Chapter 1

1. 1831 法拉第电磁感应→1837 莫尔斯电报→1873 麦克斯伟电磁场理论→1876 贝尔电话→1894 特斯拉短波无线通信实验→1895 马可尼无线电→1906 范信 AM→1927 跨洋电视广播→1946 第一个公共移动电话系统→1958SCORE 通信卫星→1981NMT→1988GSM→1997 无线局域网第一个版本发布

2. 蜂窝系统、移动管理、移动 IP、Wi-Fi、WiMAX、自组织网路、无线网络安全、无线个人局域网路、传感网络、物联网、软件定义网络

Chapter 2

1. 传播介质，光纤光缆 VS 大气，稳定性，带宽，广播特性

2. 授权：1GHz-蜂窝系统，2GHz-PCS/WLAN，5GHz-WLAN，28-60GHz-LMDS，IR；非授权：ISM，U-NII，PCS

3. 介质，频率，距离

4. 反射:当障碍物的尺寸大于电磁波的波长时发生反射; 绕射:边沿衍射; 散射:粗糙表面

5. 户内:散射，反射，衍射；户外:地面反射，建筑反射，屋顶衍射

6. 距离大损耗大/天线增益小/基站高度低=>在发射能量一定的情况下接受能量小

7. 自由空间电波传播，两径模型 Pr/Pt 的公式

8. 阴影衰落 LP，也叫慢衰落

9. 路径损耗公式

10. 开阔环境及城市环境的路径损耗 -C 不同，对不同大小城市有不同的固定值

11. 多径衰落:信号通过不同路径到达后的叠加，多普勒：由移动引起的频移

12. 瑞利分布多用于多径衰落接收信号的包络分布，莱斯分布用于描述接收信号包络的衰落变化

13. 多普勒频移公式，基站分子，接收端分母

14. 在不同的接收电压信号的均方根值前提下，通过瑞利分布和莱斯分布的 PDF 可得必要信号强度

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&4

1. 2008 年 5 月 3G 公布，TD-SCDMA，WCDMA，CDMA2000

2. 由几个小功率发射机支持许多用户，以替代一个高功率发射机的技术

3. 由 N 确定层数 k，确定层数半径 D，可绘制同通道干扰小区

4. 基站:共用移动通信电台; 上行线:从地面站链接至卫星; 下行线:从卫星下行到一个或多个地面站; 蜂窝网络: 利用多组低功率的无线电分块覆盖整个服务区; 服务区: 无线电所能覆盖的工作区域; MSC: 移动交换中心，是在电话和数据系统之间提供呼叫转换服务和呼叫控制的地方

5. HLR 负责移动用户管理的数据库。VLR 是一个数据库，是存储所管辖区域中客户的来话、去话呼叫所需检索的信息以及用户签约业务和附加业务的信息

6. 切换管理:基站改变，新基站识别及信道分配; 位置管理: 家乡代理及外地代理的身份认证

7. 主要区别在传输声音和数据的速度提升，在全球范围实习哪无线漫游，处理图像，音乐，视频等

8. GSM 到 CDMA

9. GPRS 核心网提供移动管理、会话管理和传输 GSM 和 WCDMA 网络中的 IP 包。GPRS 管道协议是定义 IP 的 GPRS 核心网协议，主要用于 GSM 和 WCDMA 网络，允许终端用户从一个地方移动到另一个地方时保持与 Internet 的连接

10. WCDMA, CDMA2000, TD-SCDMA

11. 实现全球漫游、实现高速数据传输、实现宽带多媒体服务

12. 结合了 GPRS2.5G 技术的 EDGE 称为 EGPRS，并且允许峰值数据速率达到 200kbits/s

13. 宽带上网、手机商务、视频通话、手机电视、无线搜索等

14. 3G 蜂窝网络针对的是 all-IP 无线网络中的归一化机制

Chapter 5

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

Chapter 6

1. Monitor the signal strength changes. Once it exceed the threshold, switch begins; Mobile station begin to recognize the new base station; After several interaction, 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. The handoff procedure in which the mobile unit adjacent cellular system which is controlled by same MTSO is referred as intra handoff

3. MCHO: Mobile station monitor the signal strength and choose the best choice. MCHO: Network monitor the signal strength and launch the switch. MAHO: Mobile station monitor the signal strength and network make the switch choice.

