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Chapter 1

1. Signal fire, sonarphone
↓
telecommunication: telegraph, telephone
↓
radio communication: telecast, mobile phone
↓
communication satellite
↓
NMT, GSM
↓

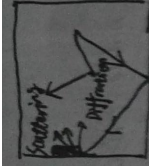
WLAN

2. ① cellular system ② mobile management
3. ③ Mobile IP ④ Wi-Fi: 802.11
5. ⑤ WiMAX: 802.16 ⑥ Ad Hoc Network
7. ⑦ WLAN security ⑧ Bluetooth, RFID
9. ⑨ Sensor network ⑩ Internet of things
- ⑪ Software-defined network

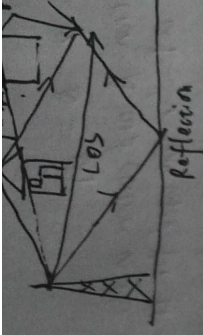
Chapter 2

wired	wireless
stable	variable comparatively
data rate high low	data rate high
bandwidth high	bandwidth low

2. LTPB is stipulated for specific uses such as cellular system and ~~that~~ WLAN
- UTB is used in industry, science and so on.
- media, trade-off, distortion
- Reflection: when the size of the obstacle is bigger than the wave length, often occur on the surface of wall and the earth
- Diffraction: when the path of ~~propagation~~ propagation is stopped by acute edge, the secondary wave spreads in the space and even the back side of the obstacle.
- Scattering: when the size of the obstacle is smaller than the wave length, often occur on the rough surface or other irregular object.



Diffraction



Reflection

6. free space modeling:

$$L_p [dB] = 32.45 + 20 \lg f_c [MHz] + 20 \lg d [km]$$

$$P_r = \frac{P_t}{d^2} \quad \tau = \frac{d}{c} = 3 \mu s \quad 10 \lg P_r = 10 \lg P_t - 20 \lg d$$

two path-ray modeling

$$L_p [dB] = 32.45 + 20 \lg f_c [MHz] + 40 \lg d [km]$$

$$10 \lg P_r = 10 \lg P_t - 40 \lg d$$

7. The expression of L_p adds a random variable whose distribution is decided by attenuation element.

8. for small and medium-size city:

$$0 [km] = [1.1 \lg f_c - 0.7] \ln - [1.56 \lg f_c - 0.8]$$

for big-size cities:

$$0 [km] = \begin{cases} 8.27 [\lg (1.54 \ln)]^2 - 1.1 & 1 \leq \ln \leq 2 \\ 2.2 \lg (1.75 \ln) - 4.97 & f_c \geq 2000 \text{ MHz} \end{cases}$$

9. macro-cell systems:

$$L_p [dB] = \begin{cases} A + B \lg d & \text{city} \\ A + B \lg d - C & \text{suburb} \\ A + B \lg d - D & \text{open} \end{cases}$$

$$A = 69.55 + 26.1 \lg f_c - 13.82 \lg (h - 0.6) \ln$$

$$B = 49.5 - 5.5 \lg h_0$$

$$C = 5.4 + 2 [\lg (f_c / 28)]^2$$

$$D = 40.94 + 9.73 \lg f_c - 18.33 f_c$$

micro-cell systems:

$$0 = 40.94 + 9.73 \lg f_c - 18.33 f_c$$

offered by many factors like distance and height and so on

10. multipath fading: the phase changes rapidly and the amplitude fluctuates, often modeled as a random variable

• Rayleigh shifts the wave length changes because of the relative displacement between the transmitter and receiver

11. When there is a channel which is dominant: Rician

When there is no such channels: Rayleigh

12. In frame of the kinetic wave source, the wave is complex.

the wave length turns shorter and the freq turns higher.

$$V_{eff} = \frac{V}{c} \cos \theta(t)$$

$$13. f_{ray}(r) = \frac{V}{\sigma^2} \exp \left(-\frac{r^2}{2\sigma^2} \right) \cdot \frac{1}{2\sigma^2}$$

$$f_{ray}(V) = \frac{V}{\sigma^2} \exp \left(-\frac{(V^2 + \sigma^2)}{2\sigma^2} \right) \cdot \frac{1}{2\sigma^2} \cdot \frac{1}{V}$$

$$14. \text{Chapter 3 and 4}$$

$$1. 2G: GSM \quad 3G: CDMA$$

$$2. 5G: 5G PRS \quad 7-13G: 5G PRS$$

4. Base station: A land station in the land mobile service uplink: a feeder link used for the transmission from an earth station to a space radio station
downlink: a feeder link used for the transmission from a space radio station to an earth station.

