Data Communications

Data Transmission and Data Communication

- **Data Transmission** is the movement of the bits over some physical medium connecting two or more digital devices.
- **Data Communication** refers to exchange of digital information between two digital devices.

- **Options of Data Transmission:**

  There are two options of transmitting the bits, namely,

  i) Parallel Transmission

  ii) Serial Transmission

Parallel Transmission

- In parallel transmission, all the bits of a byte are transmitted **simultaneously** on separate wires and multiple circuits interconnecting the two devices are, therefore required.

- It is practical only if the two devices, e.g., a computer and its associated printer are close to each other.

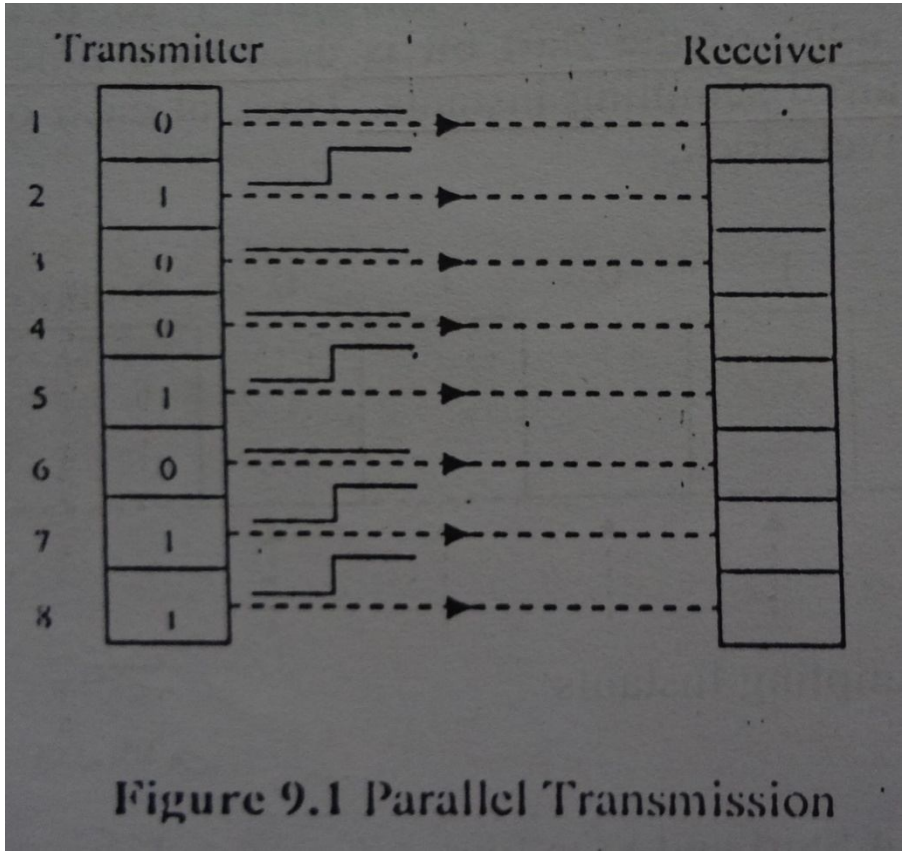


Figure 9.1 Parallel Transmission

Serial Transmission

- In serial transmission, bits are transmitted **serially** one after another. The least significant bit (LSB) is usually transmitted first.
- As compared to parallel transmission, serial transmission requires **only one** circuit interconnecting the two devices.
- Serial communication is suitable for transmission over long distances.

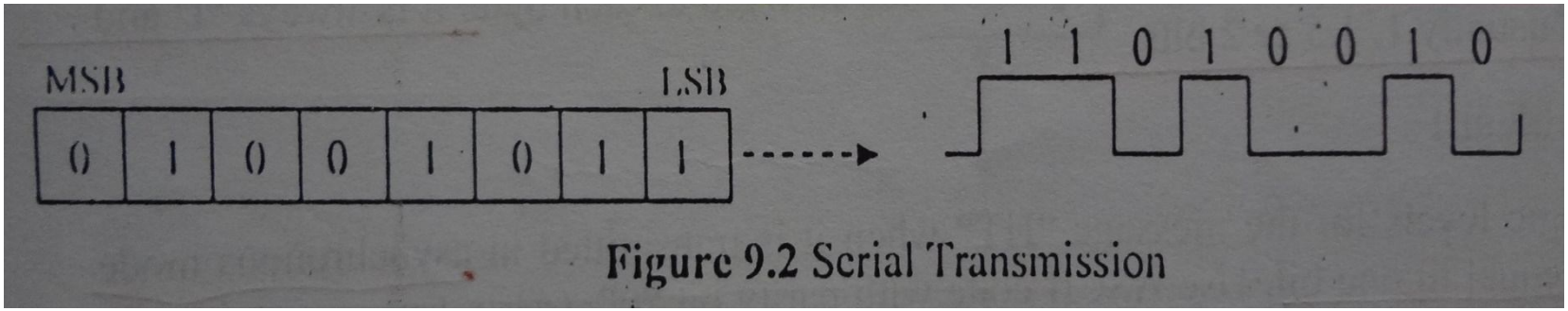


Figure 9.2 Serial Transmission

Modes of Data Transmission

- There are two methods of timing control for reception of bits. The transmission modes corresponding to these two timing methods are:

  i)Asynchronous transmission

  ii)Synchronous transmission

Asynchronous transmission:

