MODEL ANSWER

SUMMER – 2018 EXAMINATION

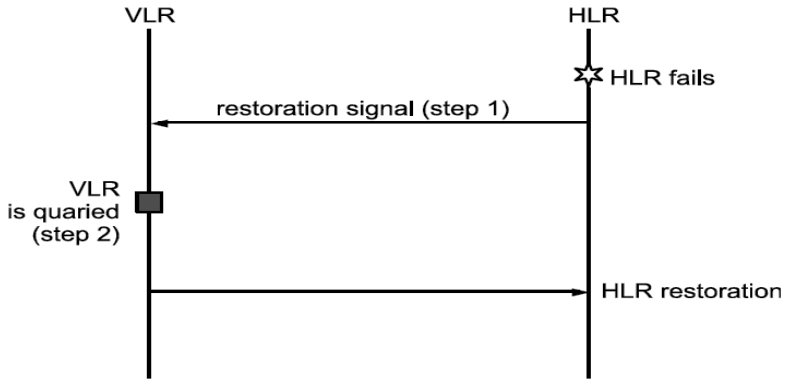
Subject: Mobile Computing **Subject Code:** **17632**

Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills).
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q. No.	Sub Q.N.	Answer	Marking Scheme
1.	**(A)**	**Answer any THREE of the following:**	**12**
	(a)	**List four mobile computing devices and state the function of two mobile computing devices.**	**4M**
	Ans.	**List of devices:** 1. Laptop (notebook computer or notepad) 2. Mobile phone 3. Personal Digital Assistant 4. Pager/Beeper 5. Sensor and Embedded Controller 6. GPS Navigation device	***Any four devices ½ M each***
		Functions:- 1. Laptop (notebook computer or notepad)- A laptop has an all-in-one design, with a built-in monitor, keyboard, touchpad (which replaces the mouse), and speakers. This means it is fully functional, even when no peripherals are connected. 2. Mobile phone-Sending text messages, Sending/receiving phone	***1M for function of each device***

		calls, Internet browsing, Time , Calculator For only smart phones, Various social networks , Various Google apps, Mobile banking, Weather, Alternative talk and text apps. 3. Personal Digital Assistant-Short for personal digital assistant, a handheld device that combines computing, telephone/fax, Internet and networking features. A typical PDA can function as a cellular phone, fax sender, Web browser and personal organizer. PDAs may also be referred to as a palmtop, hand-held computer or pocket computer. 4. Pager/Beeper-Unlike mobile phones, most one-way pagers do not display any information about whether a signal is being received or about the strength of the received signal. Since one-way pagers do not contain transmitters, one-way paging networks have no way to track whether a message has been successfully delivered to a pager.	
	(b) Ans.	**State four features of GSM.** **The features of GSM are:** **1. Call Waiting** - Notification of an incoming call while on the handset **2. Call Hold**- Put a caller on hold to take another call **3. Call Barring** - All calls, outgoing calls, or incoming calls **4. Call Forwarding**- Calls can be sent to various numbers defined by the user **5. Multi Party Call Conferencing**- Link multiple calls together **6. Calling Line ID** - incoming telephone number displayed **7. Alternate Line Service** a. One for personal calls b. One for business calls **8. Closed User Group** - call by dialing last for numbers **9. Advice of Charge** - Tally of actual costs of phone calls **10. Fax & Data** - Virtual Office / Professional Office **11. Roaming:** services and features can follow customer from market to market.	**4M** ***Any 4 features 1M each***
	(c) Ans.	**Describe the stepwise procedure for HLR Restoration.** **HLR Failure Restoration:** In GSM HLR, it is compulsory to save the update into non-volatile storage. Changes of service information are backup immediately after every update and the location information is periodically transferred	**4M**

		from HLR into backup. The service information is update infrequently because not all the subscriber changes their service profile after subscription. After HLR failure, the data in the backup are reloaded into the HLR. We also have "uncovered period" as a time interval after last backup operation and before the restart of the HLR data that changed in the uncover period cannot be recovered. The following HLR restoration procedure is executed. **Step 1:** The HLR sends an signaling system 7 (SS7) TCAP (Transaction Capability Application Part) message. MAP_RESET to the all VLRs where its MSs are located (that is restoration signal). **Step 2:** Each VLR that receives the restoration signal from HLR is queried to search the lost location information of user. **Step 3:** All the VLRs derived all MSs of the HLR, and for each MS, they send an SS7 TCAP message, MAP_UPDATE LOCATION, to the HLR.  **HLR restoration**	***Relevant procedure 4M***
	(d) **Ans.**	**List four component of information security. State the features of each.** Information security is an art of keeping the message secret i.e. to encrypt and hide it from others getting to know it. The components are: (CIANATA) 1. Confidentiality 2. Integrity 3. Availability 4. Non-repudiation	**4M** ***Any 4 features 1M each***

		5. Authorization 6. Trust 7. Accounting **1. Confidentiality:** It is the property where the information is kept secret so that unauthorized persons cannot get at the information. It is ensured through Encryption of data. **2. Integrity:** Integrity is achieved by adding additional information into a message. It is done though checksums, message digests or digital signature. The receiver of the message checks this extra information to verify whether the message has been tampered. **3. Authentication:** It is a process by which we validate the identity of the parties involved in a transaction. **4. Non-repudiation:** In non-repudiation, we identify these parties beyond any point of doubt. Non repudiation does not allow the sender of the message to refute the claim of not sending that message. **5. Availability:** Media Management is part of the larger security framework. It is essential to ensure availability of service. **6. Trust:** Trust involves developing a security policy, assigning credentials to entities, verifying that the credentials fulfill the policies. **7. Accounting:** It is the process by which usage of service is metered. Based on the usage, the services provider collects the fees either directly from the customer or through home network. This will be true even if the user is roaming in a foreign network and using the services in a foreign network.	
1.	**(B)**	**Answer any ONE of the following:**	**06**
	(a)	**Describe the stepwise procedure for GSM location update under the case inter LA movement with neat diagram.**	**6M**
	Ans.	**GSM Location Update**: The location update procedure allows a mobile device to inform the cellular network, whenever it moves from one location area to the next. Mobiles are responsible for detecting location area codes. When a mobile finds that the location area code is different from its last update, it performs another update by sending to the network, a location update request, together with its previous location, and it's Temporary Mobile Subscriber Identity (TMSI) In order to make a mobile terminated call, The GSM network should know the location of the MS (Mobile Station), despite of its movement. For this purpose the MS periodically reports its location	***Location Update Procedure 4M***

to the network using the Location Update procedure.

Location Area (LA):
A GSM network is divided into cells. A group of cells is considered a location area. A mobile phone in motion keeps the network informed about changes in the location area. If the mobile moves from a cell in one location area to a cell in another location area, the mobile phone should perform a location area update to inform the network about the exact location of the mobile phone.
The Location Update procedure is performed:

