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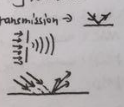
Chapter 1

1. 1876 telephone by Bale → 1895 wireless by Marconi → 19?? Television → 1946 Mobile phone → 1958 SCORE communication satellite → 1988 GSM → 1997 wireless network
2. (1) SDN (2) Wi-Fi (3) Cellular system (4) Internet of Things (5) Sensor network (6) WiMAX (7) mobile IP

Chapter 2.

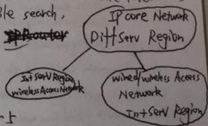
1. Wired → use cable, more stable, larger bandwidth, less convenient.
   wireless → use frequency wave, less stable ~~less~~ smaller bandwidth, more convenient
2. licensed band → WLAN, Cellular system → used with authority of country
   unlicensed → ISM, PCS, U-NII → free
3. media, frenquency, distance
4. reflection and transmission → diffraction → scattering →



5. indoor → reflection + diffraction + scattering
   out door → ground reflection + diffraction
6. distance ↗ ~~→ passloss~~
   the height of stantion ↓ → passloss ↑
   antenna gains ↓
7. ~~transmitting power~~ ~~receiving power~~ ~~Lp = Lo + 10α lg D + X~~
   2-ray: $\frac{P_r}{P_t} = G_t G_r \frac{h_b^2 h_m^2}{d^4}$ free space: $\frac{P_r}{P_t} = G_t G_r (\frac{\lambda}{4\pi d})^2$
8. shadow effect → obstruction → received signal strength ↓, ~~the~~ $L_p = L_0 + 10\alpha \lg D + X$
9. $L_p = L_0 + 10\alpha \lg D + X$
10. free space 2 indoor 1.6~1.8
    city cellular 2.6-3.5 building block 4-5
    city cellular shadow 3-5 factory block 2-3
11. small scare fading → caused by constructive and destructive interference of the multiple signal path between transmitter and receiver
12. Rayleigh → 多径衰落接收信号包络分布
    Ricrean → 接收信号包络的衰落变化
13. $v(t) = \frac{vf}{c}\cos\theta(t)$
    base station → frequency f.
    receiver → f + v(t)
14. $f_{Ray}(r) = \frac{r}{\sigma^2}\exp(-\frac{r^2}{2\sigma^2})$, $r \geq 0$
    $f_{Ric}(r) = \frac{r}{\sigma^2}\exp(\frac{-(r^2+\alpha^2)}{2\sigma^2}) I_0(\frac{\alpha r}{\sigma^2})$,
    $r \geq 0, \alpha \geq 0$;
15. Level crossing rate:
    $LCR = \sqrt{2\pi} f_d \rho e^{-\rho^2}$ fd Doppler shift
    $\rho = R_{thresh}/R_{rms}$
    average fade duration $AFD = (e^{\rho^2}-1)/(\rho f_d \sqrt{2\pi})$

Chapter 3 and 4

1. CDMA → CDMA2000, WCDMA, TD-SCDMA
2. transmitting power ↑, cell radius ↓ → system capacity ↑
3. $q = \frac{D}{R}$, $D = \sqrt{3N}R \Rightarrow q = \sqrt{3N} \Rightarrow N = \frac{q^2}{3}$
4. base station: public mobile communication station.
   uplink: from station to satellite
   downlike: from satellite to station
   cells: use many small station to cover a whole area
   location areas: the area that wireless cover
   mobile switching centres: provide service and control between phone and data system.
5. VLR: A database containing all information of call and recall.
   HLR: a database to manage mobile user
6. handoff management: switching of base station, recognize new base station, channel assignment
   Location management: local agent, non-local agent identity authentication
7. the speedup of transmitting voice and data. provide service around the world
8. TDMA use GSM
   CDMA use MSC
9. SGSN/GGSN: provide the network packet service, manage the users' data
   MSC/GMSC/HLR → make choic of the route and communicate with HLR and VLR.
10. WCDMA, CDMA2000, WCDMA
11. High ~~spp~~ speed data transmission Global Roaming, multimedia service.
12. EDGE combined with the GPRS 2.5G is called EGPRS, peak data rates in ~~peak~~ the order of 200 kbit/s, bandwidth is 400 kbits/s
13. mobile business, mobile television, mobile search,
14. ~~IP Router~~

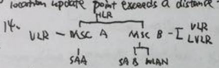


Chapter 5

1. ~~Mob~~ Mobile Computer Cloud, Mobile Access ~~website~~, Mobile Web page.

