

Computer Communications and Networks

BECE401L

DR. NITISH KATAL

Course Outline

Layered Architecture

- Network Models
- Topologies
- Switching Techniques
- Reference Models
- Network performance metrics

Internetworking Devices

- Repeaters
- Hubs
- Switches
- Routers

Data Link Layer

- Error Detection and Correction
- Data Link and Media Access Control

Network Layer

- Network Layer Protocols
- IP Addressing
- Routing Protocols

Transport Layer

- Protocols
 - Connectionless or Connection Oriented
 - UDP & TCP

Application Layer

- Server Client Architecture
- Network Management
- Multimedia
- Peer to Peer Paradigm

Books

Text Books:

- [T1] Alberto Leon-Garcia, *Communication Networks*, 2017, 2nd Edition, Tata McGraw-Hill, USA.

Reference Books:

- [R1] Dimitri P. Bertsekas & Robert Gallager, *Data Networks*, 2013, 2nd Edition, Prentice Hall, USA.
- [R2] W. Stallings, *Data and Computer Communications*, 2017, 10th Edition, Pearson Prentice Hall, USA.
- [R3] Behrouz A Forouzan, *Data Communications and Networking*, 2017, 5th Edition, Tata McGraw-Hill, USA

Module:1 Layered Network Architecture

- Evolution of data networks
- Network Topologies
- Switching Techniques
- Multiplexing
- Categories of networks
- ISO/OSI Reference Model
- TCP/IP Model
- Addressing
- Network performance metrics.

The Birth of the Internet

1

ARPANET (U.S. Advanced Research Projects Agency Network)

The precursor to the internet, developed in the 1960s by the US Department of Defense to connect research institutions and universities.

First packet switched computer network

2

Packet Switching

A revolutionary idea that allowed data to be broken into small packets and sent across multiple paths, greatly improving network efficiency.

3

Domain Name System (DNS)

Developed in the 1980s to replace the clunky system of numerical IP addresses with user-friendly domain names.

Evolution of Computer Networks

The First High-speed Backbone

NSFNET

Developed in the 1980s by the US National Science Foundation to connect supercomputing centers across the country.

MAE-East Hub

Located in Washington, DC, this was the first high-speed exchange point for internet traffic.

Evolution of Computer Networks

Ethernet and Local Area Networks (LANs)

Ethernet 3.0

The third iteration of Ethernet technology, released in the 1980s, allowed for much faster data transfer rates and enabled the creation of LANs.



LANs Become Popular

As personal computers entered the mainstream, Ethernet and LANs became an essential way to connect and share information.



Evolution of Computer Networks

Internet Protocol (IP) and Wide Area Networks (WANs)

1 IP Addresses

Developed in the 1970s, IP addresses allow devices to be identified and communicate with each other over long distances.

2 WANs and Dial-up Connections

As the internet expanded, WANs and dial-up connections became essential for connecting to remote servers and resources.

3 Fiber Optics

The development of fiber optic cables greatly improved WAN speeds and capacity, allowing for the massive expansion of internet use.

Evolution of Computer Networks

Wireless Networks and the rise of Mobile Devices

Wi-Fi

Wi-Fi technology allowed for the creation of wireless LANs, which transformed the way we connect to the internet.

Mobile Devices

The rise of smartphones and tablets created a new era of wireless connectivity, with mobile data usage surpassing desktop usage for the first time in 2016.

Evolution of Computer Networks

Cloud Computing and Virtualization

1

Virtualization

Virtual machines allowed for multiple operating systems to run on a single computer, greatly improving efficiency and utilization.

2

Cloud Computing

Cloud computing allows for remote access to computing resources and applications, reducing costs and improving scalability.

Evolution of Computer Networks

Internet of Things (IoT) and Smart Devices

IoT

The Internet of Things allows everyday devices to connect to the internet, enabling a new era of automation and data collection.

Smart Devices

The rise of smart devices, from watches to thermostats, has led to a new level of connectivity and integration in our daily lives.

Evolution of Computer Networks

Challenges and Future of Computer Networks

Security and Privacy

As networks become more complex and data flows more freely, maintaining security and privacy is an ongoing challenge.

Scalability and Bandwidth

As more devices connect to the internet and more data is generated, the need for increased bandwidth and faster speeds continues to grow.

