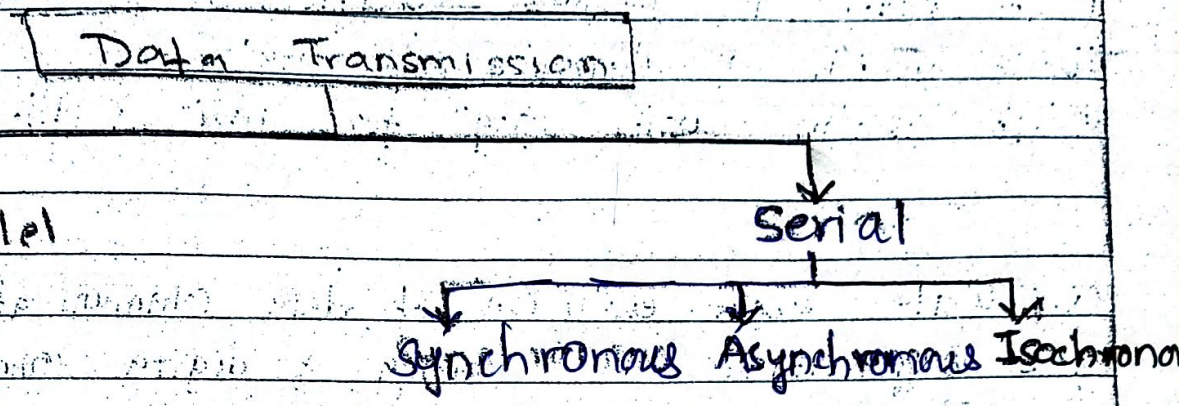
Chapter 2 — Data Transmission

Parallel and Serial Transmission

- The binary data can be transmitted across the link in either parallel form or serial form.



(i) Parallel data Tm :

→ when data transmission uses 'n' bits. data transmitted at a time, then such type of transmission is parallel data transmission.

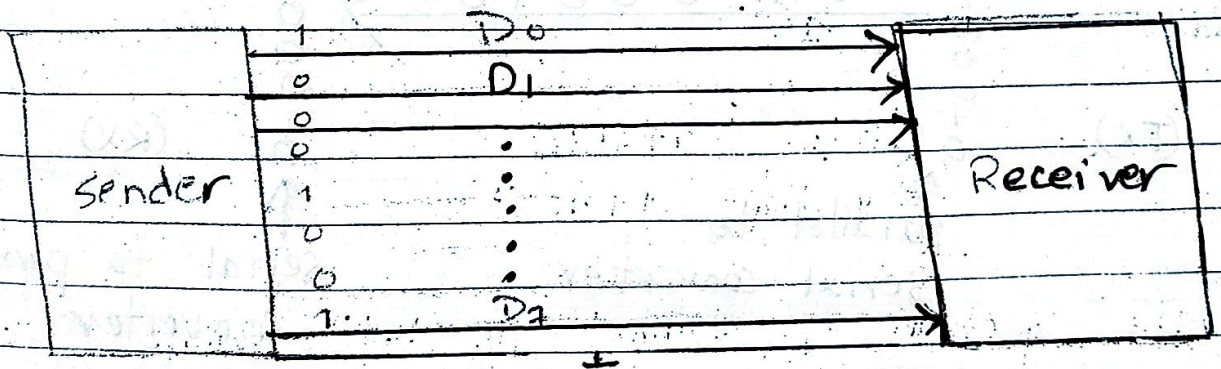


Fig. Parallel Data Txn

In such transmission, we require $(n+1)$ wires to transmit n-bits data at a time. Therefore, each bit has its own wire. In above figure $n = 8$, hence uses 8 lines (D_0-D_7) for data transmission.

The advantage of parallel data transmission is speed it increases the transfer speed by a factor of 'n' over the serial data transmission.

Disadvantage

→ 'n' Tx. lines are required to transmit 'n' bits hence expensive & not reliable in case of long distance communication.

ii) Serial data Transmission

- In such Tx, only one bit is transmitted at a time, i.e one bit follows the another bit.
- for serial data tx we need only one communication channel betn the communicating devices.

