KENYATTA UNIVERSITY

BACHELOR OF SCIENCE IN COMPUTER SCIENCE

FOURTH YEAR SEMESTER I

SCO 301: MOBILE COMPUTING & WIRELESS TECHNOLOGY. CAT 2.

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Question 1:

a) Discuss LEO, MEO and GEO satellite system.

Low Earth Orbit (LEO)

LEO is an orbit around Earth with an altitude between 160 kilometres (99 mi), with an orbital period of about 88 minutes, and 2,000 kilometres (1,200 mi), with an orbital period of about 127 minutes. LEO satellite system used in telecommunications and provide the ability for underdeveloped territories to acquire satellite telephone service in areas where it is either too costly or not geographically possible to lay land lines. LEOs are also used for data communication such as e-mail, paging and videoconferencing.

Medium Earth Orbit (MEO)/ intermediate circular orbit (ICO)

MEO is the region of space around the Earth above low Earth orbit (altitude of 2,000 kilometres (1,243 mi)) and below geostationary orbit (altitude of 35,786 kilometres (22,236 mi)). The most common use for satellites in this region is for navigation, communication, and geodetic/space environment science. The most common altitude is approximately 20,200 kilometres (12,552 mi)), which yields an orbital period of 12 hours, as used, for example, by the Global Positioning System(GPS). They have a larger capacity than LEOs. This enables them more flexibility in satisfying shifting market demands for voice or data services. A fleet of several MEO satellites, with orbits properly coordinated, can provide global wireless communication coverage. Because MEO satellites are closer to the earth than geostationary satellites, earth-based transmitters with relatively low power and modest-sized antennas can access the system.

Geostationary Earth Orbit (GEO)

GEO is an orbit whose position in the sky remains the same for a stationary observer on earth. This effect is achieved with a circular orbit 35,786 kilometres (22,236 mi) above the Earth's equator and following the direction of the Earth's rotation. An object in such an orbit has an orbital period equal to the Earth's rotational period and thus appears motionless at a fixed position in the sky to ground observers. Communications satellites and weather satellites are often placed in geostationary orbits, so that the satellite antennas which communicate with them do not have to rotate to track them, but can be pointed permanently at the position in the sky where they stay.

b) Explain the following terms and for each case gives it use.

Frequency Reuse: Frequency reuse is the practice of splitting an area into smaller regions that do not overlap so that each utilizes the full range of frequencies without interference. The elements that determine frequency reuse are the reuse distance and the reuse factor.

Roaming: Roaming helps ensure that a traveling wireless device (typically a cell phone) is kept connected to a network without breaking the connection. the ability for a cellular customer to automatically make and receive voice calls, send and receive data, or access other services, including home data services, when travelling outside the geographical coverage area of the home network, by means of using a visited network.

Question 2:

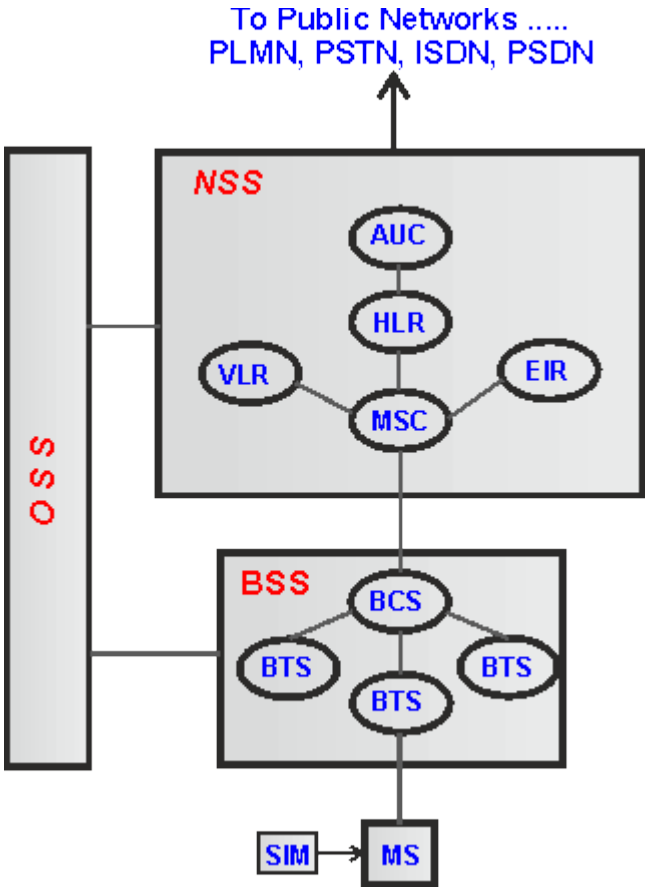
GSM System Architecture

The GSM network architecture as defined in the GSM specifications can be grouped into three main areas:

Base Station Subsystem (BSS) – performs all radio-related functions and consists of base station controllers (BSCs) and the base transceiver stations (BTSs).

BSC - The BSC provides all the control functions and physical links between the MSC and BTS. It is a high-capacity switch that provides functions such as handover, cell configuration data, and control of radio frequency (RF) power levels in base transceiver stations.

BTS - The BTS handles the radio interface to the mobile station. The BTS is the radio equipment (transceivers and antennas) needed to service each cell in the network.



Network and Switching Subsystem (NSS) - responsible for performing call processing and subscriber-related functions. The switching system includes the following functional units.

Home Location Register (HLR) - The HLR is a database used for storage and management of subscriptions e.g. permanent data about subscribers, including a subscriber's service profile, location information, and activity status.

Mobile Services Switching Centre (MSC) - performs the telephony switching functions of the system. It controls calls to and from other telephone and data systems. It also performs such functions as toll ticketing, network interfacing, common channel signalling, and others.

Visitor Location Register (VLR) - The VLR is a database that contains temporary information about subscribers that is needed by the MSC in order to service visiting subscribers.

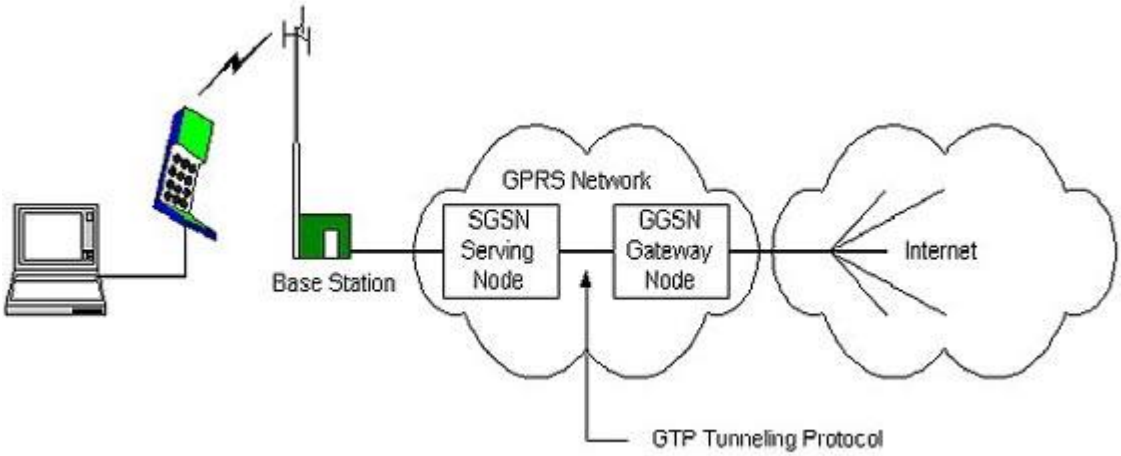
Authentication Centre (AUC) - provides authentication and encryption parameters that verify the user's identity and ensure the confidentiality of each call.