4. Advantages: 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. Disadvantages: hard handoff: at any moment in time one call uses only one channel.

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

6. FF mobility model is a microscopic mobility model and is primarily used in determining the boundary crossing rate and dwell time within a given radio range in the context of movements and movements of nodes in mobile and hoc network

7. $$\lambda_h = -\eta(1-p_o)\lambda \sum_{p\in\sigma_c} \operatorname*{Res}_{s=p} \frac{1-f^*(s)}{s^2[1-(1-p_f)f^*(s)]} f_c^*(-s).$$

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.

9. $$P_L = (1-P_f)P_{OB} \approx P_{OB}$$

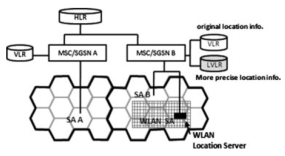
$$P_f = \frac{\frac{[\lambda_{n_1} E(T_P)]^{n_1}}{n_1!}}{\sum_{n=0}^{n_1} \frac{[\lambda_{n_1} E(T_P)]^n}{n!}}$$

$$\lambda_h = \frac{\mu_R(1-P_o)}{\mu_M + \mu_R P_f}\lambda_o$$

10. The smaller the cell is, the higher handoff rate is.

11. two-tier 结构是软件架构的表示层或接口上运行的一个客户端，将数据层或数据结构存储在服务器上

12. 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

13. 


Chapter 7

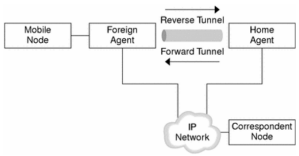
1. 一旦用户的位置发生了变化便需要一个新的地址，然而网络数据大部分是通过 TCP 传输，改变 IP 地址就会相应地建立一个新的连接，会造成应用的中断及数据的丢失。另外，用户会被分配一个外地地址来取代本地地址，那么用外地地址会使用户难以接入本地网络

2. MN:位置经常发生变化，即经常从一个链路切换到另一个链路的节点(主机); HA:移动节点家乡链路上的一台路由器，主要用于保持移动节点的位置信息，当移动节点外出时，负责把发给移

动节点的数据包转发给移动节点; FA:移动节点所在外地链路上的一台路由器，当移动节点的转交地址由它提供时，用于向移动节点的家乡代理通报转交地址、做移动地址的默认路由器，对家乡代理转发来的隧道包进行解封装，并交付给通信节点; COA:当移动节点切换到外地链路时，与该节点相关的一个 IP 地址。当移动节点和其他节点通信时，并不直接使用转交地址做目的地址或源地址，但若没有转交地址就不能维持通信。当家乡代理向移动节点转发数据时，要用转交地址做隧道的出口地址。转交地址可以分为配置转交地址和外地代理转交地址两类; CN:一个移动节点的通信对象.

3. MH sends to FA; FA tunnels packets to HA by encapsulation; HA forwards the packet to the receiver (standard case)

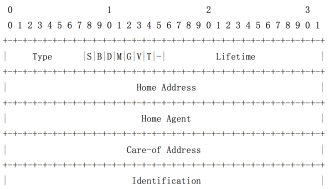
4.




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. A limited lifetime allows a mobile node registers with its home agent using a registration request message so that its home agent can create or modify a mobility binding for that mobile node .

7.




8. If a foreign or home agent that does not support reverse tunnels receives a request with the 'T' bit set, the Registration Request fails

9. IP in IP 封装:由 RFC2003 定义，在 IP in IP 技术中，整个 IP 数据包被直接封装，成为新的 IP 数据包的净荷。其中内部 IP 头信息不便，除了生存时间减 1，而外部的 IP 头则是完整的 IP 头信息

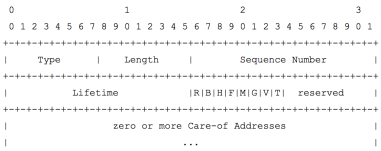
最小封装：由 RFC2004 定义。在最小封装技术中，新的 IP 头被插入到原始 IP 头和原始 IP 载荷之间，最小封装通过去掉 IP 的 IP 封装中内层 IP 报头和外层 IP 报头的冗余部分，减少实现隧道所需的额外字节数

