

Chapter 1.

1. From 1920s, communications has been used as telecommunication. Marconi found wireless in 1895, 1918, Scone flew in the sky and opened the new times of wireless communication. GSM was born in 1988. First WLAN was published in 1997.
2. 1) cellular system 2) mobile management 3) mobile IP 4) Wi-Fi 3) WiMAX 6) Self-organizing network 7) Wireless Network Safety 8) Wireless personal Area Network 9) Sensor Network 10) Internet of Things 11) Software defined Network.

Chapter 2.

1. Wired network is used to carry different forms of electrical signals from one end to the other. Wireless network does not use wires for data or voice communication; it uses radio frequency waves.
2. Unlicensed wireless device on the smart grid operate in one of the bands set aside by the FCC for Industrial, Scientific or Medical applications. Licensed spectrum devices operate within the portion of the radio spectrum designated by the FCC to be reserved for organizations that have been granted licenses.
3. space, atmosphere, ionization.
4. 1) Wave in the media interfere when the phenomenon occurs back to spread 2) When the wave encounters an obstacle, it deviates from the original line. 3) Through the local potential, due to the role of potential, wave must change its linear trajectory.
5. Indoor to send information to each other and outdoor to communicate with each other by wave.
6. The relation between the average received power and the distance is determined by the expression where γ is called the path loss exponent. The wireless radio channel puts fundamental information to the performance of wireless communication systems.
7. $L_p = L_0 + 10 \log P + X$
8. The shadow effect caused by the obstruction of the obstruction the received signal strength decreased, but the field strength with the geographical changes slowly.
9. $f_{dn} = f_d = f_m \cdot \cos \theta = \frac{v}{c} f_c \cos \theta$
10. Environment Loss Environment Loss
Free > buildings 1.6-1.8
cellular > 6-7.5 obstacle 4-6
cellular shadow 3-5 by factory 2-3

11. large scale fading, due to path loss of signal as a function of distance and shadowing by large objects such as buildings and hills. Small scale fading, due to the constructive and destructive interference of the multiple signal paths between the transmitter and receiver.
12. Ricean distributions.
13. $f_d = \frac{1}{2\pi} \frac{\Delta \phi}{\Delta t} = \frac{v}{\lambda} \cos \theta$.
14. $J_0(x) = \frac{1}{\sqrt{x}} \int_0^x \exp(x \cos \theta) d\theta$.
15. $P_2(z) = \frac{2m\gamma z^{m-1}}{\Gamma(m) \Gamma_T^m} \exp\left[-\frac{mz}{\Gamma_T}\right]$.

Chapter 3 & 4.

1. 2G: TDMA 3G: CDMA
2. The technique of substituting a single high power transmitter by several low power transmitters to support many users is the backbone of the cellular concept.
3. The same frequency band is used by two or more base stations that are located in relative proximity to each other.
4. the entire network coverage area is divided into cells based on the principle of frequency reuse.
4. The HLR in telecom is the reference database for subscriber parameters. The VLR contains a copy of most of the data stored at the HLR.
7. faster & more efficient.
8. GSM to CDMA.
9. The inter-SGSN routing update is the most complicated routing update. The MS changes from one SGSN area to another, and it must establish a new connection to a new SGSN.
10. Three standard principle: CDMA2000, WCDMA, TD-SCDMA
11. CDMA technology.
12. EDGE combined with the GPRS 2.5G technology is called EGPRS, and allows peak data rates in the order of 200kb/s, just as the original UMTS WCDMA versions, and thus formally fulfills the IMT2000 requirements on 3G systems.
13. A channel-access scheme is based on a multiplexing method, that allows several data streams or signals to share the same communication channel or physical medium. In this context, multiplexing is provided by the physical layer
14. 3G cellular networks towards a uniform architecture for all-IP wireless networks.

Chapter 5.

Mobile Compute Cloud, Mobile website, Mobile Web Initiative.

Chapter 6.

1. Monitor the signal strength changes. Once it exceeds the threshold, switch begins.

a) Mobile station begins to recognize the new base station.

b) After several interactions, the new link was established.

2. If during ongoing call mobile unit moves from one cellular system to a different cellular system which is controlled by different MTSO, a handoff procedure which is used to avoid dropping of call is referred as inter handoff.