Data Communication

Communication: Sharing of information.

- Between individuals, devices, etc.
- Can be Direct or Remote.

Telecommunication: means communication at a distance (*tele* is Greek for “far”).

Data: refers to information presented.

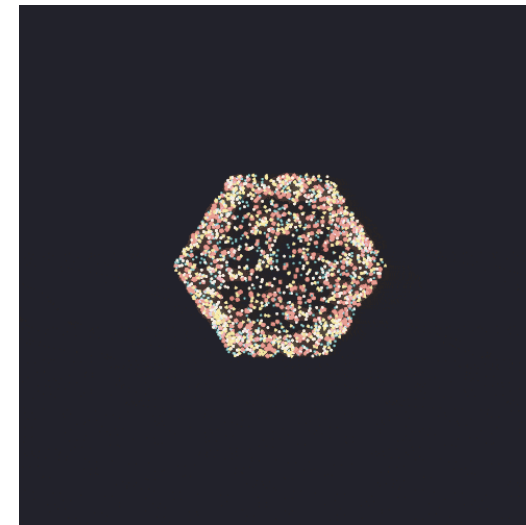
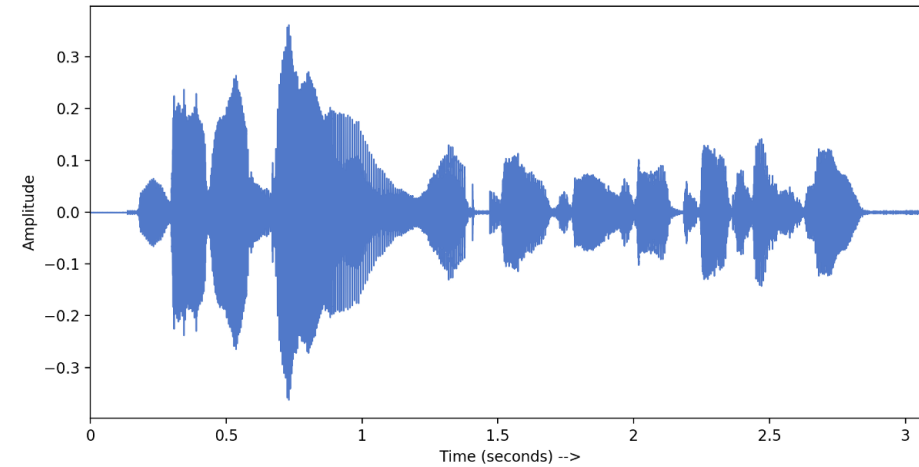
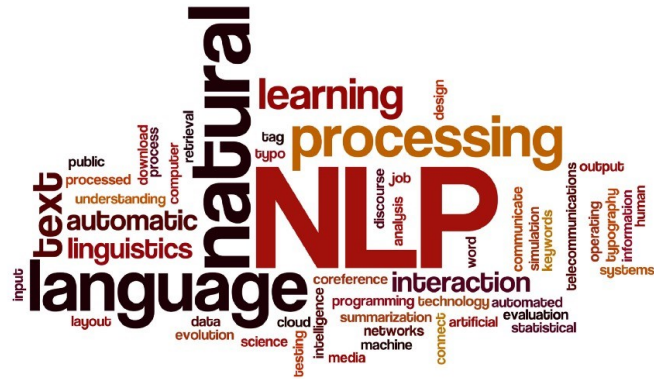
Data communications:

- The exchange of data between two/more devices via some form of transmission medium.

