Introduction to Mobile Network Mid-term exam

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Chapter 1 Overview of Wireless Network

1. In 1895, Marconi found radio. In 1930s, communication has been used as telecommunication. 1958, SCORE satellite used for wireless communication flied in the sky. In 1997, first WLAN was published.
2. Cellular system, mobile management, mobile IP, Wi-Fi, Wi-Max, Self-organizing Network, Wireless Network Safety, Sensor Network, IoT, SDN.

Chapter 2 Radio Propagation

1. Propagation medium, stability, bandwidth, propagation characteristic.
2. Licensed spectrum devices operate within the portion of the radio spectrum designed by FCC to be reserved for organizations, Unlicensed operates in the band set aside by FCC for industrial, scientific or ISM.
3. Medium, frequency and distance.
4. Reflection, wave reflects from obstacles, diffraction, digression of line, scattering, occurs in rough surface
5. Indoor: reflection, diffraction and scattering. Outdoor: reflection of ground and buildings, roof diffraction
6. Larger distance, higher loss, less gain, lower height, smaller receiving power given transmitting frequency
7. $L_p = L_0 + 10 \log_a D + X$
8. The Shadow effect caused by the obstruction of obstacles decreased the RSS but the field strength with the geographical changes slowly.
9. $f_{d,n} = f_d = f_m * \cos\theta = \frac{v}{c} f_c \cos\theta$
10. In wide area and city environment, the loss differs greatly.
11. Multipath: interference of the multiple signal paths, Doppler: caused by motivation.
12. Ricean distributions.
13. $f_d = \frac{1}{2\pi} \frac{\Delta\phi}{\Delta t} = \frac{v}{\lambda} \cos\theta$ 14. $I_0(x) = \frac{1}{2\pi} \int_0^{2\pi} \exp(x\cos\theta)\, d\theta$ 15. $p_z(z) = \frac{2m^m z^{2m-1}}{\Gamma(m)P_r^m} \exp\left[\frac{-mz^2}{P_r}\right]$

Chapter 3& Chapter 4 Cellular System

1. 2G: TDMA 3G: CDMA
2. using several low energy transmitter to substitute single high power transmitter
3. The same frequency band used by two or more base stations that are located in adjacent proximity.
4. base station: common mobile communication station; uplink: ground to satellite; downlink: satellite to several ground stations; cell: service region; location area: radio frequency covering area; Mobile Switching Center, offering call exchange and call control service
5. HLR in telecom is the reference database for the subscriber parameters, the VLR contains a copy of most of the data stored in the HLR.
6. Handoff: change base station, new station identity and new channel; location: domestic and overseas authentication
7. Data and voice transmission rate become faster, and more efficient.
8. GSM to CDMA
9. The inter-SGSN routing update is the most complicated routing update. When the MS changes from one SGSN area to another, it must establish a new connection to a new SGSN.
10. WCDMA, CDMA2000, TD-SCDMA
11. Global calling, high rate transmission, wide bandwidth media
12. EDGE combined with GPRS2.5 is EGPRS, which allows peak data rate in the order of 200kb/s.
13. Internet surfing, mobile business, video calling
14. 3G cellular networks towards a uniform architecture for all-IP wireless networks.

Chapter 5

Mobile cloud computing, mobile website and mobile initiative.

Chapter 6 Mobility Management

1. When monitored signal strength is higher than threshold, start exchange process, recognize new base station and build new connections between mobile users to base station.
2. Inter handoff: exchange techniques for avoiding cutoff call when mobile devices move from cells using different MTSO. Intra handoff: using mobile device in adjacent cells using same MTSO.
3. MCHO: mobile station monitor signal strength and choose best methods. NCHO: network monitor signal strength and turn on switch, MAHO: mobile station monitor signal strength, network turn on switching.
4. Hard handoff: only using one tunnel in one call at any moment, weakness is that having ping-ponging effect. Soft handoff: decrease the interrupt possibility of signal linking to target cell, weakness is that requiring complex hardware.
5. Monitoring changes of base station unit and mobile unit signal strength, switching once exceeds the threshold.
6. Straight-line model: define uses behavior as linear. Fluid-flow model: used to describe the water scale in reservoir at random decided moments.
7. Handoff rate E(P)
8. Intra-switch: given weak mobile signal in cell, MTSO found other cells can transmit signals, MTSO use intra-switch. Inter-switch: MTSO cannot find other cells to substitute, use inter-switch.
9. Handoff rate E(P)
10. Exchange frequency higher with smaller cells.
11. Two-tier structure is client in software structure describe layer or interface to store data structure in server.