- The MS moves from LA1 to LA2, where both LAs are connected to the same MSC

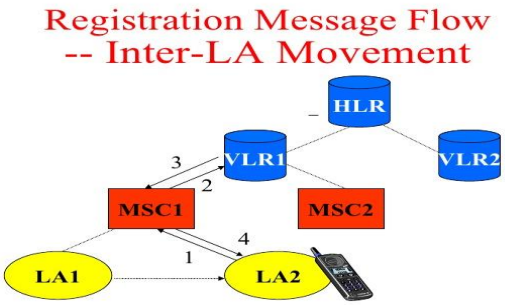


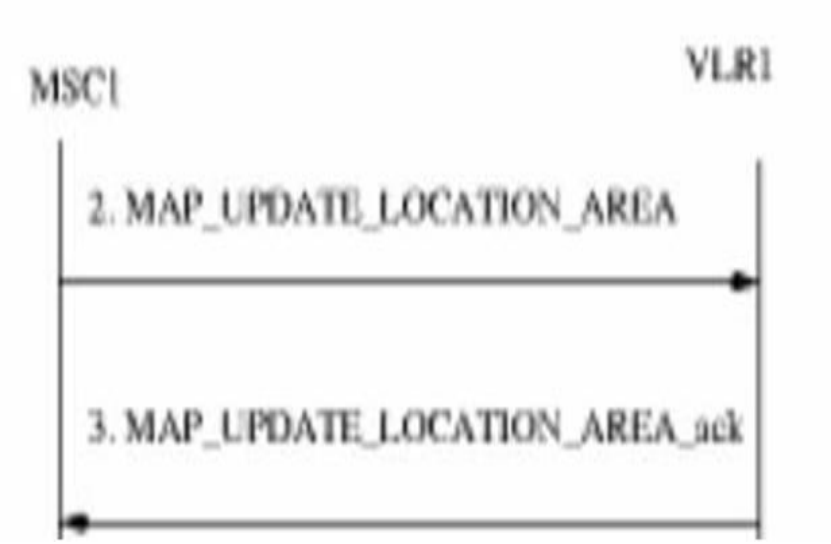
Diagram 2M

Step 1:
A location update request message is sent from the MS to the MSC through the BTS, include the address of the previously visited LA, MSC, and VLR.
In this, the addresses of previous MSC & VLR are same as those for the new MSC & VLR.
TMSI is used to avoid sending the IMSI on the radio path.
TMSI is temporary mobile subscriber identity of the MS.
This temporary identity is allocated to an MS by the VLR at inter VLR registration, and can be changed by VLR after every call setup
Step 2:
The MSC forwards the location update request to
the VLR by a TCAP message,
MAP_UPDATE_LOCATION_AREA
The message includes:

- Address of the MSC

- TMSI of the MS
- Previous location area identification (LAI)
- Target LAI

Step 3 and Step 4:
MSC updates the LAI field of the VLR record, and replies with an acknowledgment to the MS through the MSC



(b) **Draw the neat diagram of Life Cycle of Android activity and explain.** **6M**

Ans. As an activity transitions from state to state, it is notified of the change by calls to the following protected methods:

onCreate()	This is the first callback and called when the activity is first created.
onStart()	This callback is called when the activity becomes visible to the user.
onResume()	This is called when the user starts interacting with the application.
onPause()	The paused activity does not receive user input and cannot execute any code and called when the current activity is being paused and the previous activity is being resumed.
onStop()	This callback is called when the activity is no longer visible.
onDestroy()	This callback is called before the activity is

Explanation 2M

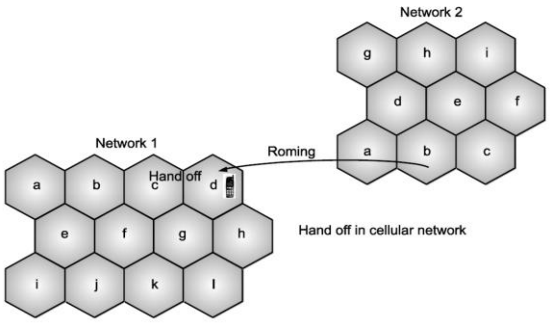
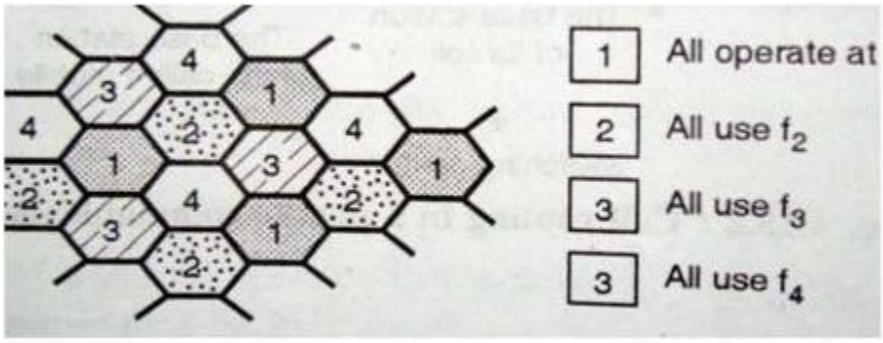
	destroyed by the system.
onRestart()	This callback is called when the activity restarts after stopping it.

Taken together, these seven methods define the entire lifecycle of an activity.

Android Activity Life Cycle

Diagram 4M

2.		**Answer any FOUR of the following:**	**16**
	(a)	**With neat diagram describe the handoff strategies. State the types of handoffs.**	**4M**
	Ans.	When a user is moving from one cell to another cell, while the call is in progress, is called as handoff. While performing handoff, mobile station acquires a channel from one base station, how mobile station moves from one cell to another cell, how mobile station requires that base station in new cell will allocate channel to mobile station. If the channel is not available in new cell then the handoff call is blocked. This type of blocking is known as "handoff blocking". Handoff blocking can be done due to mobility of the user. New call and handoff call is illustrated in Fig. A person is in network 1, in one of the cell called 'd', may move to cell 'C' thus, it perform handoff call	***Explanation 1M***

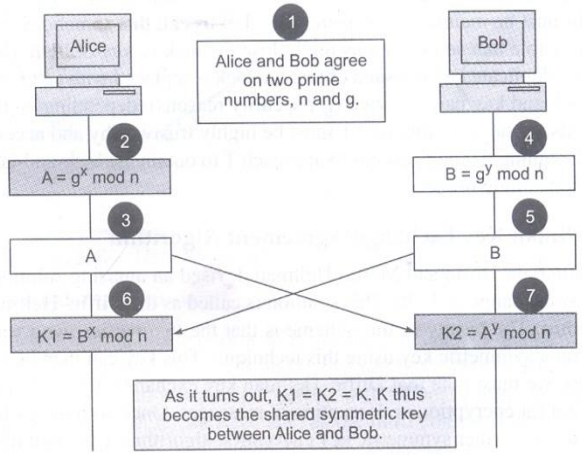
		within network 1. A person can also move from one network to another network, for example, a person is moving from cell 'd' of network 1 to cell 'b' of network 2.  **Fig.: Handoff in cellular network** **Types of Handsoff:** 1. Soft 2. Hard 3. Delayed 4. Queued 5.Mobile assisted handsoff6	***Diagram 1M*** ***Any 4 types 2M***
	(b) Ans.	**Define frequency re-use and state two advantages.**  Frequency reuse is the process in which the same set of frequencies (channels) can be allocated to more than one cell. Provided the cells are separated by sufficient distance reducing each cells coverage area invites frequency reuse cells using the same set of radio channels can avoid mutual interference, provided they are properly separated. Each	**4M** ***Frequency reuse 2M***

		cell base station is allocated a group of channel frequencies that are different from those of neighboring cells & base station antennas are chosen to achieve a desired coverage pattern within its cell. However as long as a coverage area is limited to within a cells boundaries the same group of channel frequencies may be used in different cells without interfacing with each other provided the two cells are sufficient distance from one another.
		
