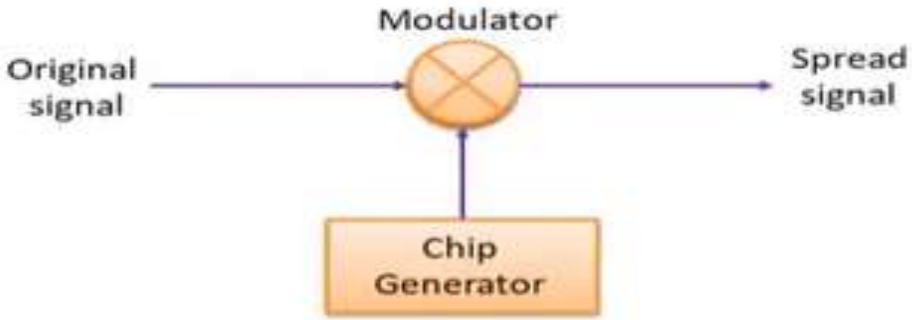
Spread spectrum

- In spread spectrum ,signals from different sources are combined to fit into the larger bandwidth.
- Communication system should be more secure , hence redundancy is added to the original signal.
- Two approaches are used in spread spectrum

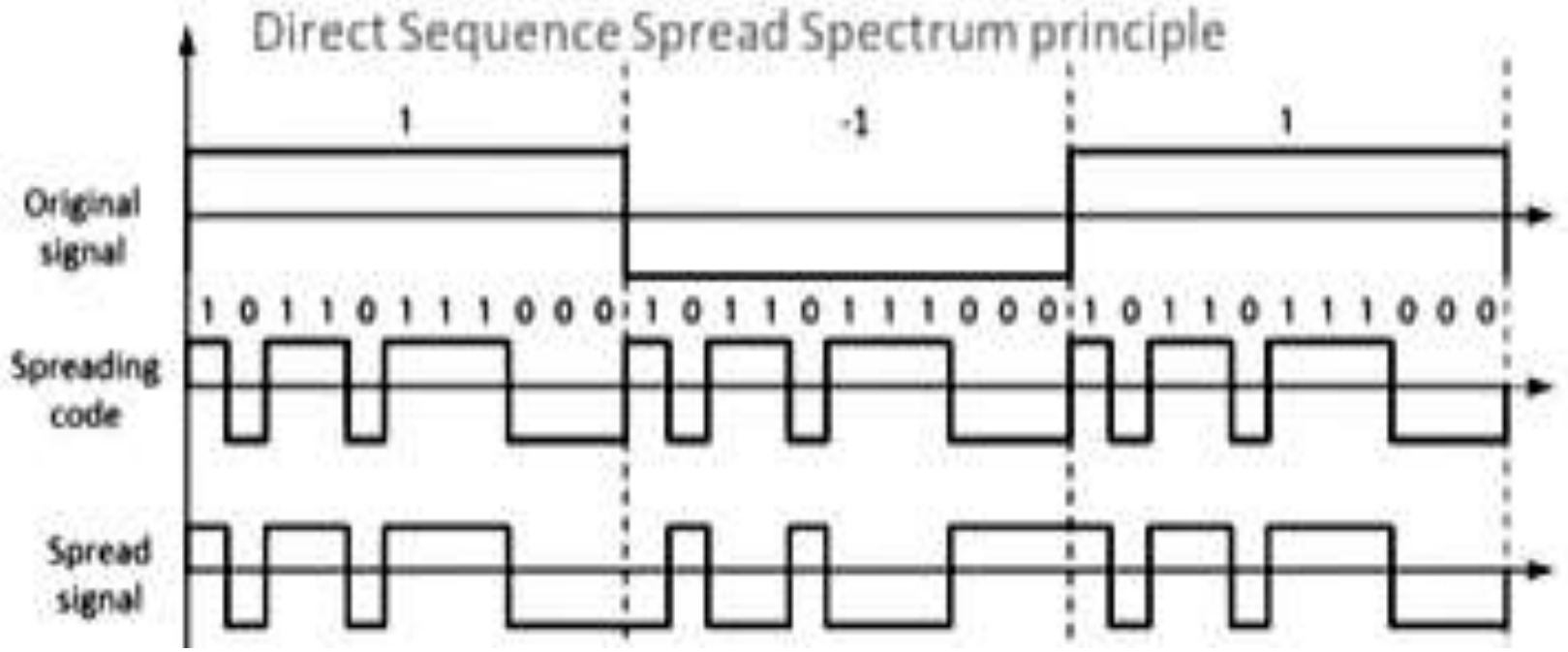
1.Direct Sequence

2.Frequency hopping

DSSS(Direct sequence spread spectrum)



Direct Sequence Spread Spectrum principle



- Information bit is multiplied with the chipping sequence.
- Each bit is represented by multiple bits using the spreading code.
- If chipping bit is large, then bandwidth of the message signal will have wider frequency band. Number of chip bit is in the direct proportion to the spreading bandwidth of the original sequence.