For data communications to occur,

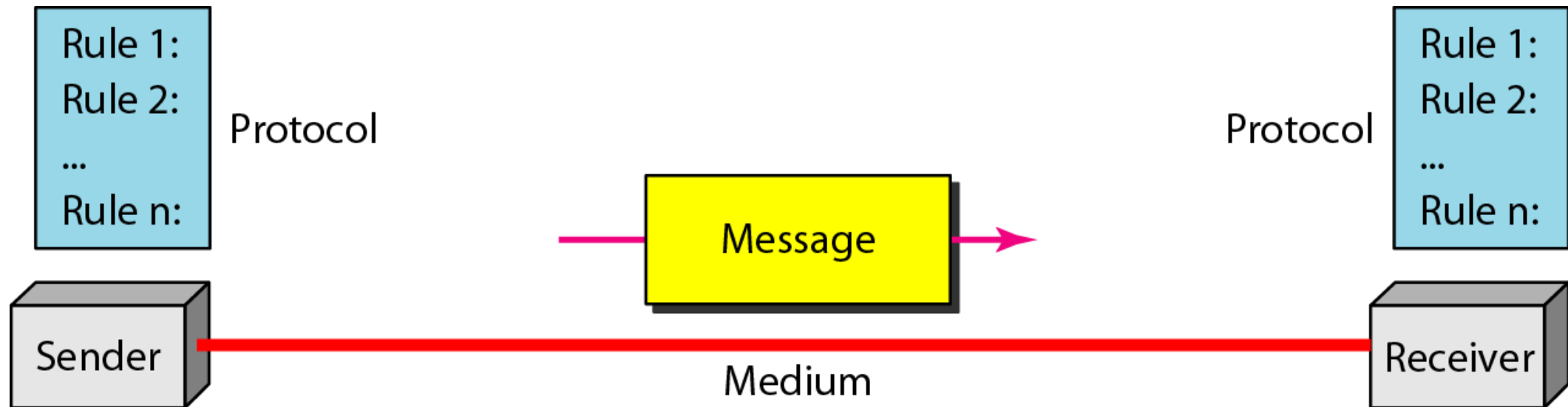
- The communicating devices must be part of a communication system
 - Combination of Hardware (physical equipment) and
 - Software.

