Mobile Computing

General Wireless Networking and Related Concepts

Wireless Technology

- Wireless Communication
  - Transfer of Information over a Distance (both long and short) without the Use of Wires/Cables
  - Communication may be
    - One-Way
    - Two-Way
  - Examples: Cellular (Mobile) Telephones, Wi-Fi, TV Remote Control etc.

GSM

- GSM—Global System for Mobile Communication
- GSM Frequency Bands
  - 850 MHz/900 MHz/1800 MHz/ 1900MHz
  - Each Frequency Band Represents a Range of Frequencies e.g. 1800 MHz Represents 1710 to 1880 MHz)
- GSM Uses both FDMA (Frequency Division Multiple Access) and TDMA (Time Division Multiple Access)
- CDMA uses Code Division Multiple Access

GSM Cell Clusters

- Area to be covered is divided into radio zones or cells
- Each Cell has its own subset of frequencies assigned to respective mobile network
- Frequency reuse is done keeping in mind that interference does not occur.
- Automatic change of channels occur when moving from one cell to another.

GSM Cell Clusters

Handoff

- Cell
  - The area covered by a cellular base station
- Handoff / Handover
  - The transfer of control of an in-progress cellular phone call from one cell to another, without any discontinuity
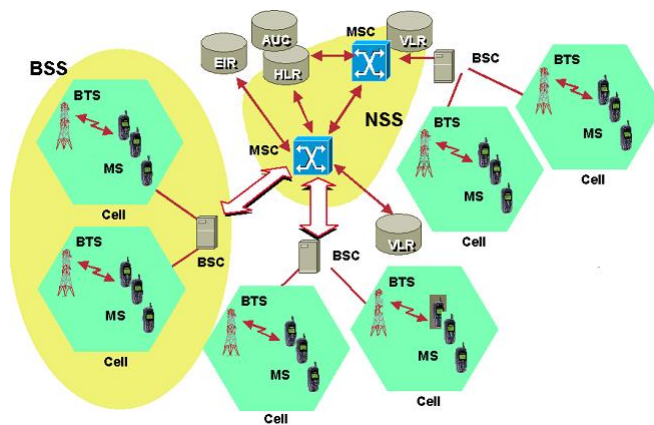
GSM Network Elements

- Mobile Station
- Base Transceiver Station
- Base Station Controller
- Mobile Switching Center
- Equipment Identity Register
- Home Location Register
- Authentication Center
- Visitor Location Register
- Network Switching Subsystem

GSM Network Elements

GSM Addresses and Identifiers

- IMEI—International Mobile Station Equipment Identity.
- IMSI—International Mobile Subscriber Identity.
- Mobile Subscriber ISDN Number (MSISDN)

Short Message Service (SMS)

- SMS enables sending and receiving text messages to and from mobile handsets.
- SMSC (SMS Center or Service Center) is responsible for handling SMS operations of a wireless network

Characteristics of SMS

- Session less
- Asynchronous
- Always Connected

SMS Concepts

- Types of SMS
  - SMMT (Short Message Mobile Terminated)
    - SMSC→MS
  - SMMO (Short Message Mobile Originated)
    - MS→SMSC
- Store and Forward at SMSC (SMS Center) or SC (Service Center)
- Subscriber Messages Delivery
  - Step 1: MS→SMSC [MO Message]
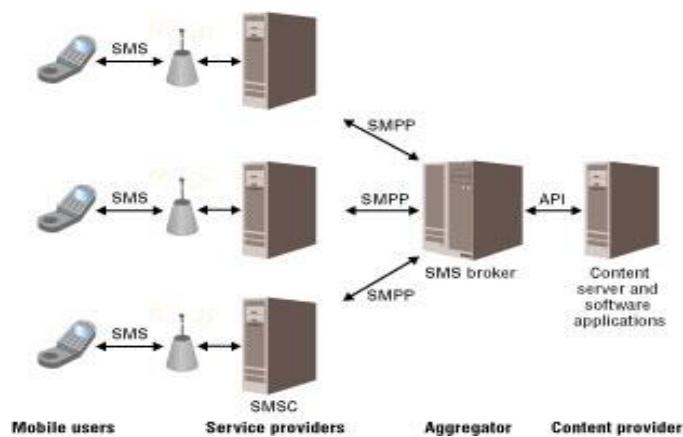 - Step 2: SMSC→MS [MT Message]