- Asynchronous transmission refers to the case when the sending end commences transmission of bytes at any instant of time.
- After sending a byte, the next byte can be sent after arbitrary delay.
- In the idle state, when no byte is being transmitted, the polarity of the electrical signal corresponds to ‘1’.

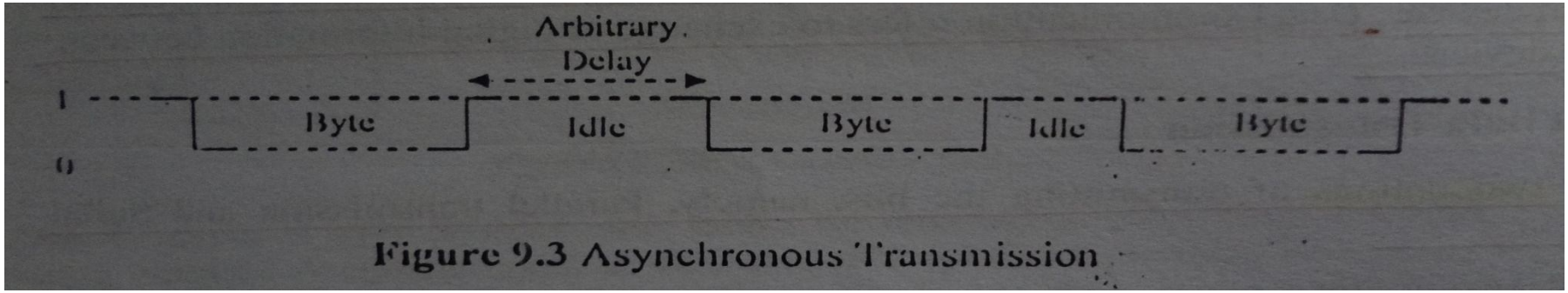


Figure 9.3 Asynchronous Transmission

Asynchronous transmission:

- To synchronize the clock pulses at the receiving end, a start bit at the beginning and a stop bit at the end of a byte are provided.
- The start bit is always ‘0’ and its duration is 1 bit.
- The stop bit is always ‘1’ and its duration is usually 1, 1.5 or 2 bits.

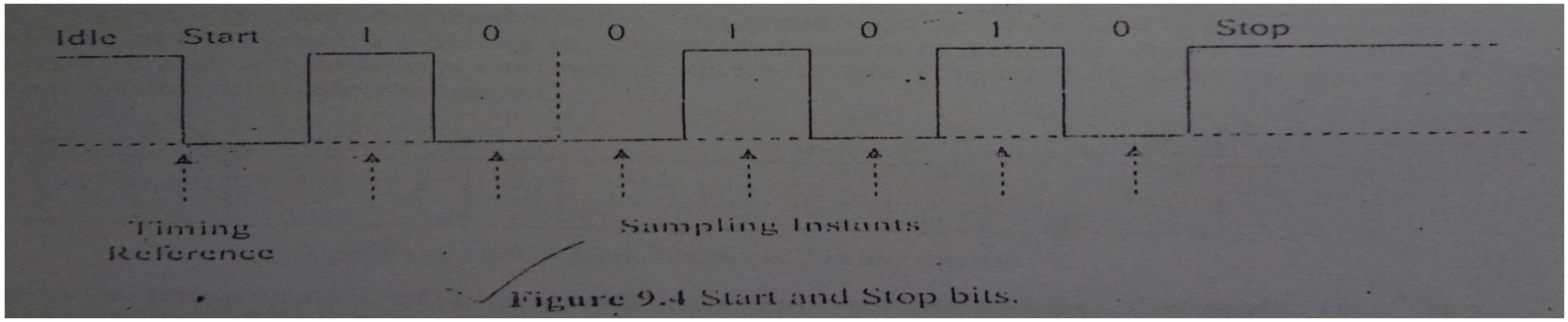


Figure 9.4 Start and Stop bits.

Example problem 1: Sketch the logic levels for the message ‘HT’ when it is transmitted in asynchronous mode with stop bit equal to one bit. Use ASCII code with parity bit ‘0’.

