一.1. In 1831, Faraday discovered electromagnetic induction. Morse developed telegraph in 1837, Maxwell proposed the theory of electromagnetic field, after which, Bell ~~devis~~ invented telephone in 1875. In 1894, Tesla successfully make the experience of wireless communication. One year later, Marconi invented radio, which marked the beginning of a new era in wireless communication. Since the 20th century, the wireless communication network developed quickly. In 1958, the communication satellite SCORE was sent to the space, and in 1981, the first analogic cellular system was built. In 1986 GSM, the first digital cellular system was built in Europe. The first version of WLAN was published in 1997.

2. Cellular system, IP management, Mobile IP, Wi-Fi: 802.11, WiMAX: 802.16, Ad Hoc, Wireless network security Wireless personal area network, Sensor network, Internet of things, Software defined network.

二.1. Wired media is fixed, and the signal is transmitted from a fixed end to another fixed end. And the media is a kind of filter, whose pass band is finite.

2. Wireless media is not fixed. And the signal is transmitted through the air, which could pass a various of signals with different frequency.

2. Licensed band is the frequency band which is licensed to someone or enterprises, others, except ~~of~~ for licensed uses could not use the licensed band

Unlicensed band is the band which is ~~rese~~ reserved internationally, everyone can use the frequency but shond make sure that the transmitting power is limited, which may not interfere with users in other frequency band.

3. Landform (indoor and outdoor), the speed of mobile user, interference source, operating frequency.

4 Reflection occurs when the size of obstacle is larger than the wavelength, ~~of the~~ It usually happens on the surface of the earth, buildings and walls.

Diffraction occurs when the wave ~~occurs~~ encounters an obstacle or slit, whose corner is sharp, the wave passes ~~through~~ around the corner into the region of shadow of the obstacle.

Scattering occurs when the size of obstacle is smaller than the wavelength, but the number is very large. It usually happens on the rough surfaces. Small objects or other anomalous objects.

5. Indoor: reflection and diffraction, and the strength of diffraction is much smaller

Out-door: diffraction and scattering

6. $L_p = \frac{P_t}{P_r} = G_r G_t \cdot (kd)^{-\alpha} = G_t G_r \frac{(h_b h_m)^2}{d^4}$

L_p – pass loss; P_t – transmitting power; P_r – receiving power; d – distance between transmitter and ~~rec~~ receiver; h_b – the height of base station; h_m – the height of mobile station

7. ① free space modeling

$10\lg P_r = 10\lg P_0 - 20\lg d \quad P_0 = P_t \cdot G_t \cdot G_r \left(\frac{\lambda}{4\pi}\right)^2$

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

② two-ray modeling

$10\lg P_r = 10\lg P_0 - 40\lg d \quad P_0 = P_t \cdot G_t \cdot G_r \frac{(h_b h_m)^2}{1}$

$L_p(dB) = 10\lg(G_t G_r h_b^2 h_m^2) - 40\lg d$

8. slow fading is the ~~fading~~ change of signal strength because of the change of position, which usually caused by the shelter from buildings or walls the ~~change~~ is very slow compared with the fast fading.

variation with distance

9. $L_p = L_0 + 10\alpha\lg D + X$

10. ~~log~~$L_p(dB) = \begin{cases} A + B\lg d & \text{city} \\ A + B\lg d - C & \text{suburb} \\ A + B\lg d - D & \text{open area} \end{cases}$

$A = 69.55 + 26.16\lg f_c - 13.82\lg h_b - a(h_m)$

$B = 44.9 - 6.55\lg h_b$

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

$D = 40.9 + 4.78(\lg f_c)^2 - 18.33\lg f_c$

$a(h_m) = \begin{cases} (1.1\lg f_c - 0.7)h_m - (1.56\lg f_c - 0.8) & \text{small city} \\ 8.29[\lg(1.54 h_m)^2] - 1.1 & \text{large city, } f_c \le 300MHz \\ 3.2[\lg(11.75 h_m)]^2 - 4.97 & \cdots f_c \ge 300MHz \end{cases}$

11. multipath fading is the ~~accident~~ phenomenon, ~~not~~ where the signals arriving from different paths ~~are~~ composed together, which affect the signal strength.

