FREQUENCY BANDS

ISM

- 900 Mhz (902 – 928 Mhz)
  - Low throughput and used by GSM phones , baby monitors , wireless home phones, etc
- 2.4 Ghz (2.4 Ghz – 2.483 Ghz)
  - Defined by IEEE 802.11-2007 standard. The band consists of 14 Channels.
  - 802.11 , b , g , n(draft 2.0) use the 2.4 Ghz ISM.
  - ***ADVANTAGE*** : Higher throughput than 900 Mhz.
  - ***DISADVANTAGE*** : Interference .
- 5.8 Ghz (5.725 Ghz – 5.875 Ghz)
  - Is the same frequency range as UNII-3 band , but this is 50 Mhz wider
  - Preferred for outdoor bridging because there are no power constraints
  - ***ADVANTAGE*** : Lesser interference , higher speeds.

UNII

Official name	Nickname	Freq. Range	# of Channels	Used where?	FCC Power Ratings (mW)*	IEEE Power Ratings (mW)*
UNII -1	Lower	5.15 – 5.25 Ghz	4	Indoors	50	40
UNII -2	Middle	5.25 – 5.35 Ghz	4	Indoor/Outdoor	250	200
UNII -2~	Extended	5.47 – 5.725 Ghz	11	Indoor/Outdoor	250	200
UNII -3	Upper	5.725 – 5.825 Ghz	4	Outdoor	1000	800

* - All the power ratings are @ the IR i.e this is excluding the Antenna Gain.

~ - Was only allowed after **802.11H** Ratification

- UNII-2 Devices must supports **Dynamic Frequency selection**(DFS) to prevent interference with Mil and radar systems.

DELAY SPREAD: The time difference between the original signal and the reflected signal (in case of multipath). This might cause **Inter symbol Interference (ISI)**

- 802.11 (DSSS) , 802.11b (HR-DSS) , 802.11g (ERP) : max delay spread which can be tolerated : **500 ns**
- If delay spread increases, the speeds are dropped.

Frequency Range	Max delay spread @ the indicated speed
802.11b (11 Mbps)	65 ns
802.11g (54 Mbps) – OFDM has higher tolerance	150 ns

SPREAD SPECTRUM TECHNOLOGIES

	Throughput	Frequency	Modulation
FHSS	1-2 Mbps	2.4 GHz ISM (79 MHz used)	GFSK
DSSS	1,2,5.5, 11 Mbps	2.4 GHz ISM	DBPSK (slow) DQPSK(Faster)
OFDM	6,9,12,18,24,36,48,54	5 and 2.4 Ghz	BPSK ,QAM (slow) 16-QAM , 64-QAM (faster)

FHSS

- 1-2 Mbps . 2.4 Ghz ISM.
- 79 Mhz of frequencies to be used.
- Keeps hopping b/w frequencies during transfer .
- Each hop is 1 Mhz wide, and the time it spends in each hop frequency is called *DWELL TIME.*
- Time spent in HOPPING is called "HOP TIME". Usually around 100 – 200 uS. Affects throughput inversely.
- The sequence in which the hop frequencies are chosen is called a "hopping sequence".
- IEEE mandates :
    - Each Hop = 1 mhz wide
    - Atleast 75 hops (max 79).
    - Max dwell time = 400 ms (in a 30 second interval).
- The hop seq. can be config. on an AP and delivered to the clients through the Beacon frames.

DSSS

- The data is spread and sent across the channel -> Data Encoding.
- The process of converting a single bit into a sequence -> Spreading or Chipping.
  This involves XOR'ing the bit with a PN code.
- 2 types of PN :
    - Barker Code
        - 11 bit CHIP
        - Slower
        - More resilient to ISI.
    - CCK (Complementary Code keying)
        - 4 bits with 8 chips(5.5 Mbps) , 8 bits with 8 chips (11 Mbps)
        - Faster.

OFDM

- OFDM is not a spread spectrum technology but similar to one..
- Each channel is split into 52 sub-channels (each 312.5 khz)
- Only 48 subcarriers carry data, others are "pilot" subcarriers, which carry phase and amplitude info.
- Convolutional Coding is used as a Forward Error Check. Expressed as ratio.