3. MCHHO: Mobile station Monitor the signal strength and choose the best choice.

MUSO: Network monitor the signal strength and launch the switch.

MAHO: Mobile station monitor the signal strength and network make the switch choice.

4. Advantage:

Soft: the connection to the source cell is broken only when a reliable connection to the target cell has been established and therefore the chances will be terminated due to the failed handovers are lower.

hard: at any moment in time one call uses only 1 channel.

Disadvantage:

Soft: require more complex hardware in the phone.

hard: ping-ponging effect may occur.

5. Monitor the signal strength change between base unit and mobile unit and once the change exceeds the threshold, execute handoff.

6. fluid flow model is a mathematical model used to describe the fluid level in a reservoir subject to randomly determined periods of filling and emptying.

Straight-line model: user's behavior is linear.

8. intra-switch: When a mobile signal becomes weak in a given cell and MTSO find other cells within its sys to which it can transfer the call then it uses Intra system handoff.

Inter-switch: when a mobile signal becomes weak in a given cell and MTSO can not find other cell within its sys to which it can transfer the call then it uses Inter-sys handoff.

9. The smaller the call is, the higher the handoff rate is.

10. When mobile unit boots or shuts down, cellular network will ask it to report its location and it is also asked to report its location in a certain interval.

12. When mobile unit boots or shut down, cellular network will ask it to report its location and it is also asked to report its location in a certain interval.

Service delivery: Cellular network search for the called user. Access interface for called user. If succeed, caller will send a feedback to end this service delivery.

14. 1) Transfer training signal data to the feature values by the approximated distribution model to calculate the reference points probabilities.

2) Matching the movement history for selecting the k largest probability reference points.

3) Calculate the center of gravity according to these reference points for user position estimation.

Chapter 7.

1. If your business often needs to receive large files then you'll probably be investigating setting up your own FTP server so people can send you files. If so, you'll benefit from having your own static IP address so that your suppliers, clients or anyone else can reliably connect to your server.

3. Mobile IP enables routing of IP datagrams to mobile nodes. The mobile node's home address always identifies the mobile node, regardless of its current point of attachment to the Internet or an organization's network. When away from home, a care-of address associates the mobile node with its home address by providing info about the mobile node's current point of attachment to the Internet or an organization's network.

4. Priority Registration begins with a fixed time frame based upon your student type, called a registration "appointment".

⊙ Prior to registration begins, each eligible student will receive an email from the University Registrar.

⊙ It is very important to review all the information, to take the appropriate action to correct inaccurate info.

7. The Mobile IP discovery process has been built on top of an existing standard protocol, Router Advertisement. Mobile IP discovery does not modify the original fields of existing router advertisements. Can carry information about the default routers.

8. To secure the registration request, each request must contain unique data so that 2 different registrations will in practical terms never have the same MD5 hash.

9. Model assumptions, thus regularize a registration problem and may lead to an appropriate behavior even in case of artifacts or severe noise.

10.

Chapter 8.

1. PCF is a Media Access Control technique used in IEEE 802.11 based WLANs. It resides in a point coordinator also known

to access the channel. The AP waits for RTS duration and hence the point coordinator always has the priority to access the channel.

2. The RTS/CTS access mechanism is mainly used to minimize the amount of time spent when collision occurs since collisions occur in these short messages.

Before commencing the transmission of a data packet, the source station sends a short control frame called RTS, declaring the duration of the forthcoming transmission.

3. IEEE 802.11e-2004 or 802.11e is an approved amendment to the IEEE 802.11 standard that defines a set of quality of service enhancements for wireless LAN applications through modifications to the Media Access Control layer.

The standard is considered of critical importance for delay-sensitive applications, such as voice over wireless LAN and streaming multimedia.

4. Ad-Hoc mode:

An Ad-Hoc network allows each device to communicate directly with each other. There is no central Access point controlling device communication.

Infrastructure mode:

An infrastructure mode network requires the use of an Access point. The access point controls wireless communication and offers several important advantages.

6. 802.11 is a set of data link and physical layer protocols.

Data link layer is responsible for reliable link-to-link data transfer.

7. Infrared is used in devices such as the mouse, wireless keyboard and printers. Infrared signals have frequencies between 300THz to 400THz. They are used for short-range communication.