Processing Gain=Tb/Tc

Tb-Bit duration

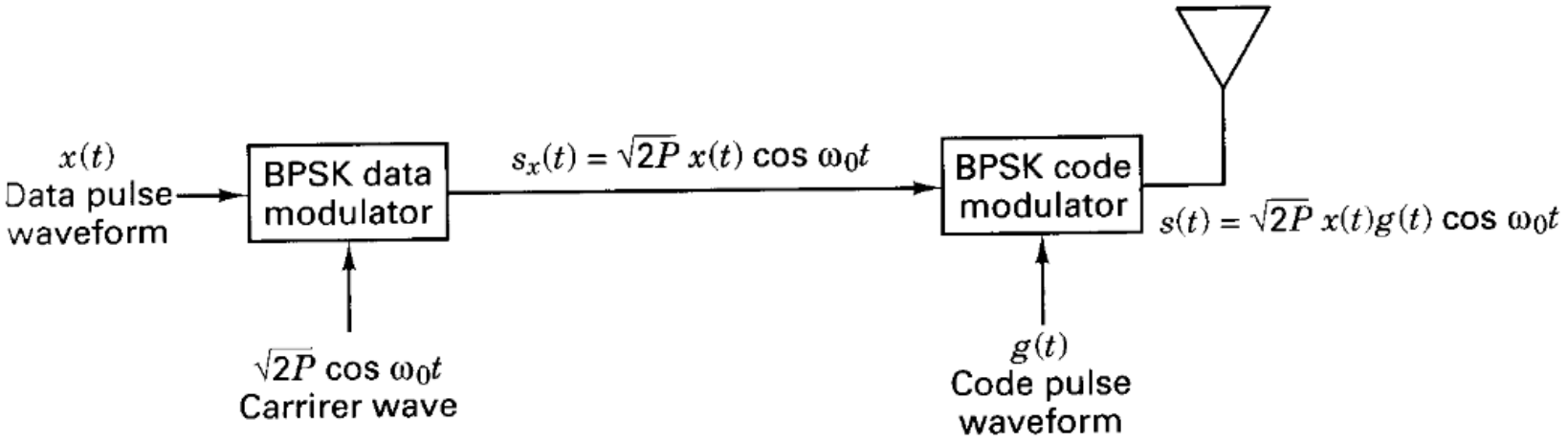
Tc=Chip duration

Bit rate of binary data entering into the transmitter Rb=1/Tb

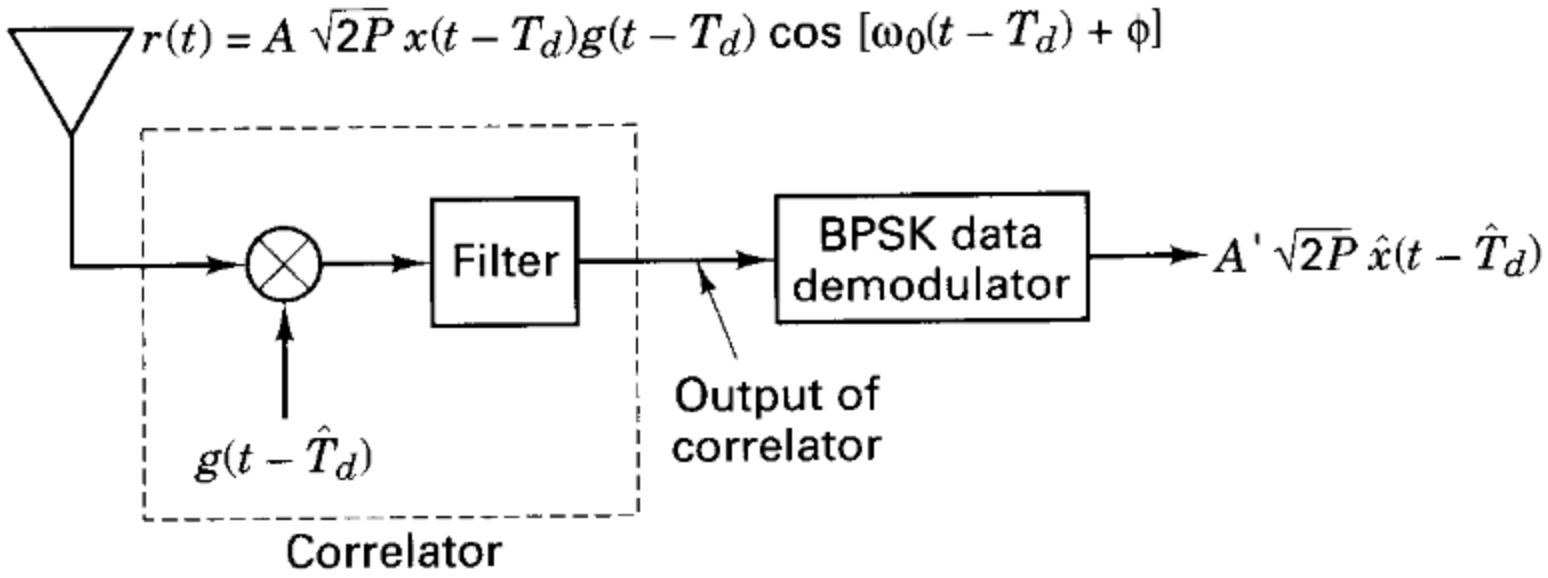
Bandwidth of PN sequence is Wc=1/Tc

Hence Processing Gain=Wc/Rb

DSSS(a)Transmitter (b)Receiver

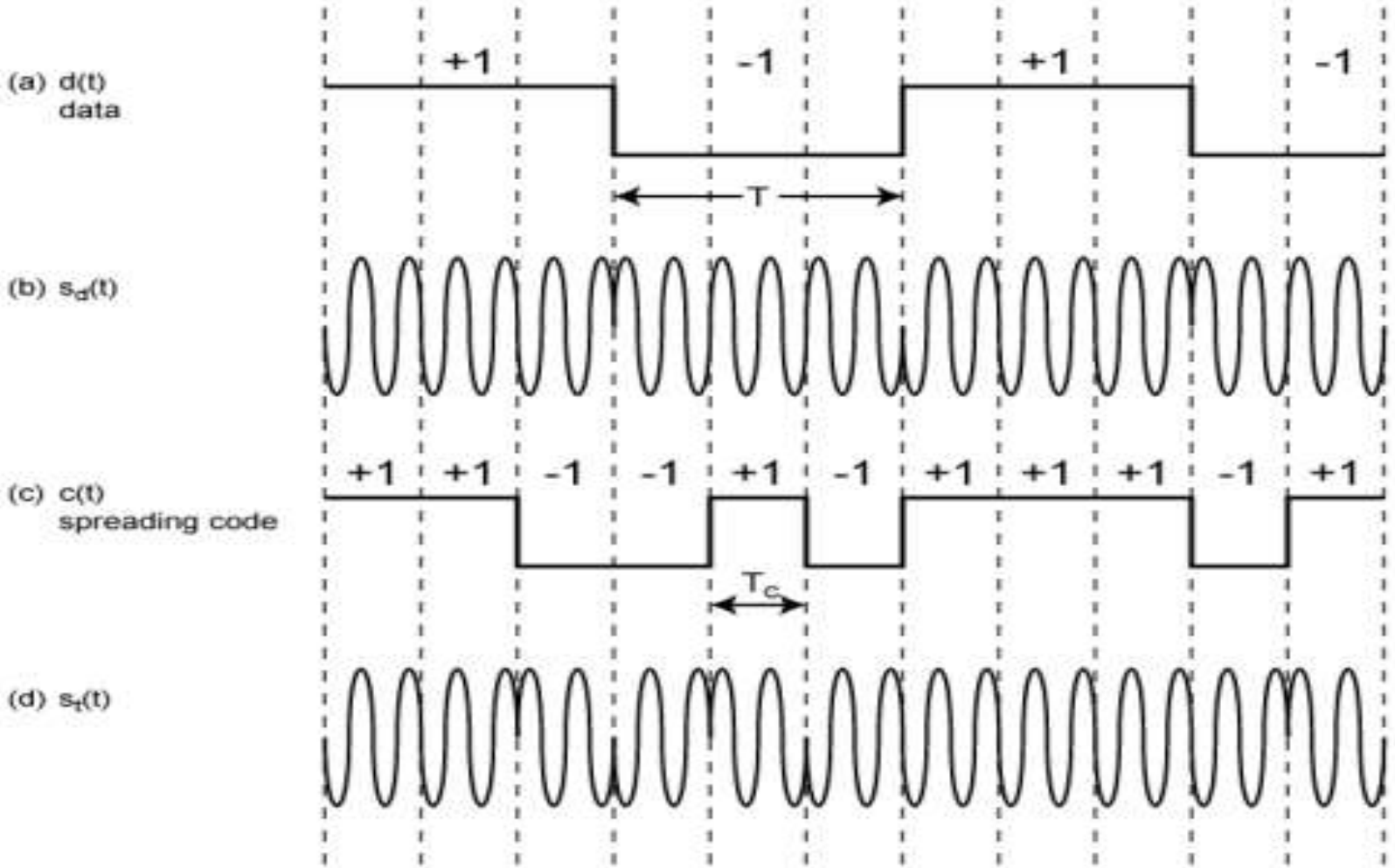


(a)



(b)

DSSS using BPSK



1	0	0	1	Data to be transmitted
0010	0010	0010	0010	Chip or spreading code
1101	0010	0010	1101	Resultant spread data output

1101	0010	0010	1101	Incoming CDMA signal
0010	0010	0010	0010	Chip or spreading code
1111	0000	0000	1111	Result of de-spreading
1	0	0	1	Integrated output