② When the mobile user is moving at the speed of V, though the frequency of transmitting signal from base station is f, the ~~receiver~~ frequency of signal that receiver ~~as~~ sensed is $f + v'(t)$, $v(t) = \frac{Vf}{c}\cdot\cos\theta(t)$ $\theta(t)$ is the angle of the distance and the moving speed

③ Because of the Doppler shift, the receiver could sensed ~~the~~ the frequency which can not be sensed when the user is ~~sta~~ stable. The sensable frequency band is ~~exp~~ enlarged.

12. ① Rayleigh Distribution: when there is no direct signal $f_{ray}(r) = \frac{r}{\sigma^2} e^{-\frac{r^2}{2\sigma^2}} \quad (r \ge 0)$

② Rician Distribution: when there is a strong signal dominating the strength of signal. $f_{Ric}(r) = \frac{r}{\sigma^2} e^{-\frac{(r^2+a^2)}{2\sigma^2}} \cdot I_0\left(\frac{ar}{\sigma^2}\right) \begin{cases} r \ge 0 \\ a \ge 0 \end{cases}$

13. When the mobile user is moving at the speed of V, and the frequency of transmitting signal is f, the distance between base station and mobile user is d, the angle of d and v is $\theta(t)$ so the Doppler shift is $\Delta f = \frac{V}{c} f \cos\theta(t)$, and the ~~signal arrives the receiver~~ will sense the signal at the frequency of $f + \Delta f$. So if the receiver could sensed the frequency between f_1 and f_2, then because of Dopple shift. it may sense the frequency between $f_1 - \Delta f$ and $f_2 - \Delta f$, and the V and $\theta(t)$ may change with time, so the sensable frequency band enlarge.

14. Rayleigh distribution: $f_{ray}(r) = \frac{r}{\sigma^2} \exp(-\frac{r^2}{2\sigma^2})$ $(r \geq 0)$

Ricean distribution $f_{ric}(r) = \frac{r}{\sigma^2} \exp(-\frac{r^2+a^2}{2\sigma^2}) I_0(\frac{ar}{\sigma^2})$ $\begin{pmatrix} r \geq 0 \\ a \geq 0 \end{pmatrix}$

15.

三. 1. 3G system combine the wireless communication with Internet communication and it can transmit voice and data simultaneously

There are 3 standard: CDMA2000, WCDMA, TD-SCDMA for 3G systems.

2. the larger the cell radius, the smaller the system capacity, the larger the transmitting power.

3. suppose the whole number of cell is A, system capacity is C, cluster size is N, the whole number of channel is k

$C = \frac{A}{N} \cdot JN = \frac{A}{N} \cdot k$ k, A is fixed $\frac{S}{I} = \frac{(\sqrt{3N})^k}{N_1} = \frac{(\sqrt{3N})^k}{6}$ $k \geq 0$, $\frac{1}{3}[2\times(\frac{S}{I})_{min}]^{\frac{2}{k}}$

which means C decrease and $\frac{S}{I}$ increase with the increasement of N, so [redacted] $\leq N \leq \frac{Ak}{C_{min}}$

4. Base station: a transceiver connecting a number of other devices to one another and/or to a wider area

~~Uplink: the portion of a feeder link used for the transmission of signals from an earth station to a space radio station~~

Downlink: the transmission path from a cell site to the cell phone

Uplink: the transmission path from the mobile station to a base station

cell: a cellular organization structure

location area: a set of base stations that are grouped together to optimise signalling

mobile switching centre: the primary service delivery node for GSM/CDMA

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

HLR: central database that contains details of each mobile phone subscriber that is authorized to use the GSM core network

The VLR provides subscriber information when the subscriber is outside its home network

HLR it can provides data about the SIM and mobile services ISDN number

6. Hand off management: When the user moves from one cell to another, The mobile user should hand off and connect to another base station whose signal is ~~more~~ stronger without interrupting the communication

Location management: tracing the location of MH and keep the connection between MH and its home agent.

7. ① Fuse in the transmission of voice and data ② can connect to the Internet

8. Call Admission Control prevents oversubscription of VoIP networks. TDMA allows users to share the same frequency channel by dividing the signal into different time slots. CDMA employs spread-spectrum technology and a special coding scheme, where each transmitter is assigned a code.

