

# *Physical Layer: Transmission Modes & Spread Spectrum*

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# ***Digital Transmission:***

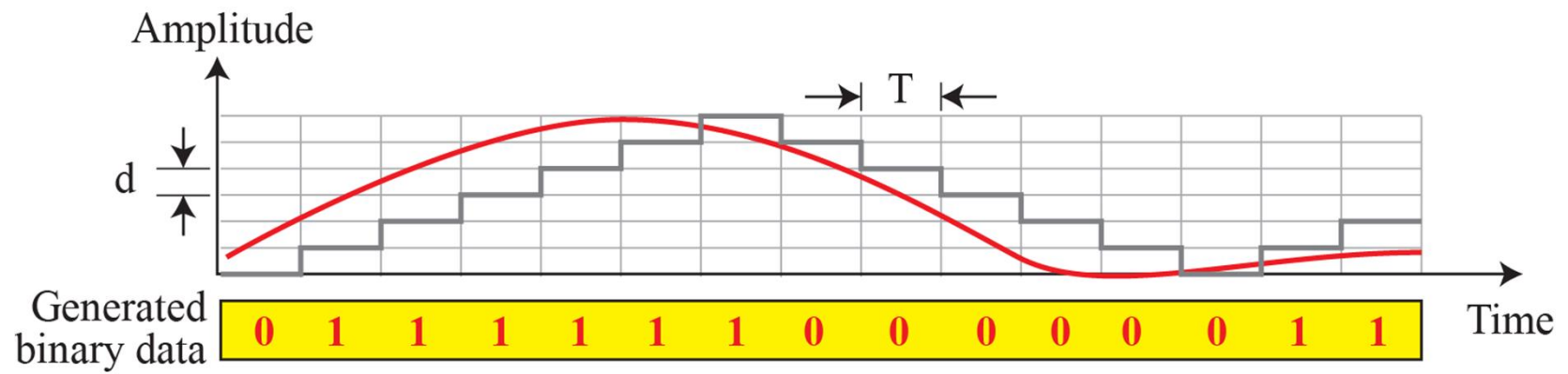
## *Transmission Modes*



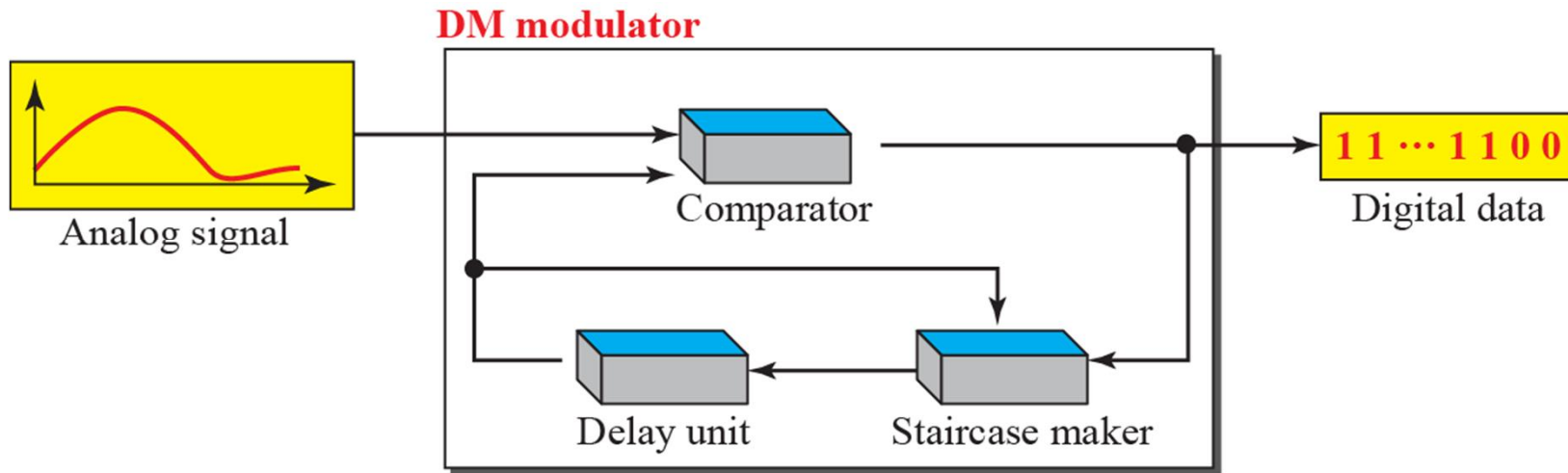
## *Delta Modulation (DM)*

- *PCM is a very complex technique. Other techniques have been developed to reduce the complexity of PCM.*
- *The simplest is delta modulation. PCM finds the value of the signal amplitude for each sample; DM finds the change from the previous sample.*
- *Figure shows the process. Note that there are no code words here; bits are sent one after another.*