Performance parameter of DSSS System

- Processing Gain(PG)
- Probability of error(Pe)
- Jamming Margin(J/Ps)

(Refer notes)

Jamming margin

- Level of interference(jamming) that the system able to accept and still maintain the specified level of performance.
- The larger the J/Ps, the greater is the system is to interference but forces to employ the greater processing gain.

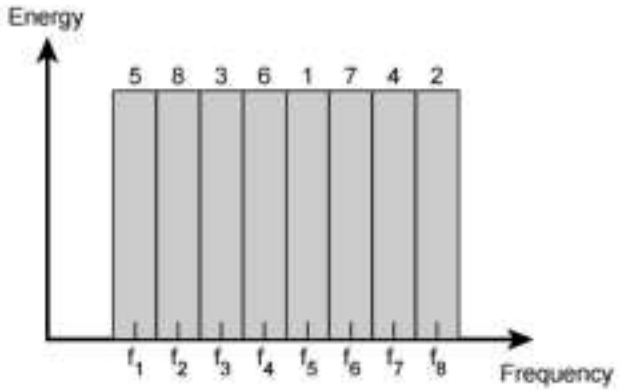
Frequency Hopping Spread Spectrum(FHSS)

- In a frequency – hop Spread – Spectrum technique, the spectrum of data modulated carrier is widened by changing the carrier frequency in a pseudo – random manner. The type of spread – spectrum in which the carrier hops randomly form one frequency to another is called Frequency – Hop (FH) Spread Spectrum.