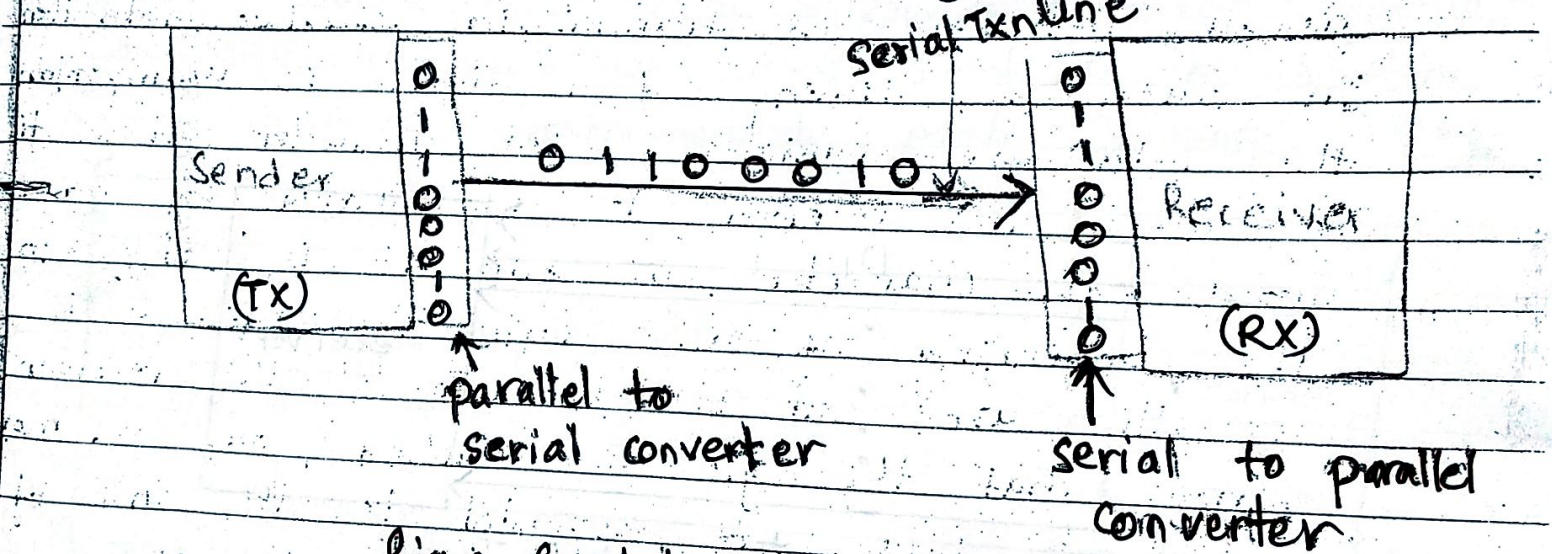


fig: Serial data Txn.

The advantage of serial data transfer over the parallel is that only one communication channel is required.

Serial Tx. reduces the cost of transmission over parallel by a factor of 'n'.

In serial Tx, speed is slow than the parallel Tx & conversion devices are required at the interface betⁿ the sender & line (parallel to serial converter) & betⁿ the line & the receiver (serial to parallel converter), as the devices communicate in parallel mode.

Serial transmission mechanisms can be divided into three broad categories depending on how transmissions are spaced in time.

(a) **Asynchronous Transmission**

- It can occur at any time with an arbitrary delay between the transmission of two data items.
- In such Tx, timing of a signal is unimportant the data are transmitted one character at a tim To alert the receiver to the arrival of a group of character, an extra bit is added to the beginning of each byte. The logic 0 is usually used at start-bit. To let the receiver know that the byte is reached, one or more additional bits are appended to the end of byte. The logic 1 is used as stop-bit.