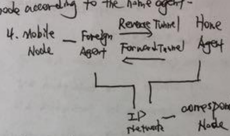
Chapter 6

1. scout the signal → switch begin if it exceeds the threshold → ~~regn~~ recognize the new basestation → establish new link
2. intra-switch handoff: mobile terminal → moves from one base station to another → both base stations are connected to the same switch
   inter-switch handoff: mobile terminal → move from one base to another → connected to diffrent switch
3. NCHO (Network controlled handoff) Network monitor the signal strength and launch the switch.
   MCHO (~~Network~~ mobile controlled handoff): Mobile station monitor the signal strength and choose the best choice.
   MAHO (Mobile assisted handoff): Mobile station monitor the signal stregth and network make the switch choice
   the transmitting ~~the~~ node.
4. advantage:
   hard handoff: use a channel at a time
   soft handoff: reduce the probability of connection failure.
   disadvantage:
   hard: will cause ping-ponging effect
   soft: require more complicate design inside the user-equipments.
5. If signal intensity variance beyond the threshold the mobilestation will launch the transform program
6. straight-line model: regard the users as the linear behavior ones. Fluid flow model: to describe ~~fluid~~ the fluid level in a reservoir subject to randomly determined periods of filling and emptying.
7. $f(t) = \frac{\beta^{\gamma} t^{\gamma-1}}{\Gamma(\gamma)} \cdot e^{-\beta t}$ $f^*(s) = (\frac{\beta}{s+\beta})^{\gamma}$, $\beta = \gamma\eta$
8. intra-switch: a mobile signal becomes weak in a given cell and MTSO find othercell within its system to which it can transfer the call → it uses Intra system handoff.
   Inter-switch: a mobile signal becomes weak in a cell and MTSO can not find other cell within its systems to which it can transfer the call then it uses Inter system handoff.
9. $f(d_0, d_{av}) = a(d_0)[d_{av}]^{d(d_0)}$
   $g(d_0, d_{av}) = b(d_0)[d_{av}]^{c(d_0)}$
10. cell splitting → reduce the cochannel interference → make the handoff rate higer
11. a software architecture in which a presentation layer or interface runs on a client, and data layer or data structure gets stored on a server.
12. mobile boots or shuts down → cellular network asks to report its location in a certain interval.
    Service delivery: Cellular network search for the available access interface for called user, succeed caller will send a feedback to end the service delivery.
13. time based scheme: an MT performs location updates periodically at given time intervals.
    Movement-based scheme: an MT performs a location update whenever it completes a predefined number of movements across cell boundaries.
    Distance-based scheme: an MT reports its location to the network when its distance from the last location update point exceeds a distance threshold.
14.



Chapter 7.

1. permanent IP: reduce the reconnection and make the system more stable and easy to connecte
2. MN: location is always changing.
   HA: the home for the mobile node, constantly send info to the outside nodes.
   FA: a router for the outside nodes and send them to the communication nodes.
   COA: a forwarding node which should forward the message from one to its node
   CN: a mobile node to communicate.
3. MH sends to FA. FA tunnels packets to HA by encapsulation HA forwards the packet to the packet to the receiver
5. mobile node sends a registration to the prospective foreign agent to begin the registration process. Foreign agent processes the registration request and then relays it to the home agent. The home agent sends a registration reply and then delay the request. finally, the foreign agent respond to the mobile node according to the home agent.
4.



6. limited lifetime allows a mobile node registers with its home agent using a registration request message so that its home agent can create or modify a mobility binding for the mobile node.
9. If any of foreign or home agent don't support the matching request with 'T' bits sequence, the request will fail.
10. IP in IP: into a datagram to deliver
    Minimum: new IP is located between the old IP and data.
    Route: a datagram of a layer is encapsulated in the other layer's datagram.
11. RAT using reverse connection send SYN packet to client IP. to ensure client verify the outside connection in network.
12. firewall → reverse tunnelling → accept by agent
13. mobile phone is IP nodes with reverse tunneling and firewalls. Some origin server may not.

Chapter 8.

