

Chapter 1.

1. Wireless communication began in the 1830s. Faraday and Maxwell established the foundational tech theory. In the following decades, many wireless communication networks were achieved such as air cast, wireless television. Then in modern times, mobile system, communication satellite, cellular system came out.

2. electromagnetic induction; electromagnetic field theory.

Chapter 2

1. wired media: stable, interference; wireless media: unstable, lower bandwidth and broadcasting.

2. licensed band: auctioned by ITU-R, usually not free.

unlicensed band: free.

3. terrain; frequency; speed of mobile terminal.

4. Reflection: When the size of obstacle is longer than the wavelength, reflection occurs.

Diffraction: When the wave was blocked by the sharp edge, the wave created by the obstacle can spread to the back of the obstacle.

Scattering: Scattering is a general physical process where wave is forced to deviate from a straight trajectory by one or more paths due to non-uniformities in the medium through which they pass.

5. Reflection: It's not the main mechanism on outdoor.

Diffraction: It's weaker than reflection on indoor.

Scattering: It depends on the obstacle.

6. P_t : transmit power P_r : receive power

defining G_t : antenna gains of transmitter G_r : antenna gains of receiver

h_b : height of base station h_m : height of mobile station.

d : distance between transmitters and receivers.

relations: $\frac{P_r}{P_t} = G_t G_r \left(\frac{\lambda}{4\pi d}\right)^2$ $\frac{P_r}{P_t} = G_t G_r \frac{h_b^2 h_m^2}{d^4}$

7. Pass loss receiving power transmission delay

Free Space: $L_p[\text{dB}] = 32.45 + 20\lg f_c [\text{MHz}] + 20\lg d [\text{km}]$; $P_r = \frac{G_t G_r P_t}{L}$; $\tau = \frac{D}{c}$

Two-ray model:

$10\lg P_r = 10\lg P_o - 10\lg(d)$

8. Signal strength changing due to the change of location is called shadowing or slow fading. It was caused by the environment.

9. $L_p = L_o + 10\alpha\lg D + X$.

10.

11. The received waves go through different path and then they merge at the receiver. Different phases cause the interference to each other, which is called multipath fading.

Doppler Shift: $f' = \frac{V \pm V_r}{V \mp V_t} f$

12. The Amplitudes and phases of the received waves are independent, so the envelop follows Rayleigh distribution. Chapter 5.

When there is a main channel, the envelop follows Ricean distribution.

13.  $f_r = \frac{v \pm v_r}{v \mp v_r} f_t$
 f_r is different from f_t because of the relative speed of receiver and transmitter.

14. $I_0(x) = \frac{1}{2\pi} \int_0^{2\pi} \exp(x \cos \theta) d\theta$

15. $P_2(z) = \frac{2m^m \cdot z^{2m-1}}{\Gamma(m) P_r^m} \cdot \exp\left[-\frac{mz^2}{P_r}\right]$

Chapter 8 & 14

1. evolution: speed, compatibility, diversity.

2. $K = J/N$ $C = MJ/N$ $P_E = P_0 \left(\frac{d}{d_0}\right)^{-k}$

3. $K = J/N$ $C = MJ/N$

4. base station: transceiver

up link: mobile $\rightarrow$ network core

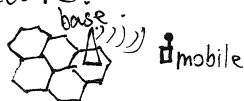
downlink: data communication $\rightarrow$ data terminal

cell: a basic unit of cellular network.

5. HLR: reference database for subscriber parameters.

VLR: a copy of HLR.

architecture:



6. handoff: When mobile user enter other cells, allocate it a stronger channel.

location: ~~manage~~ MH.

7. speed, compatibility, support for media

8. It prevents oversubscription of VoIP network.

9. SGSN performs security functions and access control

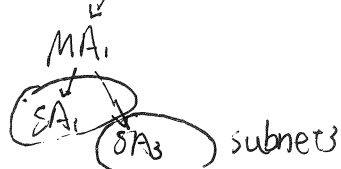
10. CDMA 2000, WCDMA, TD-SCDMA

11. CDMA

12. 200 kbit/s, 1.25 MHz

13. BTAM: for use on the IBM system

14. Internet $\rightarrow$ Access Network.



1. 5G, mobile cloud computing, mobile web

2. ① monitor signal strength, once it exceed the threshold, handoff begins.

② mobile unit begin to recognize the new base station.

③ After several interaction, the new link was established.