9. SGSN: deliver data package from and to the mobile stations with its geographical service area

GGSN is responsible for the internetworking between GPRS network and external packet switched networks

MSC/GMSC/HLR is to connect ~~and~~ BSC to telephone network

10. CDMA2000, WCDMA, TD-SCDMA

11. 3G can serve Mobile multimedia

12. 1.2288Mcps ; 1.25MHz ; 1920~1935MHz, 2110~2125MHz

13. surf the Web ; video call ; mobile phone shopping

14. LTE

五. 1. Mobile Cloud Computing ; Mobile Web ; Mobile access

六. 1. ① detect the power and analyze whether it needs to hand off

② find a new connection

③ hand-off and ~~[redacted]~~ make sure the communication stable

2. inter-switch hand off: hand off to another MSC

intra-switch hand off: hand off to another BSC in the same MSC

3. MCHO: MS detect the signal power ~~from~~ BS around

NCHO: BS detect the signal power from MS

MAHO: Network ~~[redacted]~~ set the MS to detect the signal power from BS

4. hard hand offs: there is a break period, ~~[redacted]~~ may affect the quality of communication

soft hand offs: there is no break between the process of hand-offs.

5.

1. every IP belongs to a network, if we obtain different IP, it is not convenient.
2. MN: Mobile Node ; HA: Home agent, the router on the home network ; FA: router on the foreign network
COA: The IP address when a MN connect to the foreign network ; CN: the object communicating with MN
3. ① with tunneling, the data was packaged to a new package and the transmission obey to tunneling procto.
② without tunneling, the data have to be transmitted through the network
4. When a MN find itself connecting to a foreign network, then it will broadcast to HA, The effective HA will response and the MN make registration. The MN send message to FA. FA send it to HA through network. HA response to FA and FA send the response message back to MN
5. Because the MN use the temporary IP addresses, when the MN is not using the network. the IP can be distributed to others
6. The agent advertisement is broadcasting from HA and FA, and the MN can judge whether itself is on the foreign network
7. registration request is the process that MN can connect with its HA through FA.
8. ① ② The data is transmitted
9. ① IP-in-IP encapsulation, encapsulate the IP into a new IP package
② Minimal encapsulation : change the IP into a new IP, and keep the important message
③ GRE : encapsulate on protocol into a new package with other protocol
10. ~~Before the package leave the tunnel, it was sent into the same tunnel.~~
11.
12.
13. DCF : Distributed coordination function PCF: Point coordination function DIFS : DCF Interframe Space
SIFS Short Interframe Space PIFS : PCF Interframe Space
14. RTS/CTS : Before the transmitting sending message, it sends RTS signal. and the receiver receives the RTS and will send a CTS signal after done SIFS. only after the transmitter received the CTS signal correctly, it will begin to send the message. If other transmitter sensed the CTS signal, they will stop trying to send message.
15. EDCA : enhanced distributed channel access HCF : hybrid coordination function
16. Ad-hoc mode : Two computers in the wireless network communication between
17. Infrastructure mode : wireless network connect with wired network through a AP
18. Infrastructure mode ① STA : every user connected with the wireless network is a STA
② AP: the router, the builder of the wireless network. Each communication is completed by AP
Ad-hoc mode : only STA, all STA can communicate with each other
19. Physical Layer and Data Layer
20. LLC : provide multiplexing mechanisms that make it possible for several network protocols to coexist within a multipoint network and to be transported over the same network medium
21. MAC : provide addressing and channel access control mechanisms that make it possible for terminals to communicate within a multiple access network
22. PLCP : Physical Layer Convergence Protocol : a physical layer protocol of several data transmission networks
23. PMD : physical Media Dependent
24. infrared wireless networks : The transmitter has to be towards the receiver and their distance can't be too long, but it's cheaper
radio wireless networks : Much more expensive, but it is more convenient.
25. 802.11a : OFDM ; 802.11b : DSSS ; 802.11 IRF : DSSS, FHSS (Infrared) 802.11g : OFDM + DSSS
26. CSMA/CA, the priority implemented by the time.
27. ED/CS/ED+CS
28. "Y"
a : transmit
b : "Y" wait "Y" transmit
29. Unicast : One IP communicate with one IP
multicast : Several IP communicate together
30. We have other physical layer standards
31. NAV : because when others are transmitting signals, sender can't send message.
and it's a counter used in virtual carrier-sensing mechanism. it can save the power
32. 802.11e support QoS
33. To control the collision
34. Both use TFS Infrastructure AP send TFS information; Adhoc : STA competes to send

19. Yes, because ~~the~~ in Ad-hoc mode STA competes to send beacons

20. Saving power

21. Infrastructure mode: DTIM. ; Ad-hoc mode: ATIM

22 DTIM: using to save power, ~~a~~ when dtim come, AP will multibroad all the data in the buffer
ATIM: using in the IBSS

23.

