

1•Telecommunication originated from the 1930s,when Faraday discovered the law of electromagnetic induction. Before that, message was conveyed with inefficient and simple methods such as beacon.

2•Cellular system,Mobile IP,Wi-Fi,WiMAX,Ac hoc

- 1•reliability,media
- 2•Licensed band is managed by the government.
- 3•Terrain,operating frequency and interference sources.
- 4•Reflection will happen when the scale of obstacle is larger than wavelength of electromagnetic wave. Diffraction refers to various phenomena that occur when a wave encounters an obstacle or a slit. Scattering is a general physical process where some forms of ra-diation, 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 is not main mechanism outdoors.Diffraction often happens in the shadow, and it is weaker than reflection indoors.Scattering happens when encountering small things with rough surface and other irregular things.It is more obvious indoors.

6• $P_r/P_t=G_tG_rh_b^2h_m/d^4$

7•free_space $L_p[dB]=32.45+20lgf_c[MHz]+20lgd[km]$

two-ray $10lgP_r=10lgP_0 - 10\alpha lgD$

8•The strength of signal will change as the location changes.

9• $L_p=L_0+10\alpha lgD+X$

10•macro $L_p=A+Blg d(-C)-(-D)$

micro $L(dB)=L_{los}(d_A,h_t)+L_B$

11•Multipath is the propagation phenomenon that results in radio signals reaching the receiving antenna by two or more paths.The Doppler effect (or 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• Rayleigh distributions:no direct path; Ricean distributions:one direct or main path.

13• $f=c+v_r)/(c-v_s)*f_0$

14• Ricean: $K(dB)=10lg(A^2/2\sigma^2)$ Rayleigh $r_{mean}=1.2533\sigma$

15• $N(R) = \int_0^\infty rp(R,r)dr \quad \tau_R=\frac{P(r\leq R)}{N_R}$

1• 3G system uses CDMA technology and packet switching technology,while 2G systems commonly used TDMA technology and circuit switching technology

2•The larger the transmitting power is, the larger system capacity is; the smaller the cell radius is, the larger system capacity is.

3•Determine k by N, then determine D.

4• Base station (also: base radio station):A land station in the land mobile service.

Uplink: the portion of a feeder link used for the transmission of

signals from an earth station to a space radio station.

Downlink:the portion of a feeder link used for the transmission of signals from a space radio station to an earth station.

Cell: area of radio coverage in a cellular network.

Location area:a set of base stations that are grouped together to optimise signalling.

Mobile switching center (MSC) is the primary service delivery node for GSM/CDMA.

5• The MSC connects to the following elements:

The home location register (HLR) for obtaining data about the SIM and mobile services ISDN number (MSISDN; i.e., the telephone number).

The base station subsystem (BSS) which handles the radio communication with 2G and 2.5G mobile phones.

The UMTS terrestrial radio access network (UTRAN) which handles the radio communication with 3G mobile phones.

The visitor location register (VLR) provides subscriber information when the subscriber is outside its home network.

Other MSCs for procedures such as handover.

6• location management:location update,call delivery; handoff management:switching base stations.

7•Improvement on speed of transmitting data and sound.Support for multimedia,website and roaming.

8• 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. TDMA allows only one user to connect ,and CDMA allows more than one users to connect.

9• SGSN/GGSN:detunnel GTP packets from the GGSN (downlink),tunnel IP packets toward the GGSN (uplink)

MSC/GMSC/HLR: set 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.

10•WCDMA CDMA2000 TD-SCDMA

11•High speed, Support for multimedia,website and roaming.

12•WCDMA:3.84Mcps,5MHz,1940~1955MHz(uplink),2130~2145MHz(downlink)

CDMA2000:

1.2288Mcps,1.25MHz,1920~1935MHz(uplink),2110~2125MHz(downlink)

GPRS:1800MHz 1710---1785MHz(uplink) 890---915MHz(downlink)

13•FDMA:used for rural area, TACS:used for urban area, DECT:used inside architectures.

14•The 3G cellular network is aimed at the normalization mechanism in the all-IP wireless network.

1•mobile website,mobile cloud,mobile access

1•A handover, in which the source and the target are different cells is called inter-cell handover. The purpose of inter-cell handover is to maintain the call as the subscriber is moving out of the area covered by the source cell and entering the area of the target cell.A

handover, in which the cell is not changed, is called intra-cell handover. The purpose of intra-cell handover is to change one channel, which may be interfered or fading with a new clearer or less fading channel.

2•MAHO:need mobile station,

3•An advantage of the hard handover is that at any moment in time one call uses only one channel. One advantage of the soft handovers is that 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.

19•The advantage of a hard handoff is that at any one time a call uses only one channel, the downside is that there is a ping-ponging effect. The advantage of Soft handoff is that it can reduce the probability of signal connection to the target cell, and the disadvantage is that it requires complex hardware conditions on the handset side.

