Network Components

Module Overview

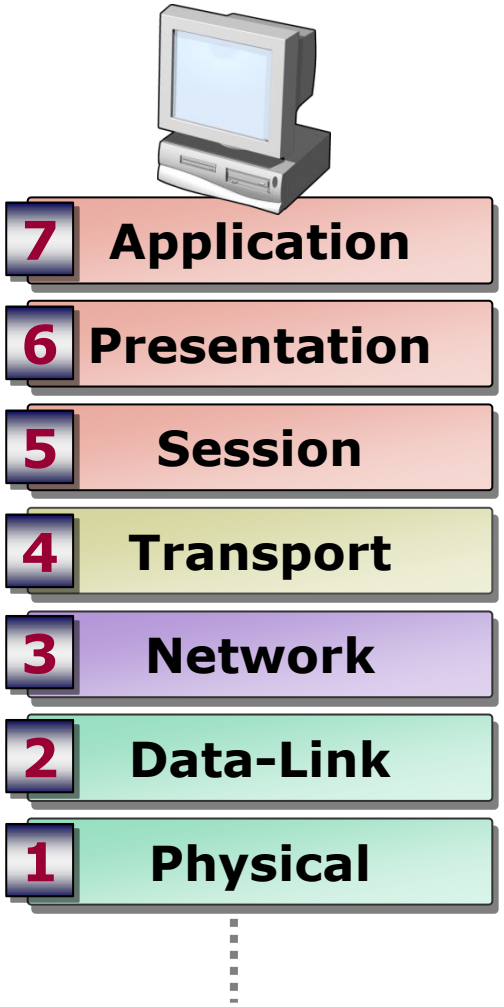
- Understanding the OSI Model
- Communication Types
- Understanding Adapters, Hubs, Switches and Routing
- Understanding Media Types

Understanding the OSI Model

- The OSI Model
- The Lower Layers of the OSI Model
- The Middle Layers of the OSI Model
- The Upper Layers of the OSI Model
- Protocols

