

Chapter 1. Communication has been used as telecommunication from 1930s. Morse found telegram in 1837. Marconi found wireless in 1895 and achieved wireless communication that opened the new century of modern wireless communication. In 1958, SCORE flew in the sky. GSM was born in 1988. **2.** cellular system; mobility management; Mobile IP; Wi-Fi; 802.11; WiMax; 802.16; Ad Hoc Network; Wireless Network Security; WPAN; Sensor network; Internet of Things; Software-defined networking. **Chapter 2.** **1.** The wired media includes twisted-pair, coaxial-cable, fibre-optical. The wireless media does not require setting up cable or fibre-optical, which includes microwave, satellite, laser, infrared ray and so on. **2.** The licensed band is different from unlicensed band in frequency. The licensed band includes cellular system at 1GHz, PCS and WLAN at 2GHz, WLAN at 5GHz, LMDS between 28GHz and 60GHz and IR used in optical communication. The unlicensed band includes ISM band and U-NII band. **3.** path loss; transmit power; type of antenna. **4.** Reflection is the change in direction of a wavefront at an interface between two different media so that the wavefront returns into the medium from which it originated. Diffraction is defined as the bending of light around the corners of an obstacle or aperture into the region of geometrical shadow of the obstacle. Scattering is a general physical process where some forms of radiation, are forced to deviate from a straight trajectory by one or more paths due to localized non-uniformities in the medium through which they pass. **5.** Reflection occurs on the surface of the earth, buildings, and wall surface. It is not the main mechanism on outdoor environment. Diffraction occurs mainly in the shadow area, which is weaker in indoor comparing to the reflection. Scattering occurs on rough surface, small objects or other irregular objects, such as leaves, street signs, lamp and so on. **6.** The path loss is affected by distance between transmitters and receivers. The receiving power is decided by transmitting power, antenna gains and path loss. The heights of mobile stations and base stations will affect receiving power. Higher mobile stations and base stations can increase receiving power. **7.** free

space modeling: $L_p[dB] = 32.45 + 20\lg(f_c[MHz]) + 20\lg(d[km])$, $P_r = \frac{G_t G_p P_t}{L}$ two-ray modeling: $\frac{P_r}{P_t} = G_t G_r \frac{h_b^2 h_m^2}{h^4}$, $L_p[dB] = 40\lg(h) - 10\lg(G_t G_r h_b^2 h_m^2)$ **8.** Slow fading arises when the coherence time of the channel is large relative to the delay requirement of the application. In this regime, the amplitude and phase change imposed by the channel can be considered roughly constant over the period of use. The received power change caused by shadowing is often modeled using a log-normal distribution with a standard deviation according to the log-distance path loss model. **9.** $f_{d,n} = f_d = f_m \cos \theta = \frac{v}{c} f_c \cos \theta$. **10.** For macro-cell system, $L_p(d) =$

$\begin{cases} A + B\lg d & \text{urban environments} \\ A + B\lg d - C & \text{suburban environments} \\ A + B\lg d - D & \text{rural environments} \end{cases}$ In which $A = 69.55 + 26.26\lg f_c - 13.82\lg h_b - a(h_m)$, $B = 44.9 - 6.55\lg h_b$, $C = 5.4 + 2[\lg(f_c/28)]^2$, $D = 40.94 + 4.78(\lg f_c)^2 - 18.33\lg f_c$ For small or medium-sized city, $a(h_m) = (1.1\lg f_c - 0.7)h_m - (1.56\lg f_c - 0.8)$ For large cities, $a(h_m) =$