通用路由封装：由 RFC 1701 定义，它是一种在移动 IP 之前就已经开发出来的协议。通用路由封装定义了在任意一种网络层协议上封装任意一个其他网络层协议的协议，运行一个协议的数据分组封装在另一个协议的数据分组的有效负载中

10. A tunnel that starts at the mobile node’ s care-of address and terminates at the home agent

11. reverse tunnel 也被称为 reverse connection,其常常用于开放端口的旁路防火墙限制，使用了 reverse connection 的 RAT 会向客户端 IP 发送 SYN 包，确保客户端根据该包确定是否允许网络上的外在连接

12.




Chapter eight

1. DCF: is the fundamental MAC technique of the IEEE 802.11 based WLAN standard, requiring a station wishing to transmit to listen for the channel status for a DIFS interval. PCF: is a Media Access Control (MAC) technique used in IEEE 802.11 based WLANs, residing in a point coordinator also known as Access Point (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 it’ s back-off, before sending RTS package. SIFS is generally the time for which receiver wait before sending the CTS (Clear To Send) & acknowledgement package to sender, and sender waits after receiving CTS and before sending data to receiver. PIFS is one of the inter-frame space used in IEEE 802.11 based Wireless LANs, enabling access point wait for PIFS duration rather than DIFS to occupy the wireless medium.

2. If the channel is found busy during the DIFS interval, the station defers its transmission. In a network where a number of stations contend for the wireless medium. If multiple stations sense the channel busy and defer their access, they will also virtually simultaneously find that the channel is released and then try to seize the channel. As a result, collisions may occur. In order to avoid such collisions, DCF also specifies random back off, which forces a station to defer its access to the channel for an extra period.

3. IEEE 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 (MAC) layer. EDCA provides high-priority traffic a higher chance of being sent than a low-priority traffic. Within the HCF, there are two methods of channel access, similar to those defined in the legacy 802.11 MAC: HCCA and EDCA.

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 :increased levels of security, potentially faster data transmission speeds and integration with a wired network.

5. Infrastructure mode: base station connects mobiles into wired network; handoff: mobile changes base station providing connection into wired networkAd hoc mode: no base station; nodes can only transmit to other nodes within link converge; nodes organize themselves into a network: route among themselves

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 and Physical Layer is responsible for putting bits on the air

7. LLC is the upper sublayer of the data link layer of the seven-layer OSI model. MAC and PHY are specified in 802.11. MAC is divided into MAC and MAC Management. MAC is responsible for access mechanism, fragmentation and encryption. And MAC Management is responsible for roaming in ESS, power management, asso-disasso-reasso-ciation. PLCP is carrier sensing assessment and forming packets for PHY’ s. PMD is responsible for modulation and coding.

8. Infrared (IR) light is electromagnetic radiation with a wavelength longer than that of visible light, measured from the nominal edge of visible red light, employed in short-range communication among computer peripherals and personal digital assistants and electronic devices. Advantage: Simple Circuit, Low Power Consumption, Higher Security, Simple Shielding, Portable; Disadvantages: Works ONLY on Line-of-Sight (LOS) Mode, Short Range, Blocked by common materials: people or walls, Low bandwidth, Speed is comparatively slow

Radio is the transmission of signals through free space by modulation of electromagnetic waves with frequencies below those of visible light. Advantages: Simple Circuit, High Speed/Bandwidth, Covers Large Areas (Penetrates through walls). Disadvantages: Limited number of free frequency bands, Shielding is difficult, Interference with other electrical devices, Greater Power Consumption, Limited Spectrum of Frequency.

9.

