

Lecture #1 Introduction to Wireless Networking

1. Define Wireless Network

- Wireless network is an interconnection of many systems capable of providing service to mobile users within a particular geographic region (country or continent)
- In wireless network, data are carried by **Electrical Wave** (e.g., *radio wave*) from one node to another.
- There is **No Physical Cable/Wire** connecting one computer to another

2. What are the components required for Wireless Networking?

- Base station
- Mobile Switching Center (MSC)
- PSTN (Public Telecommunication Switching Network)

3. What are the advantages of wireless networking?

- Mobility
- Installation speed and cost
- Reach of network
- Flexibility/scalability

4. What are the disadvantages of wireless networking?

- Speed
- Security

5. What is the hardware required for Wireless networking?

- Wireless NIC (Wireless Network Interface Card)
- Wireless Access Point (WAP)
- Universal Access Point (UAP)

Example of Wireless Devices



4. What are the types of wireless networking mode?

- a. Ad-hoc Mode
- b. Infrastructure Mode

5. What is Ad-hoc Mode?

- Each wireless node can communicate *directly* with each of the other nodes in the network (*without Wireless Access Point*)
- **Mesh** network topology

- **IBSS (Independent Basic Service Set):** a group of nodes communicating in ad-hoc mode

6. What is Infrastructure Mode?

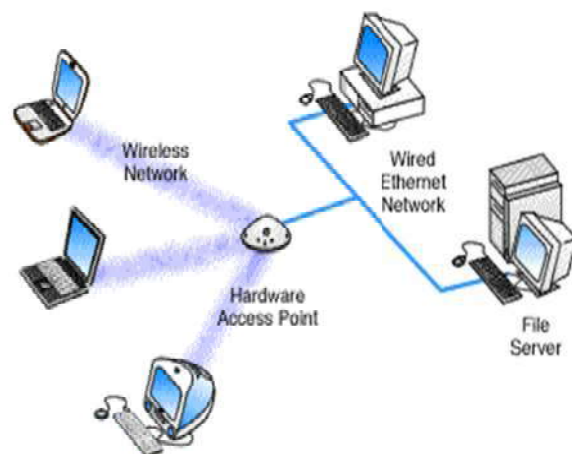
- All wireless node communicate to one another **via Wireless Access Point**
- **Star** network topology
- **BSS (Basic Service Set):** a group of nodes communicating in infrastructure mode.
 - *An BSS has one wireless access point*
- **EBSS (Extended Basic Service Set):** two or more BSS that can communicate to one another
 - *An EBSS contains two or more wireless access points*

Ad-Hoc versus Infrastructure Mode

Ad-Hoc Mode (IBSS)



Infrastructure Mode (BSS)



7. What are the types of Wireless Security?

There are three basic wireless security methods available

- **SSID** (Service Set Identification)
- **MAC** Address Filtering
- **Encryption**

8. What are factors affecting the **Speed** of the wireless network?

- The wireless network technology **Standard**
- The **Distance** between sender and receiver,
- **Interference** from other wireless devices or electronic devices
- The **Presence of Solid Object** (especially metal object, electronic appliance) between the sender and receiver

8. What are factors affecting the **Range** of the wireless network?

- The wireless network technology **Standard**
- **Interference** from other wireless devices or electronic devices
- The **Presence of Solid Object** (especially metal object, electronic appliance) between the sender and receiver

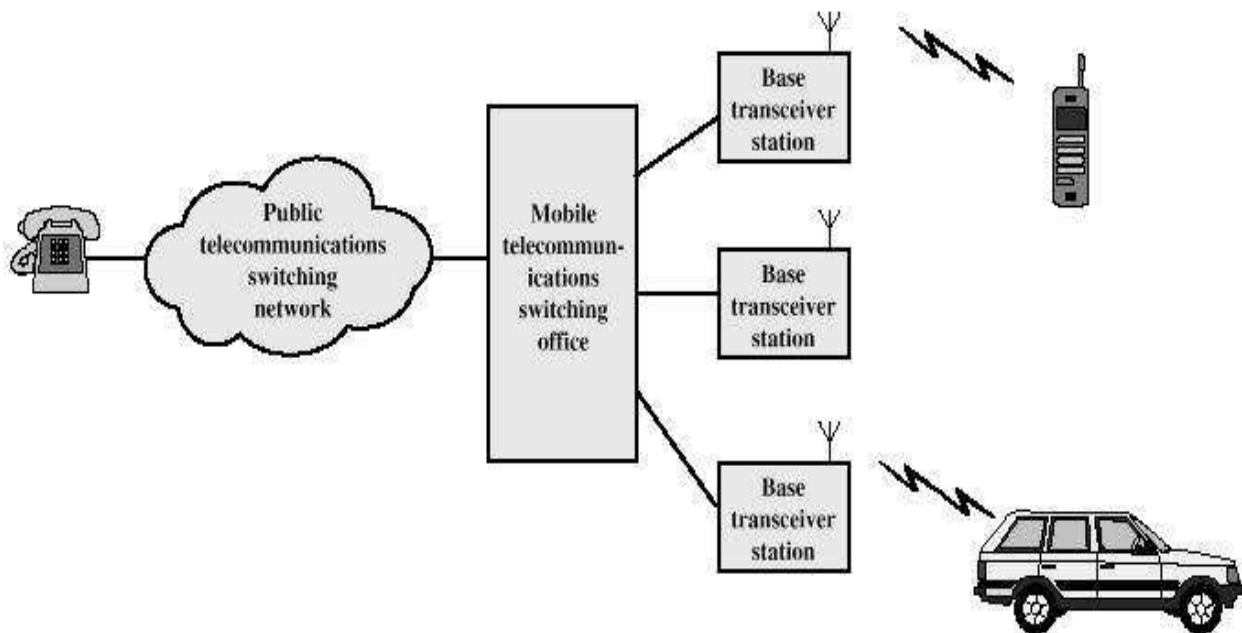
9. How can we increase the range of the wireless network?

