Chapter 1.

(1) Communication has been used as telecommunication from 1930s. wireless communication has been found in 1895 1958. Score filed in the sky and opened the new era of wireless communication. GSM was born in 1988. First WLAN was published in 1997.

(2) ① mobile management ② cellular system ③ mobile IP ④ Wi-fi ⑤ Wi Max ⑥ wireless net work safety ⑦ Sensor network ⑧ Wireless Personal Area network ⑨ self-organizing network ⑩ Software defined network ⑪ Internet of Things.

Chapter 2.

(1) Wired network is used to carry different forms of electrical signals from one end to the other's. However, Wireless network does not use wires for data or voice communication; it uses radio frequency waves as mentioned above.

(2) Licensed spectrum devices operate whithin the portion of the radio spectrum designated by the FCC to be reserved for organization that have been granted licenses. Unlicensed wireless devices on the smart grid operate in one of the bands set aside by FCC.

(3) space. atmosphere. ionization

(4) ① Wave in the media interface when the phenomenon occurs back to spred ② when the wave meet encounters an obstacle, it deviates from the original line ③ through the local potential wave must change its linear trajectory due to the role of potential.

(5) Indoor: send information to each other. outdoor: communicate with each other by wave.

(6) the relationship between the average recieved power and the distance is determined by the expression where γ is called the path loss exponent. The wireless radio channel puts fundamental limitation to the performance of wireless system

(7) $L_p = L_0 + 10\alpha \lg D + X$

(8) The shadow effect caused by the obstruction, the recieved signal strength decreased, but the field strength with the geographical changes slowly change.

(9) $f_{d,n} = f_d = f_m \cdot \cos\theta = \frac{V}{C} f_c \cos\theta$

(10)

environment	n	environment	n
free space	2	visible communication	1.6~1.8
cellular system	2.6-3.5	obstruction by building	4~6
shadow	3-5	obstruction by factory	2-3

(11) Large-scale fading: shadowed by large objects such as buildings
Small-scale fading: interference by multi path effect.

(12) Ricean distribution (13) $f_d = \frac{1}{2\pi}\frac{\Delta\varphi}{\Delta t} = \frac{v}{\lambda}\cos\theta$

(14) $I_0(x) = \frac{1}{2\pi}\int_0^{2\pi} e^{x\cos\theta}\, d\theta$ (15) $P_z(x) = \frac{2m^m z^{2m-1}}{\Gamma(m)\beta_r^m} e^{\left(\frac{-mr^2}{\Gamma_r}\right)}$

Chapter 3 & 4.

(1) 2G: TDMA. 3G: CDMA

(2) Substituting a single high power transmitter by several low power transmitter to support many users

(3) The same frequency band is used by two or more base stations that located in relative proximity.

(4) determine the floor N. and radius D. we can draw the topography of cellular network.

(4) Base station: share mobile communication radio.; Up link: from links to satellite ground station. Down link: downward from satellite to one or more stations. Cellular network: the use of multiple sets of low power radio block. covers the whole service area. Service area: radio can cover the working area; MSC: mobile switching center, it is on the phone and data between systems provide call conversion service and call control.

(5) HLR is responcible for the mobile users management database. VLR is a data base that stored the information of calls and contracts business and additional information.

(6) switching management: the base station to change, the new base station identification and channel allocation;
Location management: home agents and foreign agents of identify authenication.

(7) the main difference is the speed increase of the speed to transfer voice and data.

(8) The purpose is to increase the speed and efficency of the network.

(9) GPRS core network provide mobile management, session management. and the IP packet trasmission to GSM and WCDMA network. GPRS pipeline agreement is to define the IP of GPRS network. allowing the end user from one place to another to keep connected.

(10) WCDMA. CDMA 2000, TD-SCDMA.

(11) EDGE allows peak data rates in the order of 200 kb/s.

(12) Achieving gloabal roaming, realizing high speed data trasmission realize broad band multimedia service.

(13) Broadband Internet access. mobile commerce. video calls and mobile TV. wireless. seaarch.

(14) 3G cellular networks towards a uniform architecture for all-I

Chapter 5.

(1) Mobile Compute Cloud., Mobile Website, Mobile Web Initiative

Chapter 6

(1) ① Monitor the signal strength changes ② Mobile station begin to recognize the new base station ③ several interaction, the new link was established.

(2) If during ongoing call unit ma change cellular which controled by different MSTO, a hand off is used to avoid dropping the call is inter hand off. while if ~~xxx~~ controlled by the same MSTO is called intra hand off.

