# Data Communication

#3 Scrambling

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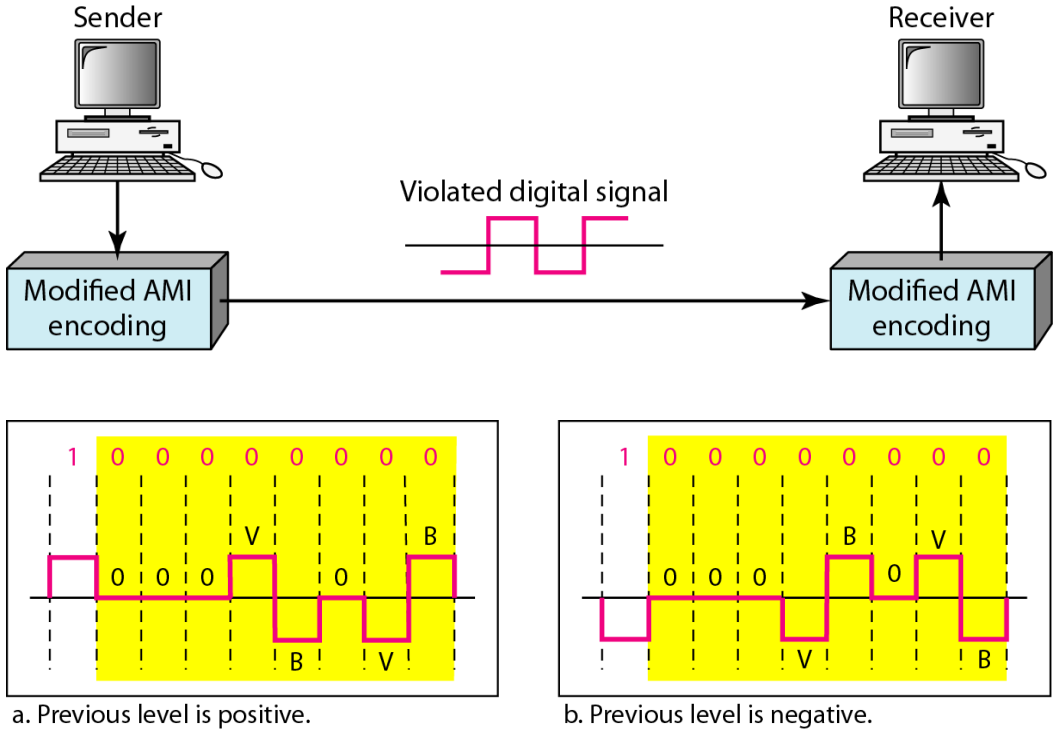
# Scrambling

- Biphase scheme that are suitable for dedicated links between station in a LAN are not suitable for long-distance communication because of their wide bandwidth requirement.
- The combination of block coding and NRZ line coding is not suitable for long-distance encoding either because of the DC component.
- Bipolar AMI encoding, on the other hand, has a narrow bandwidth and does not create a DC component. However, a long sequence of 0s upsets the synchronization.
- If we can find a way to avoid a long sequence of 0s in the original stream, we can use bipolar AMI for long distance. We are looking for a technique that does not increase the number of bits and does provide synchronisation. We are looking for a solution that substitutes long zero-level pulse with a combination of other levels to provide synchronisation. One solution is called **scrambling**.
- We modify part of the AMI rule to include scrambling. Note that scrambling, as opposed to block coding, is done at the same time as encoding.
- The system needs to insert the required pulses based on the defined scrambling rules.
- Two common scrambling techniques are **B8ZS** and **HDB3**

# Bipolar with 8 Zeros Substitution (B8ZS)

- Bipolar with 8 Zeros Substitution (B8Zs) is commonly used in North America.
- In this technique, eight consecutive zero-level voltages are replaced by the sequence 000VB0VB.
- The V in the sequence denotes violation; this is a nonzero voltage that breaks an AMI rule of encoding (opposite polarity from the previous). The B in the sequence denotes bipolar, which means a nonzero level voltage in accordance with the AMI rule.