- Using “**signal booster**”
- Using **Wireless Access Point**
- Using **MULTIPLE Wireless Access Points**

10. List out the Generation of Mobile Wireless Services.

- First Generation (1G)
 - Mobile voice services
- Second Generation (2G)
 - Primarily voice, some low-speed data
- Generation 2½ (2.5G)
 - Higher data rates than 2G
 - A bridge to 3G
- Third Generation (3G)
 - Seamless integration of voice and data
 - High data rates, full support for packet switched data

11. Draw the block diagram of Cellular System



Lecture #2 Fundamentals of Cellular Communication

1. Evolution of Cellular Communication

- 1893 - Radio communication was invented by Nikola Tesla and Marconi
- 1940 - First walkie-talkie was used by the US military
- 1947 - John Bardeen and Walter Brattain invented the transistor
- 1979 - First Cellular Phone service was launched by the Nordic Mobile Telephone (in Finland, Sweden, Norway, Denmark).



2. Cellular System Generation

1G	Voice oriented systems based on Analog technology	Advanced Mobile Phone Systems Cordless System
2G	Voice oriented systems based on Digital technology	Global System for Mobile (GSM) US Time Division Multiple Access (US-TDMA)
3G	Voice oriented systems integrate with data Services	General Packet Radio Service (GPRS) and Code Division Multiple Access (CDMA)
4G	Based on Internet protocol networks and will provide voice, data and multimedia service to subscribers	

3. What is frequency reuse?

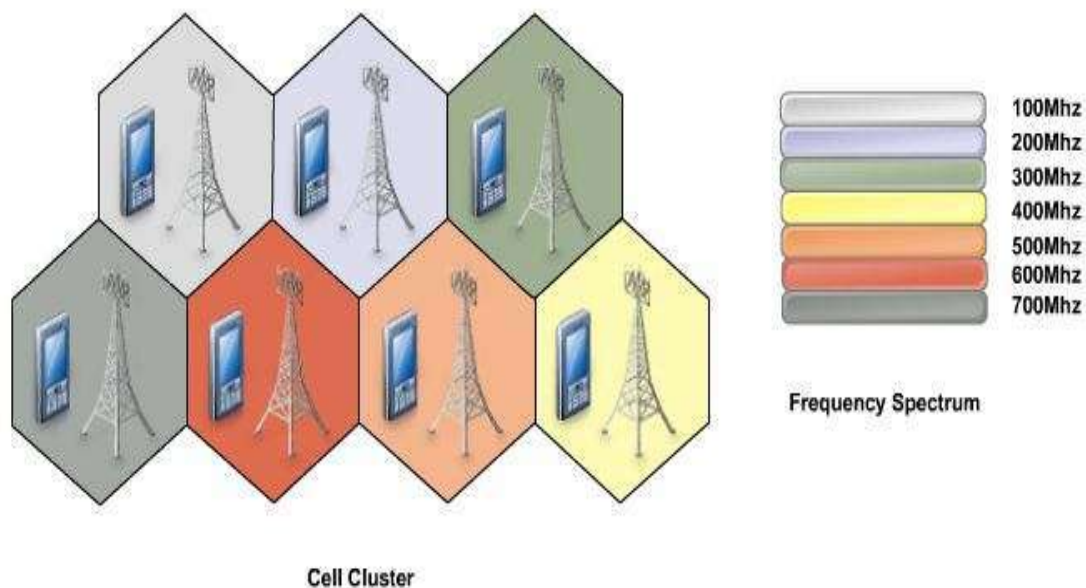
It is a method used by service providers to improve the efficiency of a cellular network and to serve millions of subscribers using a limited radio spectrum

4. Define Network Cell

- Basic geographical unit of a cellular network;
- It is the area around an antenna where a specific frequency range is used;
- It is represented graphically as a hexagonal shape, but in reality it is irregular in shape
- When a subscriber moves to another cell, the antenna of the new cell takes over the signal transmission
- In heavy traffic zones cells are smaller, while in isolated zones cells are larger

5. What is Cluster?

A cluster is a group of adjacent cells, usually 7 cells



5. What are the types of cells?

- Macro Cell
- Micro Cell
- Pico Cell

6. Define Macro Cell

- Their coverage is large (approx. 6 miles in diameter);
- It is used in remote areas,
- High-power transmitters and receivers are used

7. Define Micro Cell

Their coverage is small (half a mile in diameter)

It is used in urban zones;