$\begin{cases} 8.29[\lg(1.54h_m)]^2 - 1.1 & f_c \leq 200MHz \\ 3.2[\lg(1.75h_m)]^2 - 4.97 & f_c \geq 200MHz \end{cases}$ **11.** The signal radiated by a transmitter may also travel along many and different paths to a receiver

simultaneously; this effect is called multipath. Small-scale fading refers to the rapid changes in radio signal amplitude in a short period of time or travel distance. The Doppler shift is the change in frequency or wavelength of a wave (or other periodic event) for an observer moving relative to its source. **12.** In mobile radio channels, the Rayleigh distribution is commonly used to describe the statistical time varying nature of the received envelope of a flat fading signal, or the envelope of an individual multipath component. It is well known that the envelope of the sum of two quadrature Gaussian noise signals obeys a Rayleigh distribution. When there is a dominant stationary signal component present, such as a line-of-sight propagation path, the small-scale fading envelope distribution is Ricean. In such a situation, random multipath components arriving at different angles are superimposed on a stationary dominant signal. At the output of an envelope detector, this has the effect of adding a dc component to the random multipath. **13.** The Doppler

shift is the change in frequency or wavelength of a wave for an observer moving relative to its source. $v(t) = \frac{Vf}{c} \cos \theta(t)$ **14.** $f_{ray}(r) =$

$\frac{r}{\sigma^2} \exp\left(-\frac{r^2}{2\sigma^2}\right)$, $r \geq 0$, $f_{ric}(r) = \frac{r}{\sigma^2} \exp\left(-\frac{r^2 + \alpha^2}{2\sigma^2}\right) I_0\left(\frac{\alpha r}{\sigma^2}\right)$, $r \geq 0, \alpha \geq 0$ **15.** For Rayleigh fading, the level crossing rate is: $LCR = \sqrt{2\pi} f_d \rho e^{-\rho^2}$ where f_d is the maximum Doppler shift and ρ is the threshold level normalized to the root mean square (RMS) signal level:

$\rho = \frac{R_{thresh}}{R_{rms}}$. The average fade duration is: $AFD = \frac{e^{\rho^2} - 1}{\rho f_d \sqrt{2\pi}}$ **Chapter 3.** **1.** 3G technology is the result of research and development

work carried out by the International Telecommunication Union (ITU) in the early 1980s. 3G specifications and standards were developed in fifteen years. The technical specifications were made available to the public under the name IMT-2000. The communication spectrum between 400 MHz to 3 GHz was allocated for 3G. Both the government and communication companies approved the 3G standard. The first pre-commercial 3G network was launched by NTT DoCoMo in Japan in 1998, branded as FOMA. It was first available in May 2001 as a pre-release (test) of W-CDMA technology. **2.** The system capacity gets larger if the cell radius becomes larger. **3.** C=MJN