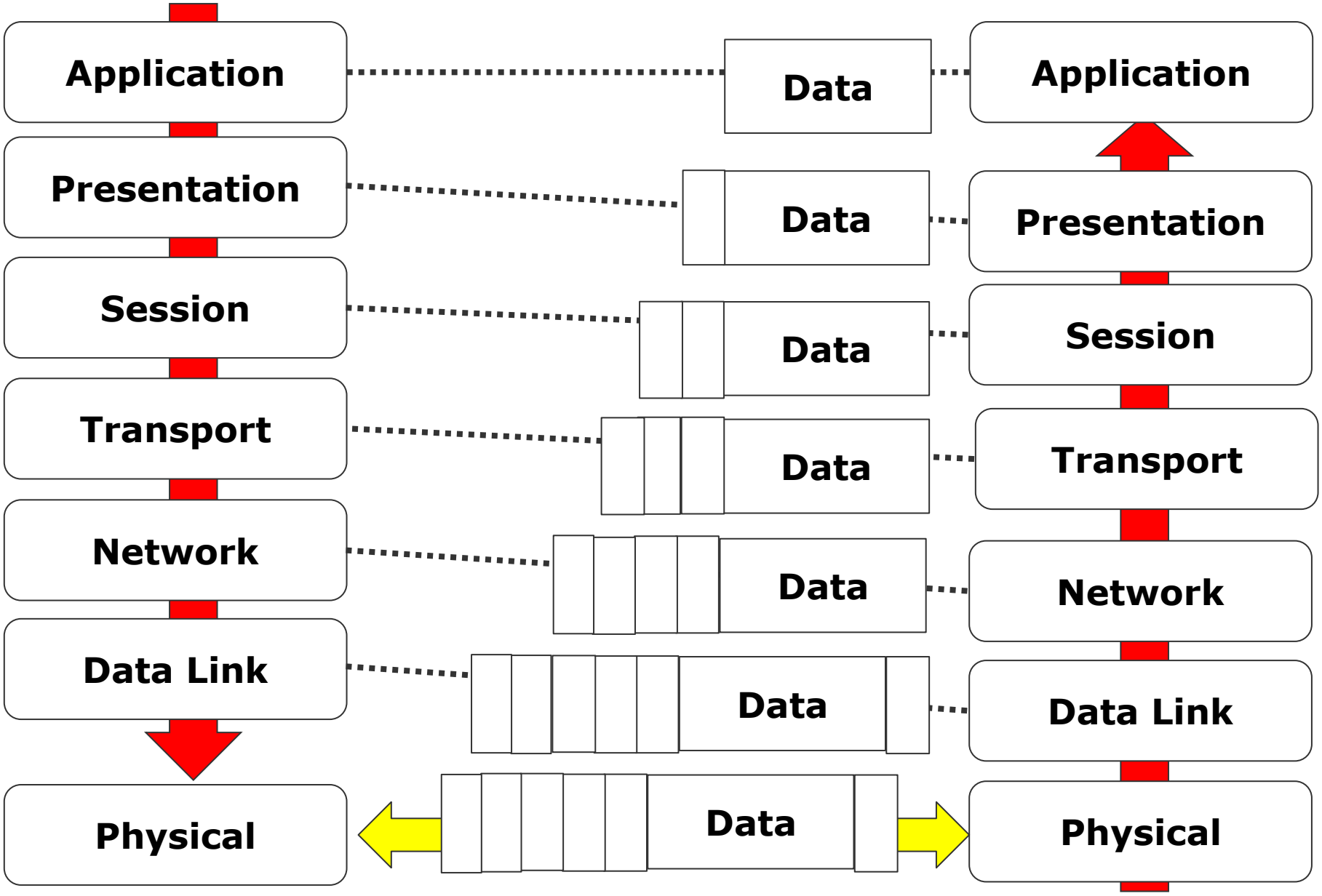
The OSI Model

The OSI model defines the generic tasks that are performed for network communication



- Each layer defines networking tasks
- Each layer communicates with the layers above and below it
- Layer 7 provides services for programs to gain access to the network
- Layers 1 and 2 define the network's physical media and related tasks

The OSI Model



The Lower Layers of the OSI Model

The lower layers of the OSI model are responsible for encapsulating requests from the upper layers into a meaningful structure to be merged onto the media

OSI Layer	Functions
Data-link layer	Transferring data between devices Managing MAC addressing Encapsulating higher protocols into frames Passing protocol-specific data up the stack Error checking
Physical layer	Managing connections to the media Managing shared media access Merging data onto the media Converting signals on the media into frames

The Middle Layers of the OSI Model

These layers are often referred to as the network protocol layer

OSI Layer	Functions
Transport layer	Transferring data between applications Providing reliable end-to-end transfer Encapsulating application requests Passing incoming datagrams to the appropriate session layer protocol
Network layer	Implementing a logical addressing scheme Routing packets to the appropriate logical address Encapsulating transport layer datagrams Passing incoming packets up the protocol stack