Physical Layer Overview

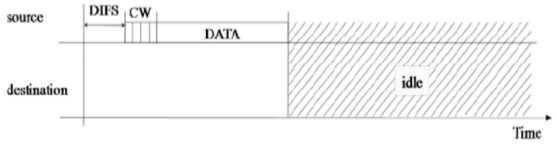
| | 802.11 | 802.11a | 802.11b | 802.11g |
|---|---|---|---|---|
| Available bandwidth | 83.5 MHz | 300 MHz | 83.5 MHz | 83.5 MHz |
| Unlicensed frequency of operation | 2.4 - 2.4835 GHz DSSS, FHSS | 5.15 - 5.35 GHz OFDM 5.725 - 5.825 GHz OFDM | 2.4 - 2.4835 GHz DSSS | 2.4 - 2.4835 GHz DSSS, OFDM |
| Number of non-overlapping channels | 3 (indoor/outdoor) | 4 indoor 4 (indoor/outdoor) 4 outdoor | 3 (indoor/outdoor) | 3 (indoor/outdoor) |
| Data rate per channel | 1, 2 Mbps | 6, 9, 12, 18, 24, 36, 48, 54 Mbps | 1, 2, 5.5, 11 Mbps | 1, 2, 5.5, 6, 9, 11, 12, 18, 24, 36, 48, 54 Mbps |
| Compatibility | 802.11 | Wi-Fi5 | Wi-Fi | Wi-Fi at 11 Mbps and below |

10. HIPERLAN 1 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. This mechanism always grants nodes with higher priority access to the medium, no matter how high the load on lower priorities.

11. the IEEE 802.11 Distributed Coordination Function (DCF) Point coordination function (PCF) the hybrid coordination function (HCF).

12.




13. In computer networking, multicast (one-to-many or many-to-many distribution) 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. In IEEE 802.11, the NAV represents the number of microseconds the sending STA intends to hold the medium busy.

15. Yes, yes, no

16. A Timing Synchronization Function (TSF) keeps the timers for all stations in the same Basic Service Set (BSS) synchronized. All stations shall maintain a local TSF timer.

17. All stations maintain a local timer. Timing conveyed by periodic Beacon transmissions.

18. Time is divided into beacon intervals, each containing a beacon generation window. Each station waits for a random number of slots and transmits a beacon.

    Beacon contains a timestamp. On receiving a beacon, STA adopts beacon’ s timing if T(beacon)>T(STA) and clocks move only forward.

19. An adaptive protocol called ASP is proposed in for time synchronization in 802.11-based multi-hop ad hoc networks. The basic idea of the protocol is to let the faster nodes send out beacon more often and self correction of the clocks. This protocol is first to do the automatic self correction in multi-hop scenario.

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

21. In ad hoc mode: CSMA/CA is used to access the channel. RT, CTS, ACK, PS-Poll are used to overcome hidden terminal.

    In infrastructure mode: CSMA/CA is used to access the channel. RT, CTS, ACK, PS-Poll are used to overcome the hidden-terminal problem.

22. ATIM: transmitted in ATIM-Window by stations who want to send buffered packets; structured the same as TIM. DTIM: transmitted less frequently for sending buffered broadcast packets.

23. In 802.11 networks, a handover means re-associating with the new AP.

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

25. Frame Control, Duration/ID, Address1-4, Sequence Control, Qos control and HT control.

26. The BSSID of the wireless network may be the TA or RA, but it can also may be an identifier to associate traffic to a BSS. Unless the access point (AP) uses the same MAC address for the management interface and the BSSID, you generally won't have any traffic where the BSSID is either the SA or DA.

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. The difference are about speed, range, interference and price.

28. Wired Equivalent Privacy

29. Standard 64-bit WEP uses a 40 bit key (also known as WEP-40), which is concatenated with a 24-bit initialization vector (IV) to form the RC4 key.

30. using equipment from different vendors is the different methods of entering the WEP key. If you are using an ORiNOCO card, it will allow the WEP key to be entered in either ASCII or Hex format. On the other hand, if you're using a Linksys or D-Link card you can either use a Passphrase or Hex method.

31. Open System authentication and Shared Key authentication.

32. In terms of WEP/WPA, as explained, they only provide confidentiality at the network level, they do not tell us who is connected. As regards MAC filtering, the problem is that it doesn’ t identify a person, easily spoofed, and not a secret information. Captive portals are very popular and flexible, but it is not transparent or standardized.

33. 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. 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. Inter framing spacing is defined different inter frame spacing, such as SIFS, PIFS, DIFS.