Low-powered transmitters and receivers are used

8. Define Pico Cell

It covers areas such as building or a tunnel

9. What is meant by Handover?

Moving a call from one zone to another zone due to subscriber's mobility

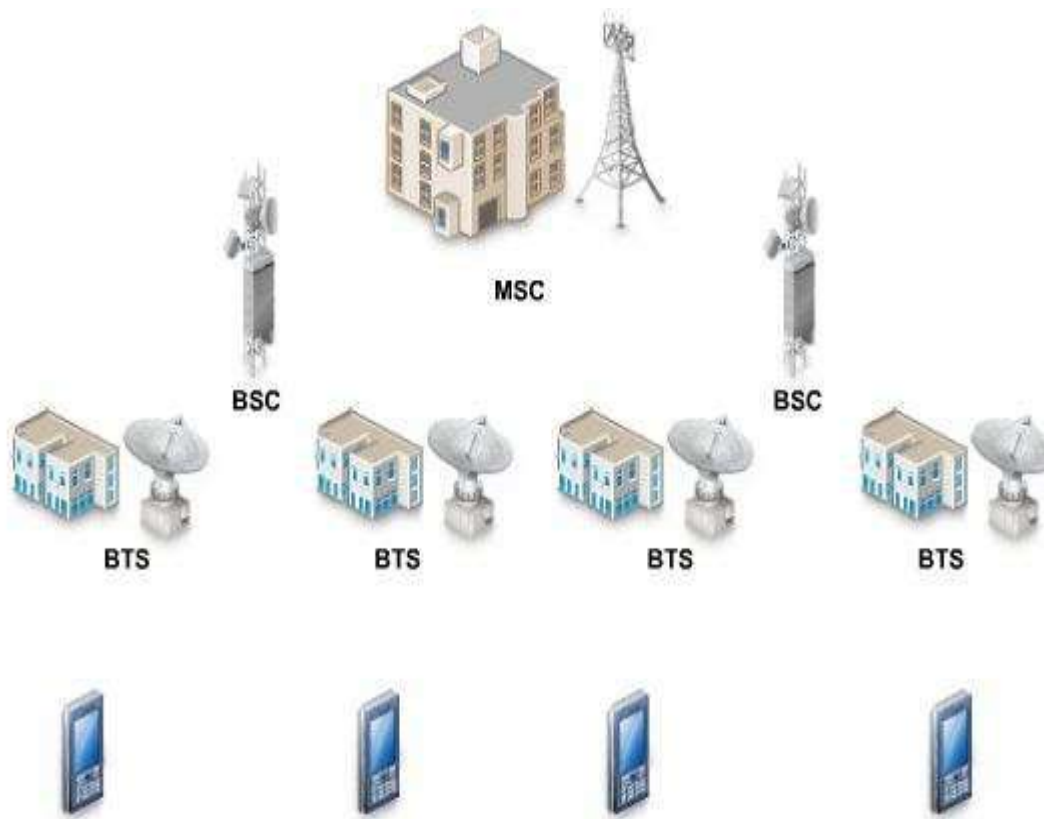
10. What is meant by Roaming?

Allowing the subscriber to send/receive calls outside the service provider's coverage area

11. What are the services provided by Cellular Networking?

- ▶ voice communication
- ▶ Short Messaging Service (SMS)
- ▶ Multimedia Messaging Service (MMS)
- ▶ Global Positioning System (GPS)
- ▶ Wireless Application Protocol (WAP) – to access the Internet

12. Draw the diagram of Cellular Network Components



BTS - Base Transceiver Station

BSC - Basic Station Controller

MSC - Mobile Switching Center

MSU - Mobile Subscriber Unit

13. What are the components of Cell Phone?

- ▶ **Radio Transceiver** – low power radio transmitter and receiver
- ▶ **Antenna**, usually located inside the phone
- ▶ **Control Circuitry** – formats the data sent to and from the BTS; controls signal transmission and reception
- ▶ **Man-Machine Interface** – consists from a keypad and a display; is managed by the control circuitry
- ▶ **Subscriber Identity Module (SIM)** – integrated circuit card that stores the identity information of subscriber
- ▶ **Battery** - the power unit of the phone



Lecture #3 Wireless Application Protocol (WAP Technology)

1. Define WAP

WAP is a Wireless Application Protocol.

2. Define Protocol

Protocol is a set of rules in network

3. Give a brief discussion about WAP

WAP stands for **Wireless Application Protocol**

WAP is an **Application Layer Communication Protocol**

WAP is used to **Access Services and getting Information**

WAP is **Inherited** from Internet standards

WAP is for **Handheld devices** such as **Mobile Phones, PDA**

WAP is a **protocol** designed for **Micro Browsers**

WAP enables the creating of **Web Applications** for Mobile Devices.

WAP uses the **Mark-Up Language WML** (not HTML)

WML is defined as an **XML 1.0** application

4. Define Micro Web Browser

A Micro Browser is a small piece of software that makes minimal demands on hardware, memory and CPU. It can display information written in a restricted mark-up language called WML.

The Micro Browser can also interpret a reduced version of JavaScript called WMLScript.

To fit into a small wireless terminal, WAP uses a Micro Browser.

