『Wireless Communications and Mobile Internet Midterm Exam』

姓名：李杰锋 学号：5140309376

Overview of Wireless Networks (Chapter 1)

1. 1(1831)法拉第电磁感应实验 2(1837)莫尔斯电报 3(1873)Maxwell 电磁场理论 4(1876)电话 5(1894)特斯拉短波无线通信实验 6(1895)马可尼无线电 7(1906)范信 AM 8(1927)跨洋电视广播 9(1946)公共移动电话系统 10(1958)通信卫星 11(1981)NMT 12(1988)GSM 13(1997)无线局域网
2. Mobile IP、cellular network、Wi-Fi、mobile management

Radio Propagation (Chapter 2)

1. Wired：transmit by line，big bandwidth，low interference，stable environment ;Wireless :transmit by air，less bandwidth，higher interference，unstable environment
2. Licensed：devices operate within the portion of the radio spectrum designated by the FCC to be reserved for organizations that have been granted licenses ;Unlicensed :Unlicensed wireless devices on the smart grid operate in one of the bands set aside by the FCC for industrial, scientific or medical (ISM) applications.
3. Reflection & Transmission: Electromagnetic waves reflect the surface of the medium when the scale is greater than the wavelength, otherwise spread to the surrounding; Diffraction: Electromagnetic waves in the transmission through the media edge, will turn the spread; Scattering: On the surface of the rough medium, the electromagnetic waves will be reflected in all directions, called scattering.
4. Indoor: many reflection, less diffraction and scattering; Outdoor: Reflected by air and ground, scattered at the edge of building.
5. Longer Distance，higher Pass Loss；Transmission Power multiply pass Loss and antenna gain = receive power；higer the mobile station and base station is，less interference and higher the **SNR** is.
6. **Free Space**：$10\lg P_r = 10\lg P_0 - 20\lg d$；**Two-ray**：$10\lg P_r = 10\lg P_0 - 20\alpha \lg d$
7. Shadowing Fading means the SNR changed with the location in long term.
8. $L_p = L_0 + 10\alpha \lg D + X$
9. **Macro**: $L_p(P) = A + B \lg d$
10. **multipath/small-scale fading**: After the signal is propagated through different paths, there is a phase difference when superimposed. **Doppler shift**: The transmitter or receiver is moving, causing the receiver to see the frequency of change.
11. **Rayleigh distribution** is used for the envelope distribution of multipath fading received signals. **Lace distribution** is used to describe the envelope attenuation of the received signal.
12. $f' = f\frac{c \pm v_1}{c \pm v_2}$
13. The signal strength can be calculated by the Rayleigh distribution and the probability distribution function of the Rice distribution.
14. $P_z(Z) = \frac{2m^m z^{2m-1}}{\Gamma(m) P_r^m} e^{-\frac{mz^2}{P_r}}$

Cellular System (Chapter 3 and 4)

1. 3G on the basis of 2G, using CDMA technology, the current development into three kinds of standards, CDMA2000, WCDMA, TD-SCDMA
2. Higher transmitting power, cell radius is bigger and system capacity is larger.
3. C=MJN
4. Base station: shared mobile communication station; Uplink: link from the ground station to the satellite; Downlink: from the satellite down to one or more ground stations; Cell: radio can cover the work area; mobile switching center: is between the telephone and data systems to provide call conversion services and Call control place.
5. **VLR** is a database, is stored in the area of the customer's incoming, outgoing calls required to retrieve the information and the user contracted business and additional business information. **HLR** is responsible for moving the user-managed database.
6. **Handoff management:** responsible for the identification of new base stations and in the new base station to support data and control signal channel allocation. **Location management:** home network agent management.
7. Can simultaneously transmit voice and data information, the rate increases, in a few hundred kb/s or more.
8. In 3G, the use of the concept of **soft capacity**, each new call generation will increase the interference level of all other existing calls, thus affecting the overall system capacity and call quality. So it is important to control the access network call in the appropriate way. Third-generation and future mobile communication systems are required to support multimedia services such as low-speed voice, high-speed data and video, so call admission control becomes more complex.
9. SGSN routing update is the most complex routing update. The MS switches from one SGSN area to another, and then re-connects to the new area.
10. CDMA2000、WCDMA、TD-SCDMA
11. Can simultaneously transmit voice and data information, global roaming, to achieve high-speed data transmission, to achieve broadband multimedia services.
12. **Transmission rate**：200kb/s or higher；**bandwidth** is bigger；**frequency** is higher.
13. broadband Internet access, audio and video entertainment, video calls, mobile TV.
14. Normalization mechanism in wireless network.