The Upper Layers of the OSI Model

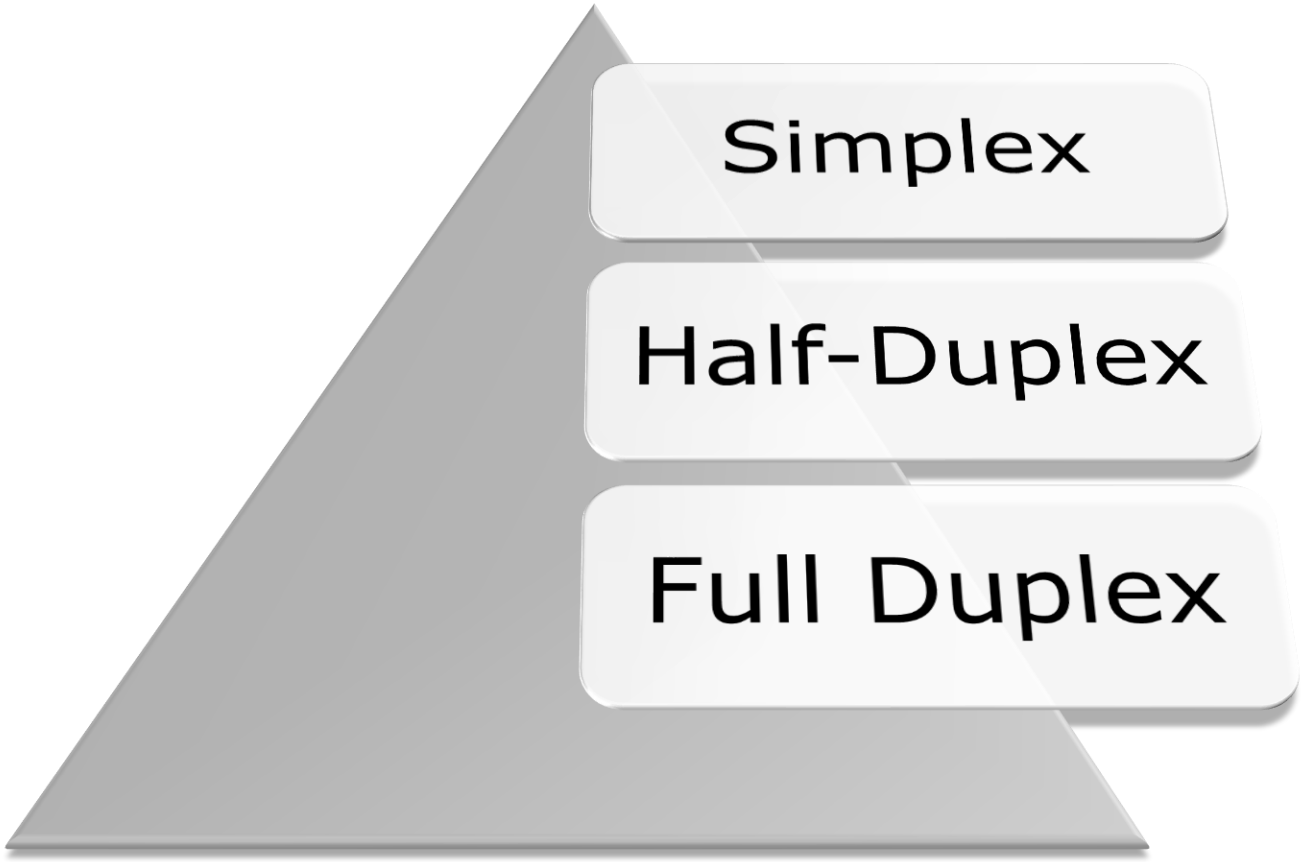
These upper layers are occupied by network applications, or services

OSI Layer	Functions
Application layer	Identifying network hosts Determining available resources Synchronizing communications
Presentation layer	Formatting and encrypting data Providing compatibility by selecting appropriate syntax
Session layer	Establishing, maintaining, and terminating sessions Selecting the appropriate transport layer protocol

The Network Protocols

OSI Layer	Protocols
Network Layer	Address Resolution Protocol (ARP) Internet Control Message Protocol (ICMP) Internet Protocol 4 (IPv4) Internet Protocol 6 (IPv6)
Transport layer	Transmission Control Protocol User Datagram Protocol
Application layer	Domain Name System Simple Mail Transfer Protocol File Transfer Protocol Post Office Protocol Hyper Text Transfer Protocol

What Are Communication Types?



What Are Communication Types?

Simplex

- Uni-directional communication
- Sender sends the data but can’t receive the data
- Usage of one channel
- Slowest Performance
- Utilizes maximum of a single bandwidth.
- Suitable for those transmissions when there is requirement of full bandwidth

What Are Communication Types?

Half-Duplex

- Two-way directional communication one at a time
- Sender can send and received the data.
- One channel for the transmission of data
- Less performance than full duplex.
- Lesser utilization of single bandwidth
- Suitable for those transmissions where there is requirement of sending data in both directions, one at a time

What Are Communication Types?

Full Duplex

- Two-way directional communication simultaneously
- Usage of two channels
- Better performance
- Full-Duplex doubles the utilization of transmission bandwidth
- Suitable for those transmissions when there is requirement of sending and receiving data simultaneously in both directions.

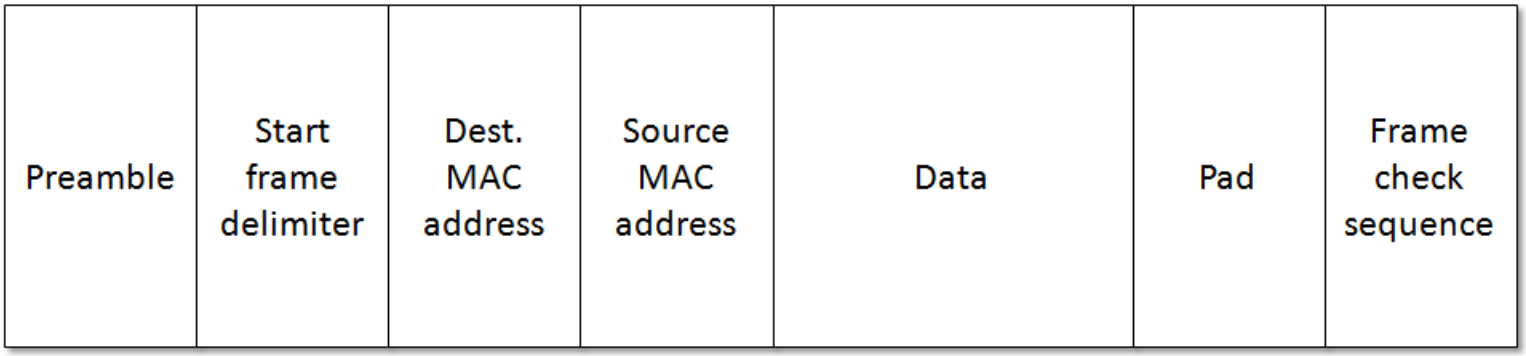
Understanding Adapters, Hubs, and Switches