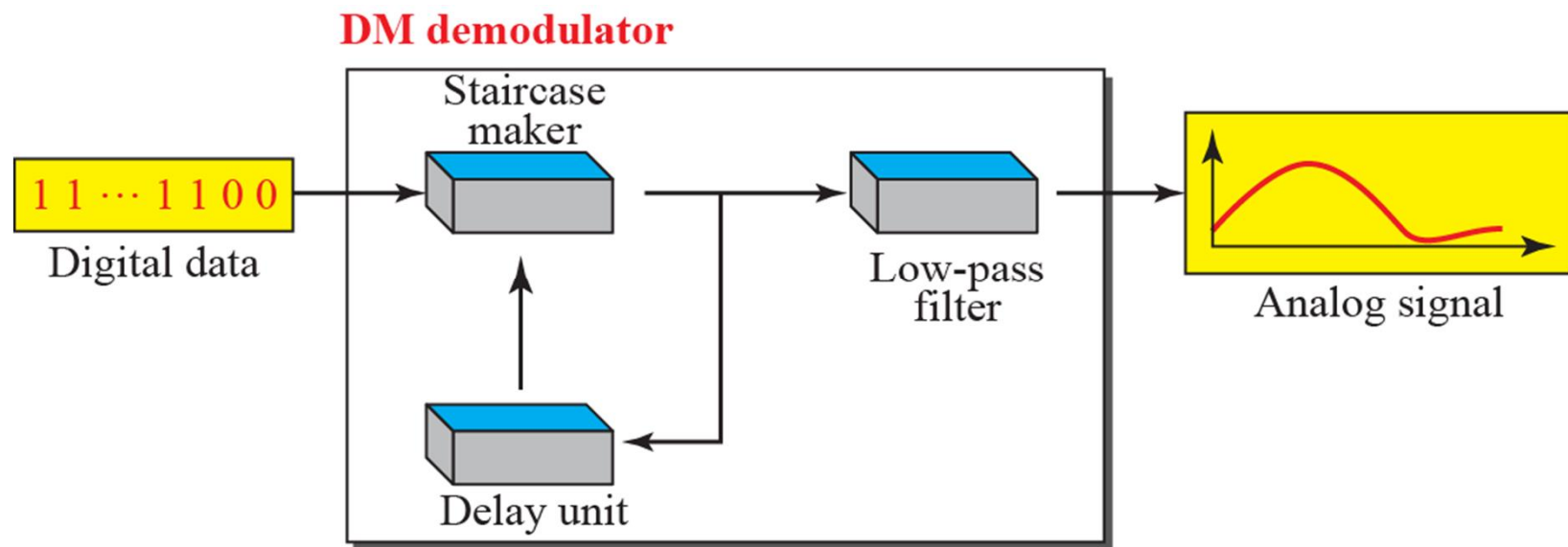
**Figure 1:** *The process of delta modulation*



**Figure 2:** Delta modulation components



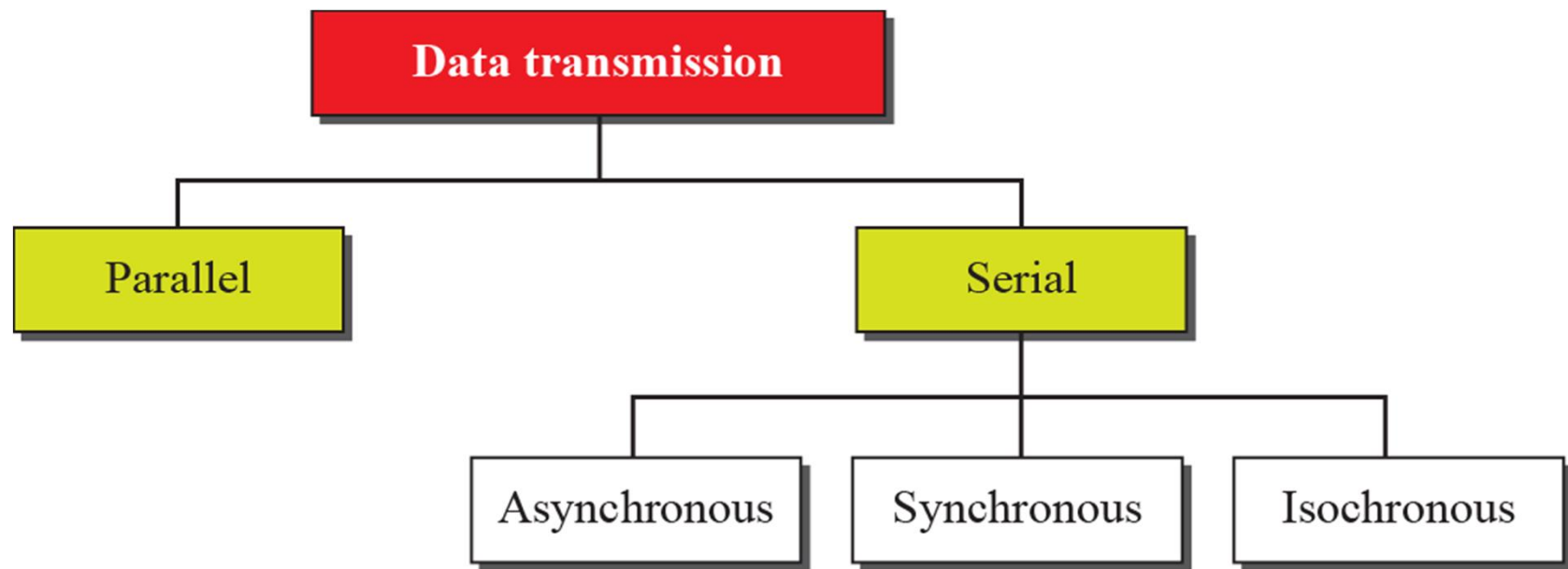
**Figure 3:** Delta demodulation components



# TRANSMISSION MODES

- *Of primary concern when we are considering the transmission of data from one device to another is the wiring, and of primary concern when we are considering the wiring is the data stream.*
- *Do we send 1 bit at a time; or do we group bits into larger groups and, if so, how?*
- *The transmission of binary data across a link can be accomplished in either parallel or serial mode.*