Chapter 9

1. WiMAX 技能提供面向互联网的高速连接，数据传输距离最远可达 50km，具有 QoS 保障、传输速率高、业务丰富多样。采用了 OFDM/OFDMA、AAS、MIMO、等先进技术，实现了宽带业务的移动化。

2. 传输汇聚子层负责吧收到的 MAC 层数据单元封装程传输汇聚子层数据单元，并执行相应的接入方案和同步控制逻辑，物理媒质依赖子层主要执行信道编码、调制等功能。支持 MAC 层与物理层间信道管理信息的协调交互，不仅能够支持自适应突发业务数据的传输，还能支持动态的调整调解编码方式和发射功率等传输参数。

3. OFDM 将信道分成若干正交子信道，将高速数据信号转换成并行的低速子数据流，调制到在每个子信道上进行传输。正交信号可以通过在接收端采用相关技术来分开，这样可以减少子信道之间的相互干扰 ICI 。每个子信道上的信号带宽小于信道的相关带宽，因此每个子信道上的可以看成平坦性衰落，从而可以消除符号间干扰。而且由于每个子信道的带宽仅仅是原信道带宽的一小部分，信道均衡变得相对容易。

Chapter 10

1. 一个是传统的 ap 模式，开启了之后只能有一个中心，其他节点接入中心点之后通过中心点进行数据交换，一个是自组网模式，各个点都是平等的，任意一点均可以和其他节点进行通信，不需要中心点

2. 在使用同一信道的情况下．满足以下两个条件，则节点 i 与 j 可以传输成功：dij≤Rt, 任何节点满足 dkj≤Rl 的节点 k 都不进行数据传输。

3. IEEE 802.11MAC 协议规定所有用户共享一个信道。当邻近的用户同时发送消息时会产 生用户间干扰，使整个网络性能恶化。有效的解决方法是设置排外范围或进行时分复用。

4. $\mathrm{TH}=\frac{E[P]}{\min\{A,H\}\times T}$ $\mathrm{Thr}=\frac{E[P]}{\min\{H,6\}\times T+\max\{H-6,0\}\times T_{ndr}}$

5. “隐藏终端”和“暴露终端”的存在，会造成 ad hoc 网络时隙资源的无序争用和浪费，增加数据碰撞的概率，严重影响网络的吞吐量、容量和数据传输时延。在 ad hoc 网络中，当终端在某一时隙内传送信息时，若其隐藏终端在此时隙发生的同时传送信息，就会产生时隙争用冲突。受隐藏终端的影响，接收端将因为数据碰撞而不能正确接收信息，造成发送端的有效信息的丢失和大量时间的浪费（数据帧较长时尤为严重），从而降低了系统的吞吐量和量。当某个终端成为暴露终端后，由于它侦听到另外的终端对某一时隙的占用信息，而放弃了预约该时隙进行信息传送。其实，因为源终端节点和目的终端节点都不一样，暴露终端是可以占用这个时隙来传送信息的。这样，就造成了时隙资源的浪费。

Chapter 11

1. 请求工作站发送认证帧; AP 收到后，返回一个验证帧;如果状态码为成功，则请求工作站将从该帧中获得质询文本并利用共享密钥 WEP 算法将其加密，然后发送一个认证管理帧；AP 在接受到第三个帧后，使用共享密钥对质询文本解密，若和自己发送的相同，则认证成功，否则认证失败。

2. IEEE802.1X 协议是针对以太网提出的基于端口进行网络访问控制的安全性标准。基于端口 z 的网络访问控制指的是利用物理层特性对连接到局域网接口的设备进行身份认证。如果认证成功，则允许设备访问局域网资源，否者禁止该设备访问局域网资源。

3. WEP 认证身份是单向的，导致可能存在假冒的 AP；WAPI 增加一个认证基础结构 WAI 用来实现用户的身份认证；IEEE 802.11i 将 IEEE802.1X 协议引入到 WLAN 安全机制中，增加了密钥管理机制。

Chapter 12

1. 最大的特点在于低功耗，极低的运行和待机功耗; 有效覆盖范围扩大到超过 60 米，而以前的版本只有 10 米; 加强不同 OEM 厂商之间的设备兼容性。

2. 传呼、传呼扫描、询呼、与询呼扫描。

3. 电子标签，阅读器，应用软件系统

4. 标签的能量供应；标签到阅读器的数据传输；数据传输的完整性与安全性。

5. 校园卡，智能电子车牌，ETC

chapter 13

1. The WSN is built of "nodes" – from a few to several hundreds or even thousands, where each node is connected to one (or sometimes several) sensors. The process of data transfer is transmitted back to the base station through the transmission of adjacent nodes, and then transmitted by the base station to the final user through satellite or wired network connection. 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.