		Advantages:
		• Higher capacity
		  • More frequent resource utilization increases the capacity
		• Less transmission power
		  • Reduced cell sizes, less power needed to cover the cell area
		  • Relaxed power amplifier specs at base stations
		  • Longer life-time for mobile station batteries
		• Localized interference
		  • Due to smaller service areas of cells, interference is as well localized to a smaller area
		• Robustness
		  • In case that one cell is down, overlapping of cells guarantees that a mobile is able to get connected through other base stations
		• No technological challenges in deployment
		  • Major problems related to minimizing the implementation and operational expenses of the system
		  • Technological challenges related to capacity improvement methods.
			Any 2 advantages 1M each

	(c) Ans.	**Describe the process of GSM to PSTN call.** 1. The subscriber unit must be synchronized to the nearby base station as it monitors the BCH. 2. By receiving FCCH, BCCH messages, the subscriber would be locked on to the system and the appropriate BCH. 3. User dials the intended digit combination and presses ―Send‖ on GSM phone. 4. The mobile transmits a burst of RACH data. 5. The base station then responds with an AGCH message on CCCH which assigns the mobile unit a channel for SDCCH connection. 6. Once tuned to SDCCH, the subscriber will wait for SACCH frame to be transmitted which informs the mobile of any required timing	**4M** ***GSM to PSTN explanation 4M***

		advance and transmitter power command. The base station is able to determine the timing advance and the signal level from mobiles earlier RACH transmission. 7. Upon receiving and processing the timing advance info in the SACCH, the subscriber is now able to transmit normal burst messages as required for speech traffic. 8. The SDCCH sends message between the mobile unit and the base station, taking care of authentication& user validation. 9. PSTN connects the dialed party to the MSC and the MSC switches the speech path to the serving base station. Data is transferred on both the forward and reverse links. The calls is successfully underway and SDCCH is vacated.	
	(d) Ans.	**Describe the mobility databases HLR and VLR.** The home location register (HLR) is database used for mobile user information management. All the permanent subscriber data are stored in this database other than a secret key. An HLR record consists of three types of information. **1. Mobile station information:** It stores IMSI (International Mobile Subscriber Identity) used by mobile station to access the network and the MSISDN (Mobile Station - ISDN) which is ISDN number - the "phone number" of cm MS. **2. Location information:** It stores the ISDN number (address) of the VLR where the MS resides and the ISDN number of the MSC where the MS resides. **3.Service Information:** It stores the information such as service subscription, service restriction and supplementary services. The visitor location register (VLR) is a database which consists of information about service area visited by the MS. The VLR contains all the data which is needed by the MS for call handling and other purposes. Similar to HLR, the VLR information also consists three types of information. **1. Mobile station information:** It stores information such as IMSI, MSISDN and TMSI (temporary mobile subscriber identity) as defined in GSM. **2. Location information:** It stores information such as MSC number and the location area Id (LAI).	**4M** ***HLR 2M*** ***VLR 2M***

		3. Service information: Service information which is a subset of service information stored in the HLR. In the MS related fields, TMSI, structure can be determined by each operator, but the length is eight digits. LAI consists of 3 digit mobile country code (MCC), two or three digit mobile network code, and location access code of 16 digits.	
	(e) Ans.	**State four applications of GPRS.** There are many applications suitable for GPRS. Many of them are of generic types, some are specific to GPRS. 1. **Generic applications** are applications like information services, internet access, email, web browsing, which are very useful while mobile. Due to higher bandwidth, mobile Internet Browsing will be better suited to GPRS. 2. **GPRS Specific Applications: Chat**: Groups of like minded people use chat services as a means to communicate and discuss matters of common interest. GPRS offers by integrating Internet chat and wireless chat using SMS and WAP. 3. **Multimedia Service**: Multimedia objects like photographs, pictures, postcards, greeting cards and presentations, static web pages can be sent and received over the mobile network. 4. **Virtual Private Network**: GPRS network can be used to offer VPN services. Many blank ATM machines are VSAT (Very Small Aperture Terminal) to connect the ATM system with the banks server. 5. **Personal Information Management**: Personal diary, address book, appointments, engagements etc. Are very useful for a mobile individual.. 6. **Vehicle Positioning**: This application integrates GPS (Global Positioning System) that tell people where they are. Vehicle Positioning system can be used to deliver several services including remote vehicle diagnostics, stolen vehicle tracking. It can be used in logistics industry.	**4M** ***Any 4 applications 1M each***
	(f) Ans.	**Explain Deffie-Hellman Algorithm.** **Deffie Hellman Algorithm:** Consider Alice and Bob want to exchange the key 1. Firstly, Alice and Bob agree on two large prime numbers, n and g. These two integers need not be kept secret. Alice and Bob can use an insecure channel to agree to them	**4M** ***Relevant algorithm 4M***

		2. Alice chooses another large random number x, and calculates A such that : $A = g^x \bmod n$ 3. Alice sends the number A to Bob. 4. Bob independently chooses another large random integer y and calculates B such that: $B = g^y \bmod n$ 5. Bob sends the number B to Alice. 6. A now computers the secret key K1 as follows: $K1 = B^x \bmod n$ 7. B now computers the secret key K2 as follows: $K2 = A^y \bmod n$  **Figure: Deffie-Hellman key exchange illustrated**	
3.	**(a) Ans.**	**Answer any FOUR of the following:** **Describe the concept of co-channel interference.** **Concept of co-channel interference:** • Due to frequency reuse, several cells in a same coverage area use same frequency. These cells are known as co-channel cell. • The interference between signals from these co-channel cells is called co-channel interference. • Co-channel interference cannot be reduced by simply increasing the carrier power of transmitter. If we increase transmit power of carrier, it will increase interference to neighboring channel cell. • To reduce co-channel interference, co-channel cell can be physically be separated by minimum distance to provide sufficient isolation due to propagation. •	**16** **4M** ***Description 4M***

MODEL ANSWER

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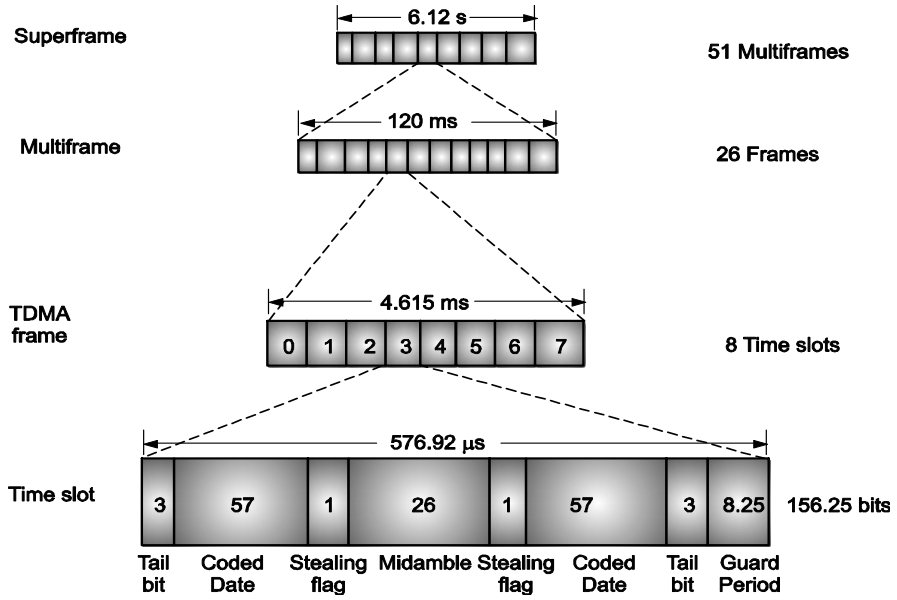
	(b) Ans.	**With neat diagram describe the GSM Frame Structure.** GSM frame structure consists of 148 bits(0.546 mS) which is transmitted at a rate of 270.833333 kbps. It is followed by 0.031 mS guard time (8.25 bits). The burst begins with 3 head bits and 3 tail bits . Out of total 148 bits per TS, 114 contains information bits which are transmitted as two 57 bits sequences close to the beginning and end of the burst. The midamble consists of 26 bits training sequence which allow mobile or base station receiver to analyze the characteristics of radio channel. On both the sides of midable bits there are control bits called stealing flags. These two flags are used to distinguish between traffic channel or control (FACCH) data.  There are eight time slots per TDMA frame, and frame period is 4.615 mS. As frame contains 8 × 156.25 = 1250 bits. These normal speech frames are grouped into larger structure called multi frames which in turn are grouped into super frame.	**4M** ***Description 2M*** ***Diagram 2M***
	(c) Ans.	**Describe the step-by-step procedure for VLR Restoration.** **VLR Failure Restoration:** After VLR failure, 1) The service information of VLR record is recovered by first contact between the VLR and the HLR of the corresponding MS.	**4M** ***Restoration 1M***