Data Communication: **Data**

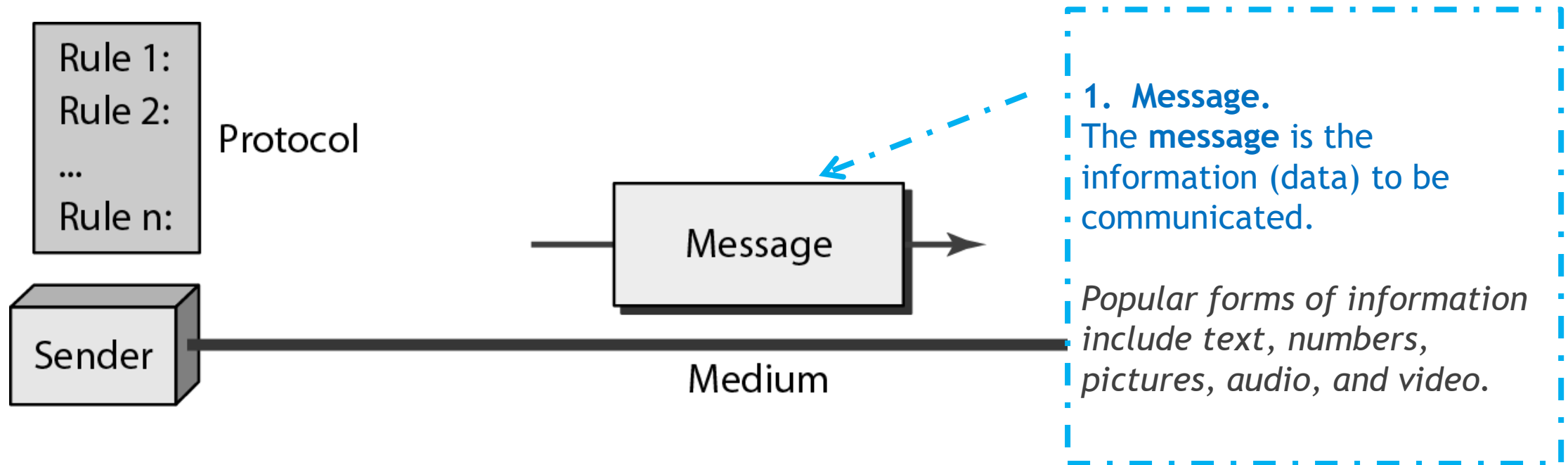


Data Communication: Components

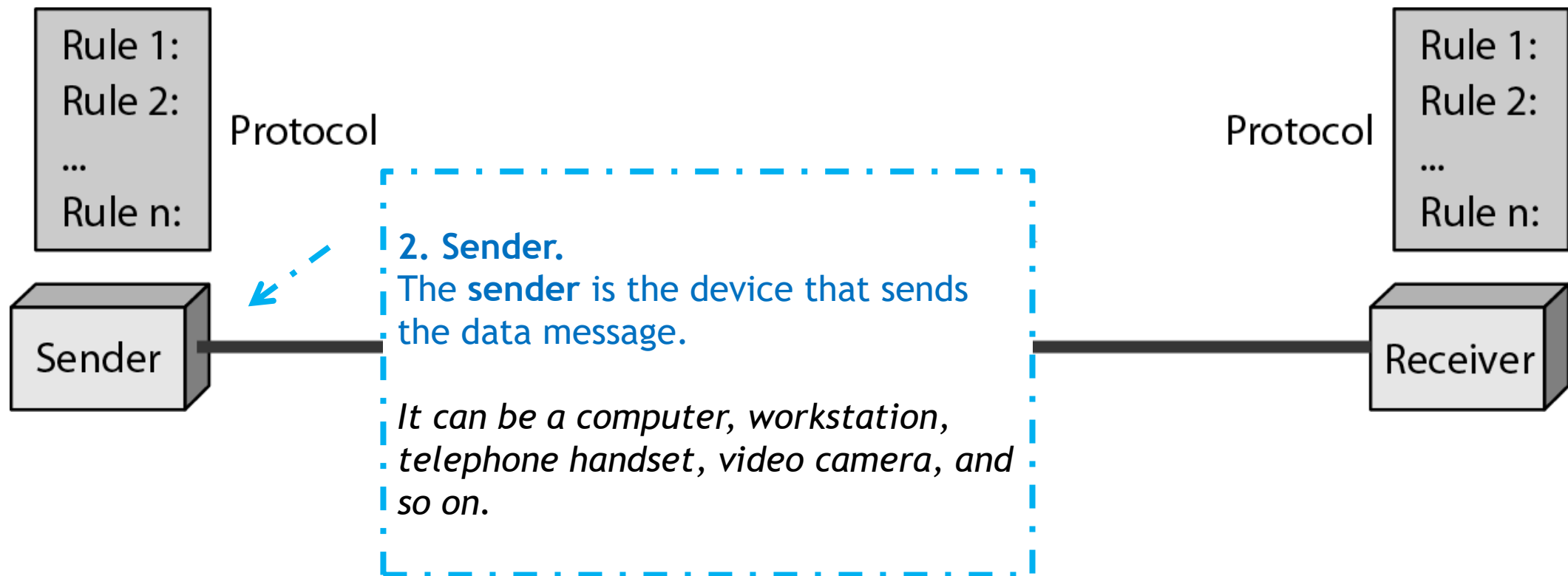
*A data communications system has **five components***