4•Monitor the signal strength change in the base station unit and the mobile unit, and once the change exceeds the threshold value, the switching program is executed.

5•Straight-line model: Define user behavior is linear. Fluid-flow model: used to describe the water level in a reservoir during a random decision.

6•

7• Before implementation of Inter System Handoff MTSO compatibility must be checked and in Inter System Handoff local call may become long distance call. In Intra System Handoff local calls always remain local call only since after handoff also the call is handled by same MTSO.

8•

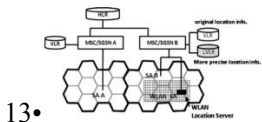
9•

10•PHY layer and MAC larey

11• The location update procedure allows a mobile device to inform the cellular network, when to the next area.

12• Location 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•

1•For identification

2•mobile node,home agent,foreign agent, care-of address, communication node

3•Mobile IP specifies how a mobile node registers with its home agent and how the home agent routes datagrams to the mobile node through the *tunnel*.

4•agent discovery,registration,Tunnel Encapsulation,Cluster Routing

5•mobile node, for link switching , home net

6•To keep tracing mobile nodes

7•To judge if mobile nodes are roaming out of home net.

8•To redister new CoA to home net.

9• Registration request is rejected.

10•IP in IP:direct encapsulation(simple)

Minimum encapsulation:new IP header is inserted between origin IP header and load.(min size)

GRE: encapsulation in valid load.(general)

11• When mobile node reaches a foreign network,it listens for proxy advertisements and selects a foreign agent that supports reverse tunneling. It requests the use of reverse tunnels when it is registered with the selected foreign agent.

12• A reverse tunnel allows a mobile node located on a foreign network to establish a topology-oriented packet to ensure that it establishes a communication connection on the foreign network where the ingress filter router is set up.

1• distributed coordination function, Packet Control Function, Distributed Inter-frame Spacing, Short interframe space, PCF Interframe Space

2• DCF has an optional virtual carrier sense mechanism that exchanges short Request-to-send (RTS) and Clear-to-send (CTS) frames between source and destination stations during the intervals between the data frame transmissions.

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 wirelessLAN 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.

The HCF (hybrid coordination function) controlled channel access (HCCA) works a lot like PCF.

4• ad-hoc mode doesn't have AP while infrastructure mode has.

5•AP:receive wireless signal and send it to wired net.

STA:wireless network devices in WLAN.

6•PHY layer and MAC layer

7• The LLC sublayer providesmultiplexing mechanisms that make it possible for several network protocols to coexist within a multipoint network and to be transported over the same network medium.

The MAC layer emulates a full-duplex logical communication channel in a multi-point network.

PLCP is the physical layerprotocol of several data transmission networks.

PMDs further help to define the physical layer of computer network protocols. They define the details of transmission and reception of individual bits on a physical medium.

8• differences: working frequency

infrared wireless networks:fast ,safe ,cheap but small coverage.

radio wireless networks:slow unsafe,but large coverage

9•DSSS TDD/TDMA OFDM STBC LDPC MIMO-OFDM

10•

11• Unicast is more reliable than multicast.

12• NAV is a logical abstraction which limits the need for physical carrier-sensing at the air interface in order to save power.

13•No,No,Yes. 802.11e supports QoS.

14•Correctly separate the time slot signals.

15•Preamble and Ranging

16•Declare the existence of a network.

17•

18•This bit indicates the power management state of the sender after the completion of a frame exchange. Access points are required to manage the connection, and will never set the power-saver bit.

19•ATIM:inform data is waiting to transmit
DTIM: informs the clients about the presence of buffered multicast/broadcast data on the access point.

20•Scan, authenticate and reconnect

21•Differnt frames in message convey differnt information.

22•For handshake during the competition and positive confirmation, the end of non-competitive period;

23•SA: Source of the data
TA : STA that transmitted the frame
RA: Immediate recipient of the frame
DA : Final recipient of the data

24•**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 transmits data faster than 802.11.802.11b uses DSSS,802.11a use OFDM.

25•to provide data confidentiality

26•WEP uses the stream cipher RC4 for confidentiality,and the CRC-32 checksum for integrity.

27•

28•In Open System authentication, 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. In Shared Key authentication, the WEP key is used for authentication in a four-step challenge-response handshake:

- 1.The client sends an authentication request to the Access Point.
- 2.The Access Point replies with a clear-text challenge.
- 3.The client encrypts the challenge-text using the configured WEP key and sends it back in another authentication request.
- 4.The Access Point decrypts the response. If this matches the challenge text, the Access Point sends back a positive reply.

29• It is possible to derive the keystream used for the handshake by capturing the challenge frames in Shared Key authentication. Therefore, data can be more easily intercepted and

decrypted with Shared Key authentication than with Open System authentication.