		2) The location information is recovered by the first contact between the VLR and the MS. 3)The mobile station information is recovered either from HLR or MS. VLR restoration procedure is initiated by one of the following three events. 1. MS registration 2. MS call origination 3. MS call termination **1. MS registration:** Since the record in the VLR get erased due to the failure, then the normal registration procedure define in inter-VLR movement is applied to recovered the VLR record. In this case, TMS1sends from the MS to the VLR that is not recognised, and MS asked to send IMSI over the air. **2. MS call origination:** When VLR receives the call origination request MAP_SEND_INFO_FOR_OUTGOING_CALL from the MSC, then the VLR record for the MS is not found. VLR considers this situation as a system error, with cause "unidentified subscriber". Request is then rejected and MS indicate the location registration procedure, then the VLR record is recovered. **3. MS call termination:** The call termination message flow is illustrated in Fig.	***Registration 1M*** ***Origination 1M***

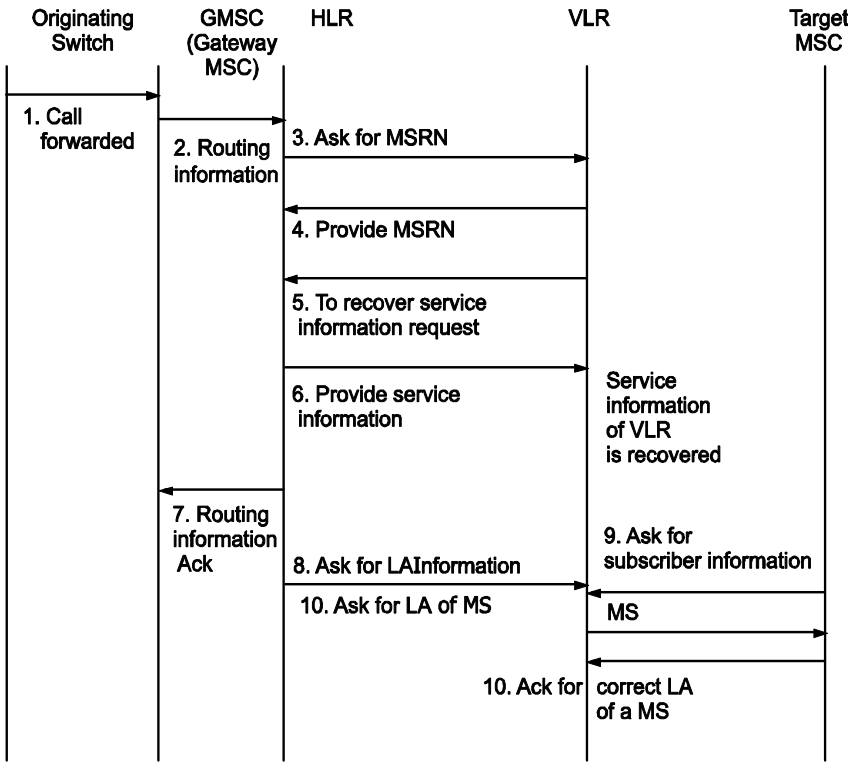


Fig. VLR failure restoration

Termination 1M

Step 1: When the MS ISDN is dialed the call is forwarded to GMSC (Gateway Mobile Switching Centre), GMSC is a switch which ask the HLR for routing information. The HLR request to VLR of the MS to provide the routing address for the MSRN (Mobile Station Roaming Number).

Step 2: The VLR returns the MSRN to the GMSC through the HLR.

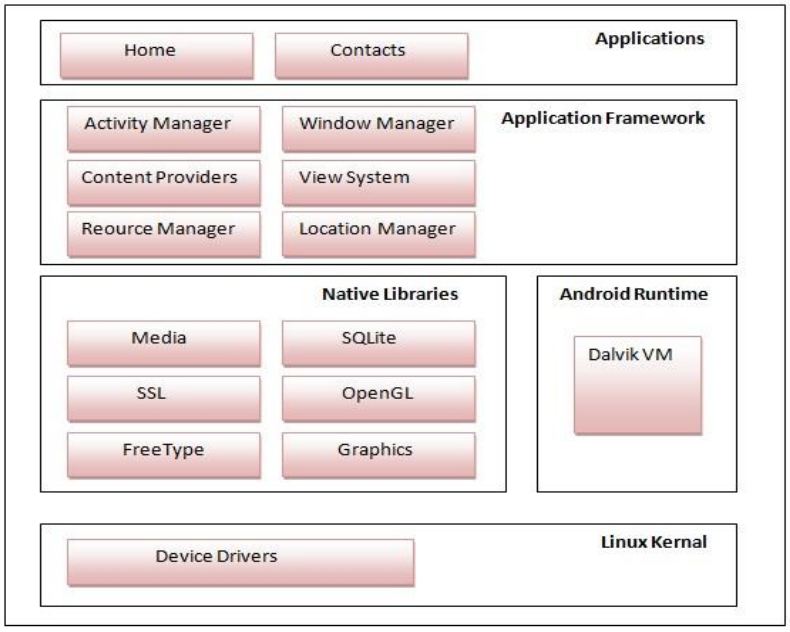
Step 3: The GMC uses the MSRN to route the call to the MS through the visited MSC (Mobile Switching Centre).

[Note that the IMSI - (International Mobile Subscriber Identity) and the MSC number are provided in the message which is send from HLR to VLR].

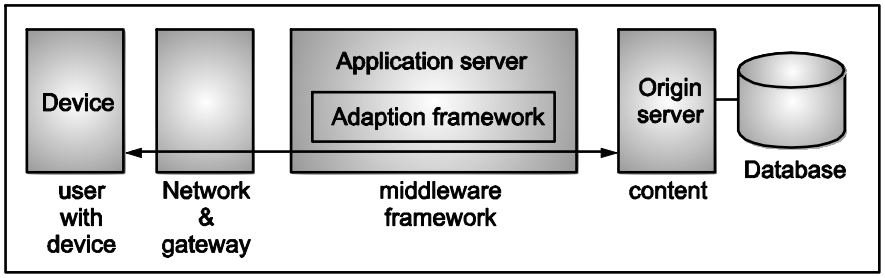
Then the VLR searches MS record, but the record is erased due to the failure because of this the search PS fails the VLR creates a new VLR record for the MS.

Neither the service nor the location information is available in this record. Steps 4 and 5 are executed parallelly.

		Step 4 and 5 : VLR does not have routing information; it uses MSC number to create MSRN. The number is sent back to gateway MSC to set up the call in Step 8. **Step 6 and 7:** The VLR recovers service information by sending MAP_RESTORE_DATA message to HLR. Then HLR sends service information to VLR by using MAP_INSERT_SUBSCRIBER_DATA message. At this point service information of VLR record has been recovered. Still the location information specifically the LAI number, still not available. **Step 8:** After gateway MSC receive the MSRN in Step 7, the target MSC does not have LA information of the MS. In order to proceed to set up the call and asked for LAI information. Unfortunately VLR does not have LAI information. Hence, VLR ask MSC to determine the LA of MS by sending MAP_SEARCH_ FOR_MOBILE_SUBSCRIBER message. **Step 9:** The MSC initiate paging of MS in all LAS. If the paging is successful, the current LA address of MS is sent back to VLR. At this point LA information of VLR record is recovered.	
	(d) Ans.	**State Four features of UMTS.** UMTS (Universal Mobile Telecommunications Service) is a third-generation (3G) broadband, packet-based transmission of text, digitized voice, video, and multimedia at data rates upto 2 megabits per second (Mbps). • Universal Mobile Telecommunications System (UMTS) is a air interface standard UMTS as a competitive open air-interface standard for 3G wireless telecommunications. • UMTS offers a consistent set of services to mobile computer and phone users, which is not depend on the location. UMTS is based on the Global System for Mobile (GSM) communication standard. Once UMTS is available, computer and phone users can be continuously connected to the Internet wherever they travel, will have the same set of capabilities. Users will get access to internet via combination of terrestrial wireless and satellite transmissions. • A packet-switched connection that uses the Internet Protocol (IP), that provides a virtual connection is always available. • UMTS also makes it possible to provide new services like alternative billing methods or calling plans. For instance, users can	**4M** ***Any 4 features 1M each***

		choose to pay-per-bit, pay-per-session, flat rate, or asymmetric bandwidth options. • The higher bandwidth of UMTS also enables other new services like video conferencing. • UMTS may allow the Virtual Home Environment (VHE) to fully develop, where a roaming user can have the same services to either at home, in the office or in the field through a combination of transparent terrestrial and satellite connections.	
	(e) **Ans.**	**State various mobile operating systems. Describe Android architecture with neat diagram.** ***(Note: Any other relevant OS may also be included)*** The various mobile operating systems are: • Symbian • Windows CE • iOS • Android • Linux  **Android architecture** or **Android software stack** is categorized into five parts:	**4M** ***Mobile Operating System 1M*** ***Architecture diagram 1M***