(3) MCHO: Mobile station monitor the signal strength and choose the optimum
NCHO: Network monitor the signal strength. and launch switch.
MAHO: Mobile station monitor the signal strength. network make choice

(4) advantages: soft hand off: comection broken only a reliable comection established. the possibility to terminate is low.
hard hand off: just only use one channel at any time.
disadvantage: soft hand off: more complex hard ware.
hard hand off: ping-ponging effect.

(5) Monitor the signal strength change between base unit and mobile units, once exceed the threshold, execute handoff

(6) ① straight-line model regards the user as the linear behavior ones
② fluid flow model regards the user as receiver and connection as pipe flow.

(7) $f(t) = \frac{\beta^\nu \cdot t^{\nu-1}}{\Gamma(\gamma)} e^{-\beta t}$ $f^*(s) = \left(\frac{\beta}{s+\beta}\right)^\gamma$, $\beta = \gamma\eta$.

(8) intra-switch: MSTSO can tranfer cellur to another with a more stronger signal within its system. it uses intra system hand off.
Inter-switch: When a mobile signal becomes weak in a given cell and MSTO cannot find another. then it use inter handoff

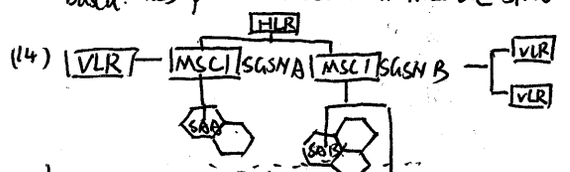
(9) $f(d_o, d_{av}) = a(d_o)[d_{av}]^{d(d_o)}$ $g(d_o, d_{av}) = b(d_o)[d_{av}]^{c(d_o)}$

(10) The smaller the cell is, the higher hand off rate is.

(11) two-tier network architecture to run above the software represent level and its data layer run on server

(12) When mobile units boots or shut down, cellular network will ask it to report its location. and it also asked to report its location ina certain interval.
service delivery: Cellular network search for the available access interface for called users. If succeed. caller will send a feed back to end this service delivery.

(13) time based: more reliable. but miss some UE quickly; movement based: less pressure on station. miss UE slow

(14)


with WLAN positioning cellular network
algorithm for integed wireless — WLAN Location server.
network
① transfer training signal data to the feature values by the approximated distribution model to calculate the reference point. probility ② Matching the movement history for selecting the k largest probility reference point. ③ calculate the center of gravity according to these reference points for user position estimation.

Chapter 7:

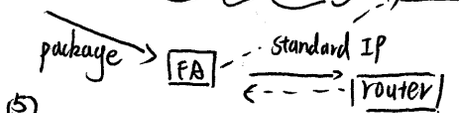
1) Once the user's position has changed then need a new address, but most of the network data is though the TCP transport, changing the IP can accordingly set up a new connection, will cause the APP interrupt and lose data. Using other IP will be difficult to connect the local network.

2) MN: the position often changes. HA: Mobile node link on the home router, is mainly used to maintain the location infomation of mobile node., when the mobile node go out, it is responsible for fowarding packets to the mobile node. FA: mobile node link on a other router. is used to substituted the address and used to be the default router. to package and unpackage packets from home router. COA: when mobile node switch to outside nodes link, an IP are associated with this node. When the mobile node and other nodes communicated., not directly dense destination address or source address. When home data forwarding agent to mobile nodes. most use make the export of tunnel to adress adress.
need to
CN: an object of a mobile node

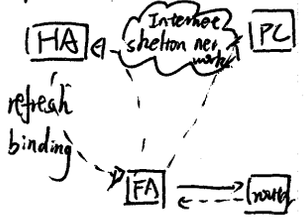
3) Trangle Router: ① data packets are tranfered to mobile nodes through communication node by IP. ② home agent intenepted packets, through the tunnel to send the packet to the mobile node address ③ in the field outside agents, unpackage the data packet. then send to mobile nodes. ④ data packets that sent by mobile nodes use standard IP to destination adress.

optimized router: ① the mobile nodes note communication nodes current address. ② the communication nodes directly transfer data packets through tunnel to the mobile nodes. ③ each node has a buffer. to store binding information. They will reach after the failure in their life cycle.