Equipment Identity Register (EIR) - Is a database that contains information about the identity of mobile equipment that prevents calls from stolen, unauthorized, or defective mobile stations.

Operation and Support Subsystem (OSS) - OSS is the functional entity from which the network operator monitors and controls the system

a) i. GPRS (General Packet Radio System) Work Diagram

Packet Control Unit (PCU) separates the circuit switched and packet switched traffic from the users and sends them to GSM and GPRS users respectively. Serving GPRS Support Node (SGSN) is equivalent to MSC in GSM. It routes data to relevant GGSN when connecting to external networks. Gateway GPRS Support Node (GGSN) is a gateway to external networks. It routes mobile packets from external networks to relevant SGSN. It also allocates both static and dynamic IP addresses to mobile devices. Domain Name Server (DNS) converts IP names into addresses. Charging Gateway (CG) bills subscribers for data transactions and Firewalls protects the IP network against external attacks



ii. Operating frequencies for GSM

GSM networks operate in a number of different carrier frequency ranges i.e.

- GSM-900 operating in 900MHZ
- GSM-850 operating between 824 MHZ and 849MHZ
- GSM-1800 operating between 1710 MHZ and 1785MHZ
- GSM-1900 operating between 1850 MHZ and 1910MHZ
- GSM-450 operating between (450 MHZ and 457MHZ.

iii. How does GPRS architecture differs from GSM?

- In GPRS multiple timeslots are allocated to one UE while in GSM one timeslot is allocated to one UE.
- GSM is used for circuit switched traffic (mainly voice) and GPRS is used for packet switched traffic (mainly internet/MMS). Due to this in GPRS PDTCH (Packet Data Traffic Channel) is allocated on demand unlike static nature of TCH in GSM.
- In GSM location area concept is used while in GPRS routing area concept is used.
- In GSM Mobile or UE will be in two states i.e. IDLE and READY while in GPRS UE will be in three states i.e. IDLE, STANDBY and READY.

Question 3:

Compare Ad hoc networks and other networks. What advantages do Ad hoc network offer.

Explain in details by giving suitable example.

Ad hoc networks refers to any set of networks where all devices have equal status on a network and are free to associate with any other ad hoc network device in link range.

Ad hoc networks has no base station and involves two or more wirelessly communicating devices. Such devices support peer-to-peer communication such that each device can act as a router. Unlike other wired networks, ad hoc networks are autonomous, they are infrastructure-less and they don't depend on other networks.

Unlike the Wireless LANs, ad hoc networks have no access point and multi hop routing, since there is no router is used as each device can act as a router.

Ad hoc networks uses multi hop routing, since there is no router used in these networks each device acts as a router to route information to the next device. Furthermore, unlike in wired networks, devices in ad hoc networks depends on portable power source. They use battery which does not guarantee constant power supply hence energy efficiency is a problem in ad hoc networks.

Example of ad hoc network is Bluetooth (IEEE 802. 15)

Advantages of ad hoc networks

- Mobility allows ad hoc networks created on the fly in any situation where there are multiple wireless devices.
- Flexibility is enhanced in ad hoc networks since they can be temporarily setup at any time, in any place.

- The nodes in ad hoc network need not rely on any hardware and software. So, it can be connected and communicated quickly.
- Scalability incorporates the addition of more nodes.
- Lower getting started costs due to decentralized administration.

Question 4:

Compare and contrast the delivery mechanisms used by SMS and MMS. Describe each, and give details about how MMS messages are sent to legacy (non MMS capable) devices.

Short message service (SMS)

Short message service is a mechanism of delivery of short messages over the mobile networks. It is a store and forward way of transmitting messages to and from mobiles. Each short message can be no longer than 160 characters. The message (text only) from the sending mobile is stored in a central short message centre (SMS) which then forwards it to the destination mobile.