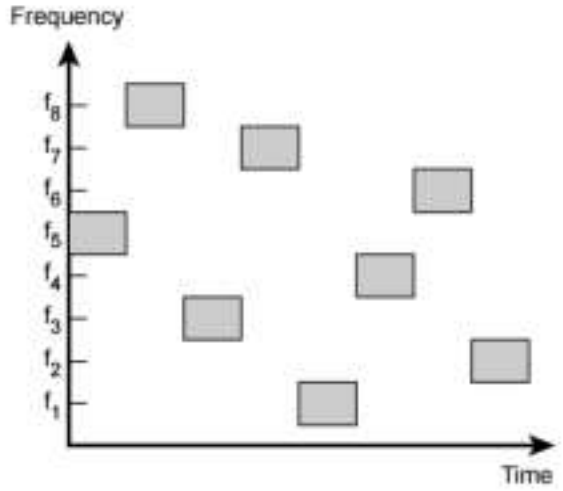
There are two types of frequency hop Spread spectrum

1. Slow frequency hopping:- In which the symbol rate Rs of the MFSK signal is an integer multiple of the hop rate Rh. That is several symbols are transmitted on each frequency hop.
2. 2. Fast – Frequency hopping:- In which the hop rate Rh is an integral multiple of the MFSK symbol rate Rs. That is the carrier frequency will hop several times during the transmission of one symbol. A common modulation format for frequency hopping system is that of M- ary frequency – shift – keying (MFSK).