2. inter: mobile unit moves to a different cellular system controlled by different MTSO.

intra: mobile unit moves to the cellular system controlled by the same MTSO.

3. MCHO: mobile station make decision

NA/VCHO: Network make decision.

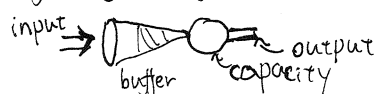
MAHO: mobile unit monitor the signal and network make decision.

4. advantage: soft handoff: termination rate is very lower. hard handoff: one call uses only one channel.

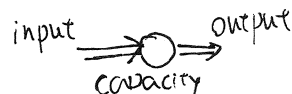
disadvantage: soft handoff: more complex require in hardware. hard handoff: ping-pong effect.

5. Monitor the signal strength, and once it ~~execute~~ exceed the threshold, execute hand off.

6. ~~flow~~ fluid flow model:



straight-line:



8. ~~inter~~ intra-switch: switch to other cells within system.

inter-switch: switch to other system.

10. The smaller the cell is, the higher handoff rate is.

11. two-tier architecture: a presentation layer ~~is~~ runs on a client, and a data layer stored on a server.

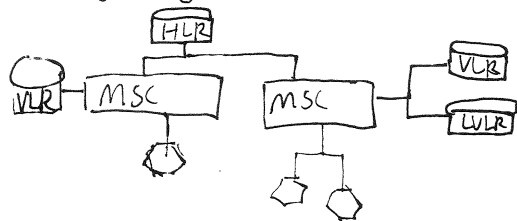
12. When mobile unit boots or shuts down cellular network will ask it to report its location. And it will report its location in a certain interval.

13. Time-based: difficult to consider paging delay

movement-based: too many unnecessary.

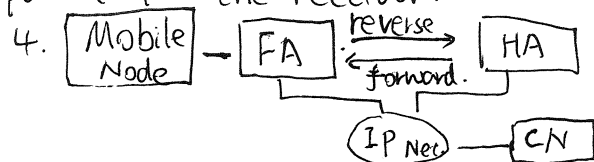
distance-based: hard to implement.

14. location management scheme with WLAN positioning algorithm.



Chapter 7.

1. ~~It~~ It doesn't change, so I can easily connect it.
2. MN: change frequently
HA: keep track of the mobile unit's location
FA: report the transport address.
COA: connect the mobile unit to a new IP.
3. MH sends to FA; FA tunnels packets to HA by encapsulation. HA sends the packet to the receiver.



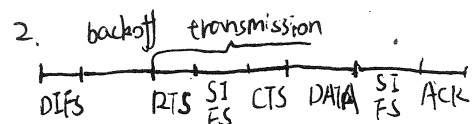
5. Mobile node sends a request.
6. Limited lifetime allows a mobile node registers with its home agent using a request.
9. If a foreign or home agent doesn't support the request, it may fail.
10. IP in IP: The whole packet was encapsulated directly

minimize minimal: New IP was inserted between original IP head and load.

general routing: The data packet in one protocol will be encapsulated into the data packet in another protocol

Chapter 8.

1. DCF: distributed coordination function. is the fundamental MAC technique.
PCF: It resides in a AP to communicate within the network.
DIFS: It's a acronym for DCF interframe spacing.
PIFS: PCF enabled the AP wait for PIFS rather than DIFS to occupy the wireless medium



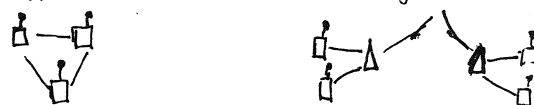
3. IEEE 802.11e is the standard that defines a set of quality of service enhancements for LAN application to MAC.

EDCA: a station with high priority traffic waits a less before it sends its packet.

4. Ad-hoc network allows each device to connect with each other directly.

infrastructure mode: It requires to use AP

5. Ad-hoc: no base station infrastructure:



6. MAC and PHY

7. Data link layer	LLC	
	MAC	MAC management
physical layer	PLCP	
	PMD	PHY management.

8. infrared: simple circuit, cheap, portable, short range, low bandwidth.

radio: high speed, cover large area; difficult shielding

10. management packets: for association authentication.

control packet: usually have some relevance to data packets

Data packets: raw data packets.

11. DCF, PCF, HCF

13. multicast: information is addressed to a group of destination computers simultaneously.

unicast is the sending of messages to a single network destination identified by a unique address.