**Figure 4:** *Data transmission modes*





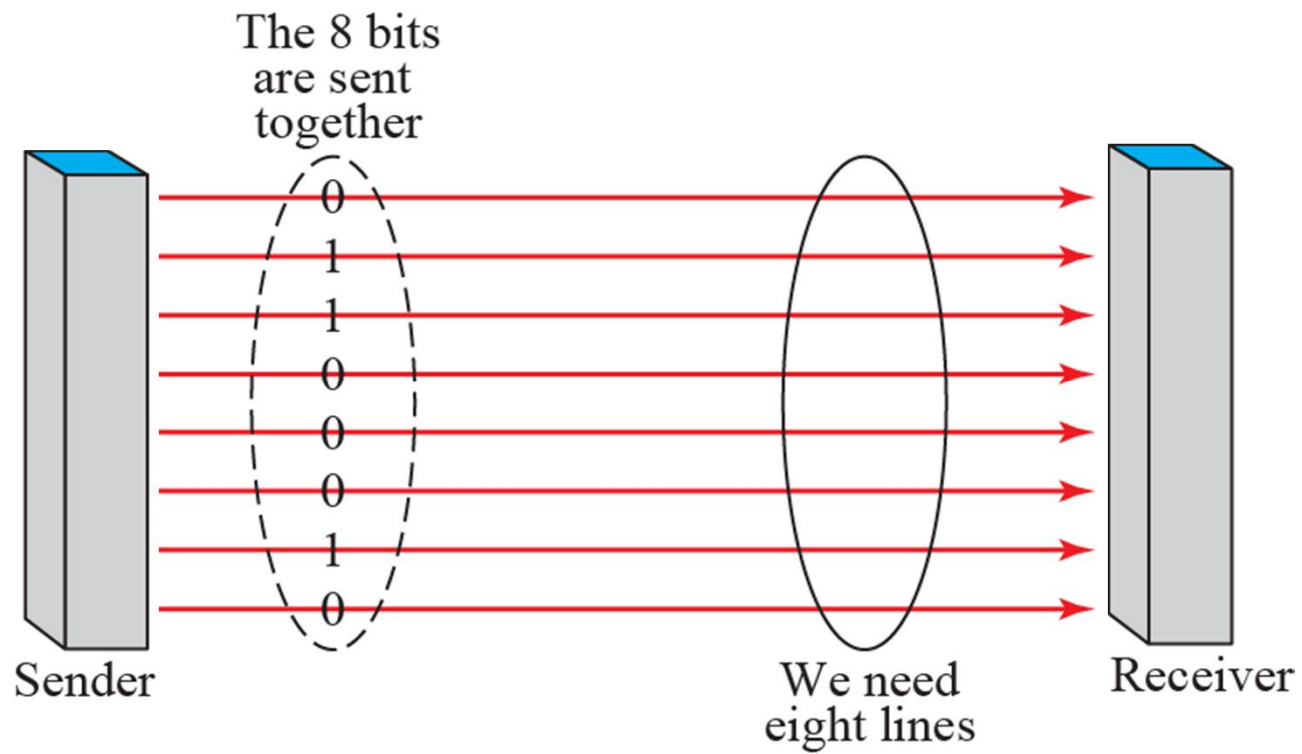


# *1 Parallel Transmission*

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- *Line coding is the process of converting digital data to digital signals.*
- *We assume that data, in the form of text, numbers, graphical images, audio, or video, are stored in computer memory as sequences of bits.*
- *Line coding converts a sequence of bits to a digital signal.*
- *At the sender, digital data are encoded into a digital signal; at the receiver, the digital data are recreated by decoding the digital signal.*