cells: land areas served by at least one base station
MSC: the primary service delivery node for GSM/GSM-R
J. MSC: responsible for routing voice calls and SMS
HLR: a central database that contains details of each mobile phone subscriber that is authorized to use the GSM core network

AUC: Authenticate each SIM card that attempts to connect to the GSM core network

VLR: a database of the subscribers who have roamed into the jurisdiction of the MSC which it serves.

ELR: keep a list of mobile phones which are to be banned from the network or monitored.

~~base station~~ Hand off management:

As the phone user moves from one cell to another while a call is in progress, the mobile station will search for a new channel to attach to in order not to drop the call.

7. higher data rates; greater security; more applications

3. CAC is used in the call set-up phase and applies to real-time media traffic as opposed to data traffic.

QoS is responsible for the internet working between the

GPRS network and external packet switched networks.

QoS is responsible for the delivery of data packets

from and to the mobile stations within its geographical service area.

③ MSC set-up and test released the end-to-end connection.

handle mobility and handover requirements during the call and takes care of charging and real time prepaid account monitoring

④ GSMSC: All mobile to mobile calls and PSTN to mobile

calls are routed through a GSMC

⑤ HLR ~~store details~~ is a system which directly receives and processes MAP transactions and messages from elements in the GSM network.

Security: the users can be sure the network is the intended one and not an impersonator.

Applications: The bandwidth and location information available to 3G devices gives rise to applications not previously available to mobile phone users.

transmission rate	bandwidth	operation freq
2.5G 15K/s	177.6 kHz	
3G 2M/s, 3.1K/s, 144K/s		

17. DAS: hard drives = solid-state drives

SDN: disk arrays, tape libraries

NAS: load-balancing and web server systems.

18. All-IP

Chapter 5.

1. mobile cloud; mobile web; pervasive computing

Chapter 6.

1. ① MSC

② MATHO

2.

3. ① MCHO: measure mobile station judge mobile station

② VCHT: mobile network network

③ MATHO: mobile station network

4. Hand: save channel resources; ping pong

Soft: better quality of connection; lower availability

5.

6.

2. MN: mobile node whose location changes frequently
- HA: home agent, is a router in the home link of MN
- FA: a router in another link of ~~FA~~
- Goal: when MN change to ~~FA~~ another link, the IP address CN's the communication of MN
3. a mobile node sends its packets through a router on foreign network, if routing is independent of source address, establish a topologically correct reverse tunnel from GATEWAY to MN
4. transport 114.114.114.114
5. FA produce forwarding address for MN and inform the HA
6. After a registration, HA will create a item for MN including the life time of this registration
7. Foreign agent advertise GFA which are used by mobile IP
- 8.

9. Registration request can be refused by HA or FA
10. Φ IP in IP @ minimal encapsulation @ GRE
11. The source IP address of a packet transmitted by a MN does not correspond to the network prefix from where it emanates. Mobile IP does dictate the use of reverse tunnels in the context of multicase datagram routing and mobile routers

Chapter 8

1. VCF: the fundamental MAC technique of the IEEE 802.11 based WLAN standard.
- PCP: a MAC resides in a point coordinator also known as AP, to coordinate the communication with the network
- PIFS: The IEEE 802.11 family of standards describe the VCF protocol, which controls access to the physical medium
- SIFS: the amount of time in microseconds required for a wireless interface to process a received frame and to respond with a response frame.
- PIFS: one of the interframe space used in IEEE 802.11 based wireless LANs.
2. PCF doesn't solve the hidden terminal and/or exposed terminal problem completely, it only alleviates the problem through the use of RTS and CTS, and recommends the use of a larger carrier sensing range.
3. IEEE 802.11 is a set of MAC and PHY specifications for implementing WLAN computer communication in the 2.4, 3.6, 5 and 60 GHz frequency bands.

