**INTRODUCTION**

- *Frequency hopping* is the periodic changing of the carrier frequency of a transmitted Signal.
- It is one of the spread spectrum modulation techniques in which a spectrum of data modulated carrier is widened by changing the carrier frequency in a pseudo random manner. Spread spectrum is signaling scheme in which the transmitted signal occupies a bandwidth that is much larger than the minimum typically required to send the information.
OBJECTIVE

- To describe the synchronization of FH spread spectrum communication systems. Design a synchronization circuit/system and demonstrate that it works.
Spread spectrum techniques

- The principle of spread spectrum communication is that the frequency spectrum of a data signal is spread using a code uncorrelated with that signal and as a result the bandwidth occupancy is much higher than the minimum required to transmit the signal.
- Techniques include
  - Direct sequence (DS)
  - Frequency hopping (FH)
  - Time hopping
Typically, the initiation of an FHSS communication is as follows

1. The initiating party sends a request via a predefined frequency or control channel.
2. The receiving party sends a number, known as a seed.
3. The initiating party uses the number as a variable in a predefined algorithm, which calculates the sequence of frequencies that must be used.
4. The initiating party sends a synchronization signal via the first frequency in the calculated sequence, thus acknowledging to the receiving party it has correctly calculated the sequence.
5. The communication begins, and both the receiving and the sending party change their frequencies along the calculated order, starting at the same point in time.
METHODOLOGY/BLOCK DIAGRAM:
EXPLANATION:

(a) Channel assignment

(b) Channel use
Synchronization of FHHS

- Synchronization of FHHS is a two stage event that incorporates.
- Acquisition, also called coarse synchronization, involves searching throughout a region of time and frequency (chip carrier) in order to synchronize the received spread spectrum signal with the locally generated PN sequence.
- Tracking or fine synchronization continuously maintains the best possible waveform alignment by means of a feedback loop.
Acquisition

- Most effective techniques include
  - Matched filter acquisition.
  - Serial search acquisition.
Serial-search Acquisition

Works by attempting to downconvert the received frequency-hopping pattern to a fixed intermediate frequency, and then comparing the output of an energy detector to a threshold.
Tracking

- Provides fine synchronisation by reducing the residual misalignment after acquisition.
- The predominant form of tracking in frequency hopping systems is provided by the *early-late-gate tracking loop*.
The early late gate functions as a signal multiplier. Its output $u(t)$ is the product of the gating signal and the envelope-detector output $v(t)$. The error signal is the time integral of $u(t)$ and is a function of $t_e$, the delay of $r_1(t)$ relative to $r(t)$.
Matlab implementation of FHHS receiver
RESULTS

- Original Bit Sequence
- BPSK Modulated Signal
- Spread Signal with 6 frequencies
- Frequency Hopped Spread Spectrum Signal
ADVANTAGES:

- Resistant to narrowband interference.
- Difficult to intercept.
- Utilization of Bandwidth.
- Resistant to jamming
Applications:

- Military use/ Electronic warfare.
- Mobile communications/GSM.
- W/LANS
- Country wide networks for transferring mail, faxes, multimedia etc.
Conclusion/Recommendation.

- There is need to have the timing information of the transmitted signal in order to despread the received signal and demodulate the despread signal. Therefore the process of acquiring the timing information of the transmitted Frequency Hopping spread spectrum signal and the sequential tracking of the signal is essential in the design and implementation of a synchronizing system for FH-SS.

- In synchronization, the concepts of PLL techniques have been widely exploited; more precisely the PLL model has been used to synchronize an output generated by the oscillator with the reference input signal in frequency and in phase.

- The implementation of the design in Simulink had inherent problems and the results were not realized. I recommend that work needs to be done in terms of testing the circuit with raw data to verify synchronization.
THANKS

- QUESTIONS???