Future Technologies (Chapter 5)

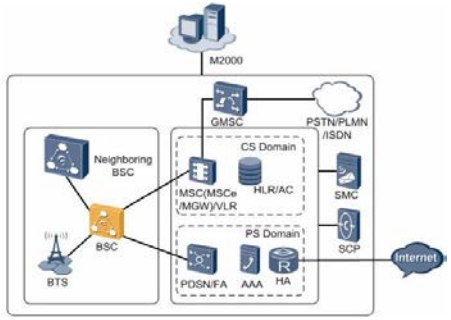
1. Mobile cloud computing, mobile web pages, mobile Internet initiative

Mobility Management (Chapter 6)

1. Monitor the signal strength changes, once exceeded the threshold, to switch. Then identify the new base station, establish a connection.
2. Intra-switch：From a cellular system to a cellular system controlled by the same MTSO. Inter-switch：From a cellular system to another cellular system that is controlled by a different MTSO.
3. MCHO: The mobile station monitors the signal strength and selects the best way. MCHO: Network monitoring signal strength and turn on the switch. MAHO: Mobile station monitor signal strength, network switch.
4. Hard：At any one time a call uses only one channel, but it will be ping-ponging. Soft：Can reduce the probability of signal connection to the target cell, but requires the phone to have complex hardware conditions.
5. Monitor the signal strength changes, once exceeded the threshold, to switch.
6. straight-line model: The behavior is linear. Fluid-flow model: Used to describe the level in the reservoir during a randomly determined period of time.
7. Sorry I don't know.
8. **Intra-switch:** When the mobile signal in the given hive becomes very weak, the MTSO discovers that the other cells in the system can transmit the signal, and the MTSO uses the intra-switch; **Inter-switch**: MTSO can not find other replaceable cells in the system to transmit signals, so use inter-switch.
9. I can't figure out the handoff rate.
10. The smaller area of the cell is, the handoff frequency is higher.
11. The two-tier structure is a client that runs on the

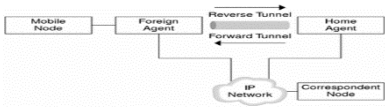
presentation layer or interface of the software architecture and stores the data layer or data structure on the server.

12. **Ocation update**: When the mobile device is restarted or shut down, the mobile network asks for the reporting location and interrupts the time to send the location information. **Service delivery**: The mobile network is looking for a viable channel for the called person. If successful, the caller will send a feedback signal to terminate the delivery.

13. 

Mobile IP (Chapter 7)

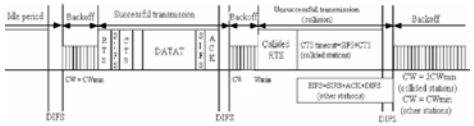
1. Once the user's location changes, a new address is required, but most of the network data is transmitted over TCP. Changing the IP address will create a new connection accordingly, resulting in application interruption and loss of data.
2. **MN**: The location is often changed, that is, nodes that are often switched from one link to another host. **HA**: A node on the mobile node's home link, which is used to keep the location information of the mobile node. **FA**: A router on the local link where the mobile node is located. **COA**: An IP address associated with the node when the mobile node switches to the foreign link. CN: A communication object for a mobile node.
3. MH -> FA. FA tunnels packets to HA by encapsulation. HA forwards the packet to the receiver.

4. 

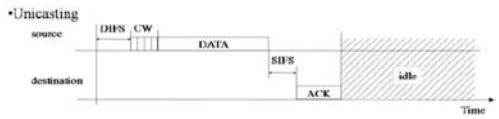
5. The mobile node sends a registration request to the prospective foreign agent to begin the registration process. The foreign agent processes the registration request and then relays it to the home agent. The home agent sends a registration reply to the foreign agent to grant or deny the request. The foreign agent processes the registration reply and then relays it to the mobile node to inform it of the disposition of its request.
6. The limited lifetime allows the mobile node to register with its home agent using the registration request message so that its home agent can create or modify the mobility binding of the mobile node.
7. The only change to the Mobility Agent Advertisement Extension is the additional 'T' bit. A foreign agent that sets the 'T' bit MUST support the two delivery.
8. If the 'T' bit is set, the mobile node asks its home agent to accept a reverse tunnel from the care-of address. Mobile nodes using a foreign agent care-of address ask the foreign agent to reverse-tunnel its packets.
9. If the external or home agent that does not support the reverse tunnel receives a request with the "T" bit set, the registration request fails.
10. **IP in IP encapsulation**: In IP in IP technology, the entire IP packet is directly encapsulated as a new IP packet payload. Minimum package: 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. **General routing encapsulation**: The generic routing encapsulation defines a protocol that encapsulates any of the other network layer protocols on any network layer protocol.
11. Every tube has a beginning and an end. The big tube, your SSH connection, started with your SSH client and ends up at the SSH server you connected to. All the smaller tubes have the same endpoints.
12. Because reverse tunneling may be the only way to go in certain situations.

