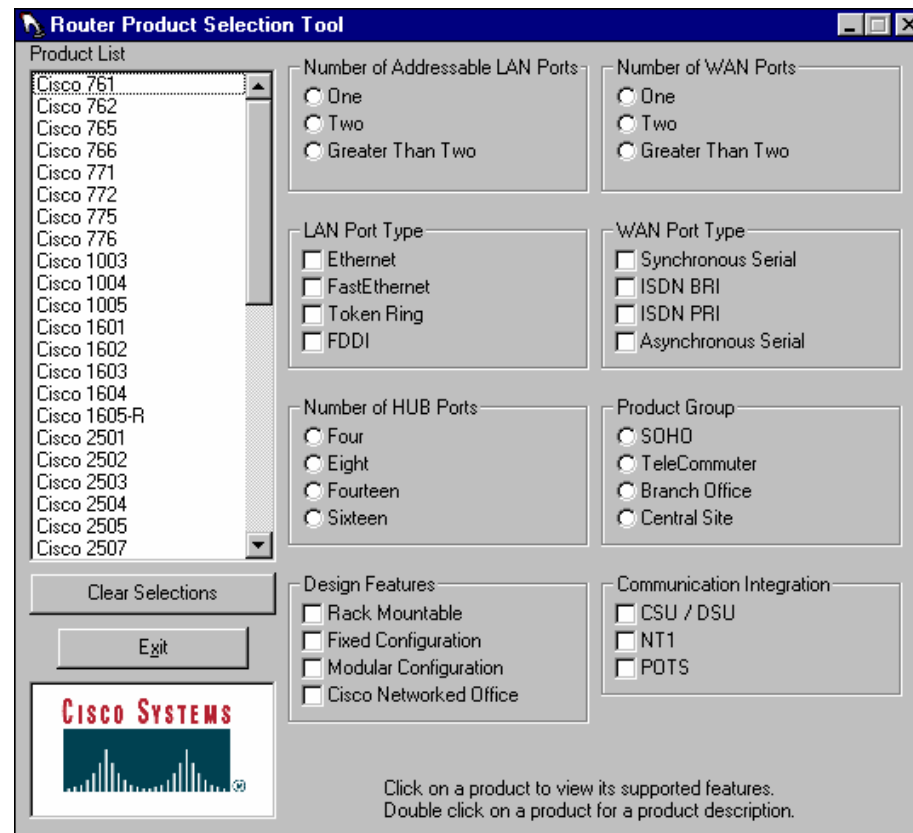
Selection Issues:

- Scale of the routing features needed
- Port density/variety requirements
- Capacity and performance
- Common user interface



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Visual Objective



**Use the product selection tool to
select Cisco Equipment**

Summary

After completing this chapter, you should be able to perform the following tasks:

- **Describe how data moves through a network**
- **Identify the roles and functions of routers, switches and hubs, and specify where each device best fits in the network**
- **Select the appropriate Cisco equipment for a network that combines switching, routing and remote access requirements**

Review Questions

- 1. What are some of the advantages of using the OSI model in a networking environment?**
- 2. Describe the encapsulation process.**
- 3. How many broadcast and collision domains are on a hub?**

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