EMBEDDED SYSTEMS
(CMPE 30247)

Asynchronous and Synchronous Serial Communication

Objectives

1. Highlight asynchronous and synchronous type of serial communication.
2. Describe the difference between asynchronous and synchronous type of communication.

Pre Test

1. What does synchronous transmission require to synchronize the sender and receiver?

A) Start and Stop bits
B) Clock signal
C) Parity bit
D) Data packets

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B) Header bits

C) Start and stop bits

D) Control bits

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In synchronous transmission, data is sent in the form of:

A) Bytes

B) Characters

C) Blocks

D) Packets

3. In synchronous transmission, data is sent in the form of:

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B) Characters

C) Blocks

D) Packets

4. The data transfer rate of asynchronous transmission is:

A) Higher

B) Lower

C) The same

D) Variable

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Serial Communication

Serial communication in embedded systems refers to the process of transmitting and receiving data between an embedded system (such as a microcontroller) and other devices or peripherals using a **serial** data transmission protocol.

Serial Communication

One of the major differences is that in **Synchronous Transmission**, the sender and receiver should have **synchronized clocks before data transmission.**

Whereas **Asynchronous Transmission does not require a clock**, but it adds a parity bit to the data before transmission.

a parity bit is an error-checking mechanism used to detect errors during data transmission. It is a simple form of error detection that helps ensure the integrity of the transmitted data.

Serial Communication

Additionally, synchronous transmission utilizes **synchronization characters**, whereas the asynchronous method employs **start and stop bits**.

These bits signal the modem when data is being transmitted and when the transmission is complete, which are referred to as **message characters**.

Comparison Chart

BASIS FOR COMPARISON	SYNCHRONOUS TRANSMISSION	ASYNCHRONOUS TRANSMISSION
Meaning	Transmission starts with the block header which holds a sequence of bits.	It uses start bit and stop bit preceding and following a character respectively.
Transmission manner	Sends data in the form of blocks or frames	Sends 1 byte or character at a time
Synchronization	Present with the same clock pulse.	Absent

Comparison Chart

BASIS FOR COMPARISON	SYNCHRONOUS TRANSMISSION	ASYNCHRONOUS TRANSMISSION
Transmission Speed	Fast	Slow
Gap between the data	Does not exist	Exist
Cost	Expensive	Economical

Comparison Chart

BASIS FOR COMPARISON	SYNCHRONOUS TRANSMISSION	ASYNCHRONOUS TRANSMISSION
Time Interval	Constant	Random
Implemented by	Hardware and software	Hardware only
Examples	Chat Rooms, Video Conferencing, Telephonic Conversations, and others.	Letters, emails, forums, etcetera.

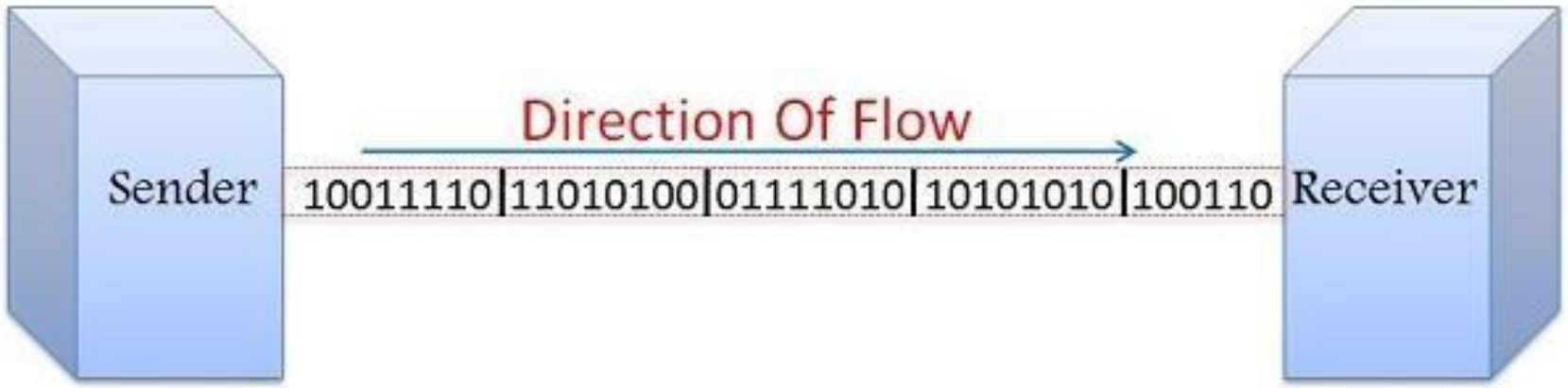
Serial Communication

In synchronous transmission, data is transmitted in **a full-duplex mode using blocks or frames**.

For effective communication, synchronization between the sender and receiver is essential, allowing the sender to identify where each new byte begins, as there are no gaps between the data.

Serial Communication

Therefore, each block of characters is labelled with the **synchronization characters** and the receiving device acquires the data until a special ending character is identified.



