

Tishk International University
Science Faculty
Information Technology Department



**Data Communication &
Computer Networks II**

Transmission Modes

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Chapter 9

Transmission Modes

Topics Covered

- 9.1 Introduction
- 9.2 A Taxonomy of Transmission Modes
- 9.3 Parallel Transmission
- 9.4 Serial Transmission
- 9.5 Transmission Order: Bits and Bytes
- 9.6 Timing of Serial Transmission
- 9.7 Bytes, Blocks, and Frames
- 9.8 Simplex, Half-Duplex, and Full-Duplex Transmission

9.1 Introduction

- This chapter
 - continues the discussion by focusing on the ways data is transmitted
 - introduces common terminology
 - explains the advantages and disadvantages of parallelism
 - discusses the important concepts of synchronous and asynchronous communication

9.2 A Taxonomy of Transmission Modes

- We use the term *transmission mode* to refer to the manner in which data is sent
- Transmission modes can be divided into two fundamental categories:
- **Serial** — one bit is sent at a time
 - It is further categorized according to timing of transmissions
- **Parallel** — multiple bits are sent at the same time
- Figure 9.1 gives an overall taxonomy of the transmission modes discussed in the chapter

9.2 A Taxonomy of Transmission Modes

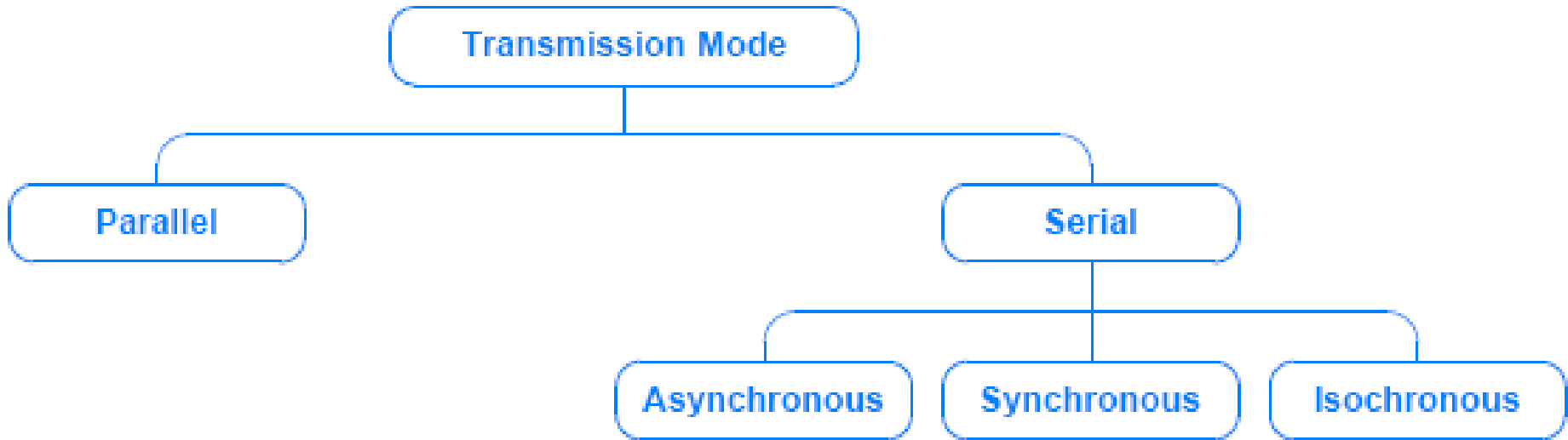


Figure 9.1 A taxonomy of transmission modes.