24. To ~~minimize~~ trade off between the effiency and fairness

25. sychonize, Locate the address, error control

26. One is the source address, others are target address

27. 802.11a is a standard improved from 802.11b ; It use OFDM. faster and have shorter band width

28. To improve the security 29. To increase the diffinity of decoding 30.

31. Open System authentication: only need SSID ; Shared key Authentication: need SSID and key

32. MAC filtering can filter other strange users across the network, and the MAC is unique. But
Captive portal: No matter what page you want to surf, you should first jump to the home page.
WEP: to encryption and decryption

33. active scanning: Mobile ~~find~~ send message actively and receiving to the response from AP
passive scanning: STA change ~~to~~ in different channels and receive the beacons from AP

34. Acording to the time 35.

WiMAX 1. Can transmite to user far from the AP ②faster ③ higher QoS

2. TCL + PMD / WMAN-SC ; WMAN-SCa ; WMAN-OFDM ; WMAN-OFDMA

3. A large number of closely spaced orthogonal sub-carrier signals are used to carry data on several parallel data streams or channels. Each sub carrier is modulated with a conventional modulation scheme at a low symbol rate.

Ad Hoc Networks: 1. Infrastructure networks: STA connect with AP and ~~so~~ they communicate through AP. Ad-Hoc network: there is no AP and STAs ~~cover~~ with each other

2. $i \rightleftarrows j$ $d_{ij} \geq d_{ii} + \Delta$ $j \rightleftarrows k$ $d_{ji} > d_{jk} + \Delta$ 3. every nodes can sense the signal with an area.

4. C_i $w_{an}^T \leq \Theta(w_{an}^T) \leq C_s \cdot w_{an}^T$ 5. hidden terminal: nodes in the coverage area of receiver but one of the coverage area of transmitter
expesion terminal: nodes in the coverage area of transmitter but out of the area of ~~receive~~ receiver.

6. Security: 1. using the key as seed to generate PRKS. PRKs Xor with the message and can the secure message
2. The STA send EAPOL Start to AP, and AP ask STA to provide ID message ③ STA response with its ID message ④ AP encapsulate the ID message and send it to AS ~~RADIUS~~ RADIUS - Access - Request ⑤ EAP Authentication Protocol Exchange ⑥ RADIUS - Access - Accept ⑦ EAP - Success
3 WEP: use the shared key to authenticate; WAPI: similar to 802.1X but STA and AP should ~~and~~ accept Two-way Authentication
802.11i: TKIP + CCMP, more ~~se~~ safe

Bluetooth and RFID: 1. same data rate as V3.0 but longer transmission distance ; low power dissipation
2. Active ; Sniff ; Hold ; Park 3. Reader: communicate with tag ; Electronic tag: the carrier of data
4. chip technology ; Antenna design technology ; encapsulation technology ; Tag application technology
5.

Wireless Sensor Networks: 1. Sensor node sense the field and transmite the data the base station. The base station transmite the message to monitoring station through Internet
2. smart dust; A Line in the Sand V. military affairs, health caveness, agriculture 3.

Internet of Things: 1. UWB ; SDR ; RFID 2. high security; high gain ; high multipath resolution ; fast data rate; large capacity
high ~~capacity of resisting of enhance~~ anti-interference ability ; low power dissipation
3. Blue-tooth low ~~re~~ energy simplify the ~~class~~ classical blue tooth, lower the power dissipation and faster data rate
4. it can change its parameter according to the change of environment 5. ~~k~~ make the body a part of communication network Application: medical care, navigation; personal multimedia entertainment.

Soft-~~Designed~~ Networking: 1. SDN: an approach to computer networking that allows network administrators to programmatically initialize, control, change... via open interface and abstraction of lower-level function 2. virtualize the server 3. OCP, pof 4. it is not dependent in hard ware and it can change the architecture by programming

Intelligent Robot: 1. camera ; electrical machinery ; inertial navigator; microphone, sensor, wifi supporter 2 military ; medical care ; environment monitoring

MIMO 1. there are more than one path from transmitter to receiver 2. $y = Hx + n$ 3. space-diversity ~~to~~ can reduce the BER ; space-multiplexing can speed up the data rate. 4. Distributed Antenna System ; virtual MIMO ; multi user MIMO

Bitcoin ··· 1. ① the price fluctuation is high, but have high privacy
2. version ~~message~~ information ; former information ; message and parity bit ; identifier ;