1. DCF: fundamental MAC technique of the IEEE 802.11 based WLAN standard. DCF employs a CSMA/CA with binary exponential backoff algorithm.
   PCF: a Media Access Control technique.
   ~~of~~ DIFS: acronym for DCF Interframe spacing.
   SIFS: stands for shortest among above mention networking terminology.
   PIFS: SIFS + Slot time.
2. RTS/CTS → minimize the amount of time spent when collision occurs.
3. IEEE 802.11e: define a set of quality of service, wireless LAN and steaming multimedia.
   EDCA: high-priority traffic > low-priority
   HCF: enhance the DCF and PCF
4. Ad-hoc model: allows each device to communicate directly with each other
   Infractructure ~~devices~~ model: use access point to control the communicate.
5. Ad-hoc model: composed of node.
   Infractructure model: nodes and base station
6. 802.11 { Data Link Layer (MAC) / Physical Layer (PHY)
7. LLC: control the logic link
   MAC: access, fragmentation, encryption.
   PLCP: carrier sensing assessment
   PMD: modulation and coding
8. Infrared: short-range communication
   radio wireless: large-range communicate
   advantage: radio wireless has higher bandwidth.
9. 802.11 1 MAC and 3 PHY
   802.11a 5GHz band at 54Mbps
   802.11b 2.4GHz, 5GHz
   802.11g 2.4GHz, 54Mbps.

10. medium → chose the packets with highest priority → send first.

11. PCF → access point wait for PIFS duration instead of DIFS

DCF → require a station → transmit to listen for the channel status for a DIFS interval

HCF → control HCCA and worked like a PCF.

12. timing diagram.

DIFS, CW, DATA, SIFS, ACK, idle.

13. unicast → send message to a single network with one address

multicast → send message to many address

14. NAV → IEEE 802.11 → limit the need of physical carrier-sensing at the air interface → save power

15. infrastructure model support QoS by PCF, stations connected to network through AP.

ad-hoc mode don't support.

16. In 802.11, node has to communicate with other node by boardcast, collision not allowed, → all nodes to synchronization,

17. Infrastructure model: AP controls timing, beeps timers from all stations.

distributed function for independent BSS.

18. Time divided into beacon intervals, each containing a beacon generation window.

If T(beacon) > T(STA) STA adopts beacon.

19. ASP is proposed in for time synchronization in 802.11-based multi-hop ad hoc network.

→ to let the faster nodes send out beacon more often and self correction of the clocks.

20. Some mobile equipment are supported by battery → saving power

21. Ad-hoc CSMA/CA is used to access the channel RTS, CTS, ACK, PS-Poll are used to overcome hidden terminal.

Infrastructure model is the same. ~~use CSMA/CA to access the channel.~~

22. DTIM: transmitted less frequently, for sending buffered broadcast packets.

ATIM: transmitted in ATIM-window by stations who want to send buffered packets. structured the same as TIM.

23. reassociating with the new AP.

MM offers seamless hand overs when moving from one network/subnetwork/BSS to another

24. The packets may be formed that can pass through a link with a smaller MTU than the original datagram size.

25. Frame control, Duration/ID, Address 1-4, sequence control, QoS control, HT control.

26. while an 802.11 device is transmitting to a receiving device, either one (or both) of these devices may not be the actual source or destination of the L2 traffic. so we need TA, RA, SA, DA.

27. 802.11a → an amendment to the 802.11 → defined requirements for an orthogonal frequency division multiplexing communication system. 802.11b. changes the radio spectrum from (5.15 GHz to 5.35 GHz) to 2.4 GHz. speed, range.

28. WEP is a security protocal for wi-fi network, making wireless networks as secure as wired network,

29. standard 64-bit WEP uses a 40 bit key → concatenated with a 24-bit initialization vector to form the RC4 key.

30. client $\xrightarrow[\text{request}]{\text{authentication}}$ AP AP $\xrightarrow{\text{reply}}$ clear-text challenge. client encrypts the text with WEP key, send back. AP decrypts the response.

31. Two methods: Open System authentication Shared Key authentication.

Open system: Any client can authenticate with the access point and then attempt to associate.

Shared key authentication: use WEP key for authentication in a four-step challenge-response handshake,

32. WEP/WPA: only provide confidentiality at the network level, they do not tell us who is connected.

MAC filtering:

problem: doesn't identify a person. Easily spoofed, and not a secret information

Captive portals

very flexible, self-explanatory, easy to implement,

Not transparent, not standardized. may require an external authentication server.