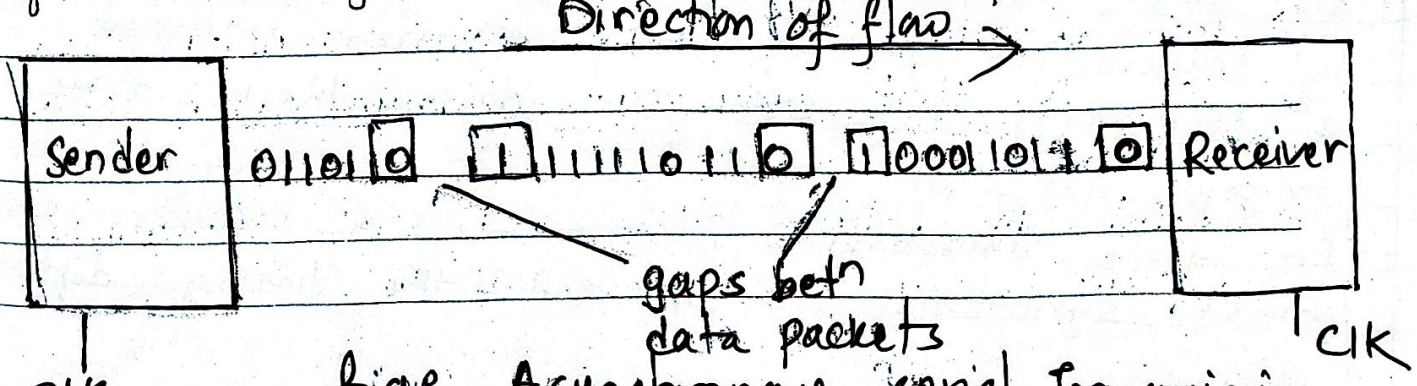


fig: Asynchronous serial transmission.

Note start bit is represented by '0' or low
stop " " " '1' or high.

if Data = 8 bit

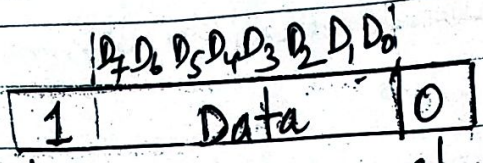


fig: Asynchronous frame format

→ Overhead increases due to start & stop-bit in each frame format.

→ The gap betⁿ each byte are of varing duration. i.e g E-mail, blog.

Demerit

→ Overhead due to start-bits & stop bits.

→ slow.

merit

→ It is cheap & effective for situation such as low speed & short distance communication e.g Tx betⁿ computer & keyboard where characters are transfer at irregular intervals.

e) Synchronous Transmission

- It occurs continuously with no gap betⁿ the transmission of two data items.
- In such transmission, a block of bits i.e frame is transmitted in a steady stream without start & stop bits or code. The data block may be many bits in length.
- In this transmission, transmitter & receiver clock must synchronise to prevent the timing difference.