Solution: 7 bit ASCII Codes for ‘H’ is 1001000 and that for ‘T’ is 1010100. According to the question for both the letters the parity bits (MSBs) will be assumed 0.

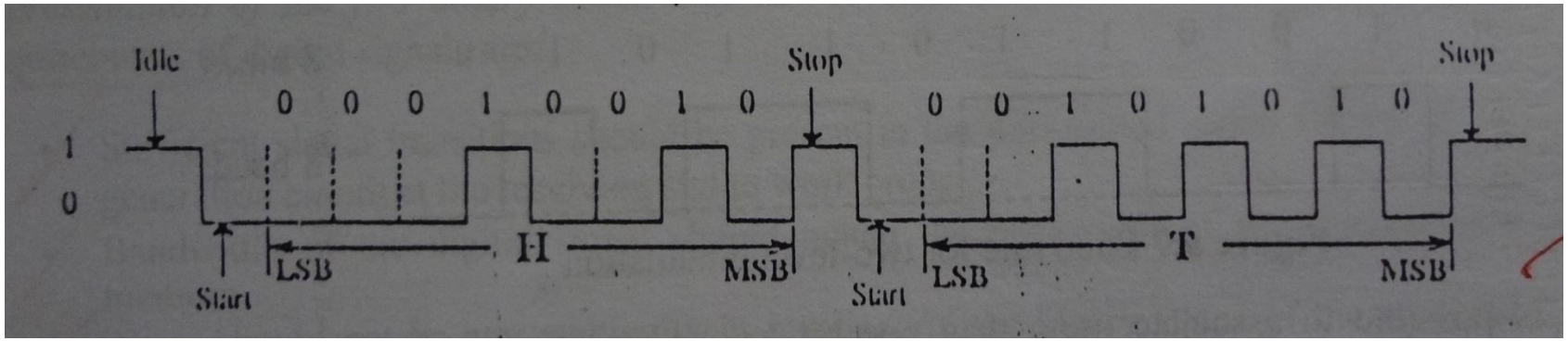
Asynchronous transmission Example

Thus the 8-bit ASCII codes for the two letters with parity bits '0' becomes as follows:

H: 01001000

T: 01010100

- H will be transmitted first, then T.
- First a start bit(low) will be sent, then the LSB of H will be sent followed by other bits up to the parity bit(MSB), then a stop bit will be sent.
- An arbitrary delay may be inserted after the stop bit.
- The next byte will be sent in a similar way.



Example problem 2: Sketch the logic levels for the message ‘HT’ when it is transmitted in asynchronous mode with stop bit equal to one bit. Use ASCII code with **even** parity.

Solution: H.W.

Example problem 3: Sketch the logic levels for the message ‘HT’ when it is transmitted in asynchronous mode with stop bit equal to one bit. Use ASCII code with **odd** parity.

Solution: H.W.

Synchronous Transmission

- In synchronous transmission, bits are always synchronized to a reference clock. There are no start or stop bits. Bytes are transmitted as a block (group of bytes) in a continuous stream of bits. Even the inter block idle time is filled with idle characters.

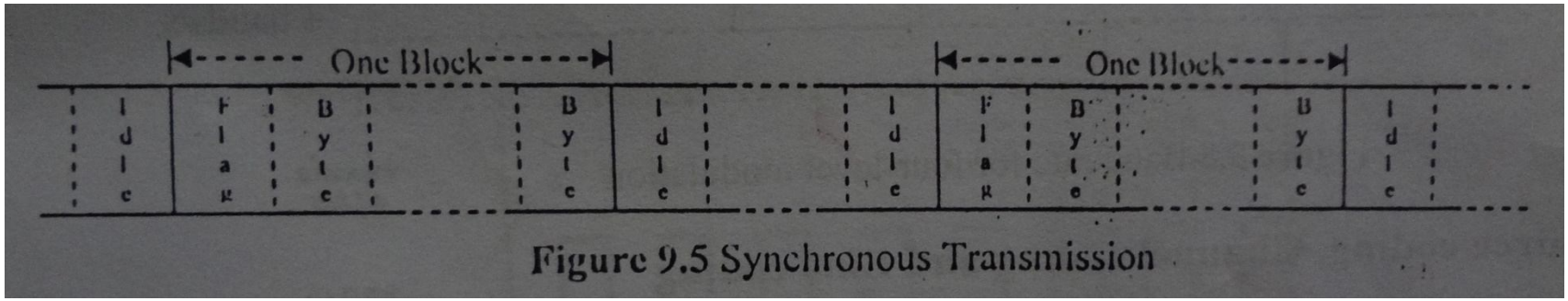


Figure 9.5 Synchronous Transmission

Baud rate, Source, Channel and Line Coding

- **Baud Rate:** Modulation rate (baud rate) is the rate at which the electrical signal changes its levels.
- **Source Coding:** Source coding produces analog-to-digital (A/D) conversion (for analog sources) and removes redundant (unneeded) information.
- **Channel Coding:** Channel coding is used for error detection and correction.
- **Line Coding:** For transmission of the bits as electrical signals, simple positive and negative voltage representation of the two binary states may not be sufficient. Some of the transmission requirements of digital signals are:

  →Sufficient signal transitions should be present.