IEEE 802.11 WLAN (Chapter 8)

1. **PCF**: a MAC technique used in WLANs. It resides in a point coordinator also known as Access Point (AP), to coordinate the communication within the network. The AP waits for **PIFS** duration rather than **DIFS** duration to grasp the channel. **PIFS** is less than **DIFS** duration and hence the point coordinator always has the priority to access the channel.

2. 

3. **IEEE 802.11e-2005 or 802.11e** is an approved amendment to the IEEE 802.11 standard that defines a set of quality of service (QoS) enhancements for wireless LAN applications through modifications to the Media Access Control (MAC) layer. 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 packet, on average, than a station with low priority traffic. Within the **HCF**, there are two methods of channel access, similar to those defined in the legacy 802.11 MAC.
4. An **Ad-hoc** network allows each device to communicate directly with each other. An **Infrastructure mode** network requires the use of an Access Point.
5. **Ad-hoc** networks are only able to communicate with other Ad-hoc devices. **Infrastructure mode**: increased levels of security, potentially faster data transmission speeds and integration with a wired network.
6. Responsible for reliable link-to-link data transfer. Including **Channel access, Addressing, Frame Validation, Error Detection and Security Mechanisms.**
7. **MAC**: access mechanism, fragmentation, encryption **PLCP**: carrier sensing assessment, forming packets for PHYs. **PMD**: modulation and coding.
8. Infrared is used in devices for short-range communication. Radio wireless networks is used in longer range. Advantages: Simple Circuit, Low Power Consumption, Higher Security, Simple Shielding and Portable. Disadvantages: Works ONLY on Line-of-Sight (LOS) Mode, Short Range, Blocked by common materials: people, walls, etc. Low bandwidth, Speed is comparatively slow.
9. **802.11**: 83.5Mhz; **802.11a:** 300MHz; **802.11b:** 83.5MHz; **802.11g:** 83.5MHz.
10. After one node has finished sending, many other nodes can compete for the right to send. The first objective of the prioritization phase 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. DCF: Distributed Coordination Function. PCF: Point coordination function. HCF: the hybrid coordination function.

12. 

13. Multicast is group communication where information is addressed to a group of destination computers simultaneously. Unicast transmission is the sending of messages to a single network destination identified by a unique address
14. The NAV may be thought of as a counter, which counts down to zero at a uniform rate. When the counter is zero, the virtual CS indication is that the medium is idle; when nonzero, the indication is busy. The medium shall be determined to be busy when the STA is transmitting.
15. It is available only in infrastructure mode.
16. Timing synchronization is achieved by stations periodically exchanging timing information through beacon frames. In (infra) BSS, the AP sends the TSF information in the beacons. In Independent Basic Service Set, each station competes to send the beacon.
17. **All stations maintain a local timer. Timing Synchronization Function:** Keeps timers from all stations in synch. AP controls timing in infrastructure networks. **Timing conveyed by Beacon transmissions:** Beacons contain Timestamp for the entire BSS. Timestamp from Beacons used to calibrate local clocks.
18. Because Beacons contains a timestamp. On receiving a beacon, STA adopts beacon's timing. Clocks move only forward.
19. Yes, it works. The basic idea of the protocol is to let the faster nodes send out beacon more often and self-correction of the clocks.
20. Since mobile hosts are supported by battery power, saving battery as much as possible is very important.
21. **Ad Hoc Mode & Infrastructure Mode:** CSMA/CA is used to access the channel. RTS, CTS, ACK, PS-Poll are used to overcome hidden terminal.
22. **TIM:** transmitted with every beacon. **DTIM:** for sending buffered broadcast packets. **ATIM:** transmitted in ATIM-Window by stations who want to send buffered packets.
23. Mobility Management offers seamless handovers when moving from one network to another.
24. IP fragmentation is an IP process that breaks datagrams into smaller pieces (fragments), so that 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, Sequence Control, Qos control, HT Control.
26. The distinction to understand is that 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.
27. IEEE 802.11a-1999 or 802.11a was an amendment to the IEEE 802.11 wireless local network specifications that defined requirements for an orthogonal frequency division multiplexing (OFDM) communication system. It was originally designed to support wireless communication in the unlicensed national information infrastructure (U-NII) bands (in the 5–6 GHz frequency range) as regulated in the United States by the Code of Federal Regulations, Title 47, Section 15.407.
28. The goal of WEP is to make wireless networks as secure as wired networks, such as those connected by Ethernet cables.
29. Once the restrictions were lifted, manufacturers of access points implemented an extended 128-bit WEP protocol using a 104-bit key size.
30. the WLAN client need not provide its credentials to the Access Point during authentication. Any client can authenticate with the Access Point and then attempt to associate. In effect, no authentication occurs. Subsequently, WEP keys can be used for encrypting data frames. At this point, the client must have the correct keys.
31. **WEP/WPA:** only provide confidentiality at the network level. **MAC filtering:** doesn't identify a person, but easily spoofed, and not a secret information.
32. **Active scanning** occurs when the client changes its IEEE 802.11 radio to the channel being scanned, broadcasts a probe request. **Passive scanning** is performed by simply changing the clients IEEE 802.11 radio to the channel being scanned and waiting for a periodic beacon from any APs on that channel.
33. ①Defined different inter frame spacing. ②SIFS. ③ PIFS. ④DIFS