Serial Communication

Synchronous Transmission is efficient, reliable and is used for transferring a large amount of data.
It provides real-time communication between connected devices.

Chat Rooms, Video Conferencing, telephonic conversations, as well as face to face interactions, are some of the examples of Synchronous Transmission.

Serial Communication

Voice-band and broadband channels are typically utilized in synchronous transmission modes because they offer faster speeds of up to **1200 bps**, facilitating high data transfer rates.

Serial Communication

How many total bits are there in a character when including the parity bit, start bit, and stop bit?

A) 8 bits

B) 9 bits

C) 10 bits

D) 11 bits

Serial Communication

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Serial Communication

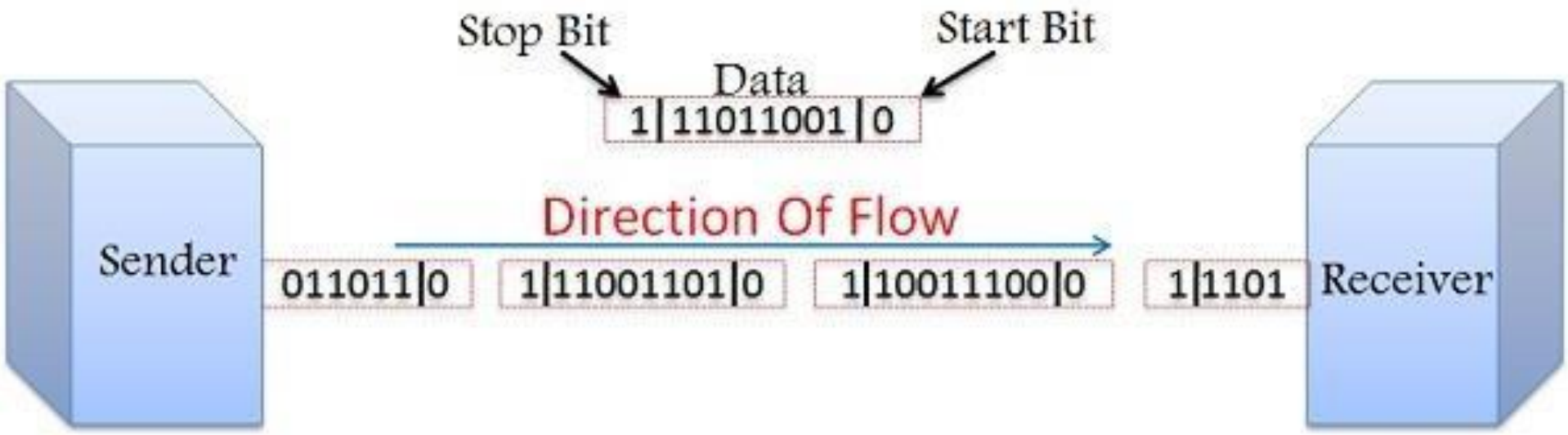
Definition of Asynchronous Transmission

In **Asynchronous Transmission** data flows in a **half-duplex mode**, 1 byte or a character at a time. It transmits the data in a continuous stream of bytes.

In general, the size of a character sent is 8 bits to which a parity bit is added, i.e. a start and a stop bit that gives the total of **10 bits**.

Serial Communication

It does not require a clock for synchronization; rather it uses the parity bits to tell the receiver how to interpret the data. These **parity bits** are known as **start and stop bits** which control the transfer of data.



Serial Communication

It uses character-based synchronization so that the receiving terminal could synchronize itself with the receipt of data on a character.

It is simple, fast, economical and does not require a 2-way communication.

Letters, emails, forums, televisions and radios are some of the examples of Asynchronous Transmission.

Serial Communication

The voice-band channels that are of a narrow type and operates on a slower speed are utilized in the asynchronous transfer. Here, the transmitting device works manually or intermittently.

Key Differences Between Synchronous and Asynchronous Transmission

Serial Communication

1. In Synchronous Transmission, data is transferred in the form of **frames**. On the other hand, in Asynchronous Transmission data is transmitted 1 byte at a time.

Serial Communication

2. Synchronous Transmission requires a **clock signal between the sender and receiver** so as to inform the receiver about the new byte.

In contrast, in Asynchronous Transmission sender and receiver does **not require a clock signal** as the data sent here has a parity bit attached to it which indicates the start of the new byte.

Serial Communication

3.Data transfer rate of Asynchronous Transmission is slower than that of Synchronous Transmission.