Frequency Hopping Example



(a) Channel assignment



(b) Channel use

FHSS Transmitter

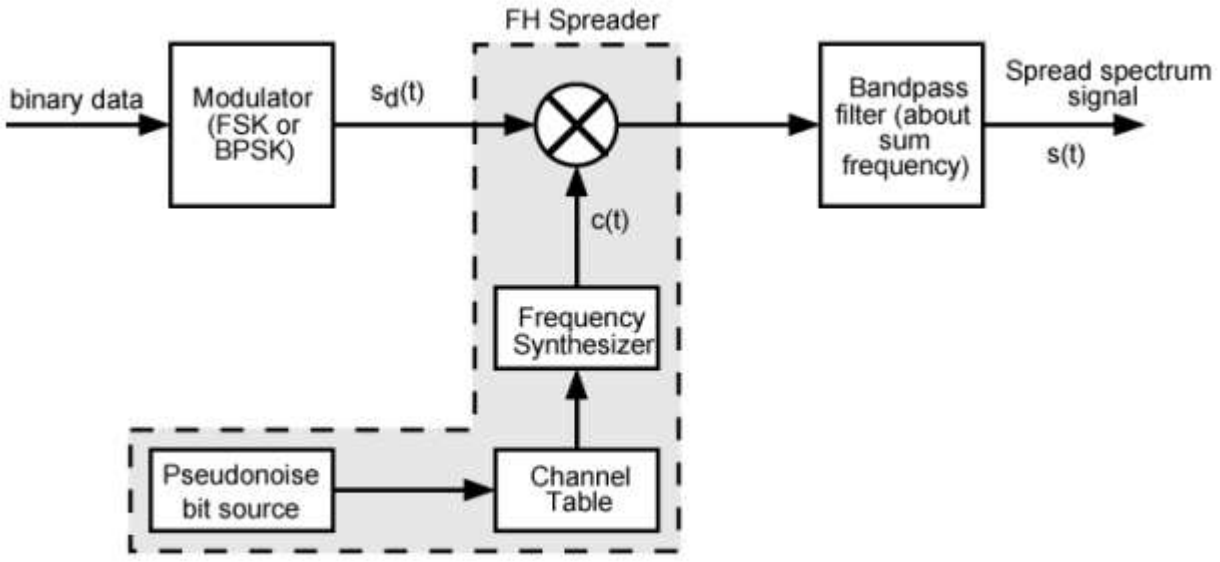


Fig :- Frequency hop spread transmitter

FHSS Receiver

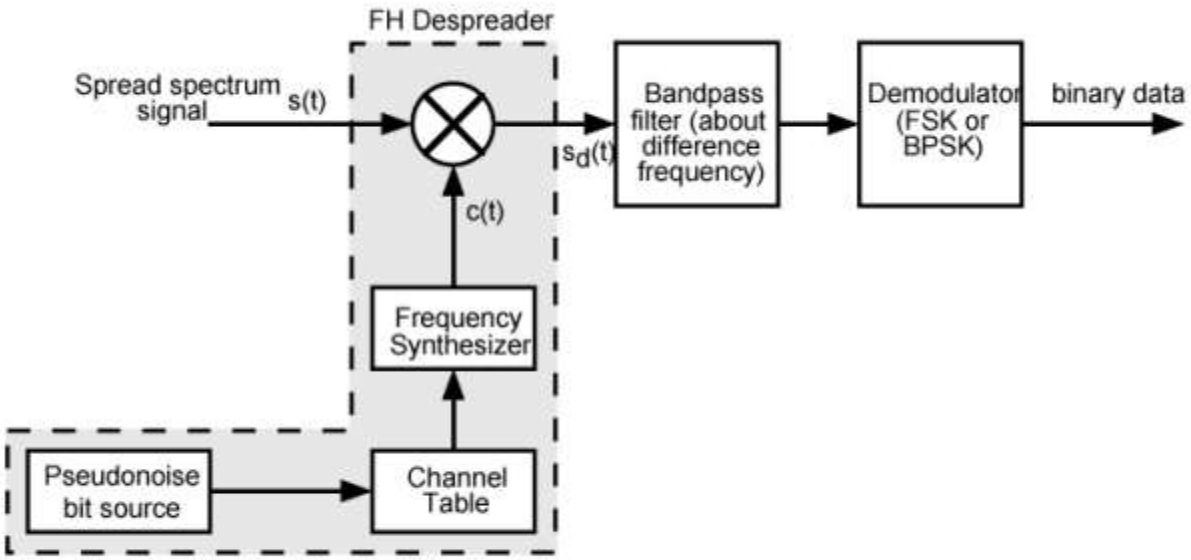


Fig :- Frequency hop spread receiver

Difference between Fast and Slow FHSS

Fast Frequency Hopping	Slow Frequency Hopping
Several frequency hops Per modulation	Several modulation symbols per hop
Shortest uninterrupted waveform in the system is that of hop	Shortest uninterrupted waveform ir the system is that of data symbol
Chip duration =hop duration	Chip duration=bit duration.