**Figure 5: Parallel transmission**



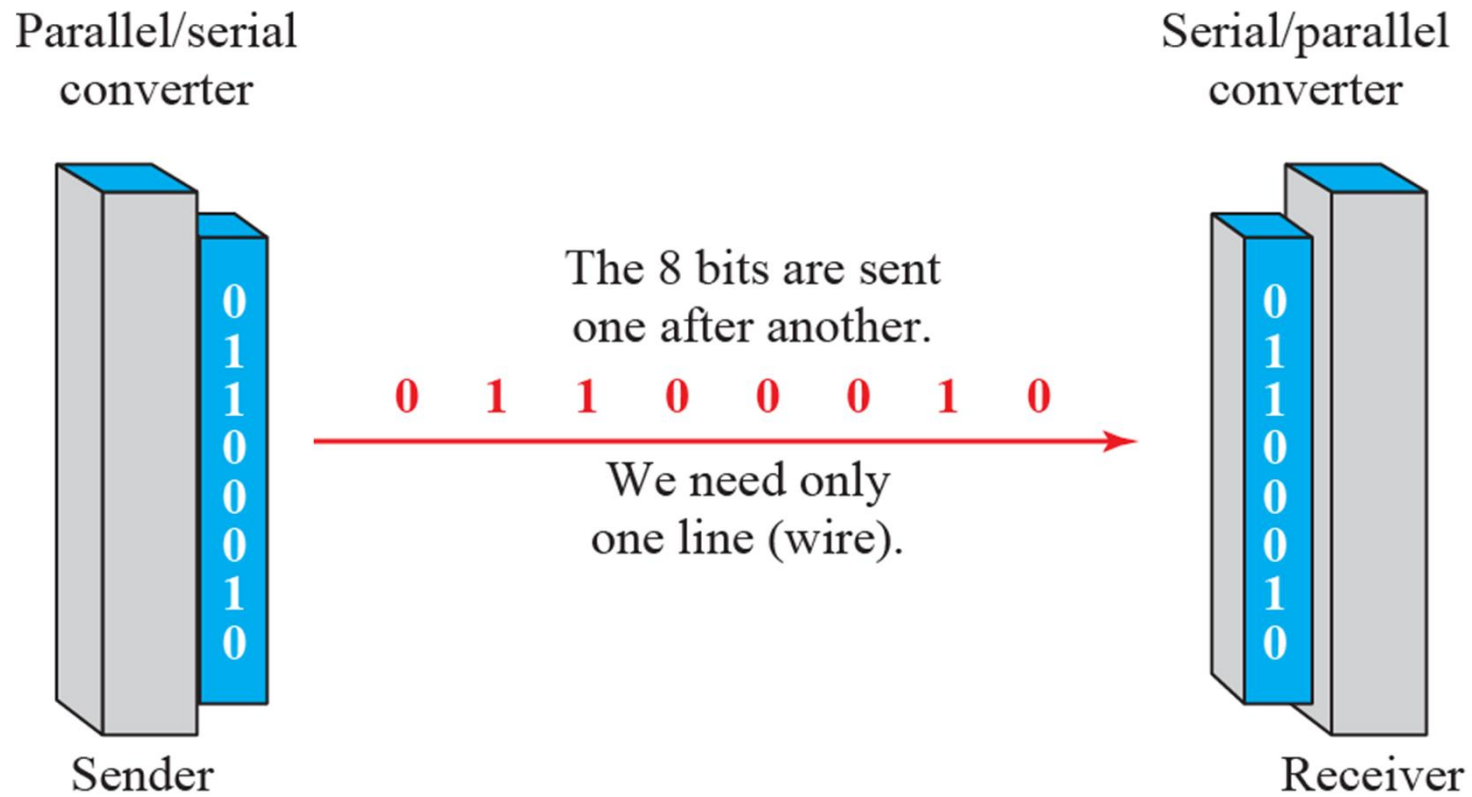


## *2 Serial Transmission*

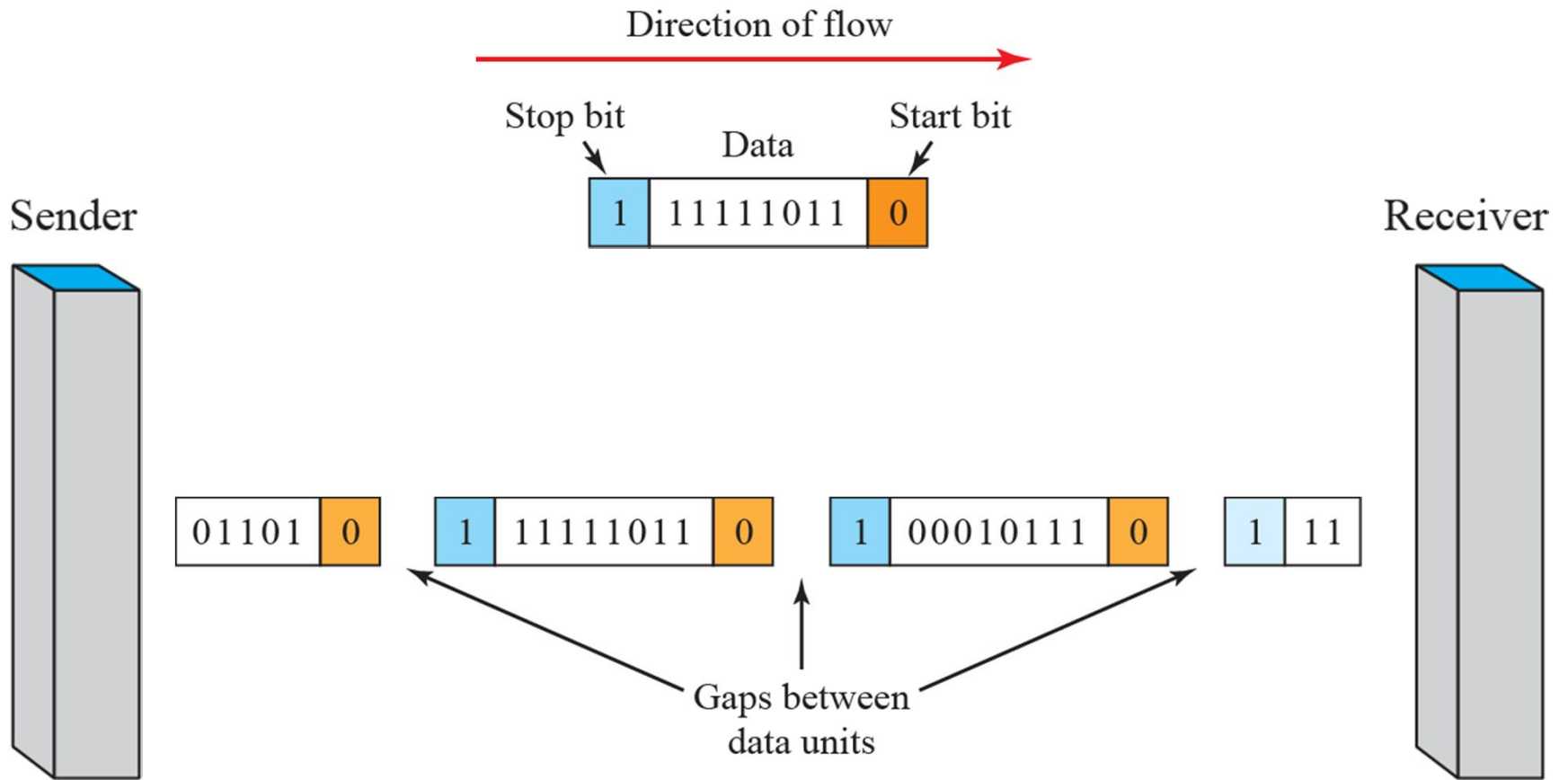
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*In serial transmission one bit follows another, so we need only one communication channel rather than  $n$  to transmit data between two communicating devices.*