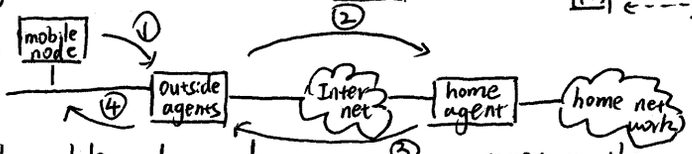
(4) Triangle router



optimized router:



(5)



① The mobile node sends a registration request to the prospective foreign agent to begin registration process.
② The foreign agent processes the registration request and then relys it to the home agent.
③ The home agent sends a registration reply to the foreign agent to grant or deny the request.
④ The foreign agent processes the registeration reply and then relays it to the mobile nodes to inform it of the disposition of its request.
(6) A limited life time 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 that mobile node.

(7) IP Header (RFC 791)
ICMP Router Advertisement Type 216. length. Sequence No registration life time. Resered. Care of Address.

(8) Type of services. total length. Identification. Flags. Fragmene. offset source address; home address; destination address Type = 10. node = 10. check sum. Resoned.

(9) If a foreign or home agent does not support reverse tunnels recieves a request with the Type bieset, the registeration fails

(10) Ip in Ip encapsulation: IP are encapsulated into a datagram to deliver. Minimumum encapsulation: new IP is located between new old IP and data. Route Encapsulation: a datagram of a layer is encapsulated in the other's datagram.

(11) RAT will send SYN packet to the IP. and agent decide whether allow the connection according to the packet.

(12) Because some agents may have a fire wall and only reverse tunneling can be accepted by these agents

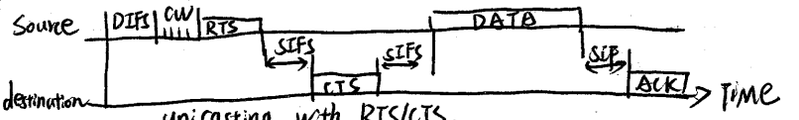
(13) Our mobile phone is the IP with firewall and some Original servers are without fire walls

Chapter 8

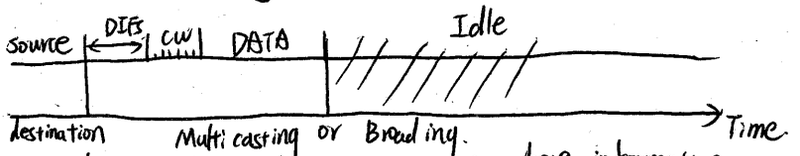
① PCF is Point Coordination Function, which is a MAC technique used in IEEE 802.11 based on WLAN. It resides a point coordinator to coordinate the no communication within the network.
② Distributed Coordination Function (DCF) employs a CSMA/CA with binary exponential backoff algorithm, which is a fundumental MAC technique ③ DIFS is acronym for DCF interframe spacing. It is the time delay for which sender wait after completing its back off. before sending RTS package ④ SIFS stands for shortest Interframe Spacing. It is shortest among network terminology. ⑤ PIFS stands for PCF Interframe Space. enabled access point wait for

PIFS duration rather than DIFS to occupy the the wireless medium

(2) Before commencing transmission, the source station sends RTS. When the destination station recieves the RTS frame, it reply with a CTS frame after SIFS interval. Upon hearing RTS and CTS. all other stations in the vicinity of the sender and the reciever update their NAV. This process. reserves the medium for the sending station.



unicasting with RTS/CTS.



Multicasting or Broading.

(3) IEEE 802.11e-2005 is an improvement approved amendment to the IEEE 802.11 standard that defines a set of quality of service. enhancements for wireless LAN application through modification to the MAC layer.

EDCA: with EDCA. high-priority traffic has a higher chance of being sent than low-priority traffic: a station with high priority traffic waits a little less before it sends its packets, on average than a station with low priority traffic.

HCF: Within HCF, there are two methods of channel access. similar to those defined in the legacy 802.11 MAC: HCF Controll Channel Access and EDCA.

(4) Ad hoc mode: An ad-hoc network allows each device to communicate directly with each other. Infrastructure mode network requires the use of access points.

(5) Infrastructue mode: base station connects mobile nodes into wired network. handoff: mobile changes base station providing connection into wired network.

Ad-hoc mode: no base stations; nodes can only transmit to other others nodes within link coverage. nodes organize themselves into a network: route among themselves.

(6) 802.11 comes in the Data link layer (MAC) and physical layer (PHY).

(7) logical Link Control (LLC) data communication protocol layer is the upper sublayer of data link layer, provides multiplexing mechanism that make it possible for several network protocols to coexist. MAC: access mechanism, fragmentation, encryption. PLCP: carrier sensing assessment, forming packets for PHY. PMD: modulation and coding.