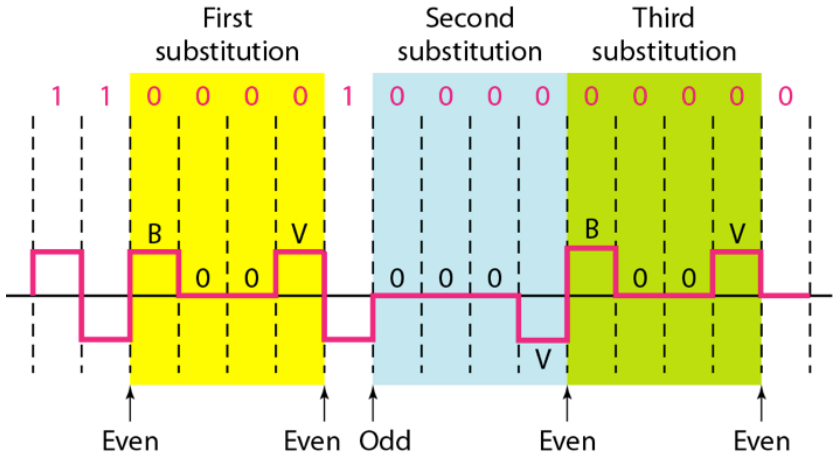

a. Previous level is positive.

b. Previous level is negative.

- Note that the scrambling in this case does not change the bit rate. Also, the technique balances the positive and negative voltage levels (two positive and two negatives), which means that the DC balance is maintained.

# High Density Bipolar 3 Zeros (HDB3)

- High Density Bipolar 3 Zeros (HDB3) is commonly used outside of North America. In this technique, which more conservative than B8ZS, four consecutive zero-level voltage are replaced with a sequence of 000V or B00V.
- The reason for two different substitutions is to maintain the even number of nonzero pulse after each substitution.
- Two rules can be stated as follows:
    1. If the number of nonzero pulse after the last substitution is odd, the substitution pattern will be 000V, which makes the total number of nonzero pulses even.
    2. If the number of nonzero pulse after the last substitution is even, the substitution pattern will be B00V, which makes the total number of nonzero pulse even.



# Data Communication

#3 Transmission Modes

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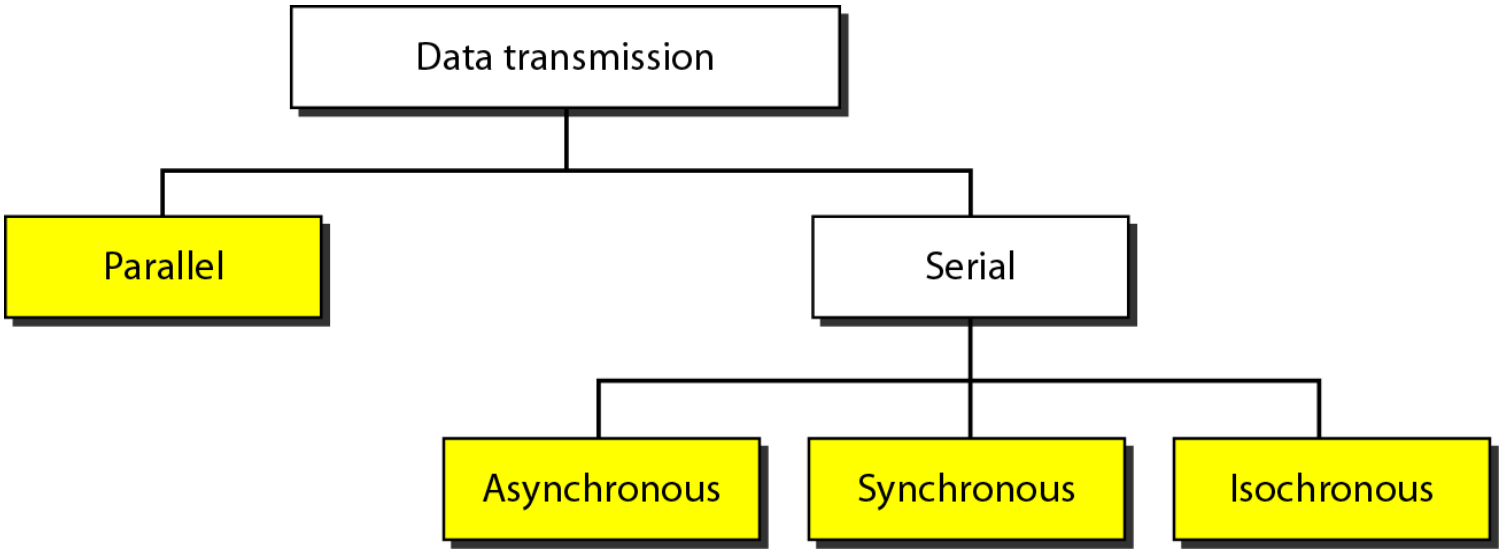
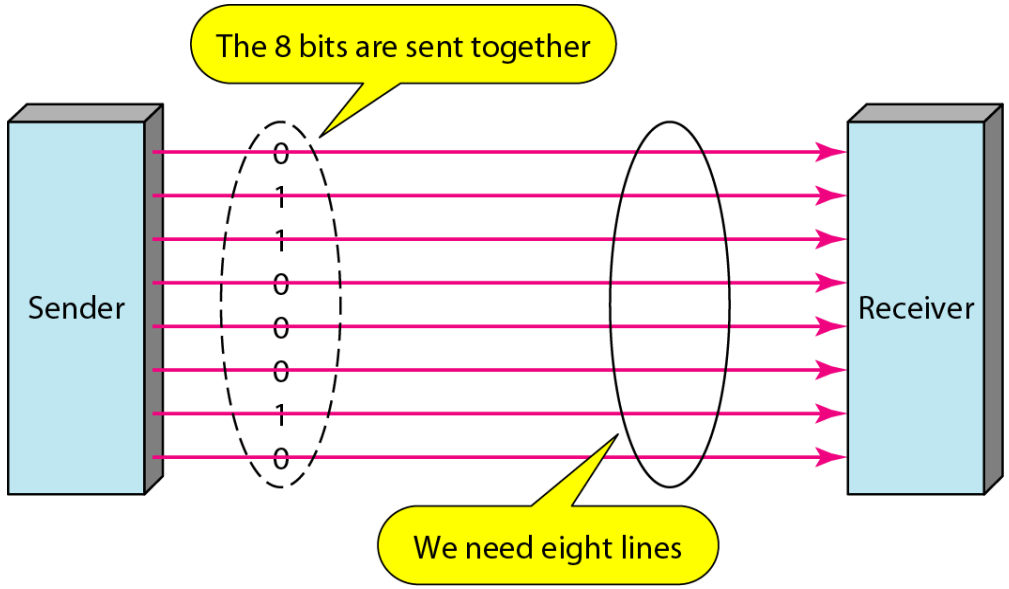
# Transmission Modes

