Base stations transmit to and receive from mobiles at the assigned spectrum  
-Multiple base stations use the same spectrum (spectral reuse)  
Service area of each base station is called a cell  
Each mobile terminal is typically served by the closest base stations   
-Handoff when terminals move

FDMA  
Each mobile is assigned a separate frequency channel for the duration of the call  
Sufficient guard band is required to prevent adjacent channel interference  
Usually, mobile terminals will have one downlink frequency band and one uplink frequency band  
Different cellular network protocols use different frequencies  
Frequency is a precious and scarce resource. We are running out of it

TDMA  
Time is divided into slots and only one mobile terminal transmits during each slot  
Each user is given a specific slot. No competition in cellular network

CDMA  
Use orthogonal codes to separate different transmissions  
Each symbol of bit is transmitted as a larger number of bits using a user specific code -Spreading  
-Bandwidth occupied by the signal is much larger than the information transmission rate  
-But all users use the same frequency band together

GSM(2G) Global System for Mobile Communications -1980s – 1990s  
Each voiceband is 13kbps  
Standard GSM has 124  
Each channel is 270.8kbps carried in 200kHz  
8 users per channel  
GSM can reuse 1/3 of channel in each cell, due to good error correction  
Capacity ~ 124 channels \*8 users per channel \*1/3 reuse = 329 users per cell  
GPRS   
-GSM upgrade that prives IP-based packet data transmission up to 114kbps  
-Users can simultaneously make calls and send data  
-GPRS provides always on Internet access and the Multimedia Messaging Service MMS whereby users can send rich text audio videos messages to each other  
-Performance degrades as number of users increase  
-GPRS is an example of 2.5G telephony -- 2G service similar to 3G

Physical Channel: Each timeslot on a carrier is referred to as a physical channel  
Logical Channel: Variety of information is transmitted between the MS and BTS  
 Different types of logical channels:  
- Traffic channel or data channel  
- Control channel

GSM Frequencies  
Originally designed on 900MHz range, nw also available on 800MHz, 1800MHz and 1900MHz ranges  
*Mobile Station, Subscriber Identity Module -> Base Transceiver System -> Base Station Controller, Transcoding Rate and Adaption Unit -> Mobile Switching Center, Visitor Location Register -> Gateway MSC /or/ Home Location Register -> PSTN*

Mobile Station – User’s handset and has 2 parts  
Radio Equipment   
User Interface  
Processing capabilities and memory required for various tasks  
- Call signalling  
- Encryption   
- SMS  
- Equipment IMEI number  
Subscriber Identity Module

Small smart card  
Encryption codes needed to identify subscriber  
Subscriber IMSI  
Subscriber’s own information  
Third party application  
Can also be used in order systems besides GSM

Base Station Subsystems  
Transcoding Rate and Adaptation Unit TRAU  
-Performs coding between the 64kbps PCM coding used in the backbone network and 13kbps coding used for Mobile Stations  
Base Station Controller (BSC)  
-Controls the channel (time slot) allocation implemented by the BTSes  
-Manages the handovers within BSS area  
-Knows which mobile stations are within the cell an informs the MSC/VLR about this  
Base Transceiver System (BTS)  
-Controls several transmitters  
-Each transmitter has 8 time slots, some used for signalling on a specific frequency

MAC Functionality  
-Independent and Infrastructure configuration support  
--Each BSS has a unique 48 bit key

dBr = 10logP  
0dBr = 10 log P  
0/10 = log P  
0 = log P  
10^0 = P  
== 1 Watt

Frequency Hopping is one of the variants of Spread Spectrum a technique which enables coexistence of multiple networks (or other devices) in the same area  
FCC recognizes frequency Hopping as one of the techniques withstanding Fairness Requirements for unlicensed operation in the ISM bands  
802.11 Frequency Hopping PHY uses 79 nonoverlapping frequency channels with 1 MHz channel spacing.  
FH enables operation of up to 26 collocated networks, therefore enabling high aggregate throughput  
Frequency hopping is resistant to multipath fading through the inherent frequency diversity mechanism  
Multiple propagation paths, interfering with each other, create a frequency selective fading.  
The fades re correlated at adjacent frequencies and get decorrelated after few MHz

Wired Equivalent Privacy WEP  
Used for authentication in 802.11  
40-bit secret key by external key management service  
-Only payload of Data frames are encrypted   
-Encryption on per MPDU basis

MAC Frame:  
Frame Control -> Duration ID -> Addr1 -> Addr2 -> Addr3 -> Sequence Control -> Addr4 -> Frame body -> CRC  
Frame Control:  
Protocol Version -> Type -> SubType -> Source -> Dest -> Frag -> Retry -> power manag -> Data -> WEP -> Order/RSRV

SSID – Sequence ID

MAC Architecture   
Point Coordination Function – PCF – Point Coordinator used to determine which station currently has right to transmit  
Distributed Coordinaton Function DCF – CSMA/CA – Implemented in all stations and Aps  
Point IFS < Distributed IFS

Point Coordinated traffic shall have higher priority to access the medium, which may be used to provide a contention-free access  
Both DCF and PCF shall coexist without interference