Slow FHSS

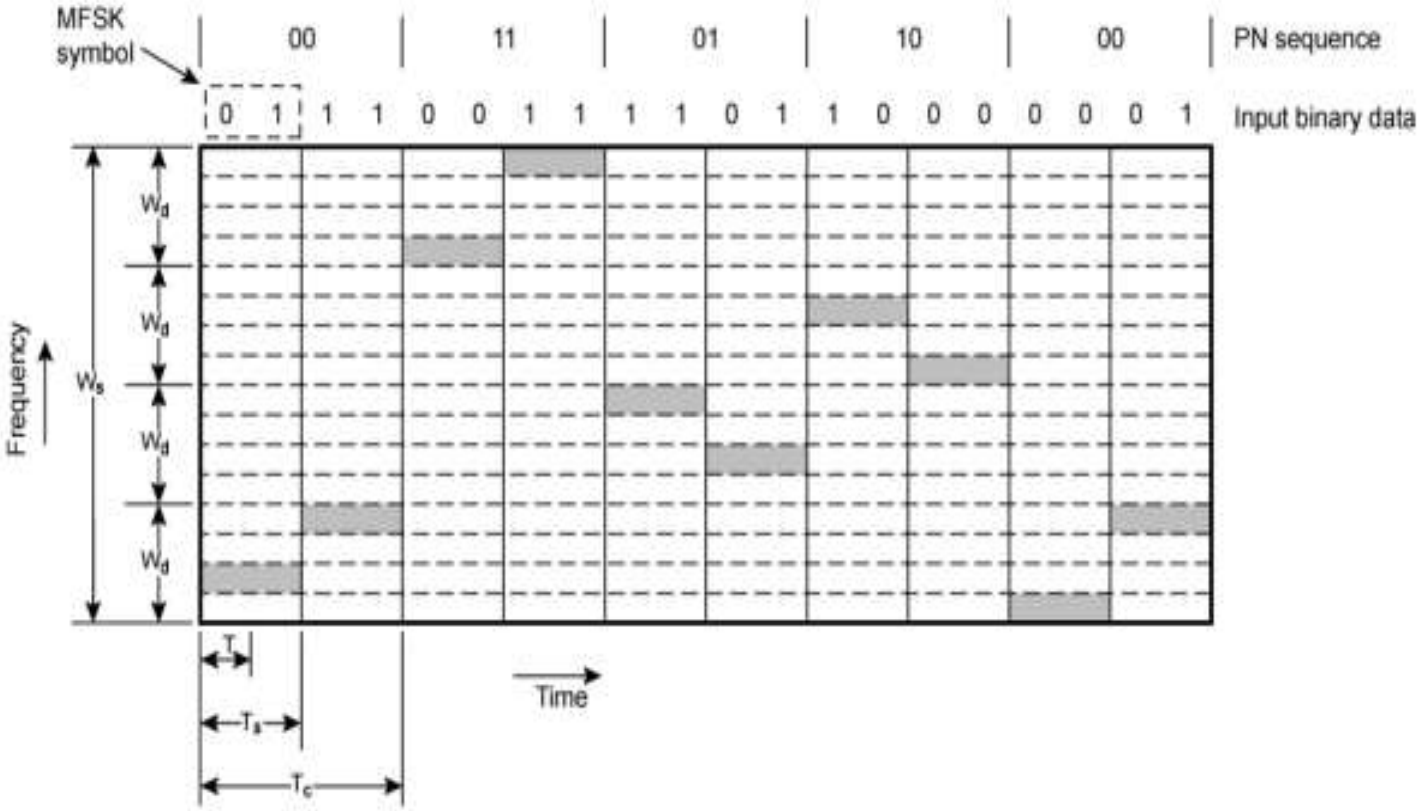


Fig. Slow frequency hopping