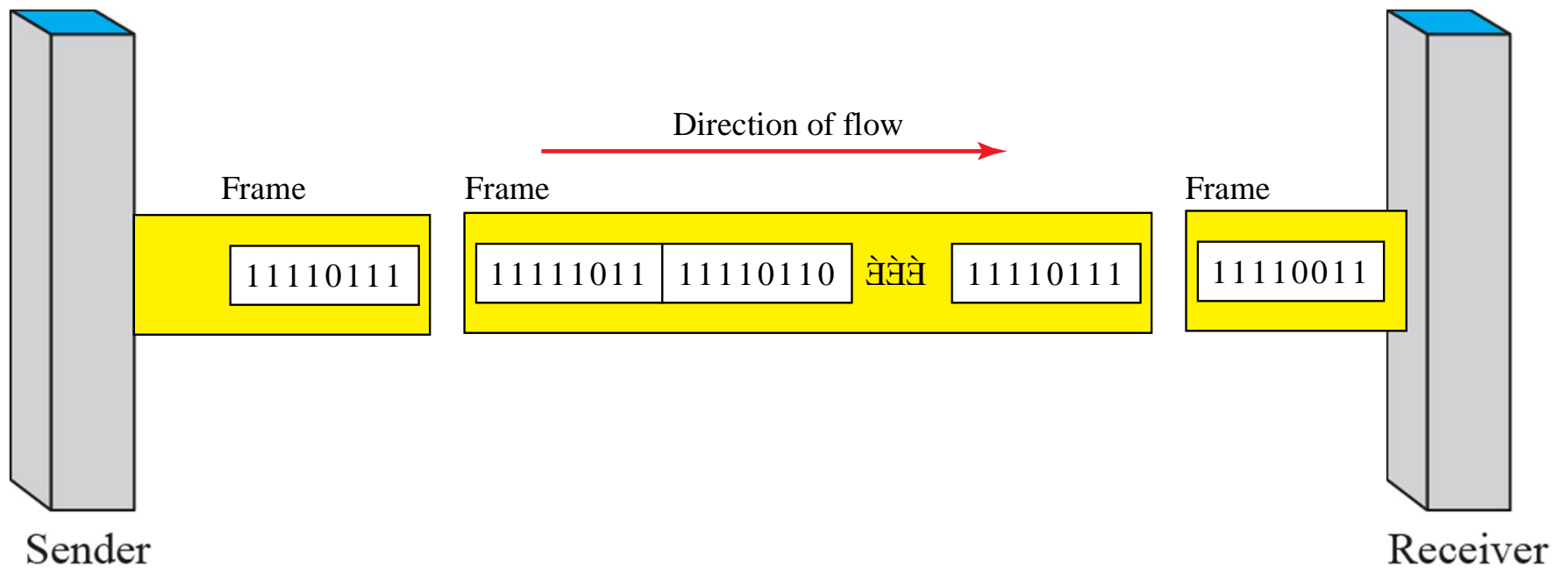
**Figure 6: Serial transmission**



**Figure 7: Asynchronous transmission**



**Figure 8: Synchronous transmission**



## **Figure 8: Isochronous transmission**

- An isochronous data transfer system combines the features of an asynchronous and synchronous data transfer system.
- Each transmission begins with a start packet. Once the start packet is transmitted, the data must be delivered with a guaranteed bandwidth.
- Isochronous data transfer is commonly used for where data must be delivered within certain time constraints, like streaming video.
- Isochronous systems do not have an error detection mechanism (acknowledgment of receipt of packet) because if an error were detected, time constraints would make it impossible to resend the data.

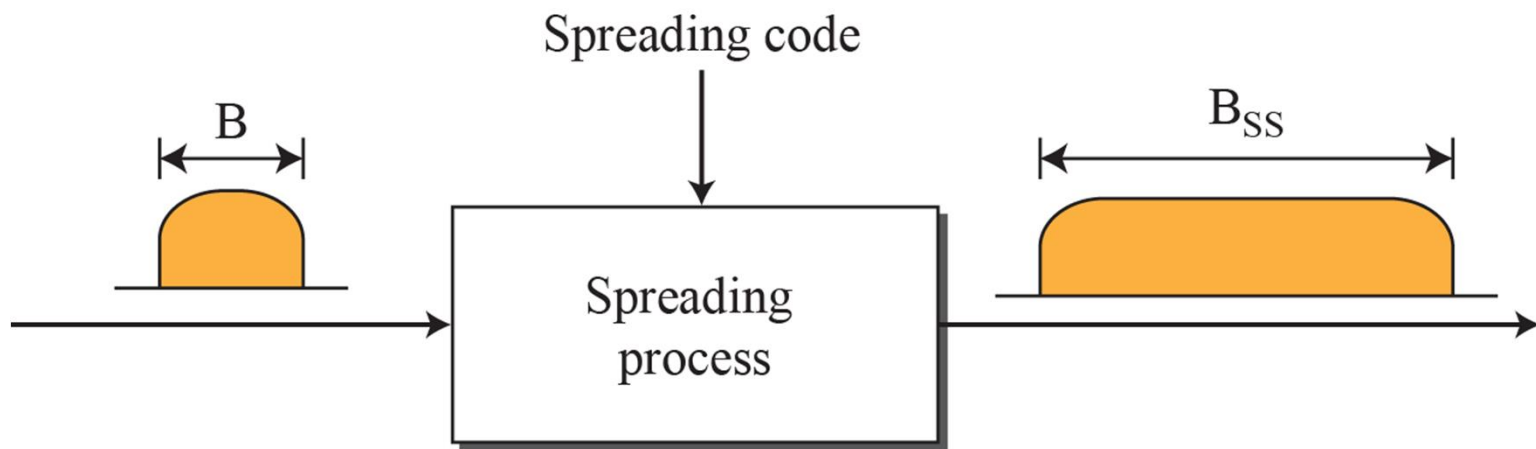
***Bandwidth Utilization:  
Spread Spectrum***



# SPREAD SPECTRUM

- *In some applications, we have some concerns that outweigh bandwidth efficiency.*
- *In wireless applications, stations must be able to share this medium without interception by an eavesdropper and without being subject to jamming from a malicious intruder.*
- *To achieve these goals, spread spectrum techniques add redundancy.*