9.3 Parallel Transmission

- **Parallel** transmission allows transfers of **multiple** data bits at the same time over separate media
- It is used with a wired medium that uses multiple, **independent wires**
- Signals on all wires are **synchronized**
 - bits travels across each of the wires at precisely the same time
- Figure 9.2 illustrates the concept, and shows why engineers use the term parallel to characterize the wiring

9.3 Parallel Transmission

*each wire carries the signal for one bit,
and all wires operate simultaneously*

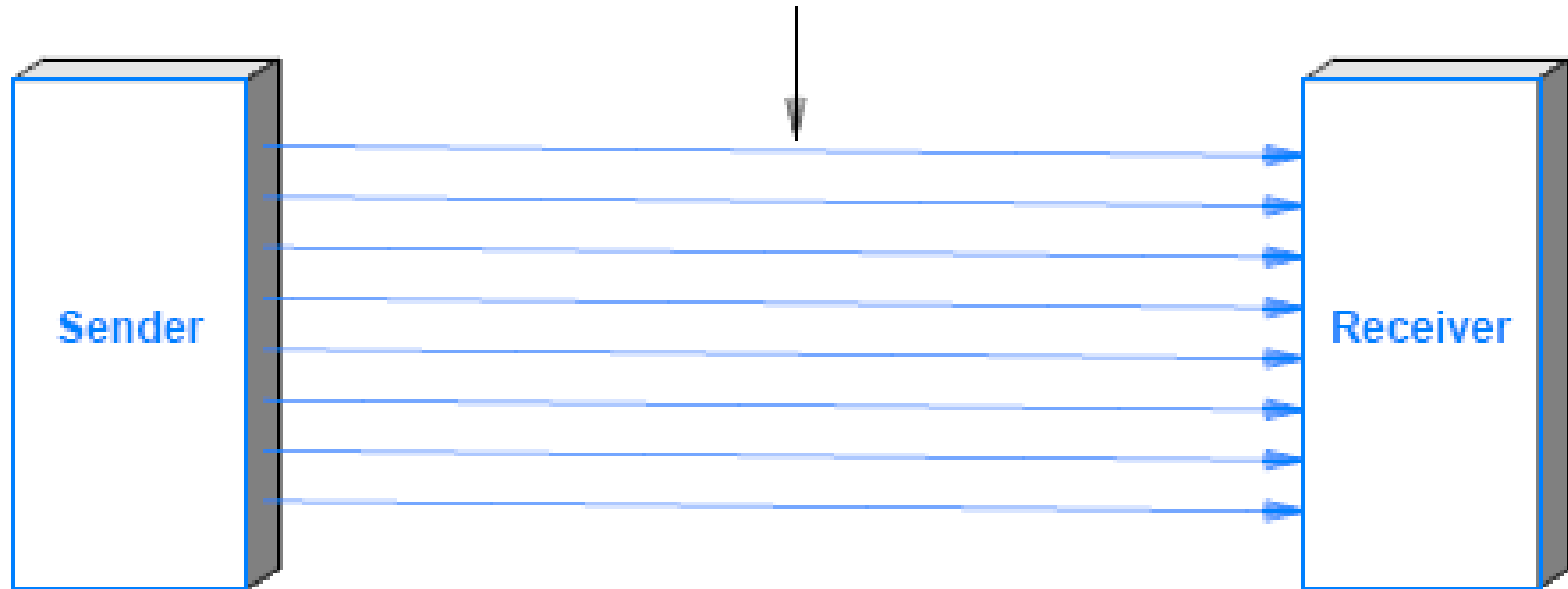


Figure 9.2 Illustration of parallel transmission that uses 8 wires to send 8 bits at the same time.

9.3 Parallel Transmission

- The figure omits two important details:
 - A parallel interface usually contains other wires that allow the sender and receiver to coordinate beside data lines
 - To make installation and troubleshooting easy the wires for a parallel transmission system are placed in a single physical cable
- A parallel mode of transmission has some advantages:
 - **High speed**: it can send **N** bits at the same time
 - **Match to underlying hardware**: Internally, computer and communication hardware uses parallel circuitry

9.4 Serial Transmission

- **Serial** transmission sends one bit at a time
- Most communication systems use serial mode
- There are two main reasons
 - serial networks can be extended over long distances at much less cost
 - using only one physical wire means that there is never a timing problem caused by one wire being slightly longer than another
- Sender/receiver contain converts data from the parallel form used in the device to the serial form used on the wire
- Figure 9.3 illustrates the configuration