MAC Filtering refers to a security access control method whereby the 48-bit address assigned to each network card is used to determine access to the network.

30•During an active scan, the client radio transmits a probe request and listens for a probe response from an AP. With a passive scan, the client radio listens on each channel for beacons sent periodically by an AP. A passive scan generally takes more time

31•Priority 6 and 5 are mainly used for delay-sensitive applications, corresponding to interactive voice and video; priority 4 to 1 are mainly used for controlled-load applications, streaming media Multimedia, business-critical traffic. Priority 0 is the default and is automatically enabled if no other priority values are set.

32•

- 1• fast,stable,scalable,far
- 2• The original version of the standard on which WiMAX is based (IEEE 802.16) specified a physical layer operating in the 10 to 66 GHz range. 802.16a, updated in 2004 to 802.16-2004, added specifications for the 2 to 11 GHz range. 802.16-2004 was updated by 802.16e-2005 in 2005 and uses scalable orthogonal frequency-division multiple access (SOFDMA),More advanced versions, including 802.16e, also bring multiple antenna support through MIMO.
- 3• **OFDM** is a method of encoding digital data on multiple carrier frequencies.

- 1• Ad-hoc mode doesn't have AP while infrastructure mode has.
- 2• Hidden terminal problem occurs when a node is visible from a wireless access point (AP), but not from other nodes communicating with that AP. Exposed node problem occurs when a node is prevented from sending packets to other nodes because of a neighboring transmitter.
- 3•
- 4•application layer,presentation layer,session layer,transport layer, network layer,MAC layer,PHY layer
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- 1• WEP uses the stream cipher RC4 for confidentiality,and the CRC-32 checksum for integrity. 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. At the time that the original WEP standard was drafted, the U.S. Government's export restrictions on cryptographic technology limited the key

size. Once the restrictions were lifted, manufacturers of access points implemented an extended 128-bit WEP protocol using a 104-bit key size (WEP-104).

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3•WEP is optional and has security vulnerabilities. WAPI has WAI for authentication,and it is safer.IEEE802.11i adds TKIP and CCMP.

4•Improve transmission distance and lower power consumption.

5•active,sniff,hold,park,middle

6•reader:two-way communication with tags,and receive commands from hosts.

Smart tags: communicate with readers and provide information.

7• Chip technology, Antenna Design Technology, Packaging technology, Tag application technology, Anti-collision technology

8•Animal identification, asset management, id card

1• WSN are spatially distributed autonomous sensors to monitor physical or environmental conditions. Base station is a transceiver connecting a number of other devices to one another and/or to a wider area. Monitoring station monitor the sensors. Potentially more powerful aggregation nodes gather and transmit information from sensors.

2•STIM:collect surrounding information and convert analog signal to digital signal.

NCAP:send message to internet.

3• Remote health monitoring,smart dust,C4ISR,environment monitoring.

4•

5• Self-organization, Multi-hop, Low power consumption,small range,dynamic,low data rates.

6•

7• solar energy, new battery

1•UBW,SDR,RFID

2•secure, high processing gain ,high multipath resolution capability,high transmission speed, large system capacity, anti-interference, low power consumption, cheap,precise localization.

3• Bluetooth Low Energy simplifies Bluetooth,lower power consumption, speeds up data transmission.

4•Cognitive 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. This process is a form of dynamic spectrum management.

5•low transmit power,high transmission speed.

Localization,health care, multimedia entertainment.

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• Directly programmable, Agile, Centrally managed, Programmatically configured ,Open standards-based and vendor-neutral.

3•SDMN,SD-WAN,SD-LAN

4• SDN is meant to address the fact that the static architecture of traditional networks doesn't support the dynamic, scalable computing and storage needs of more modern computing environments such as data centers.

5•sensors, motors, communication module,camera,

6•Environment monitoring,health care, self-driving car.

Self-driving car is a vehicle that is capable of sensing its environment and navigating without human input.[Many such vehicles are being developed, but as of February 2017 automated cars permitted on public roads are not yet fully autonomous. They all require a human driver at the wheel who is ready at a moment's notice to take control of the vehicle.

1•MIMO has more than one transmission path ,while SISO has only one.

2• $y=Hx+n$

3•space diversity is any one of several wireless diversity schemes that uses two or more antennas to improve the quality and reliability of a wireless link.

4•DAS,virtual MIMO:multi_user MIMO, Networked MIMO
DAS is a network of spatially separated antenna nodes connected to a common source via a transport medium that provides wireless service within a geographic area or structure.

1•The bitcoin protocol includes several features that protect it against some of those attacks, such as unauthorized spending, double spending, forging bitcoins, and tampering with the blockchain. Other attacks, such as theft of private keys, require due care by users.

2•Coding area and function graphics