**Figure 1: Spread spectrum**



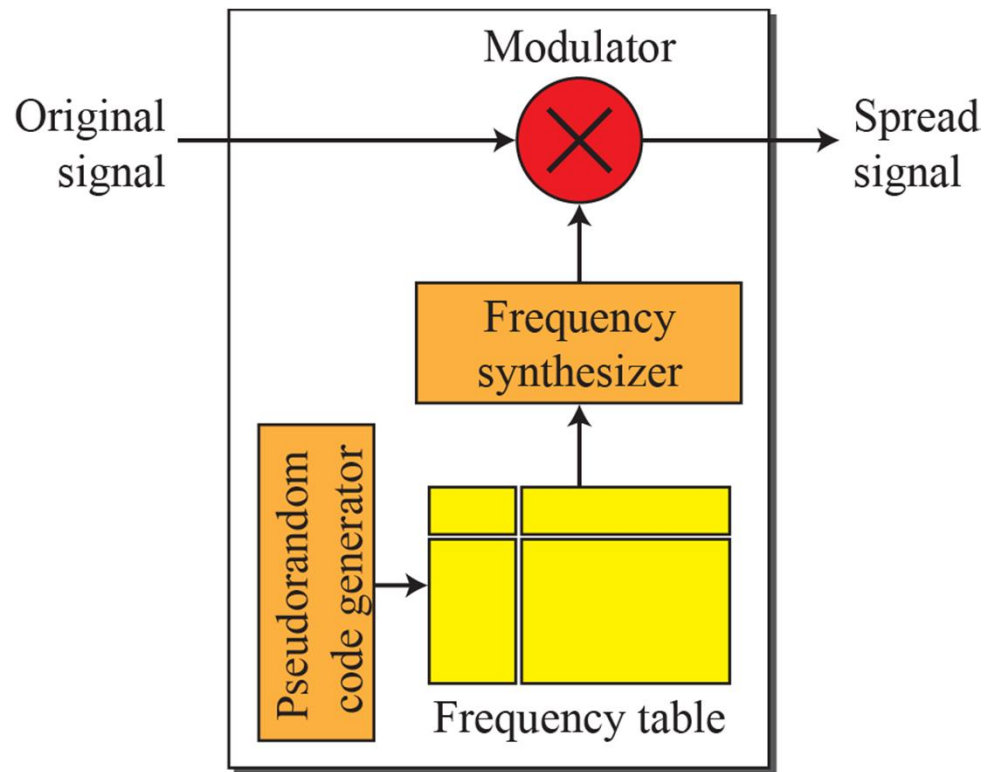


# ***1 FHSS***

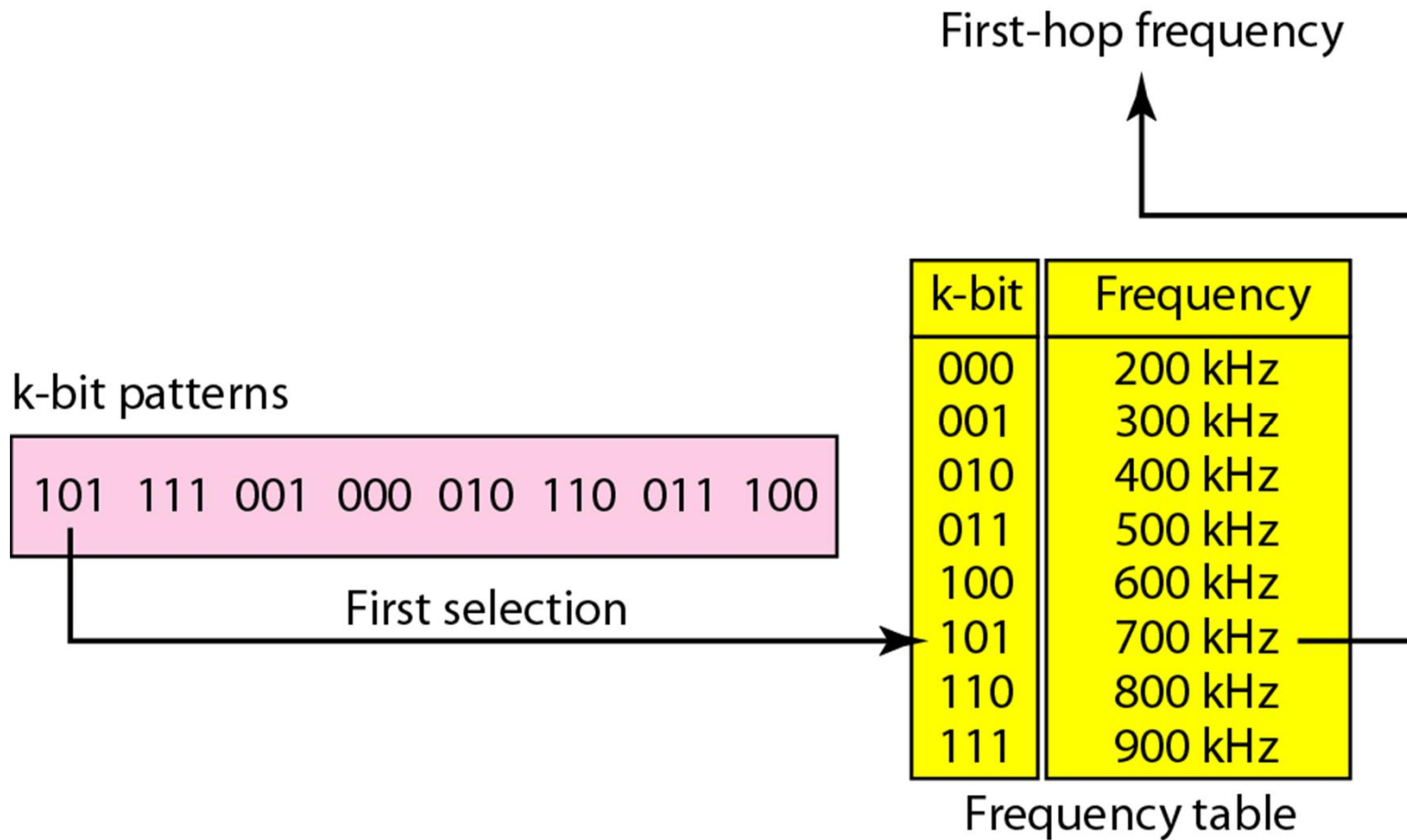
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- *Frequency-hopping spread spectrum (FHSS) is a method of transmitting radio signals by rapidly switching a carrier among many frequency channels, using a pseudorandom sequence known to both transmitter and receiver.*
- *Each available frequency band is divided into sub-frequencies. Signals rapidly change ("hop") among these in a predetermined order.*