5. What is the Expansion of WML?
Wireless Markup Language

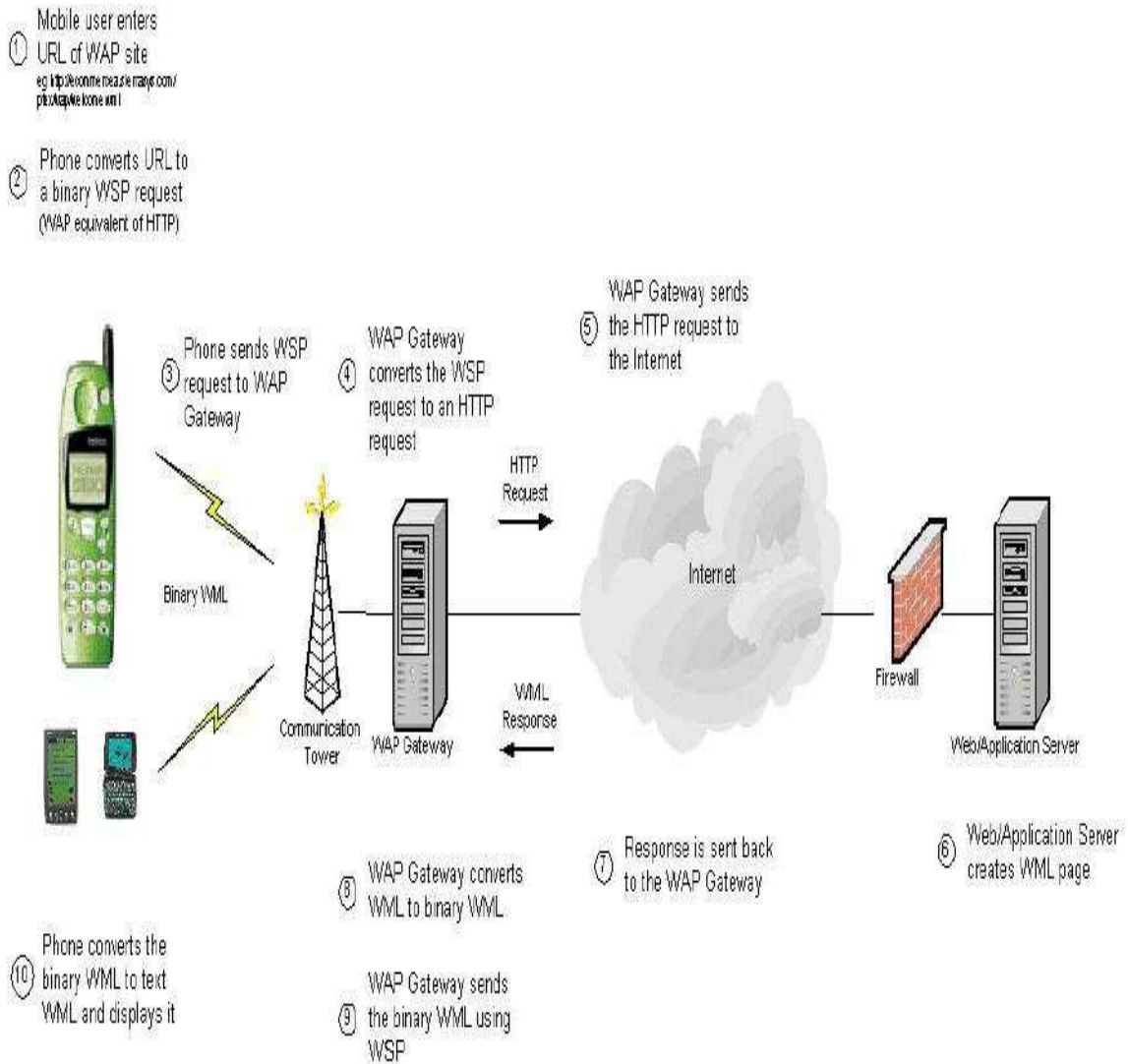
6. The home page of WML is known as Decks

7. The Decks are constructed as Cards

8. What are the limitations of WAP?
 - a. Low bandwidth network
 - b. High Latency network
 - c. Limited connection stability
 - d. Small display size
 - e. Limited input facility
 - f. Limited memory
 - g. Limited processing power

9. Draw the architecture of WAP Technology

WAP Architecture



Lecture #4 I – Mode Technology

1. Define i-mode and give brief introduction about i-mode service

- i-mode is a wireless multimedia service popular in Japan
- It provides a Multimedia and Messaging service for Mobile Phones.
- Developed by NTT Docomo
- i-mode was launched in Japan on 22 February 1999
- i-mode users have access to various services such as e-mail, sports results, weather forecast, games, financial services, ticket booking and internet browsing.
- 45 million subscribers in Japan, 4 million worldwide
- i-mode enabled handsets are needed for accessing this service
- Limited availability: only for customers of Japanese mobile phone provider NTT DoCoMo.
- i-mode was developed as an inexpensive method of packet switched high-speed communication.

2. What are the services provided by I –Mode?

I-mode provides 6 types of services

1. E-Mail
2. Transaction
3. Information
4. Database
5. Entertainment
6. Internet Web Browsing

3. Explain in details of the services provided by i-mode?

E- Mail:

I-mode user can send and receive mails from another i-mode enabled phone, PDA or a computer

Transaction Service:

Transaction services include banking, ticket reservation, airline information and credit card information.

Information Service:

Examples of information service include news updates, weather information sports news and stock quotes

Database service:

The database service provides contents such as telephone directory search, restaurant guide, and Dictionary service.

Entertainment:

Entertainment service include network game character download, horoscope

Internet web browsing:

Internet web browsing enables users to browse contents on the internet

4. What are the components needed for i-mode service?

There are four main components that are required for i-Mode service.

1. A cellular phone capable of voice and packet communication and with a browser installed
2. A packet network
3. An i-mode server
4. Information providers