12. Location update: when mobile devices restart of shut down, mobile network requires location and continuously sending sending location message in intervals. Service delivery: when the mobile device restart or shut down, mobile network finds useable tunnel for caller, if succeed, caller will send feedback to stop transmitting.
13. Time-based, movement-based, and distance-based
14. (Blank.)

Chapter 7 Mobile IP

1. Permanent IP ensures others to connect to server, such as ip.com. If IP keeps changing, website and email cannot be accessed in that IP.
2. MN: frequently location changes, HA: a router in mobile node in link. FA: Another router in mobile node. CoA: when mobile node switches to other link, IP relevant to the node. CN: communication object of a mobile node.
3. Mobile IP helps IP data telecomm send to mobile network node in given path. Identity of mobile network node depends on master address regardless of current network. Mobile IP matches node address created by address mapping using matching algorithm.
4. See figure in the right.

5. Step 1: mobile node sends match requirement to overseas proxy. Step 2: Overseas proxy send match requirement to domestic proxy. Step 3: domestic proxy responds to decide whether to postpone request. Step 4: overseas proxy returns matching result to mobile node according to domestic proxy response.
6. In limited lifetime to allow mobile nodes to send matching request to domestic proxy, agency can creates or adjust mobile nodes' mobile binding.
7. Follows the ICMP Router Advertisement fields and the two protocols can coexist without problems
8. To cut the existing connection between the home agent and the mobile host, intercept traffic destined to the mobile host
9. While overseas proxy or domestic proxy doesn't support request with T bit sequence, registration may fail.
10. IP in IP encapsulation: defined by RFC2003, in IP in IP technology, the entire IP packet is directly encapsulated as a new IP packet payload; Minimum encapsulation: defined by RFC2004, in the smallest encapsulation technology, the new IP header is inserted between the original IP header and the original IP payload, the smallest encapsulation by removing the IP in IP encapsulation of the inner IP header and the outer IP header redundant part, reducing the implementation of the tunnel with the number of additional bytes required; Generic routing encapsulation: defined by RFC 1701, defines a protocol for encapsulating any one of the other network layer protocols on any network layer protocol, a data packet that runs a protocol encapsulates data packets in another protocol of the payload.
11. Reverse tunnel, also called reverse reverse connection, often used in firewall limitation of open port. RAT with reverse connection will send client IP SYN packet to make sure whether client allows outer link in network.
12. Because reverse tunneling may be the only way to go in certain situations.
13. (Blank.)
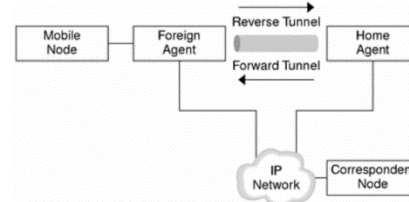
Chapter 8 IEEE 802.11 WLAN