4. Base station: in wireless communications it is a transceiver connecting a number of other devices to one another and/or to a wider area. Uplink: Pertaining to GSM and cellular networks, the radio uplink is the transmission path from the mobile station to a base station. Downlink: Pertaining to cellular networks, the radio downlink is the transmission path from a cell site to the cell phone. Cells: The cellular network is distributed over land areas called cells, each served by at least one fixed-location transceiver, known as a cell site or base station. MSC: The mobile switching center is the primary service delivery node for GSM/CDMA, responsible for routing voice calls and SMS as well as other services. **5.** The home location register is a central database that contains details of each mobile phone subscriber that is authorized to use the GSM core network. The Visitor Location Register is a database of the subscribers who have roamed into the jurisdiction of the MSC which it serves. **6.** Handoff Management: Ensuring that a mobile user remains connected while moving from one location to another; Packets or connection are routed to the new location; Location Management; Search: find a mobile user's current location; Update(Register): update a mobile user's location; Location info: maintained at various granularities; Research Issue: organization of location databases. **7.** Overcrowding is relieved in existing systems with radio spectrum; Bandwidth, security and reliability are more; Provides interoperability among service providers; Availability of fixed and variable rates; Support to devices with backward compatibility with existing networks; Rich multi media services are available. **8.** Call Admission Control (CAC) prevents oversubscription of VoIP networks. It is used in the call set-up phase and applies to real-time media traffic as opposed to data traffic. CAC mechanisms complement and are distinct from the capabilities of Quality of Service tools to protect voice traffic from the negative effects of other voice traffic and to keep excess voice traffic off the network. Since it averts voice traffic congestion, it is a preventive Congestion Control Procedure. It ensures that there is enough bandwidth for authorized flows. **9.** A SGSN is responsible for the delivery of data packets from and to the mobile stations within its geographical service area. Its tasks include packet routing and transfer, mobility management (attach/detach and location management), logical link management, and authentication and charging functions. The mobile switching center (MSC) is the primary service delivery node for GSM/CDMA, responsible for routing voice calls and SMS as well as other services (such as conference calls, FAX and circuit switched data). The MSC sets up and releases the end-to-end connection, handles mobility and hand-over requirements during the call and takes care of charging and real time pre-paid account monitoring. The Gateway MSC (G-MSC) is the MSC that determines which "visited MSC (V-MSC)" the subscriber who is being called is currently located at. **10.** WCDMA、CDMA2000、TD-SCDMA. **11.** CDMA **12.** The potential transmission rate of GPRS is 115Kbps. **13.** ADSL works by using the frequency spectrum above the band used by voice telephone calls. With a DSL filter, the frequency bands are isolated, permitting a single telephone line to be used for both ADSL service and telephone calls at the same time. ADSL is generally only installed for short distances from the telephone exchange, typically less than 4 kilometers, but has been known to exceed 8 kilometers if the originally laid wire gauge allows for further distribution. **14.** 3G cellular networks towards a uniform architecture for all-IP wireless networks. **Chapter 5** **1.** Mobile Cloud Computing; Mobile Web; Ubiquitous Computing. **Chapter 6** **1.** When the mobile station in communication moves from the coverage of a base station to another base station. MSC need to dispatch voice and command signal to the new base station channel. During the switching process, mobile station need to identify the new base station and measure the signal strength. **2.** The handoff procedure in which the mobile unit adjacent cellular system which is controlled by same MTSO is referred as intra handoff. 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.** MCHO: Mobile station monitor the signal strength and choose the best choice. NCHO: Network monitor the signal strength and launch the switch. MAHO: Mobile station monitor the signal strength and network make the switch choice. **4.** Soft handoff: the connection to the source cell is broken only when a reliable connection to the target cell has been established and therefore the chances that the call will be terminated abnormally due to failed handovers are lower. But soft handoff require more complex hardware in the phone to achieve such function. Hard handoff: At any moment one call uses only one channel. **5.** Monitor the signal strength change between base unit and mobile unit and once the change exceed 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. **8.** Intra-switch: When a mobile signal becomes weak in a given cell and MTSO finds other cell within its system 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 system to which it can transfer the call then it uses Inter system handoff. **10.** Handoff rate will increase if the cell becomes smaller. **11.** LLC&MAC **12.** Location update: 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. Service delivery: Cellular network search for the available access interface for called user. If succeed, caller will send a feedback to end this service delivery. **Chapter 7** **1.** To enable the node to receive data packets when it connects to any link. **2.** MN: Mobile Node, whose location often changes. HA: Home Agent. The home agent is a router in the home link of the mobile node, the mainly effect of which is transmitting the packets from other nodes to the roaming mobile node. FA: The foreign agent is a router in the foreign link of the mobile node, it can deliver packages to the home agent of the mobile node. COA: Care of Address. CN: Correspondent Node. **3.** MH sends to FA; FA tunnels packets to HA by encapsulation; HA forwards the packet to the receiver.

5. The registration process of Mobile IP generally carries out after completion of discovery mechanism. When mobile node discover it has returned home link, it should register to the home agent and start communication like fixed nodes or a router. When the mobile node is located at the outside link, it can get a transfer address, and register this address to home agent through the foreign agents.

6. To avoid outdated registration. 7. Mobile IP uses Agent Advertisement which broadcasts periodically to implement mobility management. 8. Mobile node sends registration request to home agent and then home agent will set up a mobile binding for mobile node. 9. If a foreign or home agent that does not support reverse tunnels receives a request with the 'T' bit set, the Registration Request fails. 10. IP in IP、 minimal encapsulation、 GRE encapsulation. 11. Reverse tunnel is the tunnel between the mobile host(MH) and its home agent(HA), it begins from the care of address of the MH, and ends in that of the HA. **Chapter 8**