Fast FHSS

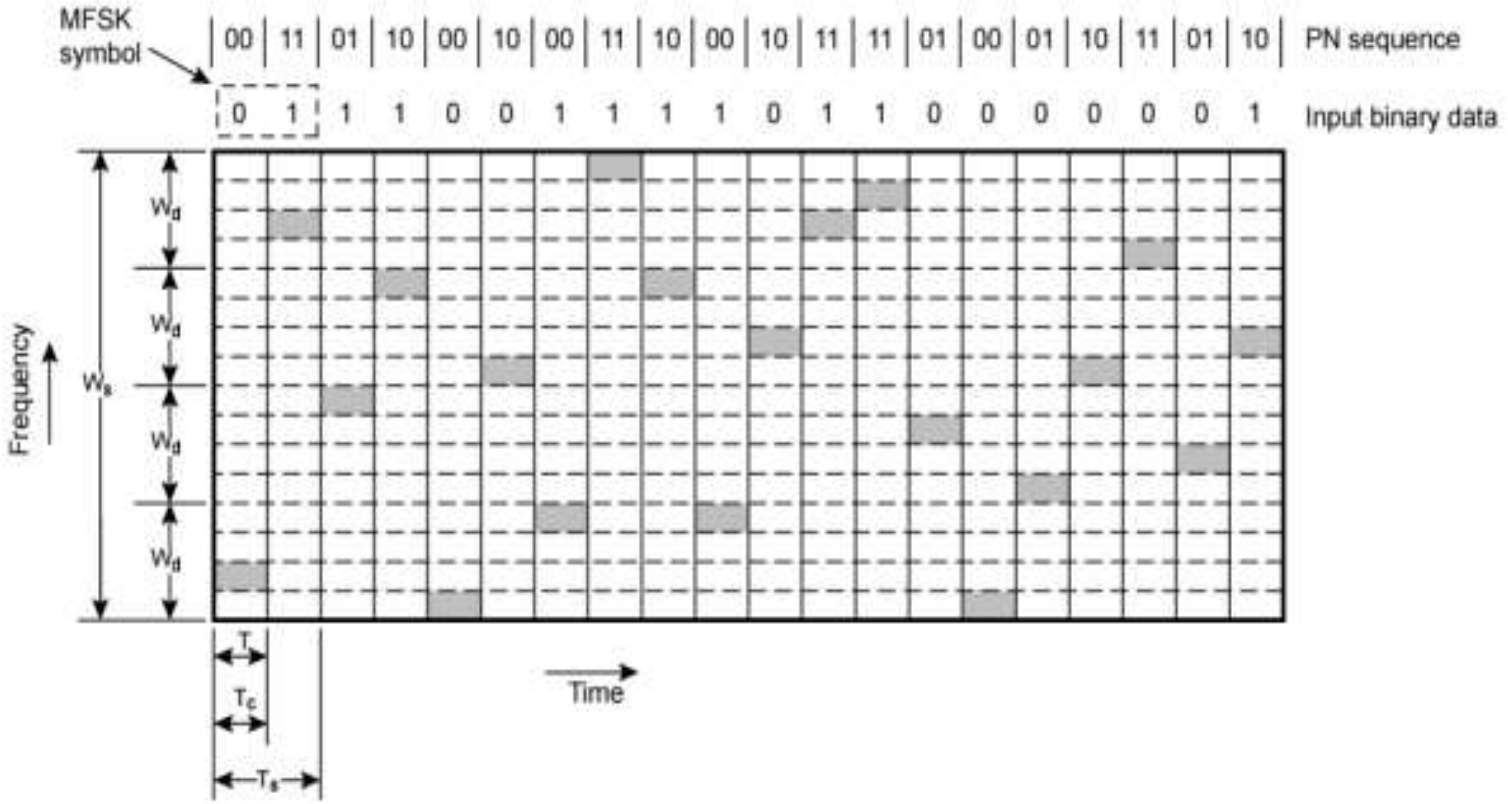


Fig. Fast frequency hopping