1. DCF, distributed coordination function, is the fundamental MAC technique for the IEEE 802.11 based WLAN standard. It employs a CSMA/CA with binary exponential back-off algorithm. PCF, point coordinate function, is also a MAC technique based WLAN. It resides in an AP to coordinate the communication within the network. DIFS is acronym for DCF Inter-frame spacing. It is the time delay for which sender wait after completing its back-off before sending RTS package. SIFS, shortest Interframe spacing, considered as shortest among above mentioned networking technology. PIF, PIF Interframe space, is one of the Interframe space used in IEEE 802.11 which enabled AP waiting for PIFS duration rather than DIFS to occupy the wireless medium.
2. Before commencing the transmission of a data packet, the source station sends a short control frame, RTS, declaring the duration of the forthcoming transmission. When the destination station receives the RTS frame, it replies with CTS frame after SIFS interval, with the duration of the future transmission. Upon hearing RTS and CTS, all other stations in the vicinity of the sender and the receiver update their Network Allocation Vectors.
3. IEEE 802.11e is an approved amendment to the IEEE 802.11 standard that defines a set of quality of services enhancement for wireless LAN applications through modifications to the MAC layer. EDCA, enhanced distributed channel access, ensures that a station with high priority traffic waits a little less before it sends its packet. HCF, hybrid coordination function, has two methods, HCCA and EDCA.
4. Ad hoc modem: ad-hoc network allows each device to communicate directly with each other without central AP controlling device communication. Ad-hoc networks are only able to communicate with other ad-hoc devices. Infrastructure mode requires the use of AP to control which has higher level of security.
5. Infrastructure mode: base station connects mobiles into wired network, handoff, mobile changes base station providing connection into wired network. Ad hoc network: without base stations, and nodes can only transmit to other nodes within link coverage, also nodes organize themselves into a network which rout among themselves.
6. 802.11 occupies data link layer(MAC) and physical layer(PHY).
7. LLC: logical link control, upper sublayer of data link layer of OSI model. MAC also belongs to the datalink layer. The physical layer consists of PLCP and PMD, which does carrier sensing assessment and modulation, coding respectively.
8. Infrared light is used in short range communications among computer peripherals and PDA. It uses simple circuit, has lower power consumption. But it works only on LOS mode with short range and can be easily blocked by walls. Radio wireless network has higher speed but has interference with other devices and much power consumption.
9. 802.11-1 MAC and 3PHY layers.802.11a operates in 5GHz band at 54Mbps. 802.11b operates at 2.4GHz and 5GHz at 5.5Mbps and 11 Mbps respectively. 802.11g operates at 2.4GHz at 54Mbps.

10. After one node has finished sending, many other nodes can competes for the right to send. First is to make sure that no node with a lower priority gains access to the medium while packets with higher priority are waiting at other nodes.
11. IEEE DCF, PCF and HCF.
12. (Blank.)
13. Multicast is group communication in computer network where information is addressed to a group of destination computers simultaneously. However, unicast transmission is the sending of message to a single network destination.
14. NAV is a virtual carrier-sensing mechanism used in wireless network protocols. The virtual carrier sensing is a logical abstraction which limits the need for physical carrier-sensing at the air interface. It can also be seen as a counter which counts down to zero at a uniform rate.
15. In infrastructure mode, PCF contains two periods, CFP and CP which allows for a better management of QoS while there is no QoS in ad-hoc network.
16. TSF ensures that all stations shall keep the timers in the same BSS. Basic Service Set needs to synchronize to serve.
17. In infrastructure mode, all stations maintain a local timer. Also, a TSF is implemented and timing conveyed by periodic Beacon transmissions. In ad-hoc mode, I didn't find synchronization.
18. Maybe it still requires the local timers keep the same to implement the synchronization.
19. In multi-hop MANET, a protocol called ASP is proposed to let the faster nodes send out beacon more often.
20. Mobile devices are supported by battery power which obviously need power management to work longer.
21. In ad-hoc mode, CSMA/CA is used to access the channel and RTS, CTS, ACK, PS-Poll are used to overcome terminal. In infrastructure mode under DCF, TIM, DTIM and Ad hoc TIM are used.
22. When the user moves to another cell, the call is not dropped but handover to another base station with signal strength detected to switch.
23. To make the packets formed to pass through a link with maximum transmission unit.
24. MAC header, frame control, duration, address, sequence control, QoS control and HT control.
25. 4 addresses, transmitter address, receiver address, source address and destination address.
26. 802.11a is an amendment to the IEEE 802.11 that defined requirement for an OFDM communication system. 802.11a, 802.11b and 802.11n operates in different frequency and radio spectrum with different speed and range.
27. WEP, wired Equivalent Privacy, is a security protocol for Wi-Fi networks. The goal of WEP is to make wireless networks as secure as wired networks such as Ethernet.
28. Standard 64-bit WEP uses a 40bit key, which is concatenated with a 24-bit initialization vector to form the RC4 key.
29. (Blank.)
30. Two methods: in open system authentication, WEP keys can be used for encrypting data frames; in shared key authentication, the WEP key is used in challenge-response handshake.
31. WEP, private but only provide confidentially at the network level. MAC filtering, can be easily spoofed and cannot identify a person. Captive portals is very flexible but not transparent and standardized.
32. Active scan, occurs when the client changes its IEEE 802.11 radio to the channel to be scanned and waits to hear any probe response while passive scan is performed by simply changing the client to the channel and waiting for periodic beacon from any Aps on that channel.
33. According to the time interval, SIFS<PIFS<DIFS while SIFS owns the highest priority.
34. (Blank.)