AP: Infrared signals have high frequencies and cannot penetrate walls. Due to its short-range communication sys, the use of an infrared communication sys in one room will not be affected by the use of another system.

8. 802.11 - 1 MAC and 3 PHY layers.

802.11a - operates in 5GHz band at 54Mbps.

802.11b - operates in both 2.4GHz and 5GHz at 1, 2, 5, 11 Mbps and 11 Mbps respectively.

802.11g - operates in 2.4GHz at 54Mbps.

7. IEEE 802.11 offers five different priorities for data packets ready to be sent. 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.

10. We have considered 4 wireless LAN access methods:

1. The 802.11 Distributed Coordination Function, Point Coordination Function, the hybrid coordination function.

2. In computer networking, multicast (one-to-many or many-to-many) is group (multicast). Group communication may either be application layer multicast or network assisted multicast, where the latter makes it possible for the source to efficiently send to the group in a single transmission.

3. The NAV is a virtual carrier-sensing mechanism used with wireless network protocols such as IEEE 802.11 and IEEE 802.16. The virtual carrier sensing is a logical abstraction which limits the need for physical carrier sensing at the air interface in order to save power.

4. The original 802.11 MAC defines another coordination function called the point coordination function. This is available only in infrastructure mode, where stations are connected to the network through an Access point.

5. Timing Synchronization Function is specified in IEEE 802.11 wireless local network standard to fulfill timing synchronization among users. A Timing Synchronization Function keeps the times for all stations in the same basic service set synchronized.

6. All stations maintain a local timer.

Time Synchronization Function

- 1. Keeps timers from all stations in synch.
- 2. AP controls timing in infrastructure network.
- 3. distributed function for Independent BSS.

7. Time divided into beacon intervals, each containing a beacon generation window.

Each station:

- 1. Waits for a random number of slots;
- 2. Transmits a beacon (if no one else has done so).
- 3. Beacon: several slots in length.

8. Automatic self-time correcting procedure, was proposed to synchronize a multi-hop MANET.

An adaptive protocol called ASP is proposed in for time synchronization in 802.11-based multi-hop ad hoc networks.

21. Since mobile hosts are supplied by battery power, saving battery as much as possible is very important.

20. Assumptions:

- 1) Beacon interval & ATIM window are known by all hosts.
- 2) Each station predicts which stations are in PS mode.
- 3) The network is fully connected.

Method:

- 1) CSMA/CA is used to access the channel.
- 2) RTS/CTS/Ack/PS-poll are used to overcome hidden terminal.

21. ATM:

Transmitted in ATM-window by stations who want to send buffered packets.
Identical to the same as TDM.

DLLM:

- 1) transmitted less frequently (over DTIM interval)
- 2) for sending buffered broadcast packets.

22. In 802.11 networks, a handover means reassociating with the new AP. Handover: In a cellular wireless network (GSM eg) the call is not dropped when a user moves to another cell. Handovers are based on measurements performed by the mobile terminal and base stations.

23. IP fragmentation is an Internet Protocol (IP) process that breaks datagrams into smaller pieces, so that packets may be formed that can pass through a link with a smaller maximum transmission unit than the original datagram size. The fragments are reassembled by the receiving host.

24. 802.11 - Frame Control

- 2 bytes - Duration/ID
- 4 bytes - Address 1-6
- 2 bytes - Sequence Control
- 2 bytes - QoS control
- 4 bytes - HT control (only for 802.11 n frms)

25. The distinction to understand is that while on 802.11 device is transmitting to a receiving device, either one of these devices may not be the actual source or destination of the L2 traffic. So this can create situations where you need four different distinct address.

26. "Stands for 'Wired Equivalent Privacy' WEP is a security protocol for Wi-Fi networks. Since wireless networks transmit data over radio waves, it is easy to intercept data or "eavesdrop" on wireless data transmissions. The goal of WEP is to make wireless networks as secure as wired networks.

Two methods of authentication can be used with WEP: Open System authentication and Shared Key authentication. For the sake of clarity, we discuss WEP authentication in the infrastructure mode. The discussion applies to the ad-hoc mode as well.

1. Directed Probe: The client sends a probe request with a specific destination SSID; only APs with a matching SSID will reply with a probe response.

Broadcast Probe: The client sends a broadcast SSID in the probe request; all APs receiving the probe request will respond, with a probe-request each SSID they support.