When a Mobile Station sends an SMS, it goes to the Serving MSC (SMSC). If the MSC is not the anchor MSC, the message is relayed by an SMS_DELIVERY_BACKWARD message notice to the anchor MSC. The final anchor MSC forwards the SMS to the Mobile Centre (MC) with an SMS_DELIVERY_POINT_TO_POINT message. The anchor MSC analyses the SMS original destination address and identifies the destination message centre from Home Location Register (HLR). The SMS reaches the SMSC through the Signalling System No.7 (SS7).

Multimedia Messaging Service (MMS)

Multimedia Messaging Service (MMS) that allows a combination of text, sounds, images and video. MMS will support pictures and interactive video. MMS uses standardized protocols like WAP, MExE and SMTP. The MMS content is encoded using Multi-purpose Internet Email Extension (MIME) format. The content is send to recipient's carrier MMS database, or MMS relay/server. The MMSC determines if the recipient's device is MMS capable. The content is extracted and sent to temporary HTTP enabled store. MMSC sends an SMS text with the contents' URL. The recipient's browser opens and receives the message from the URL.

Generally, when MMS sent to legacy or Non MMS capable devices; the MMS content is sent to a web service and the URL is forwarded to the recipient as a standard SMS text.

Question 5

Speculate on how RFID sensors could be used to transform a mobile device into a self-pay Point-of-sales device? How could a store differentiate between legitimate purchases and Shop lifted goods?

Radio Frequency Identification (RFID) is a means of identifying and tracking an RFID tag remotely through the use of an RFID scanner. The range of this tracking can depend on whether or not the RFID tag is powered, but typically, passive tags have a short range and work by becoming powered when passing near a scanner. They can be detected by "exit gates" when a live tag is carried out of a shop, thus creating an alarm; other systems rely on knowing whether a unique tag corresponds to a "purchased" or non-purchased" product.

RFID scanners can be integrated into mobile devices and could identify a product and present it as a possible sale item to the user through an application. The user could then choose to buy the item, resulting in a transaction with the store itself, and the resulting receipt being returned to the user. Self Pay systems such as those being introduced by Apple in their stores are based on an approach similar to this. Once the purchase has been made the item corresponding to the RFID tag can be flagged as purchased, thus disarming the security system when the purchaser leaves the shop.

Question 6:

a) ***Why are physical keyboards undesirable on a mobile device, and yet still preferred over the use of handwriting and character recognition. In your answer, consider the demands that different solutions place on the design of the device itself, as well as how these factors are affected by the international market. Include a contrary example where character recognition may be preferable for some international markets, and justify your argument.***

Although physical keyboards limits portability of the mobile device, physical keyboards sill remain preferred to handwriting and facial recognition since they are not prone to typing mistakes. Physical keyboards also does not require separate tools such as stylus pen therefore does not incur additional costs. Furthermore, physical keyboards increases productivity since the user spends little time hitting buttons and error rate is minimised. Again, unlike character recognition technique, physical keyboards provide much security and a tactile feel i.e. a feel of a key being pressed. This gives the user confidence that a character is being typed.

On several occasions, *character recognition* is preferred for the following reasons:

This technology involves techniques such as image enhancement, local adaptive binarization and blob colouring to extract character region and remove the noise of captured images. Camera based character recognition system can be implemented for mobile devices such as PDA and cellular phones with cameras. Character recognition functions have been preferable especially where mobile telecommunication devices have no real number computing functions and have limitation of memory space.

b) ***The use of virtual keyboards has long been used as an alternative metaphor for entering text, yet until recently have mainly required the use of a stylus, thus limiting the type of touchscreen that could be used to resistance-based. Describe the challenges of using a virtual keyboard, and explain how techniques borrowed from SMS entry have facilitated the adoption of capacitance-based touch screens.***

Several challenges associated with the use of virtual keyboard include;