Chapter 9 WiMAX
1. WiMAX offer high speed connection to Internet, 50km data transmission range at most, QoS, higher transmission rate and various services. It implements the mobilization of wide band service.
2. WiMAX: WMAN-SC, WMAN-SCa, WMAN-OFDM, WMAN-OFDMA. IEEE 802.11: DSSS, OFDM
3. OFDM divides data into parallel low rate sub-stream and modulate on each sub carrier to transmit. Orthogonal signal can be detached using demodulation tech to reduce ISI.

Chapter 10 Ad hoc Network
1. Infrastructure mode using AP control to exchange data with other nodes. Ad hoc is self-organized network and each node can communicate with other nodes in range.
2. Nodes number N, $n_i(1 \leq i \leq N)$ represents node i, d_{ij} *represent the distance between i and j*. R_t represents nodes transmit distance, RI represents interference distance, RI>R_tm $RI = QR_t$. Using same channel, node i and j can be transmitted while, $d_{ij} \leq R\_t$ and any nodes satisfies $d_{kj} \leq RI$ won't transmit.
3. In IEEE 802.11 MAC protocol, all users share one channel. When adjacent uses send messages simultaneously, use interference occur which deteriorate the network. Exclusive region is used.
4. (Blank.)
5. Hidden terminal and exposed terminal will waste disorder time source in ad hoc network, impact network's throughput, capacity and data transmission latency.

Chapter 11 Security
1. (1) Request work station to send authentication frame. (2) The AP return authentication frame with challenge text. (3) If state code is "successful", request the work station to send authentication management frame. (4) AP receives and check challenge text and authenticated if succeed.
2. Applier sends EAPOL Start frame to start authenticate and AP requests identity from applier. AP send applier's identity in RADIUS AP frame to AS. RADIUS server authenticate reliability of applier identity and tell authentication result. Authentication part open a controlled port if succeed, otherwise refuse visit.
3. WEP: exists fake AP in single identity authentication.
   WAPI: appends WAI structure to authenticate identity.
   IEEE 802.11i: using IEEE 802.11X protocol in WLAN security and append secret key management.

Chapter 12 Bluetooth and RFID

1. Low energy, low cost, enhanced different manufacture compatibility, lower latency and larger effective range.
2. Standby and connection are two main states which contains page, page scan, inquiry and inquiry scan.
3. RFID tag, RFID tag reader and application software system.
4. Tag power supplement, tag to reader data transmission and data transmission integrity and security.
5. ETC system, school ID card.

Chapter 13 Wireless Sensor Network

1. WSN is built with a few nodes, where each node is connected to one node. The process of data transfer is transmitted back to the base station through the transmission of adjacent nodes. A large number of sensor nodes deployed randomly inside the monitoring area form network through self-organization. Sensor nodes monitor the collected data to transmit along to other sensor nodes by hopping.
2. A sensor node consists of power and power management module, a sensor, a microcontroller and a wireless transceiver. The power module offers reliable for system. Sensor is the bond of WSN nodes and the wireless transceiver transfer the data after microcontroller receivers the data from sensor and processed.
3. Mobile: online monitoring and early warning system for distribution networks, smart electricity consumption services. Stationary: energy efficient performance of existing buildings.
4. First, the sensor network nodes broadcast their status to the surroundings and receive status from other nodes to detect each other. Second, the sensor network nodes are organized into a connected network according to a certain topology. Finally, suitable paths are computed on the constructed network for transmitting the sensing data.
5. Short transmission range and high transmission rate.
6. Transmission rate, delivery reliability and network lifetime are three fundamental objectives. Lower transmission rate brings higher deliver reliability and longer network lifetime.
7. MEMS technology.