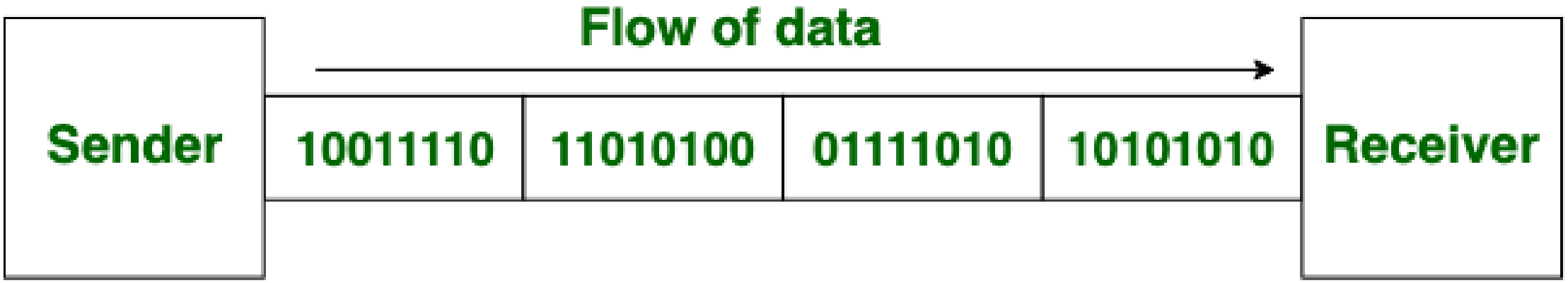
4.Asynchronous Transmission is simple and economical, whereas Synchronous Transmission is complicated and expensive.

5.Synchronous Transmission is efficient and has lower overhead as compared to the Asynchronous Transmission.

Serial Communication

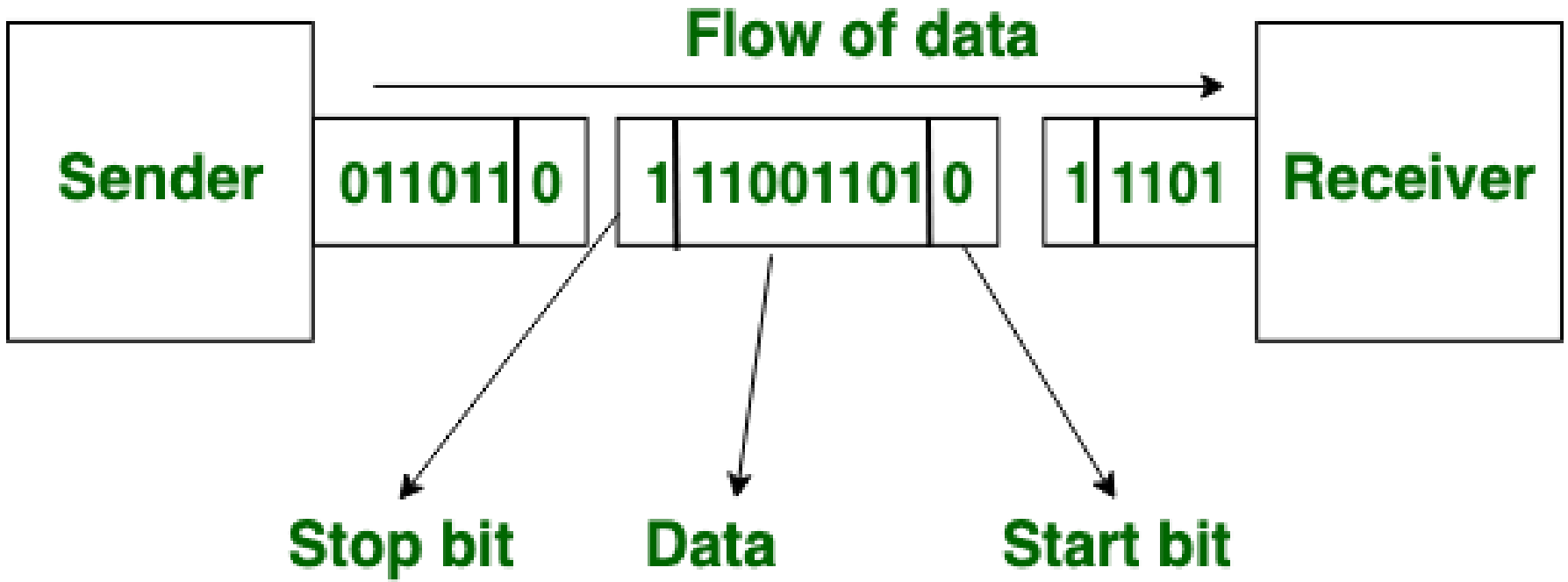
6. In asynchronous data transfer, the line is kept at a stable value (**logic 1**) if no data is transmitted through the line. As against, in synchronous transfer, the end of the data is indicated by the sync character(s). Further than the sync characters, the line can be either high or low.

Serial Communication



Synchronous Transmission

Serial Communication



Asynchronous Transmission

1. Synchronous transmission requires a _____ to synchronize the sender and receiver.

1. Synchronous transmission requires a CLOCK SIGNAL to synchronize the sender and receiver.

1. Asynchronous transmission adds _____ bits to signal the start and end of a message.

2. Asynchronous transmission adds START AND STOP bits to signal the start and end of a message.

The data transfer rate of asynchronous transmission is _____ than synchronous transmission.

The data transfer rate of asynchronous transmission is LOWER than synchronous transmission.

END OF LESSON