14. NAV is a logical abstraction which limits the need for physical carrier-sensing to save power.

15. QoS is supported in 802.11 infrastructure.

16. It keeps the timer for all stations in the same BSS synchronized.

18. Beacon contains a timestamp. When receiving a beacon, STA adapts.

19. ~~in chapter 6~~ ASP was proposed to synchronize a multi-hop MANET.

20. save mobile power.

21. Ad-hoc: CSMA/CA is used to access the channel
Infrastructure: RTS, CTS, ACK.

22. ATIM: transmitted in ATIM-window by stations.

BTIM: transmitted less frequently.

23. in chapter 6. 24. breaks data into smaller pieces.

25. Frame control: 2 Byte. Duration/ID
26. Addr1: 4x6 Byte. Sequence
Control: 2 Byte. Addr2 control: 2B.
HT control: 4B.

26. Devices may not be the actual source or destination of L2 traffic.
27. It defines requirements for OFDM. It fix 802.11

28. WEP is a security protocol for wifi net work.
29. Standard 64-bit WEP uses a 40-bit key to encrypt the data.

31. Open system. Shared key:
32. WEP: Only provide confidentiality at network level.

MAC: Easily spoofed. doesn't identify a person
33. Active scan: Changes its IEEE 802.11 radio to the channel scanned.

passive scan: wait for a periodic beacon from any APs.
34. SIFS: highest priority
PIFS: medium.

DIFS: lowest priority.
35. AP means the entry of the system and base station determine the output of the system

3. in chapter 7, 8.

Chapter 9.

1. high speed, long distance, various support for media data.
2. UWB: physical layer is based on OFDM. 802.15: support for MIMO antennas.

3. OFDM: data → frequency → wave → frequency → data.
Chapter 10.
1. In chapter 7, 8.

2. The impact of interference from a transmitting node is determined by whether a receiver falls within the interference range.

3. It's a zone established by a scanning body to protect specific activities in a specific area.

5. They will cause resource waste and more conflicts
Chapter 11.

1. Each message has an exact meaning intended to elicit a response for that particular situation.
2. EAP authenticator
EAP server
supplicant
internet or LAN resource

3. in chapter 7, 8.

Chapter 12.

1. low power assumption. cheap, less delay. long distance connect.
2. Page, page scan, inquiry inquiry scan.

3. Tags: use it attached to the objects to be identified
headers: read tags.
4. power supply to tags. data transmit from tag to reader.

The safety and integrity of the data.
5. access control. advertising promotion track.

Chapter 13.
by a scanning body to protect specific activities with more computational energy and communication

2. radio transceiver: transmit microcontroller: manage the energy source.
3. smart car, smart home
4. air pollution monitoring

forest fire detection
landslide detection
5. short range, high data rates.

3. in chapter 7, 8.

b. transmission rate, delivery reliability and network lifetime.
transmission rate ↑ ⇒ network lifetime ↓.

7. solar energy
Chapter 14

1. sensor network. new bluetooth technology EPC, RFID
2. safety, low Energy cost, cheap, high transfer rate.

3. BLE is intended to provide considerably reduced power consumption and cost while maintaining a similar communication range.

4. CR automatically detects available channels then changes its transmission or reception parameters to allow more connection

5. low power consumption comfortable to wear, healthy to human.
6. healthy monitoring.

7. flow-based data transmitting. Center-control routing application-oriented.

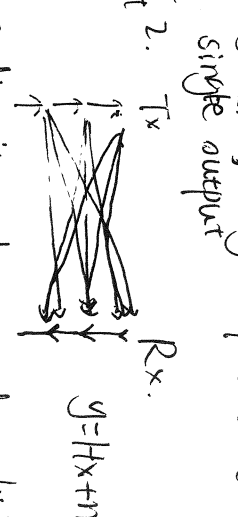
3. in chapter 7, 8.

8. smart car; smart home
9. Traditional network doesn't support the dynamic scalable computing and storage needs.

Chapter 16, 17, 18.
1. microphone, camera, engine, wifi and various sensor.

2. explore narrow space. automated guide vehicle: It's a mobile robot that follows the markers or wires on the floor.

Chapter 19
1. SISO are special case of MIMO; single-input and single output
2. Tx Rx.



3. diversity coding sends multiple copies through multiple transmit antennas.
multiplexing:
4. used in 3GPP, 3GPP2; non-wireless communication

Chapter 21, 22
1. It's a cryptography and electronic payment system.
2. version information format information data.

3. in chapter 7, 8.