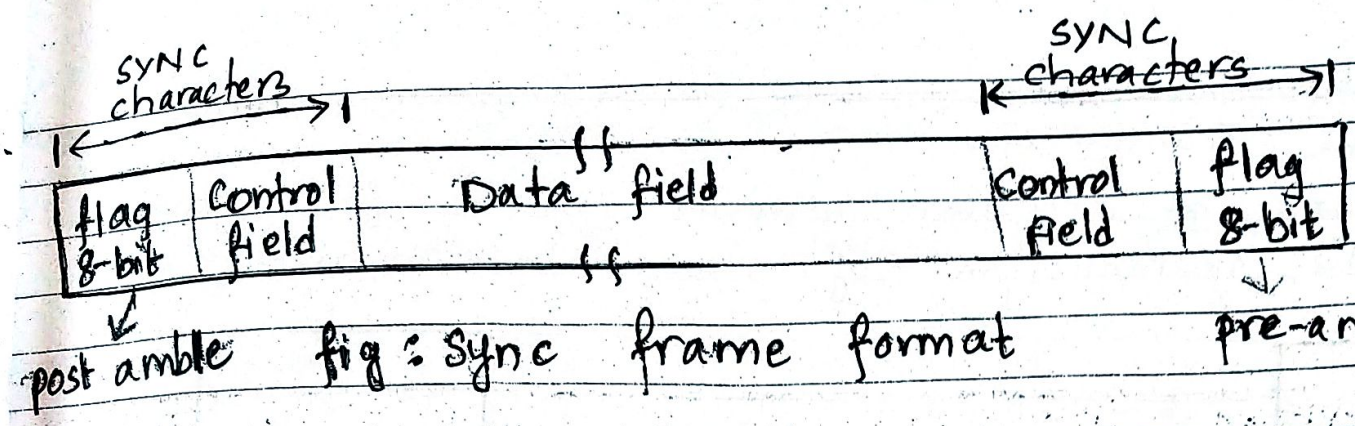


fig: Sync frame format

Two techniques are generally used for synchronization

(i) Provide a separate line betn the transmitter & receiver to transmit the clock information & then data. This is suitable for short distance.

(ii) The next alternative is to embed the clocking information in data signal & This is suitable for long distance.

Inorder to determine the beginning & end of a block of data each block begins with a pre-amble bit pattern & ends with a post-amble bit pattern.

The advantage of sync. Tx is speed.

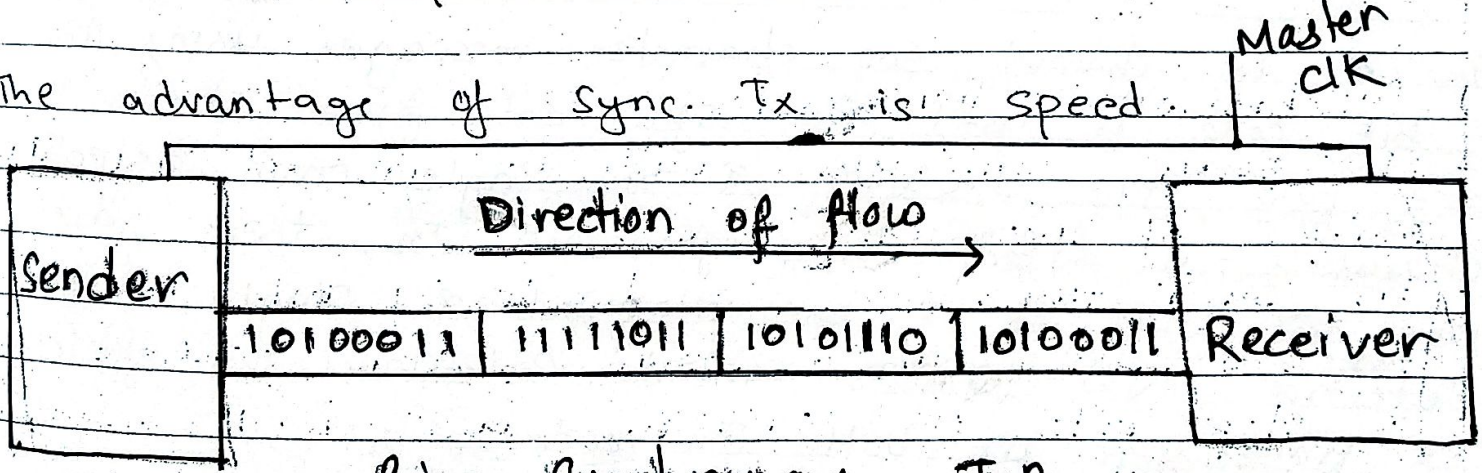


fig: Synchronous Txn

eg: Telephone conversation chat Room etc

Isochronous Transmission

- It occurs at regular intervals with a fixed gap bet^n the transmission of two data items.