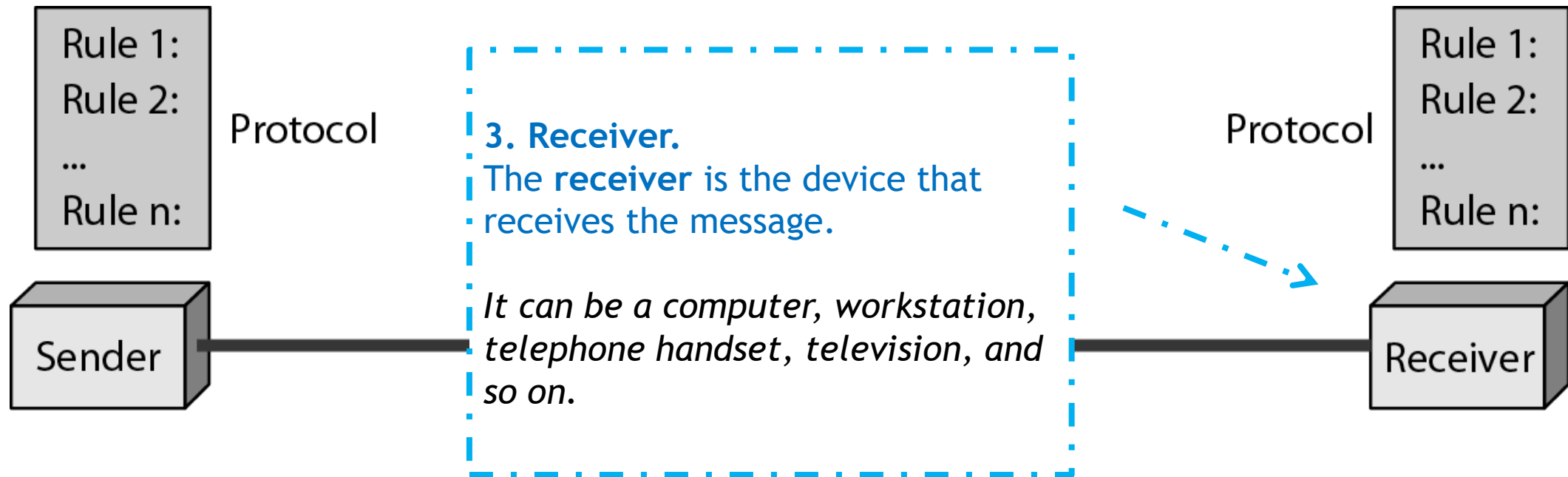
Data Communication: **Components**



Data Communication: **Components**



Data Communication: **Components**

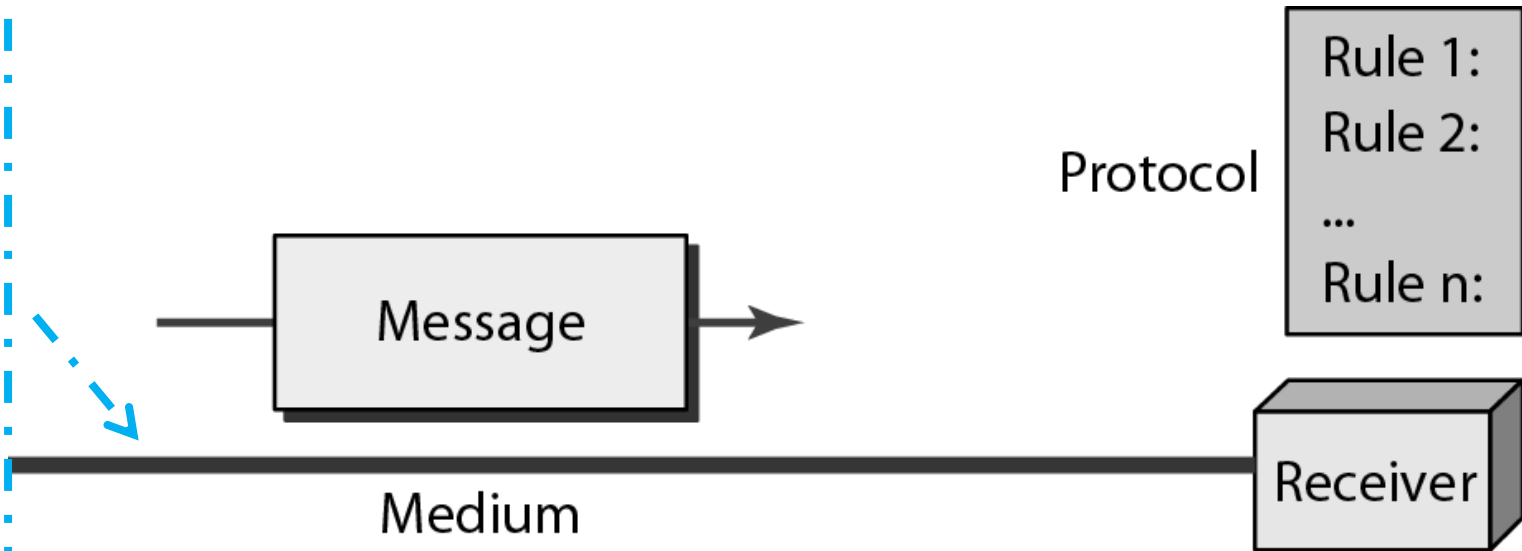


Data Communication: **Components**

4. Transmission medium.

The **transmission medium** is the physical path by which a message travels from sender to receiver.

Some examples of transmission media include twisted-pair wire, coaxial cable, fiber-optic cable, and radio waves.



Data Communication: **Components**



Networks

Network:

- Is the interconnection of a set of devices capable of communication.