HCF: the hybrid coordination function

4. Ad hoc mode: The WLAN does not require an access point, but rather than interface with all other wireless nodes directly.

Infrastructure mode: all data is transferred using the access point as the central hub.

5. Infrastructure mode: All nodes connecting to the access point must have the same service SSID as the access point. if a kind of wireless security is enabled on the access point they must share the same keys.

Ad hoc mode: All the nodes in an Ad hoc network must have the same channel and SSID.

- 6.
7. MAC provides addressing and channel access control mechanisms. PCF is the physical layer protocol of several data-link transmission PMO further help to define the physical layer of network computer network protocols.

- 8.
9. 802.11: diffuse infrared operating at 1Mbit/s; 1Mbit/s

frequency-hopping spread spectrum operating at 1Mbit/s

direct-sequence spread spectrum at 1Mbit/s

802.11a: an OFDM based air interface

802.11b: simultaneous substantial price reductions

802.11g: bitrate of 54Mbit/s exclusive of forward error correction codes.

10.

11.

12.

13. unicast addressing uses a one-to-one association between a sender and destination.

Multicast addressing uses a one-to-many or many-to-many association

14. The wireless carrier sensing is a logical abstraction which limits the need for physical carrier sensing at the air interface in order to save power.

15. Infrastructure mode X Ad hoc V

16. Association request frame: Sent from a station it enables the access point to all located resources and synchronize

17. The frame carries information about the WLAN including supported data rates and the SSID of the network the station wishes to associate with.

18.

20. This bit indicates the power management state of the sender after the completion of a frame exchange. APs are required to manage ~~the~~ the connection and will never set the power ~~bit~~ ^{save} bit.
 21. Preambles
 22. a PTM period value is a number that determines how often a beacon frame includes a Delivery Traffic Indication Message, and this number is included in each beacon frame.
 - 23.
 - 24.
 25. The first two bytes of the MAC header form a frame control field specifying the form and function of the frame.
 26. An 802.11 frame can have up to four address fields. Each field can carry a MAC address. Address 1 is the receiver. Address 2 is the transmitter. Address 3 is reserved for filtering purposes by the receiver.
 27. The OFDM waveform at 5.8 GHz is now defined in clause 18 of the 802.11 specification, and provides protocols that allow transmission and reception of data at rates of 15 to 54 Mbps.
 - The 802.11 standard uses the same data link layer protocol and frame format as the original standard, but an OFDM based air interface.
 28. To provide data ~~confidentiality~~ confidentiality comparable to that of a traditional wired network.
 29. WEP, recognizable by it by of 10 or 26 hexadecimal digits, was once used widely in use and was often the first security choice presented by to used by router configuration tools.
 - 30.
 31. Open System authentication and Shared Key authentication.
 - 32.
 - 33.
- Chapter 9.
1. Adding support for mobility @ WLAN @ ADS @ MAN @
 2. Denier sub-channelization @ LP PC
 3. WMAN was a connection-oriented MAN.
 4. IEEE uses scalable OFDMA to carry data, supporting channel bandwidths of the between 1.25 MHz and 20 MHz, with up to 30 subcarriers.

achieved by assigning different OFDM sub channels to different users.

Chapter 10

1. Infrastructure: through AP. Association
2. Ad hoc: all nodes equal

Chapter 11

1. 64-bit WEP key entered as a string of 10 characters (10 digits of 4 bits each gives 40 bit; adding 24-bit IV produces the complete 64-bit key
- 2.
- 3.

Chapter 12

1. Very low power applications running off a coin cell. Chip designs allow for two types of implementation, dual mode, ~~single~~ single-mode and enhanced power versions
- 2.
- 3.

Chapter 13.

1. Controller, External memory, Power source, Sensors
2. Area monitoring, Health care monitoring, Environmental sensing
3. Distributed sensor network, Data integration and sensor network, ~~integration~~ integration in-network processing, Secure data aggregation.

Chapter 14

1. Short-range wireless (BLE, LoRa, NFC) LTE-advanced, Ethernet
2. Low energy level for short range. high-bandwidth communications over large portion
3. The 1.5 GHz is an architecture propelling to be dynamic, manageable, cost effective and adaptable, seeking to be suitable for the high-bandwidth, dynamic, mobile