  →Bandwidth of the digital signal should match the bandwidth of the transmission medium.

  →There should not any ambiguity in recognizing the binary states.

Line Coding

- Three common data codes used in digital communications are: NRZ, RZ and Manchester data.
- What distinguishes each code is how a high or low is represented for a given bit time.
- **Non-Return-to-Zero (NRZ) data:** The binary data for any given bit in NRZ data is fixed for the entire bit time. During logic 1, the high voltage level always remains high throughout the bit duration and never returns to zero during this interval.
- **Return-to-Zero (RZ) data:** The binary data for any given bit in RZ data is represented during the first half of the bit time. A binary one or zero will be at a 1 level or 0 level respectively for the first half of the bit time. The **second half** of the bit time is always represented by a **0 level**.

Line Coding

- **Manchester Data:** In Manchester data, a transition occurs at the mid point of each bit time. A binary **one** is defined as a **1 to 0** transition and a binary **zero** is defined as a **0 to 1** transition at the mid-point of each bit duration or bit time.

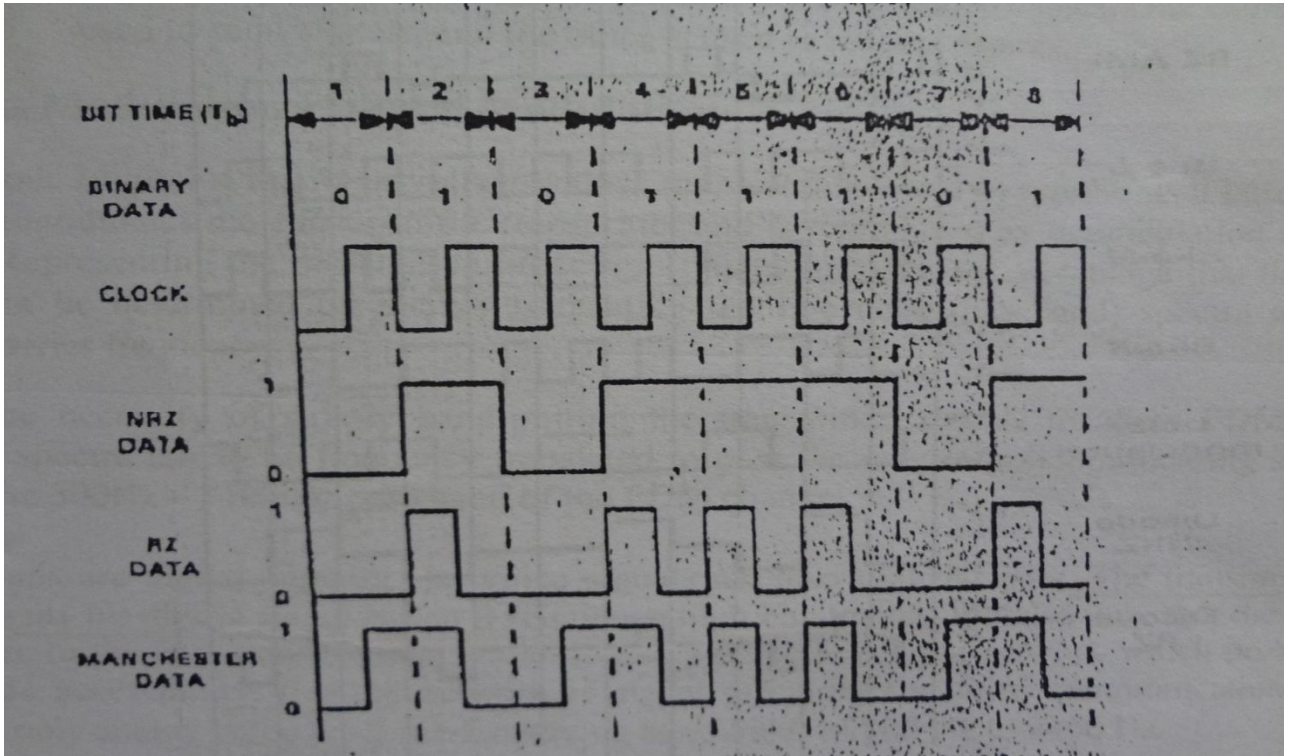


Figure 9.9: Various line codes.