5. Draw the architecture of i-mode

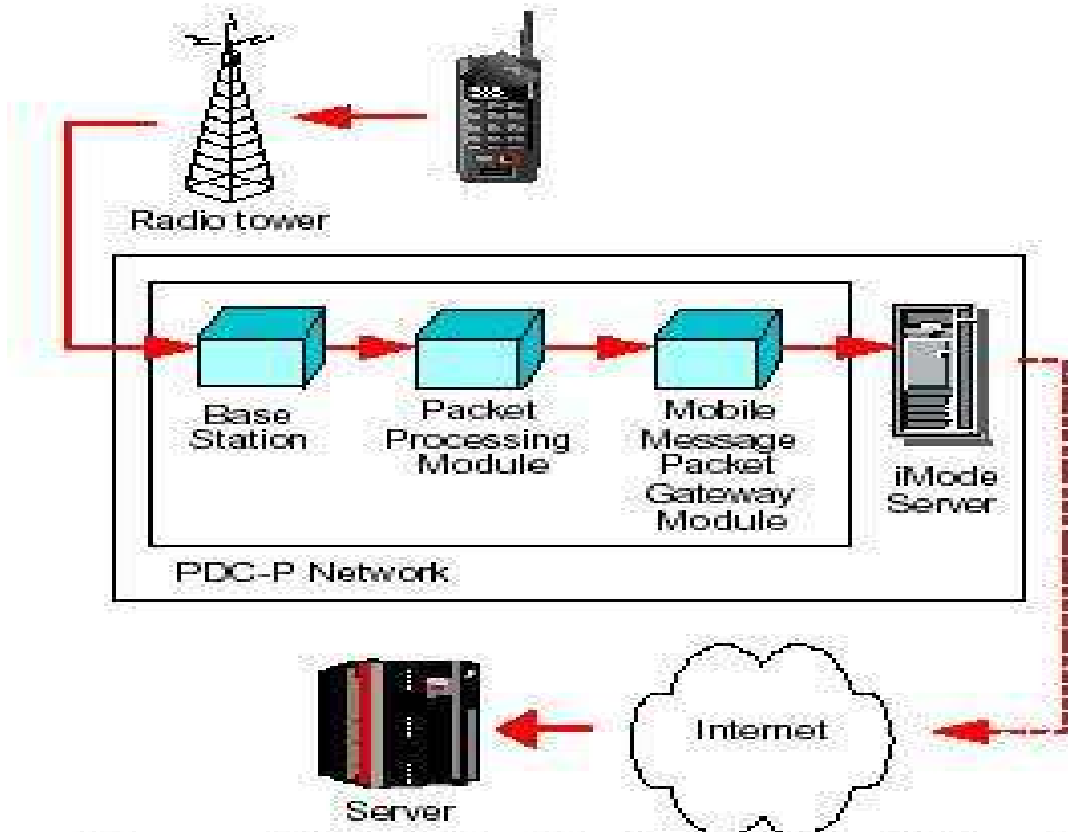


Figure 5: DoCoMo iMode Wireless Networking Environment.

- The PDC-P (Personal Digital Cellular Packet) network transports data between i-mode phone and i-mode server.
- i-mode phone sends data to the base station which forwards them to PPM(Packet processing module)
- PPM routes the packets to the M-PG (Message Packet) gateway.
- Connection between i-mode server and internet are made using TCP/IP
- I - mode server: it act as a proxy between the packet network and the internet.
- Content providers:
 1. Official content providers
 2. Unofficial content providers

- MPG (Mobile Packet Gateway) handles the protocol conversion between the two protocol platforms.

6. What are the technologies used in I – mode

1. Packet Switched Network
2. Compact Hyper Text Markup Language (CHTML)

7. Mention some I – mode phones released in UK

The first nine i-mode handsets released in the UK are:

1. NEC343i
2. NEC41i
3. Samsung s500i
4. Samsung Z320i
5. Samsung S400i
6. Sony EricssonK610im
7. MotorolaSLVRL7 i-mode
8. Motorola SLVRL6 i-mode
9. NokiaN95i

8. What is the difference between WAP and I – mode

WAP	I - mode
Circuit Switch method	Packet Switch method
use text and no images	Use images, animated images and color
users are charged for the connection time	users are not charged for the connection time

Lecture #5 Speech and Channel Coding Techniques

1. Define Bandwidth

It is the range of frequencies that is available for the transmission of data.

2. Define Frequency

It is the rate (cycles/sec or HZ) at which the signals repeat.

3. What is the use of Speech Coding?

Speech Coding is used to save the bandwidth and improve bandwidth efficiency

4. What are the methods followed in Speech Coding?

- ♣ Wave Form Coding
 - ♣ Time Domain Waveform Coding
 - ♣ Frequency Domain Waveform Coding
- ♣ Source Coding
- ♣ Hybrid Coding

5. What are the attributes of Speech Coding?

- ♣ Transmission Bit Rate
- ♣ Delay
- ♣ Complexity
- ♣ Quality

6. Define Channel

A channel is a portion of the communications medium allocated to the sender and receiver for conveying information between them.

7. What is the use of Channel Coding?

It is used to improve the signal quality and reduce the Bit - Error – Rate (BER)

8. What are the classifications of Channel Coding?

- ◆ Automatic Repeat Request (ARQ)
- ◆ Forward Error Correction (FEC)

9. What is the process of ARQ?

In this, the transmission errors are detected by the receiver but not corrected.

10. What is the process of FEC?

In this, the transmission errors are detected by the receiver and also corrected

11. What are the common Error Correction Codes used now a days?

- Reed Solomon (RS)
- Viterbi (V)
- Reed Solomon Viterbi (RSV)

12. What are the Schemes used in Channel Coding?

- ❖ RS Codes
- ❖ Convolutional Codes
- ❖ Turbo Codes

Lecture #6 Mobility Management in Wireless Network

1. What are the categories of Mobility?

- ◆ Radio Mobility - deals with the signal handoff / handover process
- ◆ Network Mobility - deals with the mobile location management

2. Define PLMN (Public Land Mobile Network)

It is an integrated service digital cellular network providing wireless access for mobile subscribers to other network services.