Chapter 9:

- 1. WiMAX has QoS guarantee, high transmission speed, variety of business, adopted advanced technologies speed, variety of adopted advanced technologies such as OFDM/OFDMA/AA/MIMO.
- 2. The transport convergence sublayer data unit to the receive MAC layer data unit.
- 3. OFDM divides the channel into a number of orthogonal subchannels, ~~the channel into a number of orthogonal subchannels~~ converts the high speed data signal into a parallel low speed sub-data stream.

Chapter 10:

- 1. One is the traditional AP mode, another one is the ad-hoc network mode.
- 2. The following two conditions are met, then node i and j can be transmitted successfully. $\ominus d_{ij} \leq R_{ij}$ No node of K 's R does not perform data transmission.
- 3. Neighboring users send messages at the same time will be inter-user interference, so that the entire network performance deteriorates.
- 4. For optimal throughput, the transmission rate of each node must be strictly controlled and carefully scheduled.

Chapter 11:

- 1. request the work station to send the authentication frame.
- 2) returns a validation frame.
- 3) status code = "Success", get the question text and encrypt it, and then send an authentication management frame.
- 4) use the standard key to decrypt the challenge text.
- 2. 1) ~~request~~ the applicant sends the EAPOL Start frame to the authenticator frame.
- 2) The certifier requests the requester to provide identity information.
- 3) the applicant will be their own identity info sent to certifier.
- 4) The identity info of applicant is sent to AS.
- 5) The RADIUS server informs the authenticator of the authentication result.
- 6) The certifier sends the certification results to the applicant.
- 3. 1) WEP: Authentication status is unidirectional, resulting in intentional invulnerable AP.

- 5) WAPI: add a certification infrastructure will use to converge the user's identity authentication
- 3) IEEE 802.11: the IEEE 802.1X protocol into the WLAN security mechanism to enhance the WLAN ~~security mechanism~~ identity authentication and access control capabilities.

Chapter 12.

1. The biggest feature is low power consumption
 - ⊙ low cost; support two deployment methods
 - ⊙ to enhance equipment compatibility.
 - ⊙ reduce the delay
 - ⊙ effective coverage to expand.
2. Standby → connection, Page, Page Scan, Inquiry, Inquiry Scan.
3.
 - ⊙ RFID Tag
 - ⊙ RFID Tag Reader.
 - ⊙ Application software system.
4.
 - ⊙ the energy supply of the label.
 - ⊙ tag to the reader data transmission.
 - ⊙ Integrity and security of data transmission
 - ⊙ multi-target recognition technology.
5.
 - ⊙ Campus card
 - ⊙ RFID only electronic license plate
 - ⊙ Toll station ETC system.

Chapter 13.

2. The power module offers the reliable power needed for the system. The sensor is the bond of a WSN node which can obtain the environment and equipment status.
3. WSN application in smart homes WSNs are key for improving the energy efficiency performance of existing buildings.
4. The sensor network nodes broadcasts their status to the surroundings and receive status from other nodes to detect each other.
 - ⊙ the sensor network are organized into a connected network according to a certain technology.
5. The communication distance of the nodes in the network is generally short. The nodes can communicate with its neighbors.
7. Ambient energy harvesting from external sources are used to power small autonomous sensors such as those based on MEMS technology. It's very suitable for WSN.

Chapter 14.

1. Ultra-wideband wireless communication. Software Defined Radio.

Bluetooth Low Energy
Body Area Network.

2. Good security
High processing gain
Multi-path resolution ability
High transfer rate
System capacity is large
Anti-jamming performance
Accurate positioning
Low cost.
3. Bluetooth Low Energy is based on Bluetooth, at the same time simplify the Bluetooth. In the chip design, the use of two ways to achieve, that is, single-mode and dual-mode form.
4. A CR "monitors its own performance continuously", in addition to "reading the radio's outputs", it then uses its information to "determine the RF environment, channel conditions, link performance, etc." and adjust the "radio's setting to deliver the required quality of service subject to an appropriate combination of user requirements, operational limitations and regulatory constraints.
5. BAN devices embedded inside the body
 - Short distance
 - High speed
 - Time change
 - Personalize.
 - Healthcare domain, especially for continuous monitoring and logging vital parameters of patients.