SMS Concepts

- SMS Pull
- SMS Push (or Alerts or Notifications)
- SMS Center (SMSC or SC)
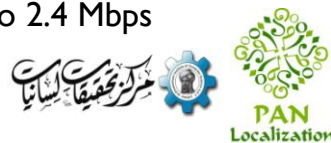- Short Message Peer-to-Peer (SMPP)

SMS and SMPP

Multimedia Messaging Service (MMS)

- MMS Enables Mobile Subscribers to Exchange Multimedia Messages with Each Other
- Multimedia Messages Contain
  - Formatted Text, Graphics, Animations , Images, Audio, Video
- Require Data Channel like GPRS, EDGE
- Messages are Relayed Through Multimedia Messaging Service Center (MMSC)

Data Communications

- GPRS (General Packet Radio Service)
  ◦ Provides Data Communication on GSM Network
  ◦ Data Rate: Upto 115 Kbps
- EDGE (Enhanced Data Rates for GSM Evolution)
  ◦ Also Called Enhanced GPRS
  ◦ Data Rate: Upto 384 Kbps
- UMTS (Universal Mobile Telecommunication System)
  ◦ Data Rate: Upto 2 Mbps
- CDMA2000/EVDO (Evolution Data Optimized)
  ◦ Provides Data Communication on CDMA Networks
  ◦ CDMA2000 Data Rate: Upto 2.4 Mbps

Generations of Wireless Networks

- Various Generations of Wireless Networks
  - 1G, 2G, 3G, 4G
- Major Difference is of Data Services.
- Data Services have been Enhanced while Moving from 1G to 2G, 3G and then to 4G

Generations of Wireless Networks

- Various Generations of Wireless Networks
  - 1G, 2G, 3G, 4G
- Major Difference is of Data Services.
- Data Services have been Enhanced while Moving from 1G to 2G, 3G and then to 4G

USSD

- Unstructured Supplementary Service Data (USSD)
- USSD is used for High Speed Communication between Subscribers and Applications on a GSM Network
- Primarily Used to Send Text between a User (Mobile Station) and an Application on Mobile Network
- Session Oriented
- Does Not Require Users to have High-End Handsets
- Allows Users to Quickly Access Information/Services (in the form of Menu as well) from Network Operator
  - User Messages Formats are Composed of #,* and digits
  - A User may Dial *#1234# from the Handset to Access a Specific USSD Service

USSD

- A USSD Message Request from User Travels as Follows
  - Mobile Station → Mobile Network → USSD Gateway → External Applications
- USSD Modes
  - Pull Mode: Mobile Initiated USSD Requests
  - Push Mode: Network Initiated USSD Requests
- Applications
  - Balance Inquiry e.g. *100#
  - Recharge Request
  - Balance Transfer
  - Purchase or Cancel some Services like SMS Bundles
  - Request for Weather Forecast, Sports Information etc.

Bluetooth

- Bluetooth technology allows to make ad hoc wireless connections between devices like mobile phones, desktop, laptops.
- Speed: around 720 Kbps (Maximum 1Mbps)
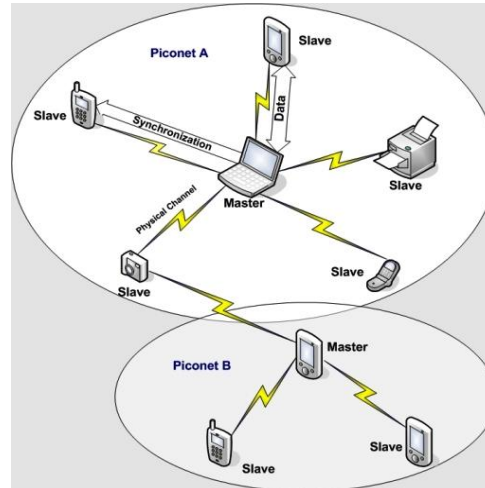- Range: around 50 meters (Maximum 100 meters)