- What Is a Network Adapter?
- Some Network Devices

What Is a Network Adapter?

A network adapter:

- **Converts instructions from the network protocol stack into electrical signals**
- **Merges these signals onto the wire**
- **Converts electrical signals received on the wire into meaningful instructions for the network protocol stack**



The network adapter encapsulates the instructions it receives from the protocol stack into a logical sequence known as a frame

Transmission Speeds

The term bandwidth is often used to describe the transmission speed of a network

- **Early Ethernet operated at 3 Megabits per second**
- **Today's Ethernet is typically 10 Gigabits per second**
- **Contention reduces throughput**

Network Devices

- Repeater
- Hub
- Bridge
- Switch
- Router

Characteristics of a Repeater

A repeater is a device which regenerates a weak signal

A repeater:

- ✓ **Regenerates a weak signal on the same network**
- ✓ **Amplifies the signal**
- ✓ **Is a 2-port device**
- ✓ **Works at the Physical layer**

What Is a Hub?

A hub is a multi-port repeater

A hub:

- ✓ **Enables star wiring to provide a central wiring point**
- ✓ **Supports multiple ports**
- ✓ **Provides for a degree of fault isolation**
- ✓ **Extends your network**

Characteristics of a Bridge

A bridge is a hub with additional functionality

A bridge:

- ✓ **Filters content by reading MAC addresses**
- ✓ **Enables network traffic management**
- ✓ **Maintains MAC table to redirect traffic to appropriate devices**
- ✓ **Makes redirection decisions based upon incoming MAC addresses**

Characteristics of a Switch

A switch provides the same basic functionality as a Bridge

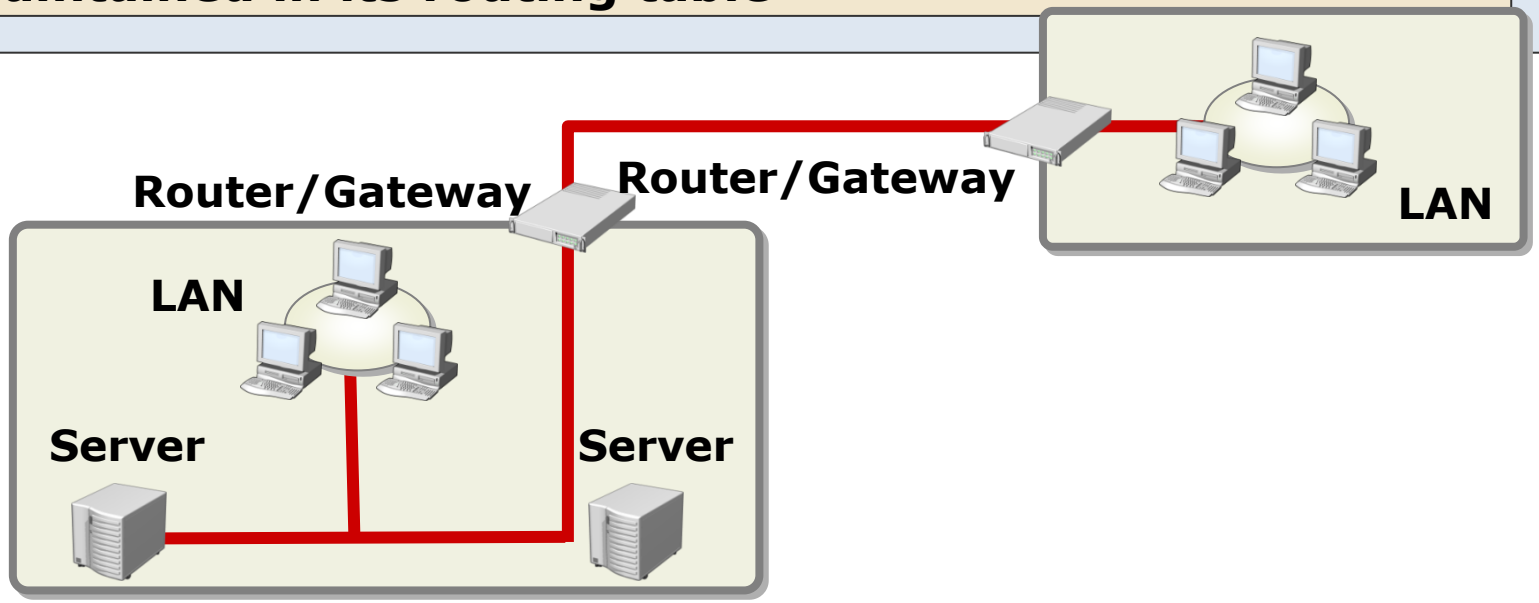
A switch:

- ✓ **Provides wiring concentrator functionality like a hub**
- ✓ **Is a data link layer device**
- ✓ **Performs firewall functions**
- ✓ **Makes routing decisions based upon traffic priority**
- ✓ **Is a multi-port bridge with buffer**

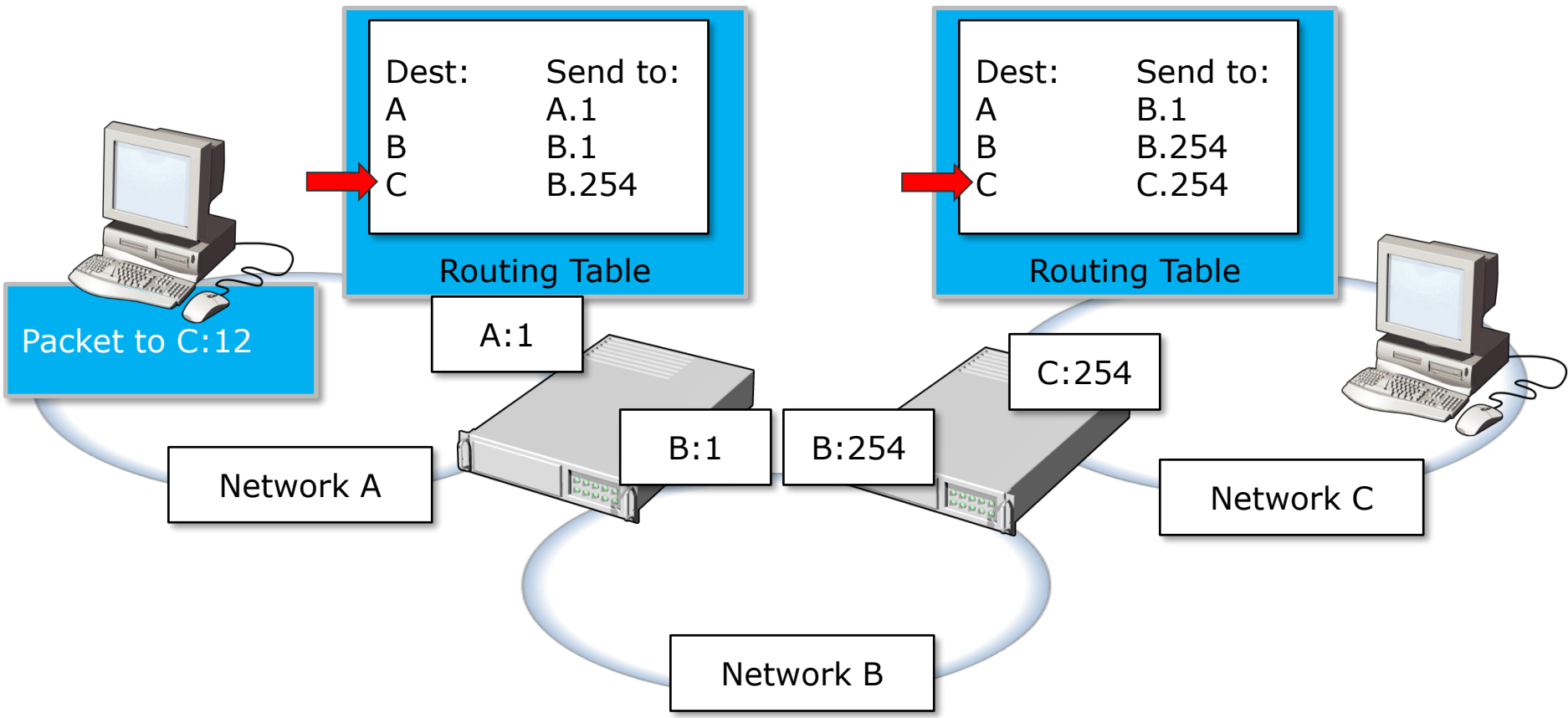
What Is a Router?