		1. Linux kernel 2. Native libraries (middleware), 3. Android Runtime 4. Application Framework 5. Applications **1) Linux kernel** It is the heart of android architecture that exists at the root of android architecture. **Linux kernel** is responsible for device drivers, power management, memory management, device management and resource access. **2) Native Libraries** On the top of linux kernel, there are **Native libraries** such as WebKit, OpenGL, FreeType, SQLite, Media, C runtime library (libc) etc. The WebKit library is responsible for browser support, SQLite is for database, FreeType for font support, Media for playing and recording audio and video formats. **3) Android Runtime** In android runtime, there are core libraries and DVM (Dalvik Virtual Machine) which is responsible to run android application. DVM is like JVM but it is optimized for mobile devices. It consumes less memory and provides fast performance. **4) Android Framework** On the top of Native libraries and android runtime, there is android framework. Android framework includes **Android API's** such as UI (User Interface), telephony, resources, locations, Content Providers (data) and package managers. It provides a lot of classes and interfaces for android application development. **5) Applications** On the top of android framework, there are applications. All applications such as home, contact, settings, games, browsers are using android framework that uses android runtime and libraries. Android runtime and native libraries are using linux kernal.	***Relevant explanation 2M***
4.	**(A)**	**Answer any THREE of the following:**	**12**
	(a)	**With the help of neat block diagram, describe the logical function of mobile computing.**	**4M**
	Ans.	**Mobile Computing Functions** The mobile computing functions can be logically divided into following major segments.	

		1. User with device: The user could have fixed device like desktop computer or portable device like mobile phone, PDA etc.  **Network:** When user is mobile, he will use different network at different places at different time. **Gateway:** This is required to interface different transport bearer. This gateway converts one specific transport bearer to another bearer (environment). **Middleware:** It is a software layer between user application and the operating system. **Content:** It is a place or server where originally the content is stored. This could be an application, system or even collection of system.	***Diagram 2M*** ***Functio n 2M***
	(b) **Ans.**	**Draw a block diagram and explain speech signal processing in GSM.** GSM signal is processing from transmitter to receiver. **1. Speech coding:** The GSM speech coder is based on the Residually Excited Linear Predictive Coder (RELP), which is enhanced by Long Term Predictor (LTP).The coder provides 260 bits for each 20 ms block speech, which means a bit rate of 13 kbps. In the normal conversation, each person speaks on average for less than 40% of the time. By incorporating Voice Activity Detector (VAD) in speech coder, GSM system operates in a discontinuous	**4M**

transmission mode (DTX) which provides longer battery life and reduced radio interface since the GSM transmitter is not active in silent period.

2. Channel Coding (TCH/FS, SACCH and FACCH):

The output bits of speech coder are grouped for error protection, out of the total 260 bits in a frame, the most important 50 bits, called type Ia bits, have 3 parity check (CRC) bits added to them. This facilitates the detection of non-correctable error at the receiver.

The next 132 bits along with first 53 (50 types Ia bits + 3 parity bits) appended by four zero bits, thus, providing a data block of 189 bits. This block is then encoded for error protection. It provides a sequence of 378 bits. The least important 78 bits do not have any error protection and are concatenated to the existing sequence of block of 456 bits in 20 ms frame error protection coding increases the gross data rate of GSM speech signal, with channel coding to 22.8 kbps.

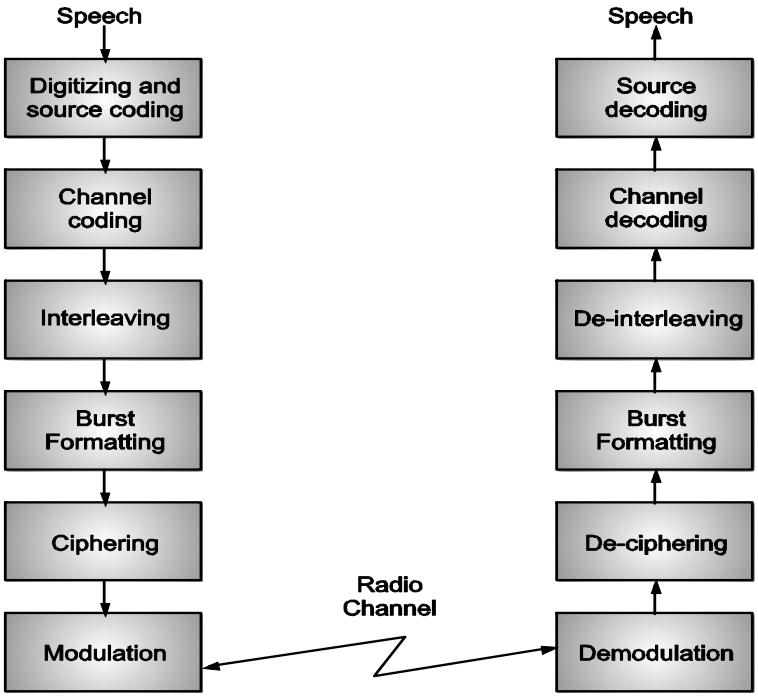
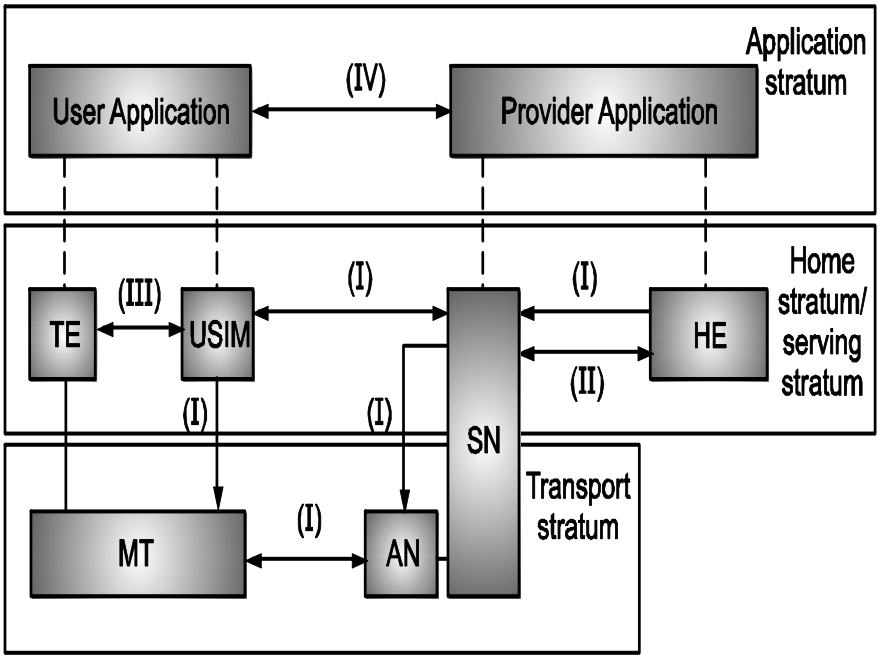


Diagram 2M

Interleaving:

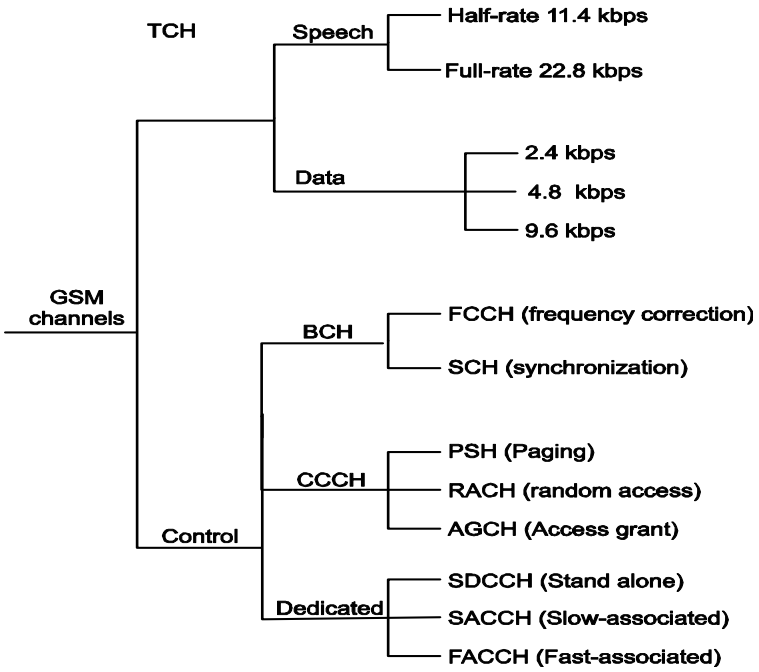
In order to reduce the effect of sudden fades on the received data, the

		total 456 encoded bits within each 20 ms speech frame or control message frame are broken into eight 57 bits sub blocks. These eight sub-blocks which make up a single speech frame are spread over eight consecutive TCH time slots. If a burst is lost due to interference or fading, channel coding ensures that enough bits will still received correctly to allow error correction. **Ciphering:** Ciphering made changes in a content of eight interleaved blocks through the use of encryption technique. Security is also enhanced by the changes in encryption algorithm call to call. Two types of security algorithm called A3 and A5 are used in GSM to prevent unauthorized network access. A5 algorithm is used to authenticate each mobile by verifying user password within SIM (Subscriber Identity Module). A5 algorithm provides the scrambling for the 114 coded data bits. **Burst formatting:** Burst formatting adds binary data to ciphered block, in order to help synchronization of the received signal. **Modulation:** Modulation technique used by GSM is 0.3 GMSK, where 0.3 describes the 3 dB bandwidth. GMSK is a special type of FM modulation. Binary once and zeros are represented in GSM by shifting the radio frequency carrier by ± 67.708 kHz. This minimize the bandwidth occupied by the modulated spectrum and hence improved channel capacity. **Frequency hopping:** Under normal condition, data belong to particular physical channel is transmitted using same frequency. Some time user in a particular cell have served with multipath problem, then the cell can be called as hopping cell by the network operator, in that case slow frequency hopping is carried out to cope up with multipath. Frequency hopping is carried out frame by frame. Frequency hopping is specified by the service provider. **Equalization:** Equalization is performed at receiver end with the help of training sequences transmitted in midamble of every time slots. Type of	***Relevant explanation 2M***

		equalization is not fixed in GSM, it depends upon manufacturer. **Demodulation:** At receiver's end, appropriate TS is demodulated with the aid of synchronization data provided by the burst formatting. After demodulation the binary data is deciphered, de-interleaved, channel decoded and speech decoded.	
	(c) **Ans.**	**Draw the block diagram of Mobile Security framework and explain.** • It is 3rd Generation Partnership Project. • 3rd Generation Partnership Project (3GPP) is a collaborative project aimed at developing globally acceptable specifications for third generation (3G) mobile systems. It is a collaboration between groups of telecommunications associations, to make a globally applicable third generation (3G) mobile phone system. Overview of the complete 3G security architecture.  **Figure. GPP security architecture framework**	**4M** ***Diagram 2M***

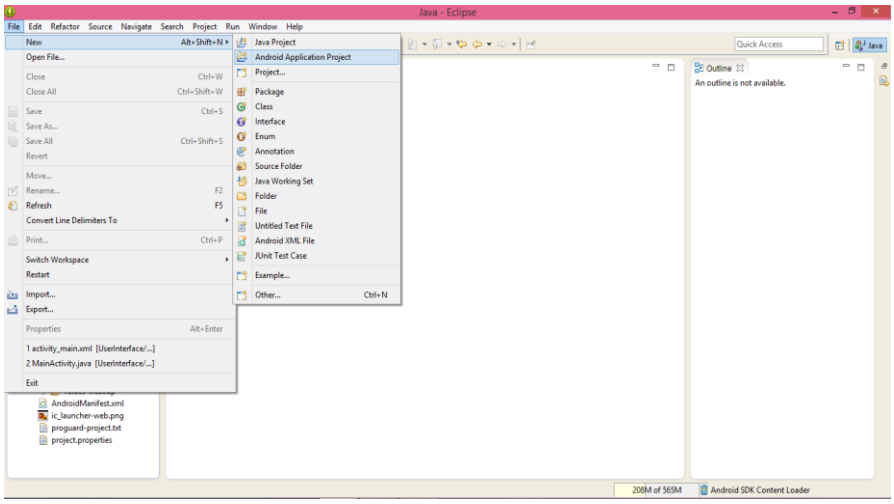
		From Fig. four security feature groups are defined. Each of these feature groups meets certain threats, accomplishes certain security objectives: **(i) Network access security (I):** The set of security features that provide users with secure access to 3G services, and which in particular protect against attacks on the (radio) access link. **(ii) Network domain security (II):** The set of security features that enable nodes in the provider domain to securely exchange signaling data, and protect against attacks on the wireline network. **(iii) User domain security (III):** The set of security features that secure access to mobile stations. **(iv) Application domain security (IV):** The set of security features that enable applications in the user and in the provider domain to securely exchange messages.	***Relevant explanation 2M***
	(d) Ans.	**Describe mobile VPN.** A virtual private network (VPN) is a network that uses a public telecommunication infrastructure, such as the Internet, to provide remote offices or individual users with secure access to their organization's network. A VPN works by using the shared public infrastructure while maintaining privacy using security procedures and tunneling protocol. The tunneling protocols VPN uses are: • Layer Two Tunneling Protocol (L2TP). • Internet Protocol Security (IPSec). In effect, these protocols in sequence do: • Encrypts data at the sending end. • Send the data through a "tunnel". • and decrypts it at the receiving end. An additional level of security involves encrypting not only the data, but also the originating and receiving network addresses. Mobile VPN: A mobile VPN is a network configuration in which mobile devices such as notebook computers or personal digital assistants (PDAs) access a virtual private network (VPN) or an intranet while moving from one physical location to another. An effective mobile VPN provides continuous service to users and can seamlessly switch across access technologies and multiple public and private networks. The functioning of an effective mobile VPN is transparent to the end user	**4M** ***Description 4M***

		without compromising security or privacy. The foundation of a successful mobile deployment is a Mobile VPN (virtual private network) software that provides mobile workers with secure, reliable, remote access to network resources and information from virtually anywhere. Only a Mobile VPN is designed to deal with the unique challenges associated with mobile computing such as wireless security, performance and roaming.	
4.	**(B)**	**Answer any ONE of the following:**	**06**
	(a)	**Explain Traffic & control GSM channels along with its sub types and characteristics.**	**6M**
	Ans.	There are mainly two types of GSM logical channels: (i) Traffic channels (TCHs). (ii) Control channels (CCHs). Traffic channels carry digitally encoded user voice or user data and have identical formats of both forward link and reverse link. Control channels carry signal and synchronization commands between the base station and mobile station. Other control channels are used only for forward and reverse link. **There are six types of GSM traffic channels (TCHs).** GSM traffic channel carry digital voice and user data either at half rate or at full rate. When signal is transmitted at full rate, user data is contained within one TS per frame. When signal is transmitted at half rate, user data is mapped on to the same time slots, but it is sent in alternative frames. **Full Rate Traffic Channels (TCH):** **(i) Full-rate speech channel (TCH/FS):** This channel carries user speech in digitized form at a raw data rate of 13 kbps. GSM channel coding is added to digitized speech then the full rate speech channel carries 22.8 kbps.	***1M***
		(ii) Full-rate data channel for 9600 bps (TCH/F9.6): This channel carries raw user data which is transfers at 9600 bps with additional forward error correction applied by GSM, the 9600 bps data sent at 22.8 kbps. **(iii) Full-rate data channels for 4800 bps (TCH/F4.8):** This channel carries raw user data which is transferred at 4800 bps with additional forward error correction applied by GSM, the 4800 bps is	