1. DCF: Distributed Coordination Function; PCF: Point Coordination Function; DIFS: DCF Interframe Space; SIFS: Short Interframe Space; PIFS: PCF Interframe Space. 2. The RTS/CTS access mechanism is mainly used to minimize the amount of time spent when a collision occurs since collision occurs in these short messages. 3. 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. EDCA: Enhanced distributed channel access. HCF: hybrid coordination function. 4. In ad-hoc mode, wireless devices can communicate with each other directly. In infrastructure mode, wireless devices can communicate with each other or can communicate with a wired network. 5. infrastructure mode: base station connects mobiles into wired network; mobile changes base station providing connection into wired network. ad-hoc mode: no base stations; nodes can only transmit to other nodes within link coverage; nodes organize themselves into a network. 6. Physical Layer. 7. LLC: Logical Link Control. MAC: medium access control; PLCP: Physical Layer Convergence Protocol; PMD: Physical Media Dependent. 8. Compared to the infrared wireless networks, the radio wireless networks have a longer bandwidth. 9. PLCP、 PMD 10. HIPERLAN 1 offers five different priorities for data packets ready to be sent. 11. Distributed Coordination Function (DCF)、 Point coordination function (PCF)、 the hybrid coordination function (HCF) 13. Unicast of any to be transmitted over WIFI are at much higher rates than multicasts. 14. 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. 15. QoS is supported in 802.11 in both modes by measuring quality of service like bit rate. 16. To fulfill timing-synchronization among users. 17. All stations maintain a local timer and there are time synchronization functions. 18. Frames are transmitted periodically to announce the presence of a wireless LAN not PLCP. 19. Yes. Power management protocol need clock synchronization. 20. The power cannot be inefficient to the mobile devices. 21. The transmitter and receiver will be awake and asleep switch every small time period: in ad-hoc mode, the frequency may be higher to suit the high mobility. 22. ATIM is a management frame with no frame body. When a STA receives ATIM, the formally dozing station must begin the process of retrieving buffered frame from the stations that transmit the ATIM. DTIM beacon is identical to the ordinary beacon. 23. Handover operations between Aps in IEEE802.11 is entirely driven by STA. 24. A message's length may not suit a package, so we fragment it to use standard to transmit. 25. The MAC header contain the message's source and destination. 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. 802.11a was an amendment to the IEEE 802.11 wireless local network specifications that defined requirements for an orthogonal frequency division multiplexing communication system. 28. To make wireless networks as secure as wired networks. 29. Standard 64-bit WEP uses a 40 bit key, which is concatenated with a 24-bit initialization vector to form the RC4 key. 30. Open System authentication and Shared Key authentication. 31. WEP、 MAC filtering、 Captive portals. 32. Active scanning occurs when the client changes its IEEE 802.11 radio to the channel being scanned, broadcasts a probe request, and then waits to hear any probe responses from APs on that channel. 33. 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. 34. SIFS, highest priority; PIFS, medium priority; DIFS, lowest priority. **Chapter 9**

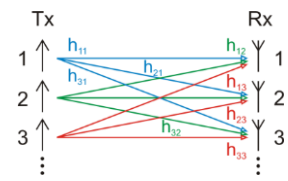
1. adding an extra QoS; high transmitting rate; various service. 2. Convergence sublayer is responsible for the receiving of MAC layer data cell encapsulation process convergence sublayer data unit, and perform the corresponding access and synchronization control logic, physical media mainly rely on sublayer performing channel coding, modulation, and other functions. 3. OFDM is a method of encoding digital data on multiple carrier frequencies. **Chapter 10**

1. infrastructure mode: base station connects mobiles into wired network; mobile changes base station providing connection into wired network. ad-hoc mode: no base stations; nodes can only transmit to other nodes within link coverage; nodes organize themselves into a network. 3. The IEEE 802.11 MAC protocol specifies that all users share a channel. The overall network performance deteriorates when nearby users send messages at the same time as they do so. The effective solution is to set exclusive or time-division. 5. Hidden terminal and exposed terminal will cause the disorder of AD hoc network time slot resources contention and increase the probability of data collision, seriously affect the network throughput, capacity, and data transmission delay. **Chapter 11**

1. The client sends an authentication request to the Access Point. The Access Point replies with a clear-text challenge. The client encrypts the challenge-text using the configured WEP key and sends it back in another authentication request. The Access Point decrypts the response. If this matches the challenge text, the Access Point sends back a positive reply. 2. Initialization; Initiation; Negotiation; Authentication. **Chapter 12**

1. low power consumption; low cost; decrease delay. 2. Page; Page Scan; Inquiry; Inquiry Scan.