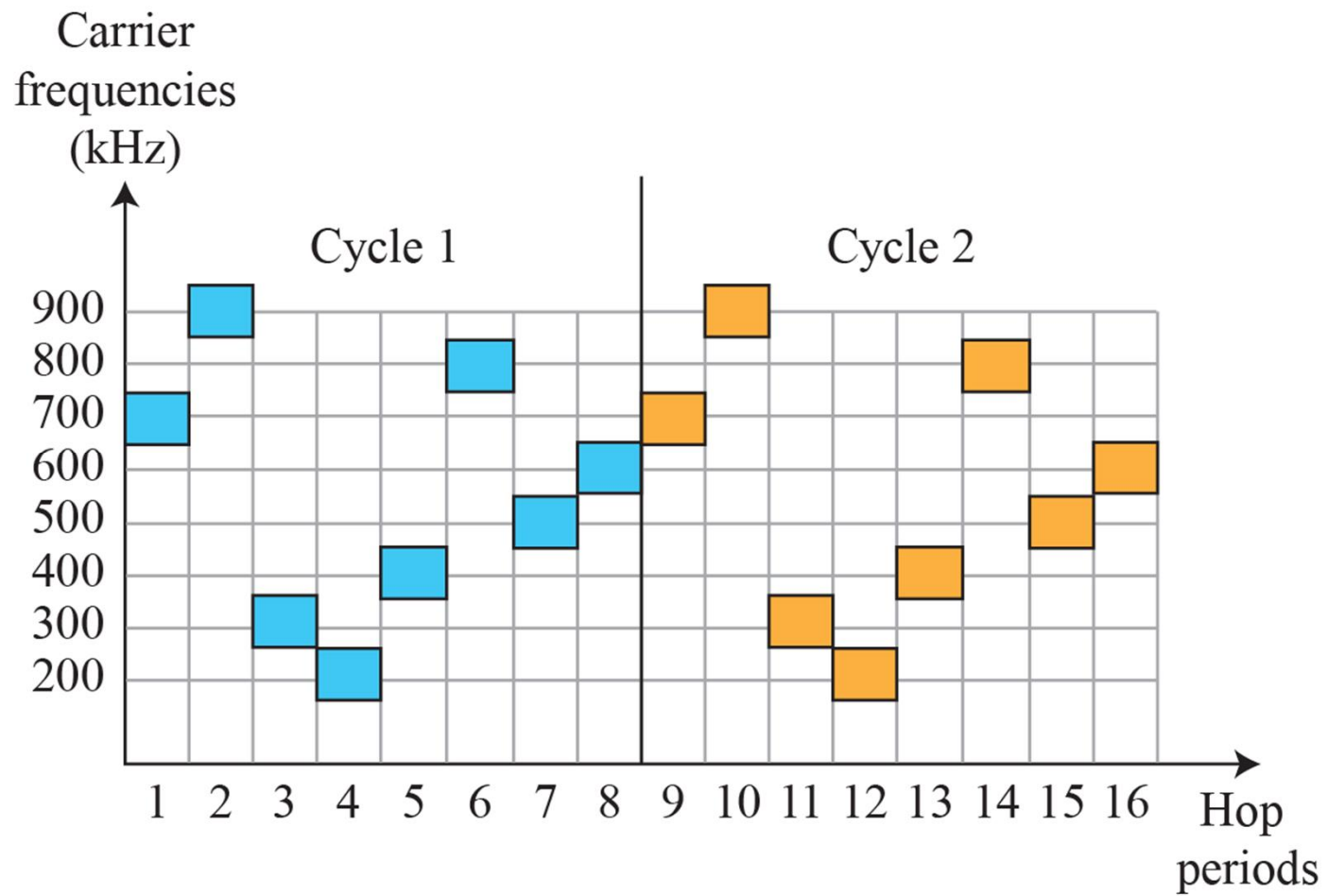
**Figure 2:** *Frequency hopping spread spectrum (FHSS)*