3. What are the functions of Mobility Management System?

- ♣ Automatic Roaming
- ♣ Authentication
- ♣ Intersystem Handoff

4. What are the types of Mobile Registration?

1. Distance based registration
2. Geographic based registration
3. Parameter change registration
4. Periodic based registration
5. Power-down based registration
6. Power-up based registration
7. Timer based registration

5. What is meant by handoff / handover signal?

As the mobile moves from one cell area to another, an active cell must undergo a switch from one channel to another. This process is called as handover process.

6. What are the techniques used in handoff process?

- ◆ Mobile controlled Handoff (MCHO)
- ◆ Network Controlled Handoff (NCHO)
- ◆ Mobile Assisted Handoff (MAHO)

7. What are the types available in handoff technique?

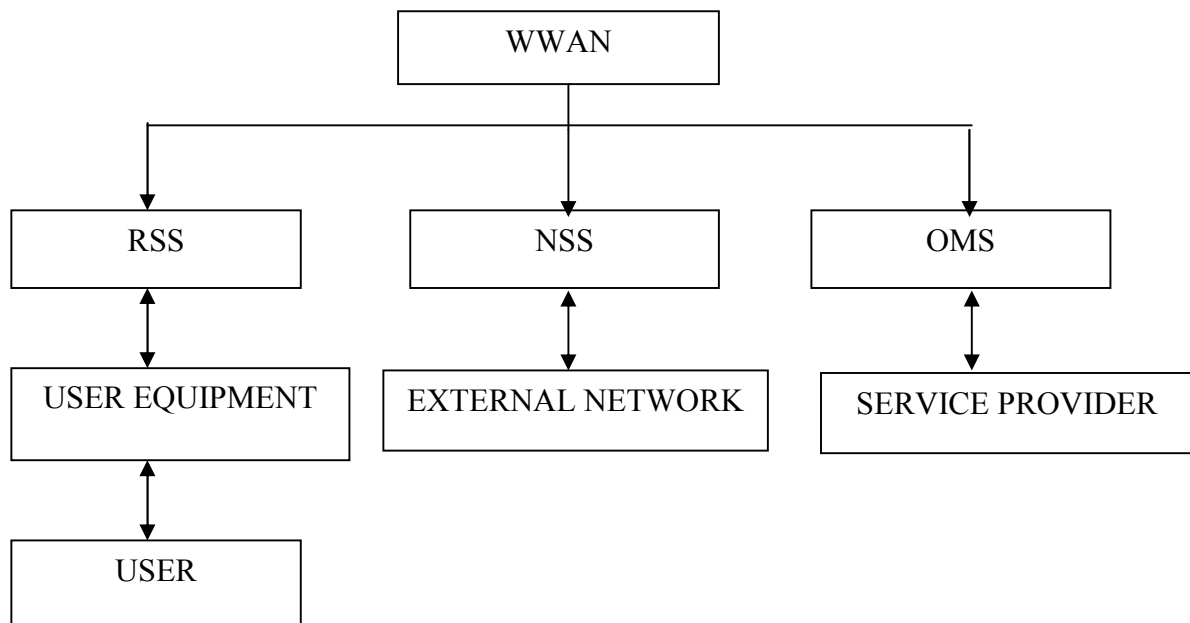
1. Hard Handoff
 - a. Inter Frequency
 - b. Intra Frequency
2. Soft Handoff
3. Softer Handoff

8. Mention some handoff Algorithms

- ♣ RSS (Radio Station Subsystem) Type
- ♣ RSS plus Threshold Type
- ♣ RSS plus Handoff Margin Type

Lecture #7 Wireless Wide Area Network (WWAN) & GSM**1. What are the three subsystems used in WWAN?**

- Radio Station Subsystem (RSS)
- Networking and Switching Subsystem (NSS)
- Operational and Maintenance Subsystem (OMS)

2. Draw the model of WWAN**3. What is the Expansion of the followings that are used in WWAN?**

1. IMSI - International Mobile Subscriber Identity
2. TMSI - Temporary Mobile Subscriber Identity
3. IMEI - International Mobile Subscriber Identity
4. SIM - Subscriber Identity Module
5. GSM - Global System for Mobile Communication

4. Mention the two types of channels in GSM

1. Physical Channel
2. Logical Channel
 - a. Traffic Channel
 - b. Control Channel
 - c. Cell Broadcast Channel

5. What are the three types of services provided by GSM?

- ♣ Bearer Services
- ♣ Tele Services
- ♣ Supplementary Services

6. What are the enhanced services provided by GSM?

- GPRS - General Packet Radio Service
- UMTS - Universal Mobile Telecommunication Service

Lecture #8 Bluetooth Technology

1. What is Bluetooth?

Bluetooth is the wireless technology that connects and transmits voice and data to mobile phones, computers and other devices and it work without cable

2. Why the technology is called Bluetooth?

The name of Bluetooth was getting from 10th century Danish King Harald Blatand who unified Denmark and Norway

3. What is the Expansion of the followings that are used in WWAN?

1. IMSI - International Mobile Subscriber Identity
2. TMSI - Temporary Mobile Subscriber Identity
3. IMEI - International Mobile Subscriber Identity
4. SIM - Subscriber Identity Module
5. GSM - Global System for Mobile Communication

4. What is the history of Bluetooth?

In 1994, Ericcson a Swedish company created the Bluetooth Technology

In 1998, five major companies IBM, Intel, Nokia, Toshiba and Ericsson worked together to connect their product using Bluetooth Special Interest Group (SIG).

5. What are the types of Bluetooth?

- ♣ Bluetooth Dongle
- ♣ Bluetooth Headset

6. What is Bluetooth Dongle?

Installing a Bluetooth dongle is easy; simply insert the CD that came with it, follow the on screen prompts and then plug the dongle into a free USB port.