Host (end-device)

- Can be a device such as a large computer, desktop, laptop, workstation, cellular phone, or security system.

Connecting device

- A device can also be a such as a router, a switch, a modem, and so on.

These devices are connected

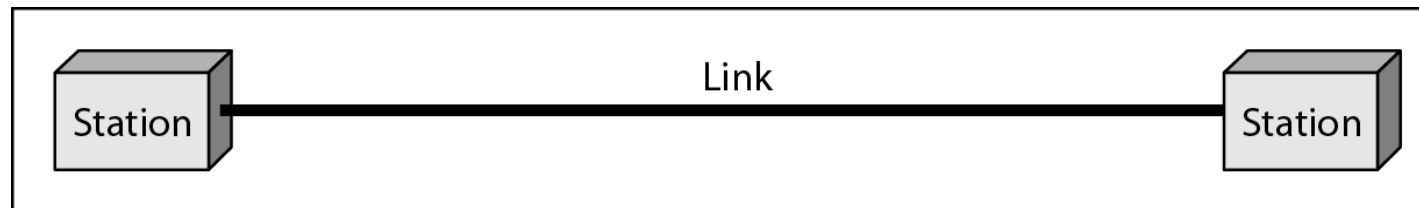
- Using wired or wireless transmission media such as cable or air.

Networks : Types of Connection

- A **network** is two or more devices **connected** through **links**.
- Link is a communications pathway that transfers data from one device to another.
 - *For communication to occur, two devices must be connected in some way to the same link at the same time.*

A. Point-to-Point Connection

- Provides a **dedicated link** between two devices.
 - *Entire capacity of the link is reserved for transmission between those two devices.*
- **Example:** When we change television channels by infrared remote control.
 - *In that case we are establishing a point-to-point connection between the remote control and the television's control system.*

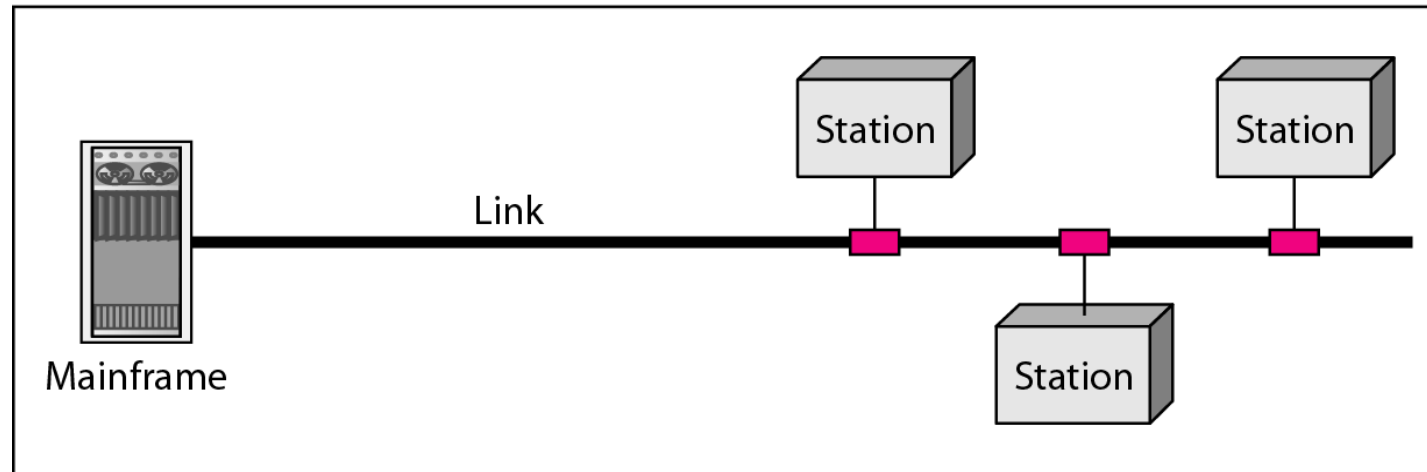


a. Point-to-point

Networks : Types of Connection

B. Multipoint

- A multipoint (also called multidrop) connection is one in which **more than two specific devices share a single link**.
- In a multipoint environment, the **capacity of the channel is shared**
- If users must take turns, it is a **timeshared** connection.



b. Multipoint