9.4 Serial Transmission

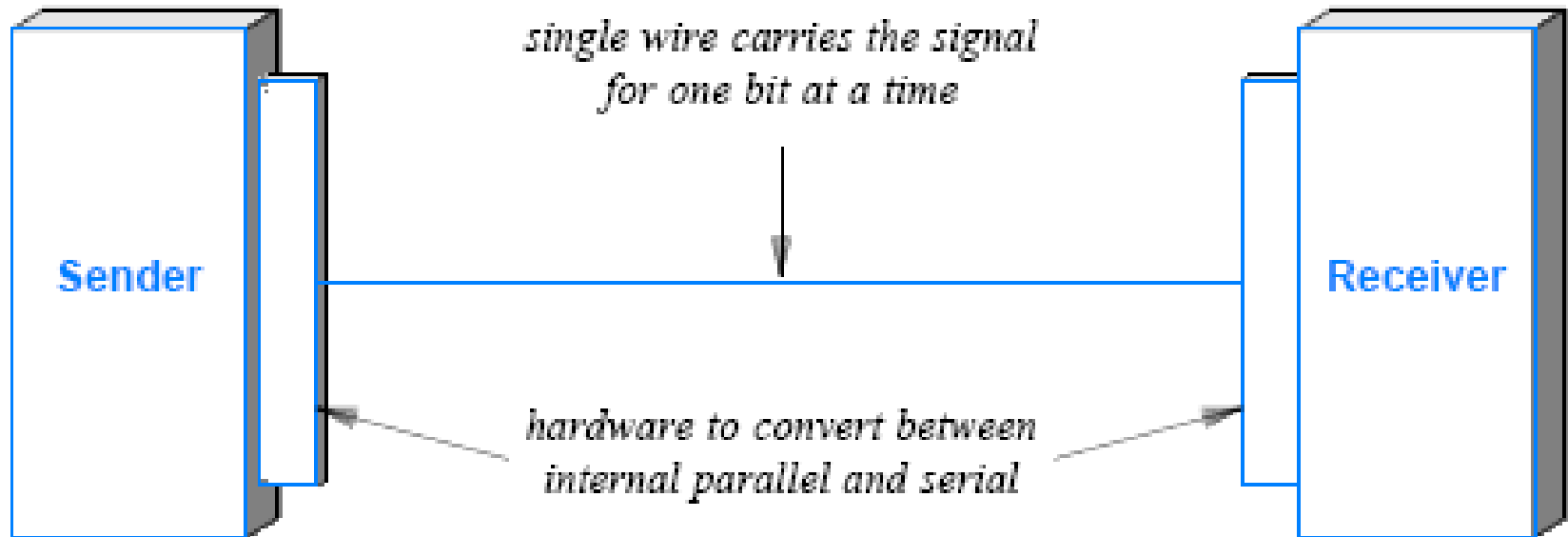


Figure 9.3 Illustration of a serial transmission mode.

9.4 Serial Transmission

- Hardware needed to convert data between an internal parallel form and a serial form can be simple or complex
- In the simplest case, a single chip that is known as a **Universal Asynchronous Receiver and Transmitter (UART)**
- A related chip, **Universal Synchronous-Asynchronous Receiver and Transmitter (USART)** handles conversion for synchronous networks

9.6 Timing of Serial Transmission

- Serial transmission mechanisms can be divided into three broad categories (depending on how transmissions are spaced in time):
 - **Asynchronous** transmission can occur at any time
 - with an **arbitrary delay** between the transmission of two data items
 - **Synchronous** transmission occurs continuously
 - with **no gap** between the transmission of two data items
 - **Isochronous** transmission occurs at regular intervals
 - with a **fixed gap** between the transmission of two data items