- Of primary concern when are considering the transmission of data from one device to another is the wiring, and of primary concern when are considering the wiring is the data stream.
- The transmission of binary data across a link can be accomplished in either parallel or serial mode.
- In parallel mode, multiple bits are sent with each clock tick.
- In serial mode, 1 bit is sent with each clock tick.



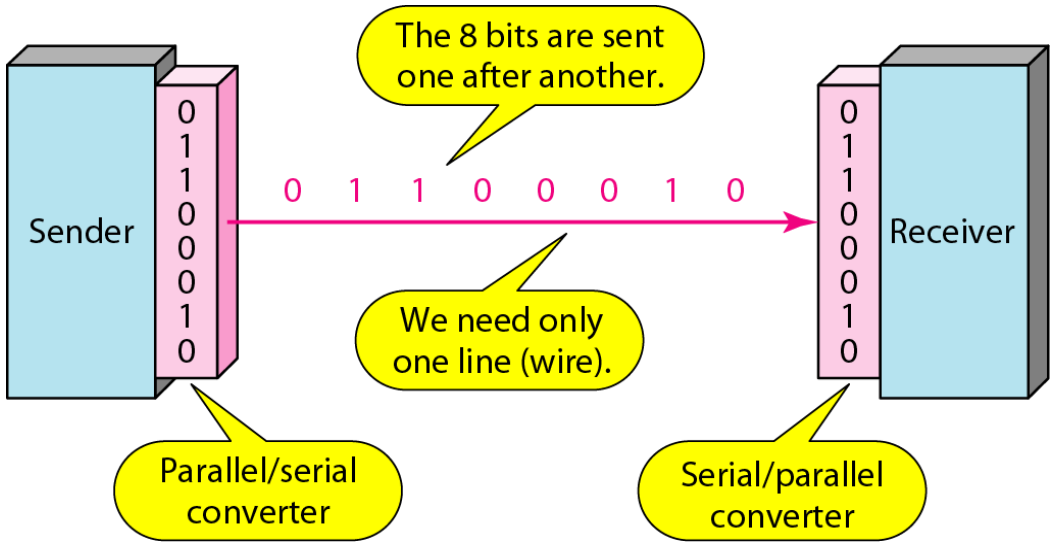
# Parallel Transmission

- The mechanism for parallel transmission is a conceptual simple one: Use n wires to send n bit at one time. That way each bit has its own wire, and all n bits of one group can be transmitted with each clock tick from one device to another.
- The advantage of parallel transmission is speed.
- The significant disadvantage : cost.
- Parallel transmission requires n communication lines (wires in the example) just to transmit the data stream. Because this is expensive, parallel transmission is usually limited to short distance.