WiMAX (Chapter 9)

1. WiMAX technology to provide high-speed connection for the Internet, the data transmission distance up to 50km, with high transmission rate, business diversity. Using OFDM / OFDMA, AAS, MIMO, and other advanced technology to achieve the broadband business mobile.
2. The transport convergence sublayer is responsible for receiving the MAC layer data unit encapsulation transfer convergence sublayer data unit, and the implementation of the corresponding access scheme and synchronization control logic, the physical media dependent sub-layer mainly performs channel coding, modulation and other functions. It supports the coordination between MAC layer and physical layer channel management information, not only can support the transmission of adaptive burst traffic data, but also supports the dynamic adjustment of transmission parameters such as mediation coding mode and transmitting power.
3. **OFDM** divides the channel into a plurality of orthogonal subchannels, converts the high speed data signal into a parallel low speed sub-data stream, and modulates the transmission to each subchannel. The quadrature signal can be separated by the relevant technology at the receiving end, which can reduce the mutual interference between subchannels. The signal bandwidth on each subchannel is less than the associated bandwidth of the channel, so that each subchannel can be considered to be flat, so that inter-symbol interference can be eliminated. And since the bandwidth of each subchannel is only a part of the original channel bandwidth, the channel equalization becomes relatively easy.

Ad Hoc Networks (Chapter 10)

1. **Infrastructure**: is the traditional ap mode, opening only one center, and the other nodes access the center point through the center of the data exchange. **Ad-hoc:** is ad hoc network mode, each point is equal, any point can communicate with other nodes, do not need the center point.
2. As long as the distance between any two nodes is less than the transmission distance, and the interference distance is greater than the transmission distance, can be transmitted.
3. The IEEE 802.11MAC protocol specifies that all users share channels. When the neighbor users send messages at the same time will produce inter-user interference, so that the entire network performance deterioration. An effective solution is to set the exclusion range or time division multiplexing.
4. In order to achieve optimal throughput, the sending rate of each node must be strictly controlled and carefully scheduled. In order to calculate the end-to-end throughput limit, it is necessary to find out how many hops the nodes are spaced enough to ensure that they can transmit data at the same time. Throughput decreases with data schedules.
5. The existence of **hidden terminal** and **exposed**

terminal will cause the disorderly contention and waste of ad hoc network time slot resources, increase the probability of data collision, and seriously affect the network throughput, capacity and data transmission delay.

Security (Chapter 11)

1. Request the workstation to send the authentication frame. -> When AP received, return a verification frame. ->Requesting workstation will obtain the challenge text from the frame and encrypt it with the shared key WEP algorithm, and then send an authentication management frame. -> AP after receiving the third frame, the use of shared key to decrypt the question text, if the same and send their own, the certification is successful. And the corresponding workstation sends an authentication management frame.
2. The applicant sends an EAPOL Start frame to the certifier to start the authentication process. -> The certifier sends a request asking the requester to provide identity information. -> The applicant responds to the request of the certifier and sends his / her own identity information to the certifier. -> The authenticator encapsulates the identity information of the applicant into the RADIUS Access Request frame and sends it to the AS. -> The RADIUS server verifies the legitimacy of the applicant's identity, during which it may need to interact with the user through the certifier several times. -> The RADIUS server informs the authenticator of the authentication result. -> The certifier sends the authentication result to the applicant. If the authentication is passed, the certifier will open a controlled port for the applicant, allowing the applicant to access the services provided by the certifier.
3. **WEP**: Authentication status is unidirectional, resulting in potentially impoverished AP. **WAPI**: Add a certification infrastructure WAI used to achieve the user's identity authentication. **IEEE 802.11i**: the IEEE802.1X protocol into the WLAN security mechanism to enhance the WLAN identity authentication and access control capabilities.