7. What is Bluetooth Headset?

Bluetooth headsets are mainly used with compatible cell phones, place the headset on your ear and roam freely while talking to colleagues, friends and family.



8. Where we can use the Bluetooth technology?

We can use the Bluetooth in

Cars:

- Mobile Phones
- GPS navigation

Home:

- Remote Controls
- Game controllers

Medical and Health Devices:

- Stethoscopes
- Glucose Monitors

**9. What are the advantages of Bluetooth?****Wireless**

Bluetooth works without cable, it works with wireless.

Low energy consumption

Bluetooth uses low power signals. For that reason technology need little energy, and will use less battery.

Bluetooth Technology is inexpensive

Bluetooth is cheap to manufacture, and anyone can buy it.

Sharing voice and data

The Bluetooth allows to devices to share voice and data communications.

10. What are the disadvantages of Bluetooth?**Data Transfer Rate**

Bluetooth devices cannot be connected with more than one device at the same time, because it finds problem in discovering the another devices.

Range

Bluetooth has a range of 15 to 30 feet .The small range is a disadvantage for some who may want to use a Bluetooth device outside of that 30-foot radius.

Battery Use

Bluetooth uses the battery power of a particular device in order to operate. Many cell phone makers send phones out with Bluetooth powered off in order to maximize the battery life of the phone.

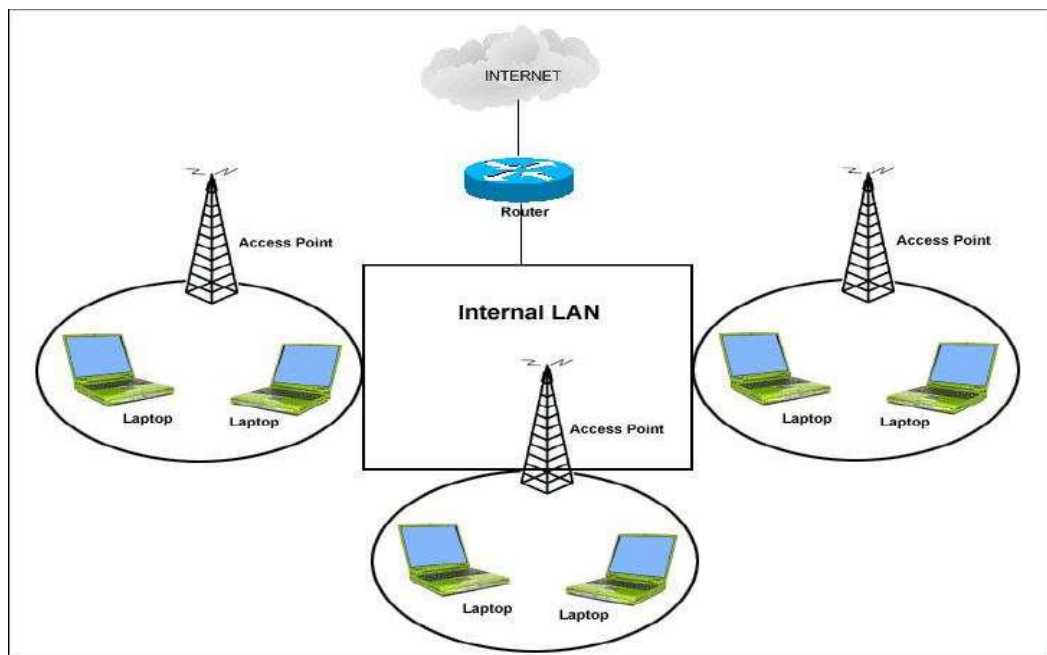
11.What are the goals of Bluetooth technology?

- Open Specification
- Voice and Data Capability
- Worldwide Usability
- Short-Range Wireless Solutions

Lecture #9 Wi-Fi Technology & IEEE**1. What is Wi-Fi?**

Wi-Fi (**W**ireless **F**idelity) is a wireless technology. Wi-Fi enabled computers send and receive data indoors and out; anywhere within the range of a base station.

Allows you to access the Internet while on the move; you can remain online while moving from one area to another, without a disconnection or loss in coverage.

2. Illustrate the sample Wi-Fi Connection?**3. What are the Wi-Fi Standards?**

Standard	Speed	Frequency bandwidth
802.11	2 Mbps	2.4 GHz
802.11a	54 Mbps	5 GHz
802.11b	11 Mbps	2.4 GHz
802.11g	54 Mbps	2.4 GHz

4. What is a Hotspot?

- A HotSpot is a geographic area that has a readily accessible wireless network.
- HotSpots are equipped with a Broadband Internet connection, and one or more Access Points that allow users to access the Internet wirelessly.
- HotSpots can be setup in any public location that can support an Internet connection

5. What are the places to install Wi-Fi?

Basically, any location which caters to business users and where people with laptops are likely to make frequent visits is an ideal choice to install Wi-Fi.

- ✓ Airports
- ✓ Hotels & Resorts
- ✓ Restaurants
- ✓ Coffee Shops
- ✓ Bookstores
- ✓ Shopping Malls

6. Who are the users of Wi-Fi?

- Frequent Travelers
- Businessmen and Corporate Managers
- Scientists & Doctors
- Students and Academicians
- Administrators & Technocrats who participate in Seminars & Conferences
- Just about anybody with a laptop

7. What are the components required for Wi-Fi?

- ♣ A PC, laptop or PDA, running Windows 98 or above
- ♣ A wireless PCMCIA / CENTRINO Card
- ♣ An Access Point
- ♣ A valid internet connection

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- Short-Range Wireless Solutions

12. Define IEEE and its Wireless Standards?

- In 1997, the **Institute of Electrical and Electronic Engineers (IEEE)** drafted the 802.11 standard for wireless local area networking.
- In 1999, networking hardware companies accepted the standard and began manufacturing products using the 802.11b protocol which operated in the 2.4 GHz range and was capable of transmitting at speeds of 11 Mbps.
- The 802.11a protocol was also released in 1999, operating at 5.8 GHz with transmissions speeds of 54 Mbps, but its cost was prohibitively high.