		sent at 22.8 kbps. **(iv) Full rate data channel for 2400 bps (TCH/F2.4):** This channel carries raw user data which is transferred at 2400 bps with additional forward error correction coding by GSM, the 2400 bps is sent at 22.8 bps. **Half-rate Traffic Channels:** **(i) Half-rate speech channel (TCH/HS):** This channel carries digitized speech which is sampled at a half rate then the full rate GSM channel coding added to digitized speech and half rate speech channel carry 11.4 kbps. **(ii) Half-rate data channels for 4800 bps (TCH/H4.8):** This channel carries raw user data which is to be transferred at 4800 bps. With additional forward error correction applied by GSM, the 4800 bps data sent at 11.4 kbps. **(iii) Half-rate data channels for 2400 bps (TCH/H2.4):** This channel carries raw user data which is to be transferred at 2400 bps with additional forward error correction by the GSM, the 2400 bp data sent at 11.4 kbps.  	*1M* *1M for diagram*

		GSM Control Channels (CCH): There are three control channels in GSM: 1. Broadcast control channels. 2. Common control channels. 3. Dedicated control channels. **1. Broadcast control channels (BCH) :** The BTS uses this channel to give information to all MSs within a cell. Information uses by this channel is cell and network identity, current control channel structure, channel availability and congestion. The broadcast control channel also sends the list of channels that are currently used within cell. **(a) Frequency Correction Channel (FCCH):** The BTS sends information for frequency correction via the Frequency Correction Channel (FCCH). The FCCH is special data burst, which occupies first frame (i.e. frame 0) and repeated after every ten frames in control channel multiframe. **(b) Synchronization Channel (SCH):** BTS broadcast information about time synchronization to all MSS via synchronization channel (SCH). If the mobile station is 30 km away from serving base station, it is often necessary to adjust the timing of particular mobile user. The SCH is transmitted once after every ten frames within the control channel multiframe. **2. Common Control Channels (CCCH):** All the information regarding setting up a connection between MS and BS is exchanged via the CCCH. The common control channel occupies TSO (framo) of GSM frame and that is not used by BCH and ideal channels. **(a) Paging Channel (PCH):** The PCH gives paging signal from the base station to all mobile stations within cell. It also notify particular mobile for an incoming call from PSTN. Alternatively, the PCH is used to provide cell broadcast ASCII text message to all subscriber, as a GSM SMS features. **(b) Random Access Channel (RACH):** If MS wants to setup a call, it uses Random Access Channel (RACH) to send data to BTS. All mobile must request access or respond to a PCH with TSO of GSM frame. At BTS, every frame will accept RACH transmission from mobile during TSO. **(c) Access Grant Channel (AGCH):** The AGCH channel is used by base station to provide forward link communication to mobile	***1M*** ***1M***

		station and carries instructional data which tells mobile to operate in particular physical channel with particular control channel. The AGCH is the final common control channel message sent by the base station before subscriber is roaming or moving off the control channel. **3. Dedicated Control Channels (DCCH):** There are mainly three types of dedicated control channels in GSM, same as traffic channel, they are bidirectional. They have same format and function on both forward and reverse links. **(a) Stand-alone Dedicated Control Channels (SDCCH):** SDCCH carries signaling data which follows the connection of mobile with base station. The SDCCH ensures that the mobile and base station connection remains constant while the base station and MSC verify the subscriber unit and resource allocation to mobile. The SDCCH is also used to send authentication and alert messages but not speech. **(b) Slow Associated Control Channel (SACCH):** The SACCH is always associate with traffic channel or SDCCH, the SACCH carries general information between the MS and BTS. On the forward link, the SACCH is used to send slow but regularly changing control information to the mobile, such as power level instruction, and specific timing advance instruction for each user. The reverse SACCH carries information about the received signal strength and quality of traffic channel as well as BCH measurement result from neighbouring cell. **(c) Fast Associated Control Channels (FACCH):** FACCH carries urgent messages, and contain the same type of information as SDCCH. A FACCH is assigned to a particular user when SDCCH has not been dedicated to particular user. The FACCH access the time slots by taking frame from traffic channel, this is done by using two special bits, called stealing bits, in TCH channel.	***1M***
	(b) **Ans.**	**Write the stepwise procedure to create program for user interface in Android.** **Open eclipse:** **1. Click the menu File → New Android Application Project**	**6M**