Bluetooth Wireless Network

- Master/Slave Model
- Piconet
  - 1 Master and 1 or More Slaves Form Piconet
  - Piconet has 3-bit Address Space
- Scatternet
  - Multiple Piconets Interact with each other

Bluetooth Wireless Network

http://www.techrepublic.com/

Bluetooth Applications

- File Transfer
- Internet Bridge
- LAN Access
- Synchronization
- Headset

WiMAX

- WiMAX (Worldwide Interoperability for Microwave Access) is Wireless Broadband
- Some New Mobile Devices are Coming in the Market that Support WiMAX
- Huge Data Bandwidth is Made Available by WiMAX.
- Wireless Alternative to DSL
- Also Enables VoIP Services

RFID

- Radio Frequency Identification
  - RFID is a radio device carrying an ID (identification) that can be read through radio frequency interface
- RFID Components
  - Transponder Tags
    - Each Tag has a Unique Identification Number
    - Tags are Attached to Different Objects like a Product, Identification Card etc.
  - Reader
    - Collects Information from Tags and Delivers it to Backend System

RFID Applications

- Manufacturing
- Security
- Animal Tagging
- Time and Attendance
- Postal, Consumer Products Tracking
- Transportation
- Payments

Push-To-Talk (PTT)

- Also Known as Push-to-Talk over Cellular (PoC)
- One Party Can Talk at One Moment
- Voice over IP Technology over GSM/GPRS
- A Method of Direct Voice Communication
- Works on Half-Duplex Communication Channel

Push-To-Talk (PTT)

- Modes of Communication
  - Reception Mode Or
  - Transmission Mode
- Advantages
  - PTT Uses Network Resources Efficiently
  - Allows Quick Calls to Groups of People with Single PTT Group Call
  - Cost Effective?
- Example Applications
  - Broadcast Messages to Field Workers

Mobile Virtual Network Operator

- Mobile Network Operator (MNO) vs. Mobile Virtual Network Operator (MVNO)
- MVNOs Provide Mobile Phone Services but Neither have their Own License Nor have their Own Telecom Infrastructure
- MVNOs Build on Infrastructure of MNOs
- MVNOs directly Communicate with Customers/End Users.
- MVNOs Manage (among others)
  - Customer Services
  - Billing
  - Marketing
  - SIM Cards

Accelerometer

- An Accelerometer Measures Acceleration of a Device
- Forces Causing Acceleration Include Gravity, Movement, Vibration etc.
- Applications
  - Orientation (e.g. Tilt) Sensing for Switching Between Landscape and Portrait Modes: Apple IPhone, Blackberry Storm, Android Phones, N95.
    - Used in Software Applications like Auto Image Rotation.
  - Other Uses Include Vehicle Collision Detection, Laptop Drop Detection etc.

Frequently Used Terms

- Subscriber
  - A User who Pays Subscription Charges for using a Mobile Communication System.
- Value Added Services (VAS)
  - All Services Beyond Standard Voice Call Services.
- Carrier/Operator/Network Operator
  - A Company that Provides Telephonic Communications Services.

Frequently Used Terms

- Voice over IP (VoIP)
  - The Routing of Voice Conversations over the Internet or Through any other IP-based Network
- Bandwidth
  - Range (or Band) of Frequencies that are Transmitted on a Channel
- Transceiver
  - A Device Capable of Simultaneously Transmitting and Receiving Radio Signals

Frequently Used Terms

- Channel
  - An Individual Communication Path that Carries Signals at a Specific Frequency
- Forward Channel
  - Radio Channel Used for Transmission of Information from Base Station to Mobile Station
- Reverse Channel
  - Radio Channel Used for Transmission of Information from Mobile Station to Base Station