(8) Infrared (IR) light is electromagnetics radiation with a wave length longer than visible lighe. employed in short-range communication. Ad: simple circuits; Low power consuption. higher security; simple shielding; portable. Dis: LOS Mode; short range; blocked by common materials.

Radio is the transmission of signals through free space with frequency below visible lights. AD: simple circuit; high speed; cover large area. Dis: limited number of free band. shielding difficult; interference with other electrical devices great power consuption.

(9)

	802.11a	802.11a	802.11b	802.11g
bandwidth	83.5MHz	300MHz	83.5MHz	83.5MHz
frequency	2.4~2.4835GHz DSSS, FHSS	5.15-5.35GHz OFDM 5.725-5.825GHz OFDM	2.4~2.4835GHz DSSS	2.4-2.4835GHz DSSS, OFDM
Datarate	1.2Mbps	6.9.12.18 24 36 48 54 Mbps	1,2,5.5,11 Mbps	1,2,5.5,6.9 11.12.18.24.36 48,54 Mbps

(10) We have considered four wireless LAN access methods: 802.11. DCF. PCF. HCF.

(11) (12) multicast is group communication. where information is addressed to a group of destination computers simultaneously. Unicast is sending of messages to a single network destination identified by a unique adress.

(13) The station listening on the wireless medium read the Duration field and set their NAV. which is an indicator for a station on how long it must defer from accessing the medium.

(14) Yes. PCF is only available in "infrastructure" mode. No QoS in ad-hoc mode. Cause there is no base station in ad-hoc

(15) In 802.11. node has to communicate with each other by broadcast which collision are not allowed thus the hold and waits need all nodes to synchronize.

(17) A TSF keeps the times for all station are the same. basic service set synchronized. All stations shall maintain a local TSF.

(18) Beacons is several slots in length., it lets them to divide into beacon intervals. if the time of Beacon is early than STA forward the clock.

(19) automatic self-time correcting procedure (ASP), was proposed to synchronize a multi-hop MANET. Basic idea is to let the faster nodes send out beacon more often and self correction the clocks

(20)

(21) Ad-hoc: CSMA/CA is used to access the channel. RTS. CTS. Ack PS-Poll one used to overcome hidden terminal.
Infrastructure: under DCF. with the same methods by Ad-hoc.

(22) DTIM: transmitted less frequency; for sending buffered broadcast packets. ATIM: transmitted in ATIM-window by stations who want to send buffered packets. structured same as TIM

(23) In 802.11, a hand over means reassociating with the new AP are based on measurements performed by the mobile terminal and base stations.

(24) the packets may be formed that can pass through a link with a small maxium transmission unit. than the original data gram size.

(25)

Octets: 2	2	6	6	6	2	6	2	4	0-7951	4
Frame Control	Duration /ID	Address1	Address2	Address3	Sequence Control	Address4	QoS Control	HT control	Frame body	FCS

(26) 802.11 can create situations where you need four different distinct addresses: TA. RA. SA. DA. so we need at largest four address in the MAC header.

(27) operates in the 5.15 GHz to 5.35GHz radio spectrum. Speed up to 54Mbps. Range: 50 feet. Less prone to interfer and defined requirement for OFDM communication system. More expensive.

(28) Standard 64-bit WEP uses a 40 bit key, which is concatenated with a 24-bit IV. to form the RC4 key.

(29) The cheat sends an authentication request to the AP. AP reply with a clear-text challenge, the cheat encrypts the challeng text using WEP key and send it back then AP decypts the response.

30) Captive portals is flexible and easy to implement but not

standard. and require regular re-authentication WEP/WPA is easy to implement but not transparent. MAC filtering is easy spoted but does not identify a person.

(32) Active scan occurs when the client changes its IEEE 802.11 radio to the channel being scanned and passive scan occurs when waiting for periodic beacons from APs on the channel being scanned.

(33) For different priority message, it has to wait different time before transmitting, the higher is the priority, the shorter is the waiting time.

(34) A station has more links will get more throughput and along with the transmitting node

Chapter 9.

(1) High speed transmitting QoS guarantee, various mobile services.

(2) WMAN-SC. WMAN-SCa. WAMAN-OFDM. WMAN-OFMA

(3) OFDM seperate channel into several subchannels which is orthodigical to each other and use low-speed data flow, transmit into ear every sub channel.