9.7 Bytes, Blocks, and Frames

- What happens if a sender does not have data ready to send at all times?
- The answer lies in a technique known as **framing**:
 - an interface is added to a synchronous mechanism that accepts and delivers a block of bytes known as a **frame**
- To insure that the sender and receiver stay synchronized
 - a frame starts with a special sequence of bits
- Most synchronous systems include an idle sequence (or idle byte)
 - that is transmitted when the sender has no data to send
- Figure 9.7 illustrates the concept

9.7 Bytes, Blocks, and Frames

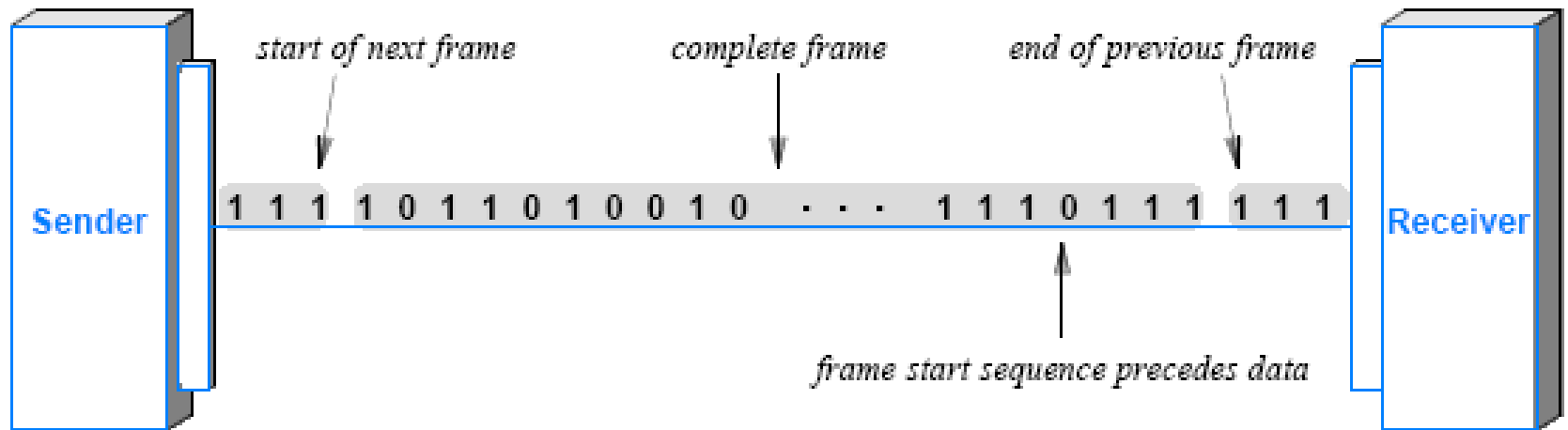


Figure 9.7 Illustration of framing on a synchronous transmission system.

9.8 Simplex, Half-Duplex, and Full-Duplex Transmission

- A communications channel is classified as one of three types: (depending on the direction of transfer)
 - Simplex
 - Full-Duplex
 - Half-Duplex
- **Simplex:** a simplex mechanism can only transfer data in a single direction
 - It is analogous to broadcast radio or television
 - Figure 9.8a illustrates simplex communication
- **Full-Duplex:** allows transmission in two directions simultaneously
 - It is analogous to a voice telephone conversation
 - a participant can speak even if they are able to hear background music at the other end
 - Figure 9.8b illustrates the concept