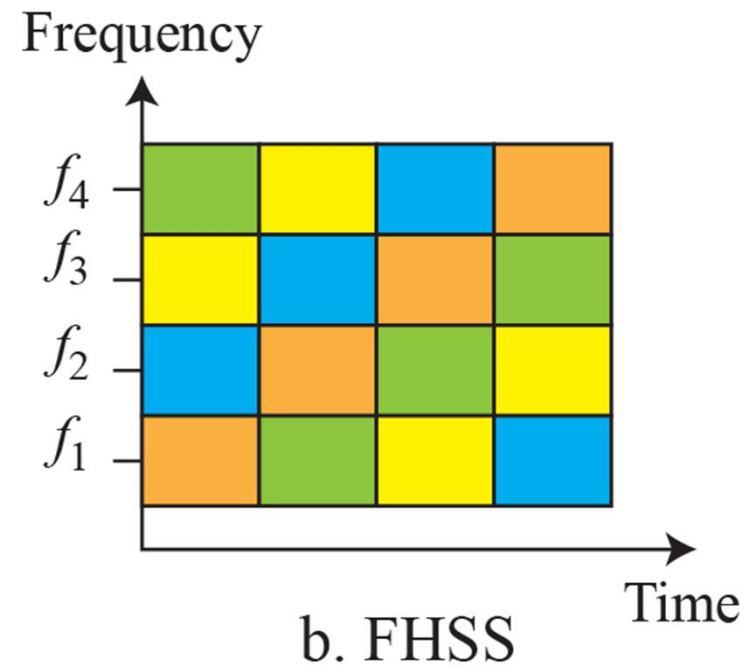
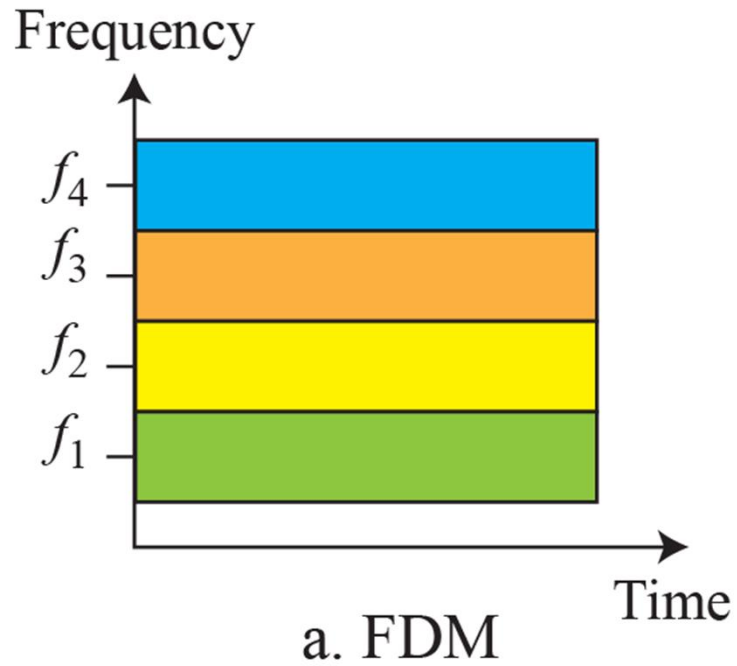
**Figure 3: Frequency selection in FHSS**



**Figure 4: FHSS cycles**



**Figure 5: Bandwidth sharing**





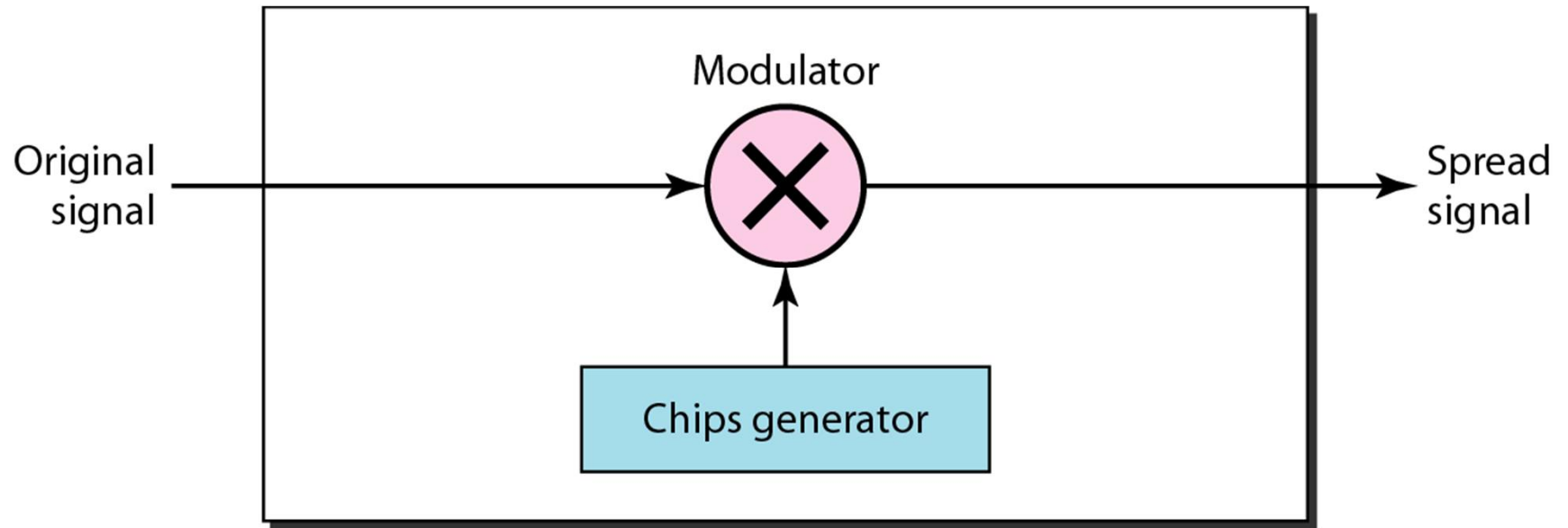
## 2 DSSS

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- *The direct sequence spread spectrum (DSSS) technique also expands the bandwidth of the original signal, but the process is different.*
- *In DSSS, we replace each data bit with  $n$  bits using a spreading code.*
- *In other words, each bit is assigned a code of  $n$  bits, called chips, where the chip rate is  $n$  times that of the data bit. Next figure shows the concept of DSSS.*



**Figure 6: DSSS**



**Figure 7: DSSS example**