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. WSN application in the smart grid; WSN application in smart homes.

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 (linear, star, tree, mesh, etc.). Finally, suitable paths are computed on the constructed network for transmitting the sensing data.

5. If you want to communicate with nodes outside the coverage area, you need to route through the intermediate node.

6. The transmission rate, delivery reliability and network lifetime are three fundamental but conflicting design objectives in energy-constrained wireless sensor networks. When transmission rate decrease, Obviously the delivery reliability will be higher and network lifetime will be longer. vice versa.

7. MEMS technology

Chapter 14

1. Body Area Network, Bluetooth Low Energy, Software Defined Radio

2. Multi-path resolution ability, Good security, Accurate positioning

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 CR "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

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. 一是基于流的数据转发机制；二是基于中心控制的路由机制；三是面向应用的编程机制。

3. Open Daylight, Protocol Oblivious Forwarding, Open Computing Project

4. 当网络被软件化时就可以像升级、安装软件一样对其架构进行修改，直接利用编程接口就可以改变其逻辑关系，从而满足企业对整个网站架构进行调整、扩容或升级。而交换机、路由器等硬件资源并不需要改变，因此节省了大量成本，同时又缩短了网络架构迭代周期，集中化的网络控制使得各类协议与控制策略能够更快地到达网络设备。

Chapter 16-18

1. 电机 摄像头 惯性导航仪 麦克风 测距仪 红外线接收器触摸传感器 压力传感器 Wi-Fi 和以太网支持 加速度传感器 气压计 超声波传感器

2. Leap-Frog Path Design, Real-Time Indoor Mapping, Cooperative Multi-Robot Estimation and Control. Real-Time Indoor Mapping: 使用到的小车机器人只具有短距离传感器。这类基于路径长度和左右两个 bumper sensor 的小车就像盲人一样，需要在复杂的室内环境中“摸索”。小车的行驶角度是离散的，使用一段段的直线和直角角度，就可以画出室内的地图，也可以为小车自己定位。

Chapter 19

1. MIMO 技术要求系统发射端和接收端配备多根天线同时进行传输; SISO 系统发射端与接收端之间只存在一条传输路径。
2. MIMO 系统在发射端和接收端均采用多根天线进行信息传输，设两端天线数为 $N_T$ 和 $N_R$，则在空间中会形成 $N_TXN_R$ 条传输途径，每根天线会收到 $N_T$ 个发射信号的叠加，各条传输路径之间的独立性越强，可以获得的分集增益和复用增益越大。经过多径信道接收到的信号对应的频域可以表示成 y=Hx+n，其中 x 表示发射信号，y 表示接收信号，H 表示频域下的信道矩阵，n 表示信道中叠加的噪声，一般认为是 AWGN。
3. 空间多样利用发射或接收端的多根天线所提供的多重传输途径发送相同的数据，以增强数据的传输质量；空分复用在发射端，高速率的数据流被分区为多个较低速率的子数据流，不同的子数据流在不同的发射天线上在相同频段上发射出去。
4. Mobile radio telephone，non-wireless communications systems， the IEEE 802.16e.

Chapter 21&22

1. 货币价值的安全性，比特币的价值波动很大，投资风险很大，由于比特币价值的不安全性，也限制了比特币的推广；账户的安全性，比特币用户可以生成一个 wallet.dat 文件脱机保管，除非钱包被窃取，否则账户不可能被盗，然而钱包一旦丢失无法被找回；交易过程的安全性，除非有一个体具有超过全网 50%的运算能力，否则不能修改区块链中的交易过程，因此比特币交易十分安全；交易双方隐私的安全性，虽然每一笔交易都公布在网上并包含交易双方的公钥信息，但是难以知道每个公钥所对应的社会中的人的身份。
2. 由正方形模块构成，组成一个正方形阵列，有编码区域和包括寻像图形，分隔符，定位图形和校正图形在内的功能图形组成。