Bluetooth and RFID (Chapter 12)

1. ①low power consumption, very low running and standby power consumption. ②low cost, support two deployment methods: dual mode and single mode. ③ Strengthen the compatibility between different OEM manufacturers equipment. ④reduce the delay. ⑤effective coverage expanded to more than 60 meters.
2. **Page, Page Scan, Inquiry, Inquiry Scan**.
3. **RFID Tag, RFID Tag reader, Application software system**.
4. ① The energy supply of Tag. ② Transmission between Tag and Reader. ③Integrity and security of data transmission. ④Anti-collision algorithm.
5. ①Ecard in SJTU. ②RFID smart electronic license plate. ③ETC system in Toll station.

Wireless Sensor Networks (Chapter 13)

1. **Sensor Networks** is built of nodes where each node is connected to one (or sometimes several) sensors. The **nodes** organized in different topologies build the sensor network. The sensor network get the data from detection area and do the Preliminary processing of data.
2. **The power supply module** provides a reliable power supply for the system. **The sensor** is a binding of WSN nodes that can get the environment and the state of the device. The microcontroller receives data from the sensor and processes the data accordingly. **The wireless transceiver** will transmit data to achieve the physical implementation of the communication.
3. ① Online monitoring and early warning system for distribution networks. ② Smart electricity consumption services
4. ①The sensor network nodes broadcast their status to the surroundings and receive status from other nodes to detect each other. ②The sensor network nodes are organized into a connected network according to a certain topology. ③Suitable paths are computed on the constructed network for transmitting the sensing data.
5. The communication distance of the nodes in the network is generally short. The node can communicate with its neighbors. If you want to communicate with nodes outside the coverage area, you need to route through the intermediate node.
6. **Transmission rate**, **delivery reliability** and **network lifetime.**
7. Ambient energy harvesting from external sources are used to power small autonomous sensors such as those based on MEMS technology.

Internet of Things (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 form.
4. ①Monitors its own performance continuously, ② Determine the RF environment ③ deliver the required quality of service subject.
5. **Short distance**, **high speed** and **Time change**.

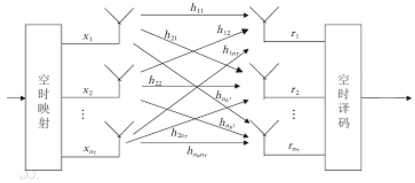
Software-Defined Networking (Chapter 15)

1. Software-defined networking (SDN) is an architecture purporting to be dynamic, manageable, cost-effective, and adaptable, seeking to be suitable for the high-bandwidth, dynamic nature of today's applications.
2. ①The flow of data forwarding mechanism; ②The central control of the routing mechanism; ③The application-oriented programming mechanism.
3. **Open Daylight**, **OCP** and **POF**.
4. In the **SDN** network control and physical network topology separation, so as to get rid of hardware restrictions on the network architecture.

Intelligent Robots, Cars and Quadrotors (Chapter 16, 17 and 18)

1. Touch sensor, Pressure sensor, Wi-Fi and Ethernet support etc.
2. Real-Time Indoor Mapping, Fully Distributed Scalable Smoothing and Mapping, Cooperative Multi-Robot Estimation and Control.

MIMO (Chapter 19)

1. **MIMO**: The system transmitter and receiver are equipped with multiple antennas for simultaneous transmission. **SISO**: only one transmission path between the transmitter and the receiver.
2. 

3. **Space-multiplexing**: At the transmitter, high-rate data streams are partitioned into multiple lower-rate sub-data streams, and different sub-streams are transmitted on different transmit antennas on the same frequency band. **Space diversity:** Use the multiple transmission paths provided by multiple antennas on the transmitting or receiving side to send the same data to enhance the transmission quality of the data.
4. **MIMO-OFDM**, **MU-MIMO** and **ITU-T**.

Bitcoin and Graphic Code (Chapter 21 and 22)

1. Bitcoin users can generate a wallet.dat file offline, unless the wallet is stolen, otherwise the account can't be stolen, but once the wallet can't be lost.
2. A square module: a coded area, a functional graphic composition including a picture pattern, a delimiter, a positioning pattern, and a correction pattern.