Chapter 10.

(1) Infrastructure mode is a single core network while ad-hoc is a peer network.

(2) Only when $d_{ij} \le R_t$ and all nodes satisfy $d_{kj} \le R_L$ is not transmitting. Then node i and j can successfully transmit.

(3) IEEE802.11 MAC regular that all users share an exclusive channel. The best solution to interfere is using TDMA.

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

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

(5) hidden terminals and exposed terminal will cause the waster of the sourse. and collision. decrease HT will cause collision. ET cause the time waste.

Chapter 11.

(1) ① request for sending identification frame. ② when AP received it, send back a Ack. ③ if ② is as success, then encypt the text and send another to response. ④ when AP recieve the response then decode the encyption. after it. send another Ack to.

(2) ① EAPOL start Frame to start the authentication. ② provide identification information ③ response the ②, ④ package info to RADIUS Acess Request Frame. send it to AS. ⑤ authentication procedure ⑥ return the result.

(3) Same as Chapater 8. (32)

Chapter 12.

(1) less consumption and less low delay.

(2) Page, page scan and inquring and inquiriry scan.

(3) RFID Tag; RFID Tag Reader & Application Software System.

(4) Ta① power providing for Tag. ② Data tranfer from Tag to Tag reader ③ Integrity and security of data tranfer transmission ④ multi-target identification.

(5) ① RFID intelligent car license ② university card. ③ ETC system. ④ Inroadoor localization.

(6) sensor network monitor the data transmitting, base station cellular the message to end user or othe satellite stations management nodes are used for MSN management.

(2) ① the power and power management module ② a wireless trasceiver. ③ a microcontroller.

(3) ① WSN application in small smart grid ② WSN application in smart homes.

(4) ① the sensor networks nodes broad cast their status to the surroundings are and receive status from other nodes to detect each other. Secondly, the sensor network nodes into a connected network. Finally. suitable paths are computed

(5) the communication distance is short. If comect with nodes out side the coverage area, need to route through intermediate node

(6) ① transmission rate, ② delivery reliability ③ network lifetime conflicting design objectives in eneny-constrained WSN.

When transmission rate decrease., delivery relability will be higher and lifetime be longer

(7) Ambient energy harvesting from external sources are used power small autonous sensors such as MEMS.

(8) Chapter 14

(1) ① Ultra-band wireless communication ② Software define Network Radio ③ Blue tooth wide Low Energy ④ cognitive radio

(2) ① Good security ② High processing gain ③ Multi path resolution ability ④ High transfer rate ⑤ large system capacity ⑥ low cost

(3) BLE is based on Bluetooth, at the same time simplify the Bluetooth. using a Low eneny protocol to lower the power consuption of the bluetooth.

(4) A CR monitor its own performance continuously", in addition to reading the radio's output. adjust the radio's setting to deliver the required quality of service.

(5) short-distance. high speed. inside the body. low consuption apply in health care.

Chapter 15.

(1) SDN is an architecture puposing to be dynamic, managable. cost-effective, and adaptable, seeking to be suitable for high-bandwidth dynamic nature of today's application.

(2) Data transmitting based on flow; Routing based on central controller coding facing to APP.

(3) video and corellation application; combined storage. spumable data

(4) SDN let us manage the network more easly and easy to update the system. to develop a APP ear effiuently.

(17) Chapter 16, 17, & 18.

(1) electrical-machine; camera. mircophone; gyro-season meter; bayometer; Wi-Fi. accelerarometer.

(2) ① Leap-Frog Path Design ② Real-time Indoor Mapping ③ Fully Dictributed Scalable Smoothing and mapping.

① : using two bumpers and SLAM algorithm to construct map

Chapter 13

(1) MIMO has more than one path between antenna in the reciever and transmitteer, SISO. just has one.

(2) $X = [X_1 \cdots X_{nT}]^T$ $Y = [Y_1 \cdots Y_{nT}]^T$ $H = [h_{11} \cdots h_{12}]$ $Y = Hx + n$ in a good quality

(3) space-diversity use multipath to transmit the data. space-Multiplexing use multipath to beter use atteras

(4) Distributed MIMO, Multiuser MIMO Networking MIMO. Multi-MIMO let difference between subchannels more clear. improve the capucity.

Chapter 21 & 22

(1) The value of bitcoin is not stable and it is hard to be stolen and to know each dealer. relative safe.

(2) Version Info, Format Infor, Data error correction keys. Required patter