33. Active scan occurs → the client changes its IEEE 802.11 radio to the channel being scanned.

passive scan → waiting for periodic beacon from APs on the channels being scanned.

34. SIFS: highest priority, for ACK, CTS, polling response.

PIFS: medium priority, for time-bounded service using PCF.

DIFS: lowest priority, for asynchronous data service.

35. A station has more links will get more throughput and along with the transmitting node.

Chapter 9

1. QoS guarantee, high speed, long distance, various services, active mobile.

2. TCL encapsulate the MAC datagram and control of the control logic. PMD deal with the channel coding and modulation.

3. OFDM split channel into several small channel and use low-speed data flow, reduce the interfere between sub channel, so the balance of channel become easy.

Chapter 10

1. infrastructure: a single core network

ad hoc model: a peer network.

2. In the transmitter and receiver's perspective: if the distance d_{ij} between i and j ≤ R_t the reachable distance, and other node $d_{kj} \leq R_I$ the interfere distance don't transmit data, the j and i could communicate successfully.

3. every user use one channel, → cause interfere, → use exclusion region

4. upper bound $TH = \frac{E[P]}{\min(4, H_c) \times T}$

lower bound $TH = \frac{E[P]}{\min(H_c, b) \times T + \max(H_c, t, 0) \times T}$

5. Hidden terminals and exposed terminals will waste ad-hoc network's time slot, increase the possibility of collision.

Chapter 11

1. same to chapter 8. 30

2. 针对以太网提出的基于端口进行网络访问控制的安全性标准→利用物理层特性对连接到局域网端口的设备进行身份验证,

3. WEP: one direction.

WAPI: add WAI to achive identity authentication.

IEEE 802.11i: add IEEE 802.1X protocol into WLAN security. TKIP and CCMP.

Chapter 12.

1. BLE 4.0 Low Energy with the lowest cost to do the same work

2. page, page scan. Inquiry, Inquiry scan.

3. RFID, RFID Tag reader, Application, software system

4. Data transmit between Tag and Reader, Tag supply, anti-collision

5. ETC system in tollbus, trace of product, bank/credit card.

Chapter 13.

1. sensor networks monitor the data transmit to base station deliver the manage node. monitoring station handle monitored data. potentially more powerful aggregation nodes: finally reach through the internet or satellite.

2. four parts: the power and power management module, a sensor, a microcontroller, and a wireless transceiver.

3. Mobile application: intelligent monitoring system; stationary APP: smart factory

4. ① The sensor network nodes broadcast their status and receive status from other nodes.

② The sensor network are organized into a connected network ③ suitable paths are computed on the constructed network,

5. The communication distance of the nodes in the network is generally short. The node can communicate with its neighbors

6. Transmission rate, delivery reliability and network lifetime

7. Ambient energy harvesting from external sources are used to power autonomous sensors such as those based on MEMS technology.

Chapter 14.

1. Radio Frequency Identification, Body area Network, cognitive radio,

2. High transfer rate: system capacity is large, Anti-jamming performance

3. In the chip design, the use of two ways to achieve, that is, single-mode and dual-mode.

4. Monitor its own performance continuously. Determine the RF environment deliver the required quality of service

5. Short distance, high speed, time change,

Chapter 15.

1. SDN is an architecture purporting to be dynamic, manageable, cost-effective, and adaptable,

2. The flow of data forwarding mechanism central control of the routing the application-oriented programming.

3. OpenDaylight, OCP and POF

4. SDN → get rid of hardware restrictions on the network architecture.

Chapter 16, 17, 18.

1. Touch sensor, Pressure sensor, Wi-Fi

2. Real-Time Indoor Mapping, Fully Distributed Scalable Smoothing and Mapping.

Chapter 19.

1. MIMO: equipped with multiple antennas.

SISO: path between transmitter and receiver

2. $X = [x_1, x_2 \cdots x_{Nt}]^T$

$Y = [y_1, y_2, \cdots y_{Nr}]^T$

$H = [h_{11}, h_{12} \cdots ; h_{21}, h_{22}]$

$Y = H \times Tn$ n is AWGN

3. spatial-diversity: better quality

space multiplexing: better use the antenna.

4. Distribute MIMO, Multiuser, Networking MIMO

Chapter 21 & 22

1. hard to stole, safe. a delimiter, a connection

2. a coded area, a functional graphic composition pattern.