9.8 Simplex, Half-Duplex, and Full-Duplex Transmission

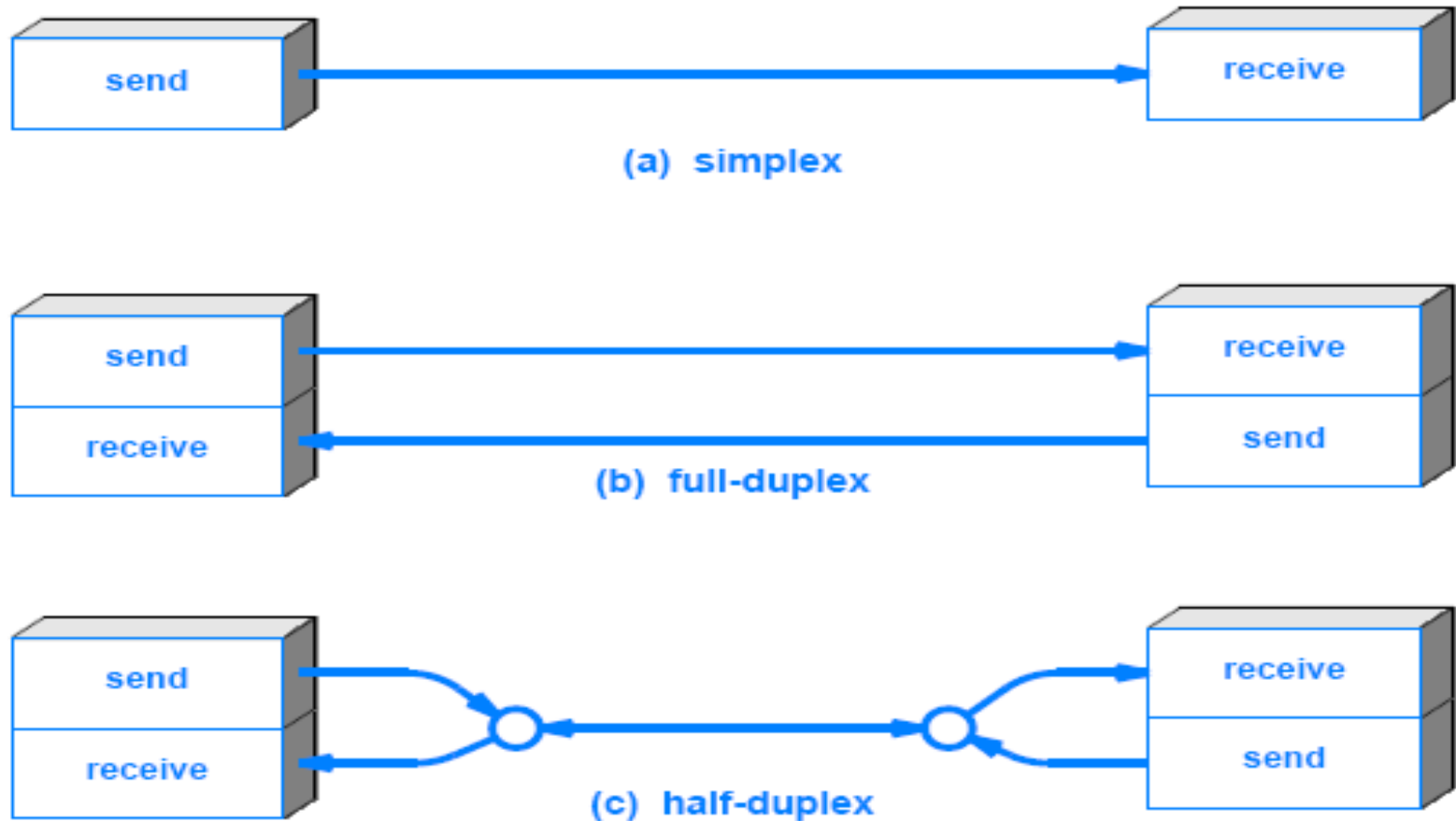


Figure 9.8 Illustration of the three modes of operation.

9.8 Simplex, Half-Duplex, and Full-Duplex Transmission

- **Half-Duplex:** A half-duplex mechanism involves a shared transmission medium
 - Medium can be used for communication in each direction
 - But the communication cannot proceed simultaneously
 - It is analogous to using **walkie-talkies**
 - Only side can transmit at a time
- An additional mechanism is needed at each end of a half-duplex communication
 - To coordinate transmission to insure that only one side transmits at a given time
- Figure 9.8c illustrates half-duplex communication