Chapter 14 Internet of Things

1. SDN, BLE and cognitive radio.
2. Good security, low cost, multi-path resolution ability and high transfer rate.
3. BLE is a simply version of Bluetooth. They differ in chip design which use single-mode and dual-mode respectively.
4. CR Network "monitors its own performance continuously", in addition to "reading the radio's outputs"; it then uses this information to "determine the RF environment, channel conditions, link performance, etc.", and adjusts the "radio's settings to deliver the required quality of service subject to an appropriate combination of user requirements, operational limitations, and regulatory constraints".
5. Short distance, high speed, time change and personalize. Navigation positioning, military and space application.

Chapter 15 Software-Defined Network

1. SDN is an architecture designed to be dynamic and manageable and allows decouple network control and forwarding functions to enable network control.
2. (1) Based on the flow of data forwarding mechanism; (2) Based on the central control of the routing mechanism; (3) the application-oriented programming mechanism
3. OpenDaylight, Protocol Oblivious Forwarding, Open Computing Project.
4. Traditional network devices' firmware relies on hardware while programmable SDN network can be change architecture directly. SDN also make network data control and management become stable and efficient.

Chapter 16,17&18 Intelligent Robots, Cars and Quadrotors

1. Camera, Microphone, Inertial Navigator, Infrared receiver, touch sensor, accelerate sensor, Wi-Fi
2. Real-Time Indoor Mapping; Fully Distributed Scalable Smoothing and Mapping; Cooperative Multi-Robot Estimation and Control.

Chapter 19 MIMO

1. MIMO, Multiple-Input Multiple-Output, requires several antennas between transmitter and receiver to work simultaneously in order to implement higher transmission rate. It also uses multipath effect. SISO, single-input single-output, only has one transmission path and severely impacted by multipath.

2. Figure in the right. The matrix H consists of h_{ij}
3. Space-diversity: transmit data in several sub carriers with same message to increase reliability; Space-multiplexing: split data and transmit data with several sub carriers with different message parallel to increase data rate.
4. MIMO-OFDM, Multi-use MIMO, Digital Home   MU-MIMO: For example, if a base station can communicate simultaneously with 10 clients, the total system capacity of the base station will be 10 times greater. In this example, a traditional base station would have to time division multiplex between the 10 clients. While in the MU-MIMO case, each client would be able to receive a continuous stream of data, resulting in 10 times the throughput for each user.
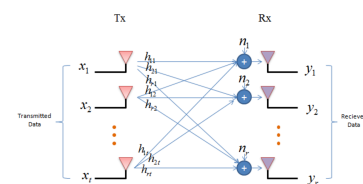
Chapter 21&22 Bitcoin and Graphic Code

1. Current value security: huge fluctuations in bitcoin value; account security: use can create a wallet.dat to save the account; trade process security: no powerful uses can interfere trade; client privacy: is carefully secured.
2. In 1994, DENSO WAVE INCORPORATED discloses a QR (Quick Response Code) code, composed of a square module, to form a square array, a coding area including graphics, delimiters, positioning graphics and correction graphics in the functional graphics, which can accommodate about 7,000 digits, can carry out Chinese characters processing, large capacity, read data more than 10 times faster than others. QR code, the storage of large-capacity information, in a small space to print, can effectively handle a variety of text, the ability to adapt to dirty and damaged stronger, you can read from any direction 360 ° to support data merge function. Also has a structure that can be connected to a mask, which can be extended to explain the features.

#(Blank.) represents that I cannot figure out suitable answers.