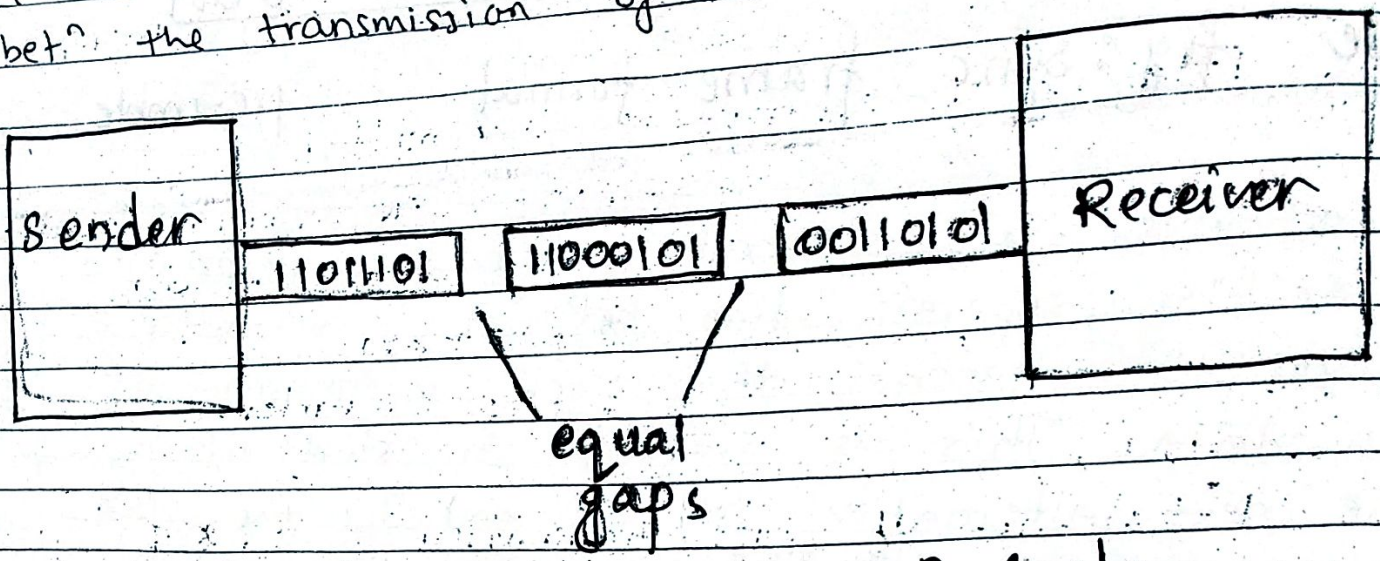


fig: Isochronous Tx^n System.

Efficiency

→ i.e efficiency of transmission

$$\text{efficiency} = \frac{\text{data bits}}{\text{total bits}} * 100\%$$

Q. On a Tx. Channel, 600 character messages using ASCII 7 bit code is used. For sync. data ~~frame~~ stream, there are two SYN character & a single error detection character is added. In async. data Tx, there are one start-bit & one stop-bit & single error detection character is added, Calculate the efficiency of transmission in both Tx. mode.

— Sol^n.

For Sync. Tx. mode:

Original information character = 600 character

Total no. of characters transmitted
= 600 + 2 SYN character + 1 error detection character
= 600 + 2 + 1
= 603 character.

Then,
total no. of bits transmitted = 603 * 7
= 4221 bits

& actual data bits = 600 x 7 = 4200 bits

Thus,
efficiency $\eta = \frac{4200}{4221} \times 100\%$

$= 99.5\%$

For Async. Tx mode:

Original info. character = 600 character

Total no. of characters transmitted = 600 + 1 Error detection characters
= 601 characters

Here,
each character is represented by:
7 ASCII bits + 1 start bit + 1 stop bit
= 9 bits

Then,

Total no. of bits transmitted = 601 * 9
= 5409 bits

Actual data bits = 600 * 7 = 4200 bits

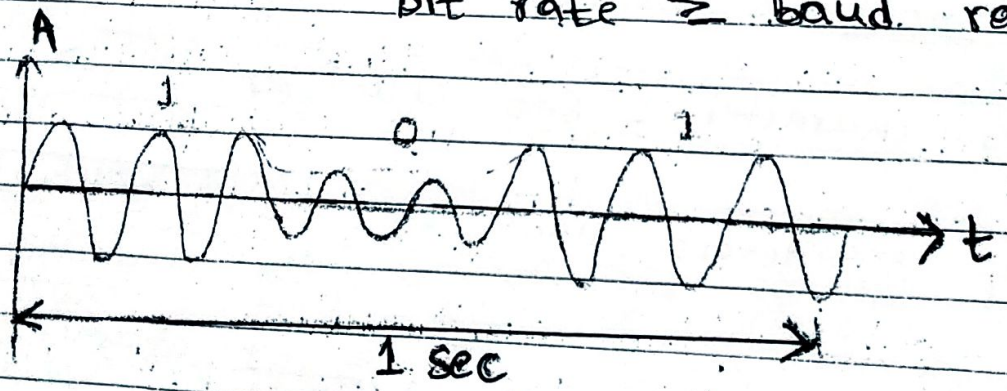
efficiency (η) = $\frac{4200}{5409} \times 100\%$ = 77.65 %