- Touchscreens and virtual keyboard can become dirty due to scratches hence making the device's screen difficult to see.
- Virtual keyboards have ergonomic problems. The device must be positioned at an angle to keep the wrists in proper typing position. The user looks directly in the screen and this can cause neck injury and fatigue.
- The user is unable to rest fingers on a virtual keyboard. Resting ones finger a virtual keyboard is can result to inputting a character. Therefore the finger always have to be in the "air" hovering above the keyboard, which is very tiresome.
- Virtual keyboards does not provide a tactile feel, the feel of keyboard keys pushing down.
- Full QWERTY virtual keyboards uses a lot of screen hence they hide the document being typed. This makes proofreading difficult because only a part of the document is visible to the user.
- In a virtual keyboard, the user have to scan the keyboard from time to time to make sure fingers are on the right keys. This problem would not have be so bad if the user can rest his/her finger on the keyboard when not typing to avoid losing the position.

Adoption of capacitance-based touch screens have borrowed from SMS entry since touchscreens are designed with an imitation of the physical keyboard. A QWERTY keyboard design allows faster input of characters, a technique that is borrowed by capacitive touchscreens.

Question 7:

Explain how you can implement VAS give a suitable example stating all possible configuration.

Value Added Service (VAS) is used to refer to options that complement a core service offering from a company but are not as vital, necessary or important. Value added services are often introduced to customers after they have purchased the core services around which these ancillary offerings are built.

Example: The nature of audio teleconferencing services

The core service provided with an audio conference call is the ability for multiple attendees to participate in a single telephone conference. Several non-core services also can be offered to complement the basic conference call, enhancing the desirability of the core service. With audio conferencing, value added services such as an operator-conducted question-and-answer session, polling services and the ability for the moderator of the meeting to initiate a sub-conference with specific attendees are routinely offered. Other non-core services such as transcriptions, on-demand dial-in formats and audio recordings also help entice customers to sign up with a particular conference call provider. From this perspective, value added services can be viewed as ways to attract and hold onto clients in a very competitive industry.

Question 8:

i) ***What is J2ME***

J2ME (Java 2 Platform, Micro Edition) is a technology that allows programmers to use the Java programming language and related tools to develop programs for mobile wireless information devices such as cellular phones and personal digital assistants (PDAs).

ii) ***Explain how J2ME (Java 2 Micro Edition) work.***

The latest Java-enabled mobile devices, you can view a list of applications, games, and services and choose which one interests you. The application is then sent over the air to your handset, where it is installed and instantly available to use. You are no longer limited to the small selection of games and applications that came with your phone. And with new content being released daily from top entertainment and software companies, you can always find new, fun applications to download.

J2ME defines two configurations, the *Connected Limited Device Configuration* (CLDC) and the *Connected Device Configuration* (CDC).

iii) ***Explain the reasons for the following***

a) *Many handset devices particularly cells, don't have a direct connection to the internet and therefore almost certainly don't support sockets*

Web Sockets do not work over cellular network as they are not forwarded by the http proxy.

A possible solution is to set the Web Socket server port to 443 (https) which forwards everything (as https is encrypted, the proxy has to forward it in order to support https).

This requires the use of two http servers that include serving you mobile application (on port 80) and serving the web sockets on (port 443)

b) *The MIDP user interface components don't provide any support for displaying HTML, so that there no built in browser capability in a MIDP device*.

Mobile Information Device Profile (MIDP) applications have to be written in MIDP Java, which usually does not support HTML and Personal Java (PJava) applications.

Question 9:

Most government institutions use ad hoc network .Discuss challenges associated with this type of network. Suggest suitable frames work that government should adopt.

Since ad hoc networks do not assume the availability of a fixed infrastructure, it follows that individual nodes may have to rely on portable, limited power sources. The idea of energy-efficiency therefore becomes an important problem in ad hoc networks.

Scalability is one of the most important open problems. Scalability in ad hoc networks can be broadly defined as whether the network is able to provide an acceptable level of service to packets even.in the presence of a large number of nodes in the network.

Lack of well-defined and widely accepted models for RF path attenuation, mobility, and traffic. These tightly interrelated models are needed for quantifying and comparing ad hoc system performance to a common baseline.