3. RFID Tag reader : The reader is responsible for two-ray communication with electronic tags, and receiver control commands from the host system meanwhile. Electronic Tag: communicate with reader; chip technology; Antenna design technology; packaging technique. **5.** student card; food tag; ETC. **Chapter 13** **1.** A large number of sensor nodes deployed randomly inside of or near the monitoring area form networks through self-organization. Sensor nodes monitor the collected data to transmit along to other sensor nodes by hopping. During the process of transmission, monitored data may be handled by multiple nodes to get to gateway node after multihop routing, and finally reach the management node through the internet or satellite. **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 environmental and equipment status. The microcontroller receives the data from the sensor and processes the data accordingly. The Wireless Transceiver Wthen transfers the data, so that the physical realization of communication can be achieved. **3.** Smart dust; A Line in the sand; C4ISR. **4.** Firstly, the sensor network nodes broadcast their status to the surroundings and receive status from other nodes to detect each other. Secondly, 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.** 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. When transmission rate decrease , the delivery reliability will be higher and network lifetime will be longer. **7.** Ambient energy harvesting from external sources. **Chapter 14** **1.** Software Defined Radio; Bluetooth Low Energy; Body Area Network **2.** Good security; High processing gain; High transfer rate; Multi-path resolution ability. **3.** Bluetooth Low Energy is based on Bluetooth. In the chip design, the use of two ways to achieve, that is, single-mode and dual-mode form. **4.** A cognitive radio is a radio that can be programmed and configured dynamically to use the best wireless channels in its vicinity. Such a radio automatically detects available channels in wireless spectrum, then accordingly changes its transmission or reception parameters to allow more concurrent wireless communications in a given spectrum band at one location. **5.** BAN devices embedded inside the body; Short distance; high speed. Personal multimedia entertainment; Wireless identification system; healthcare domain. **Chapter 15** **1.** SDN is an approach to computer networking that allows network administrators to programmatically initialize, control, change, and manage network behavior dynamically via open interfaces and abstraction of lower-level functionality. **2.** SDN Application; SDN Controller;SDN Datapath; SDN Control to Data-Plane Interface; SDN Northbound Interfaces. **3.** Protocol Oblivious Forwarding POF; Open Computing Project OCP. **4.** Because of the traditional network equipment firmware for hardware dependency is bigger, so network control in software defined network separated from the physical network topology, so as to get rid of the limitation on the network architecture hardware. **Chapter 16、17、18** **1.** Camera;motor; inertial navigator; microphone. **2.**Real-Time Indoor Mapping; Fully Distributed Scalable Smoothing and Mapping; Leap-Frog Path Design. Fully Distributed Scalable Smoothing and Mapping; Intelligent cars swap information for better location. **Chapter19** **1.** In radio, MIMO is a method for multiplying the capacity of a radio link using multiple transmit and receive antennas to exploit multipath propagation. SISO uses single transmit.

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- 3.**space-multiplexing: high rate data stream is partitioned into multiple lower rate of data flow, different child data flow on different transmitting antenna on the same frequency band.
- 2.** Space diversity: Using multiple transmission routes provided by multiple antennas on the launch or receiving end, the same data is sent to enhance the transmission quality of the data.
- 4.** Distributed-MIMO;Virtual-MIMO;Networked-MIMO.

Chapter 21 ,22 **1.**The security of value: the value fluctuations is very big; Account security; Transaction security; Privacy security.**2.**A QR code consists of black squares arranged in a square grid on a white background, which can be read by an imaging device such as a camera, and processed using Reed–Solomon error correction until the image can be appropriately interpreted. The required data is then extracted from patterns that are present in both horizontal and vertical components of the image.