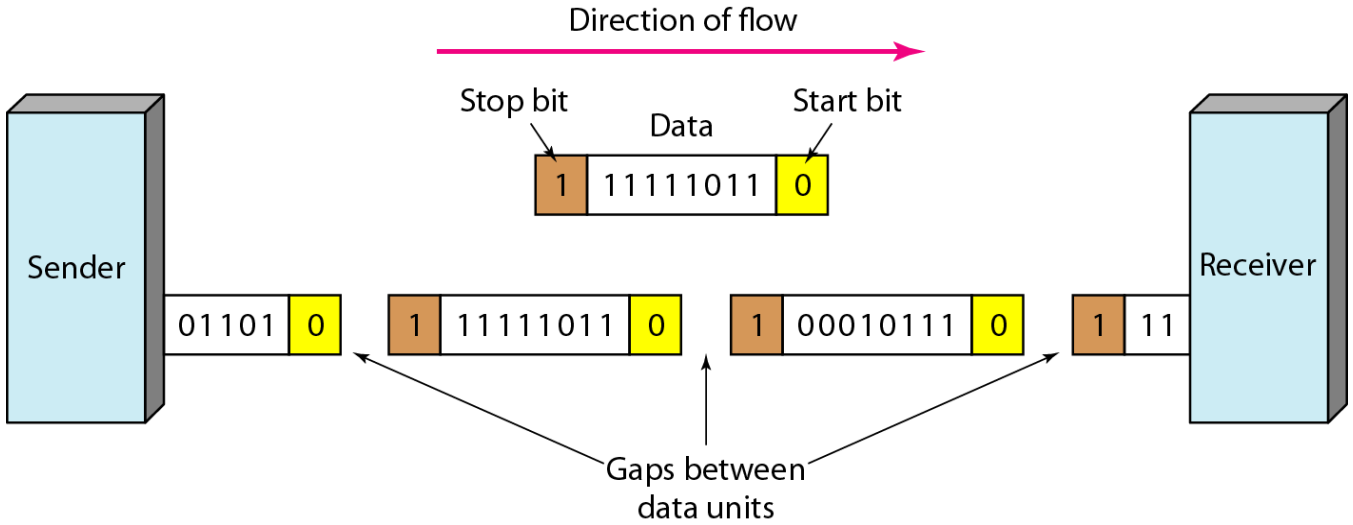
# Serial Transmission

- In serial transmission, one bit follows another, so we need only one communication channel rather than n to transmit data between two communicating device.
- The advantage of serial over parallel transmission is that with only one communication channel, serial transmission reduces the cost of transmission over parallel by roughly a factor of n.
- Serial transmission divide into : Asynchronous Transmission and Synchronous Transmission



# Asynchronous Transmission

- Asynchronous transmission is named because of the data is transmitted without synchronization.
- The receiver cannot use timing to predict when the next group will arrive.
- To alert the receiver to the arrival of a new group, therefore, an extra bit is added to the beginning of each byte. This bit, usually a 0, is called a start bit.
- To let the receiver know that the byte is finished, 1 or more additional bits are append to the end of the byte. These bits, usually 1s, are called stop bits.
- By this method, each byte is increased in size at least 10 bits, of which 8 bits is information and 2 bits or more are signals to the receiver.



# Synchronous Transmission

- In synchronous transmission, the bit stream is combined into longer “frames”, which may contain multiple bytes.
- Each byte, however is introduced onto the transmission link without a gap between it an the next one.
- In other words, data are transmitted as an unbroken string of 1s and 0s, and the receiver separates that string into bytes, or characters, it needs to reconstruct the information.
- Timing becomes very important, therefore, because the accuracy of the received information is completely dependent on the ability of the receiving device to keep an accurate count of the bits as they come in.
- Synchronous transmission is faster than asynchronous transmission. For this reason, it is more useful for high speed application such as the transmission of data from one computer to another.