#

Bit Rate & Baud rate

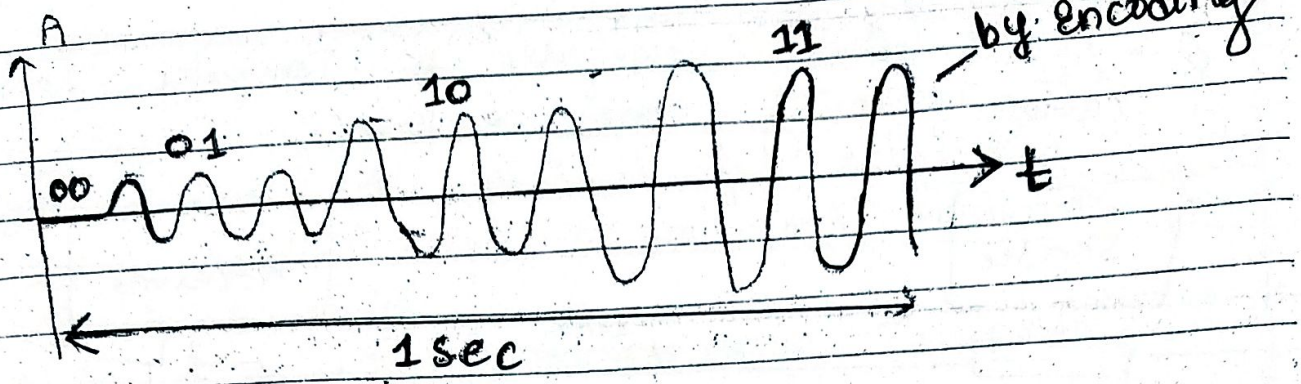
- Bit Rate is the no. of bits transmitted per sec.
- Baud rate refers to the no. of signal units per sec. that are required to represent those bits. i.e baud rate is the no. of signals changes per sec.
- Baud rate determines the bandwidth required to send the signal.
- Bit rate is always greater than or equal to baud rate .i.e

bit rate ≥ baud rate.



Here,

bit rate = 3 bits/sec
baud rate = 3 baud/sec



Here,

bit rate = 8 bits / sec

baud rate = 4 bauds / sec

$$\therefore \text{Baud rate} = \frac{\text{Bit rate}}{\text{no. of bits per signal Unit}}$$

Line Configuration:

- refers to the way by which two or more communication devices are attached to a link
- A link is a communication path that transf data from one device to another.
- There are two possible line configurations:
  (i) Point-to-point line configuration.
  (ii) Multipoint line configuration.

(i) Point-to-point line Configuration

It provides a dedicated link betⁿ two de: The entire capacity of the link is received transmission betⁿ those two devices. For this configuration, wire cable, microwave, infra-r & satellite links can be used.

e.g. TV & remote ; computer to computer Communication using NULL modem.