IEEE Wireless Standards

Wireless Standard	802.11b	802.11g	802.11a
Frequency Range	2.4 – 2.4835 GHz	2.4 – 2.4835 GHz	5.725 - 5.850 GHz
Max Speed	11 MBPS	54 MBPS	54 MBPS
Max Encryption	128 bit WEP	128 bit WEP	152 bit WEP / 256 bit AES
Discrete Channels	3	3	8
Natively Compatible	802.11b, 802.11g	802.11b, 802.11g	802.11a
Potential user	Entry level and home networks	Larger networks, small business	Large business concerned with security

Lecture #10 WiMax Technology

1. What is WiMax Stands for?

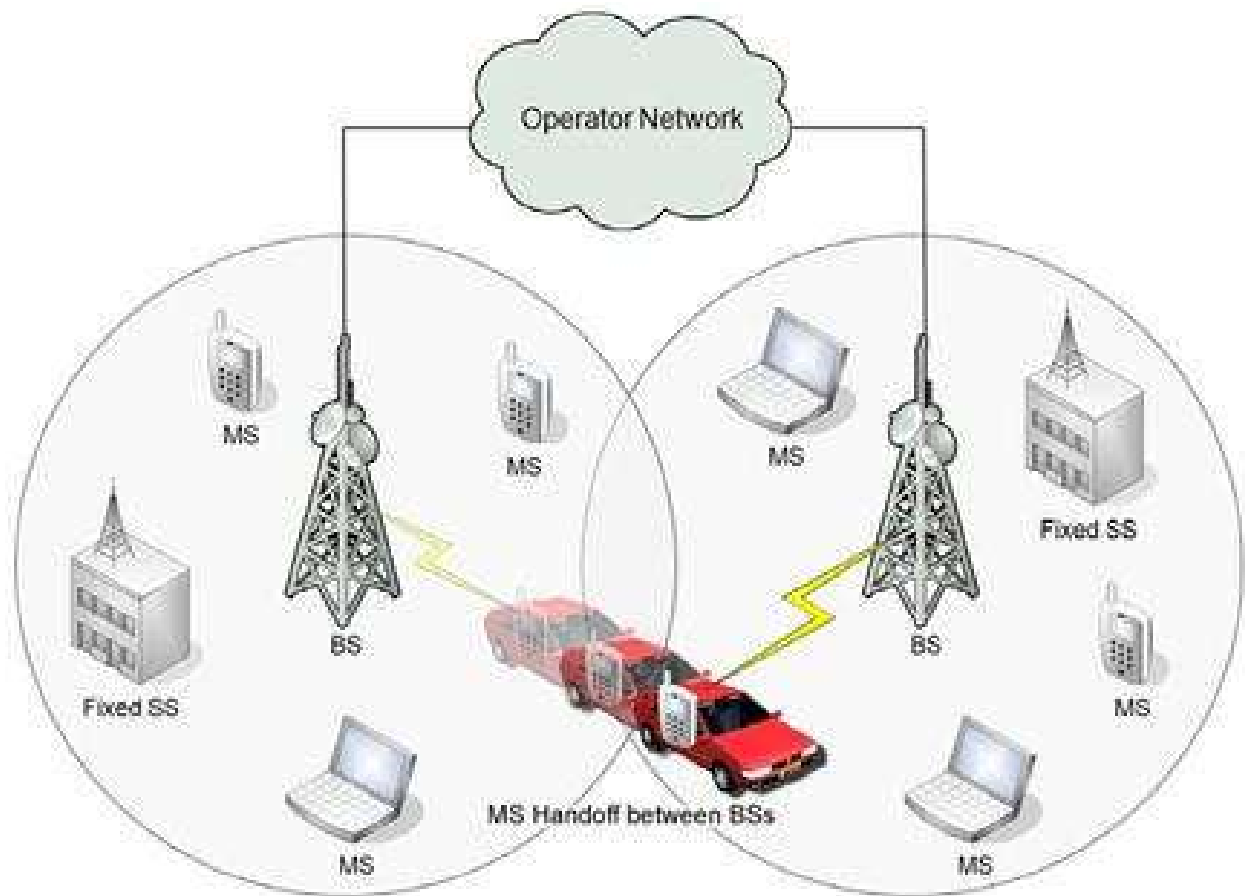
WIMAX stands for **Worldwide Interoperability for Microwave Access**

2. Define WiMax

WiMax refers to broadband wireless networks that are based on the IEEE 802.16 standard, which ensures compatibility and interoperability between broadband wireless access equipment

WiMax, which will have a range of up to 31 miles

3. Illustrate the fundamental concepts of WiMax



4. What are the components needed for WiMax?

- WiMax Tower
- WiMax Receiver

WiMax Tower



WiMax Receiver



5. What are the benefits of WiMax?

1. Speed

Faster than broadband service

2. Wireless

Not having to lay cables reduces cost

Easier to extend to suburban and rural areas

3. Broad Coverage

Much wider coverage than Wi-Fi hotspots

6. How WiMax works?