A router:

- **Manages network traffic by only forwarding packets when required**
- **Supports one or more routable protocols, such as IP**
- **Receives explicitly addressed frames from network nodes**
- **Makes routing decisions based on the information maintained in its routing table**



How a Router Determines a Destination



Common Routing Protocols

Protocol	Description
Routing Information Protocol (RIP)	Interior Gateway Protocol (IGP) distance-vector based algorithm Hop count > 16 unreachable
Open Shortest Path First (OSPF)	IGP routing protocol Link-state based Scales better than RIP
Border Gateway Protocol (BGP)	EGP specifically designed to support the Internet

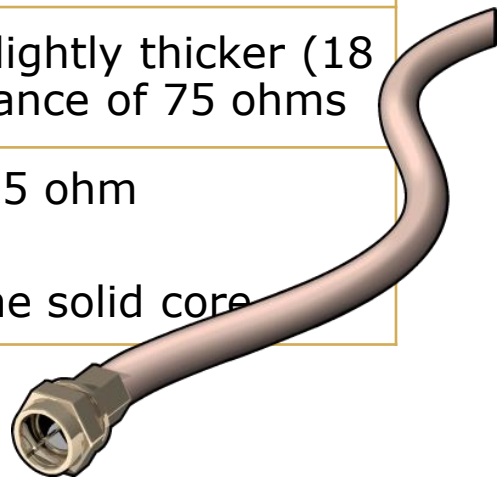
Understanding Media Types

- Coaxial Cable
- Twisted-Pair Cable
- What Are the CAT Standards?
- Fiber Cable

Coaxial Cable

Coaxial cables must be terminated

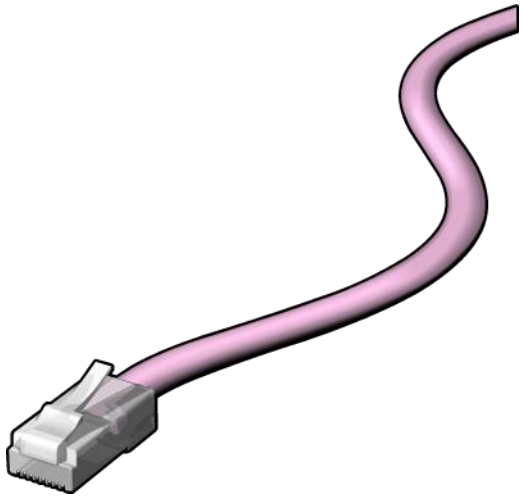
Types of Coaxial Cable	Description
RG58	• Fairly thin and flexible • Ideal for connecting nodes to the network • Does not support long cable runs or a large number of connected devices • Has an impedance of 50 ohms and uses 20 American Wire Gauge (AWG) copper wire
RG59	• As for RG58, but with a slightly thicker (18 AWG) core and an impedance of 75 ohms
RG11	• Thick coaxial cable with 75 ohm impedance • 14 AWG cable provides the solid core



Twisted Pair Cable

Twisted-pair characteristics:

- **Installation is comparatively inexpensive**
- **Fault finding is easier due to the star wired way in which the cable is laid**
- **The cable supports many uses, including data and telephony**



What Are the CAT Standards?

CAT standard	Usage
1	Voice or modem
2	IBM cabling
3	Ethernet
4	Token Ring
5	High-speed Ethernet
5e	Gigabit Ethernet
6	Gigabit Ethernet and 10G Ethernet
6a	10G Ethernet
7	10G Ethernet
8	25G - 40G Ethernet

Fiber Cable

Types of fiber cable	Description
Multimode fiber	• Supports bandwidths of around 100 Mbps at distances of up to 2 kilometers and 10 Gbps over 300 meters
Single-mode fiber	• 40 Gbps is possible over distances of several hundred kilometers