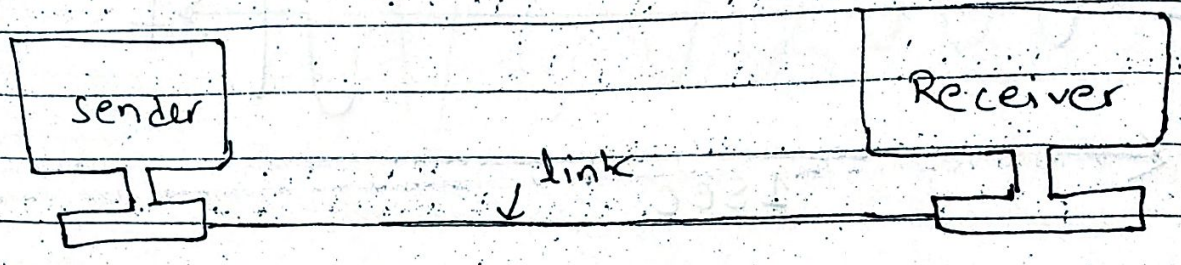


fig: point to point line configuration

(ii) Multipoint line Configuration

- It is also called as multidrop connection. A multipoint line Configuration is on which more than two devices share a single link.
The capacity of the channel is shared either spatially or temporarity.
- If several devices can use the link simultaneously, it is called spatially shared connection.
→ If the user must take turns, it is a time shared connection.

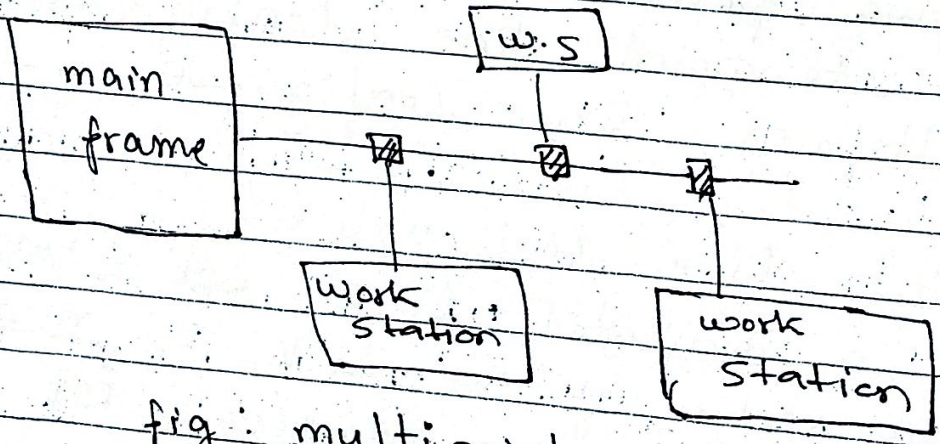


fig: multipoint line configuration.

EXAMPLE 2.4 **A system sends a signal that can assume 8 different voltage levels. It sends 400 of these signals per second. What are the baud and bit rates ?**

Solution:

(i) As the signal assumes 8 different voltage levels, we required 3 bit digital signal to have 8 different combinations. Hence, the number of bits; per voltage level is 3. Let each voltage level represent one symbol.
Hence, number of bits/symbol = 3.

(ii) The system sends 400 signal/sec. Hence, the number of symbols transmitted per second is also 400.
Therefore, symbol rate = Number of symbols/sec.
Symbol rate = 400 symbols/sec.

(iii) The baud rate is defined as the number of symbols per second.
Hence, Baud rate = Symbol rate.
or Baud rate = 400 symbols /sec. **Ans.**

(iv) We are using 3 bit to represent each symbol.
Therefore, bit rate = 3 × symbol rate = 3 × 400 = 1200 bits/sec. **Ans.**

RS-232C ("C" is current version)

- RS-232C is a standard that describes the physical interface & protocol for relatively low speed serial data comm^n bet^n computers & related devices.

→ As PC's; DTE (Data Terminal Equipment) agent, it also communicates with the modem or other serial device, which, in accordance with the RS-232C standard, has a complementary interface called the Data Communications Equipment (DCE) interface.

→ RS 232 consists of 25 pins connector.

→ Voltage more negative than -3 volts is interpred as binary 1.

→ Voltage more positive than +3 volts is interpreted as binary 0.

RS 449 → similar to RS-232

→ is a specification for a differential communications interface that uses a DB-37 connector & differential equivalents of the V.24 (RS-232) signals.

→ this interfaces are commonly found on communications equipment in some parts of the world where high throughput & long distances are required.

→ offers good noise immunity enabling reliable comm^{n}s in environments where there are high levels of EMI (electromagnetic interference).

Note: V.24 → ckt identification (ITU-T standards)