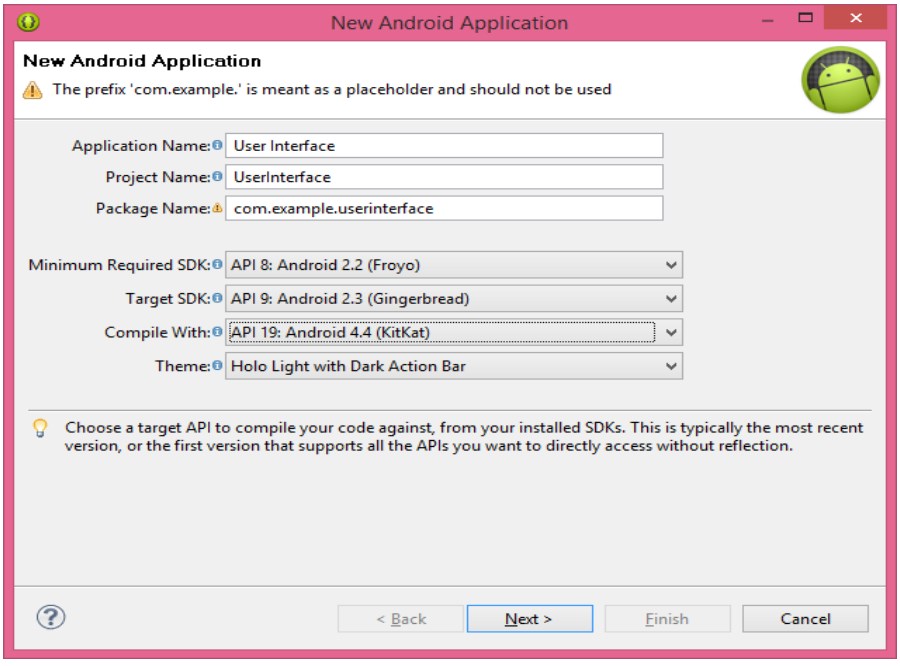


Correct steps without diagram 4M

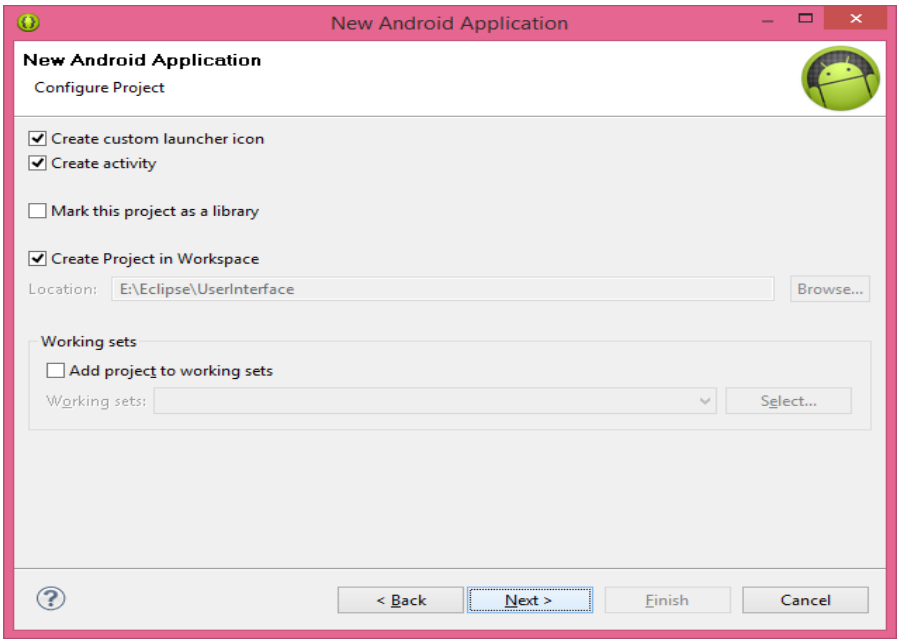
Output diagram 2M

1. Name the project: In this stage, there exist three names described as:

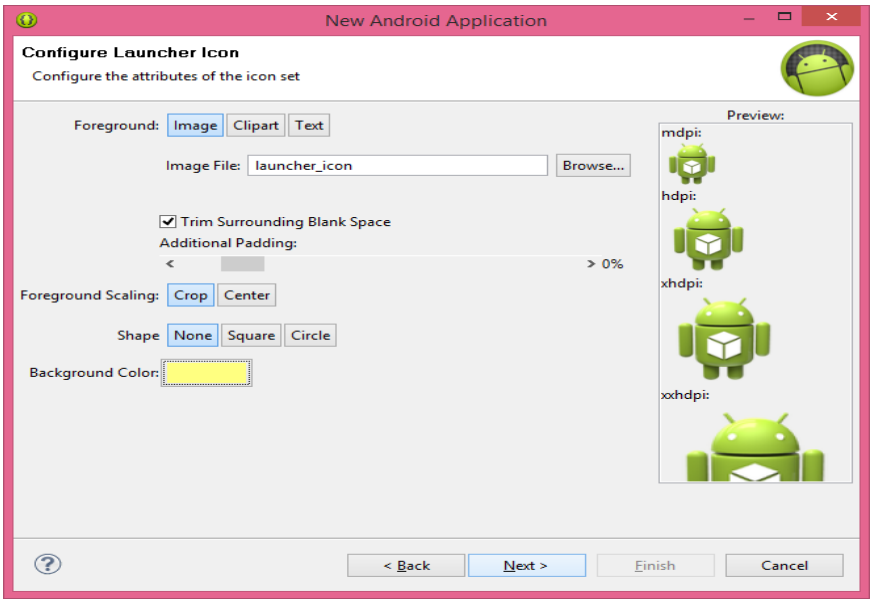
Specify Application Name, Project Name, Package name.



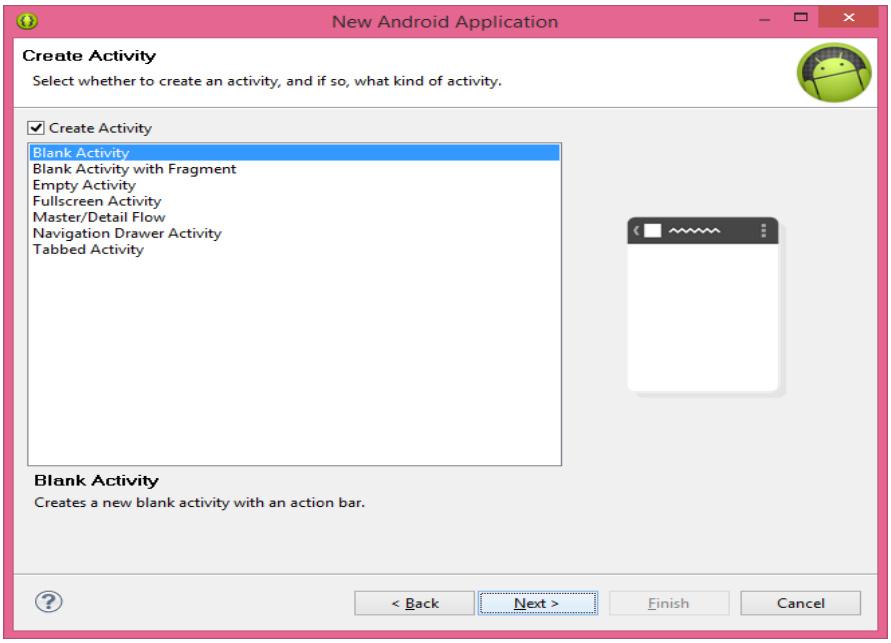
1. Click Next



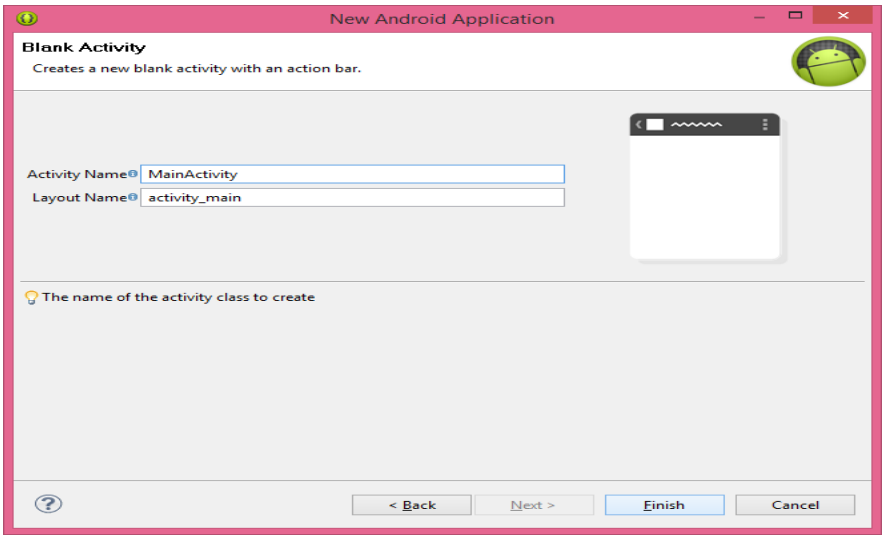
2. Configure Launcher Icon



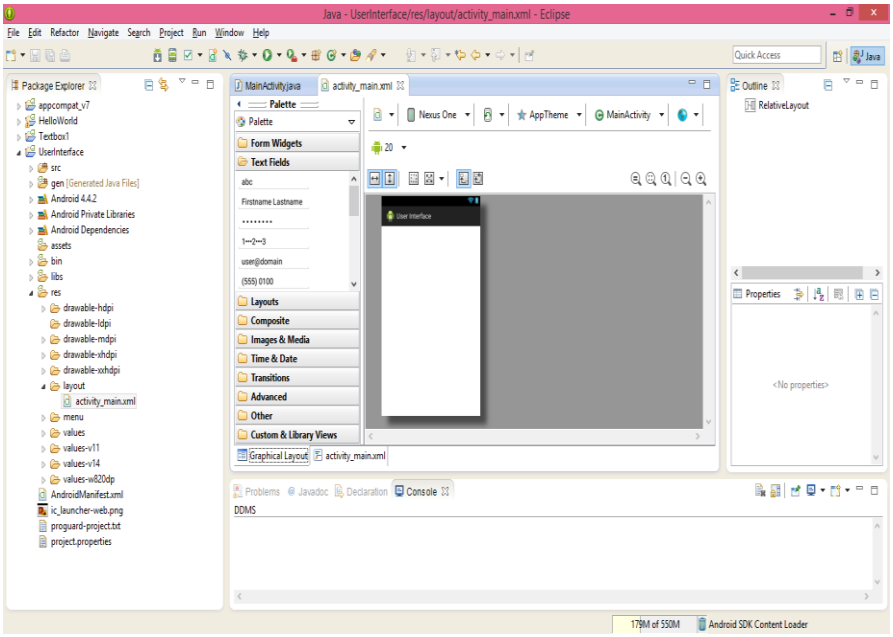
3. Choose "Blank Activity" Click next



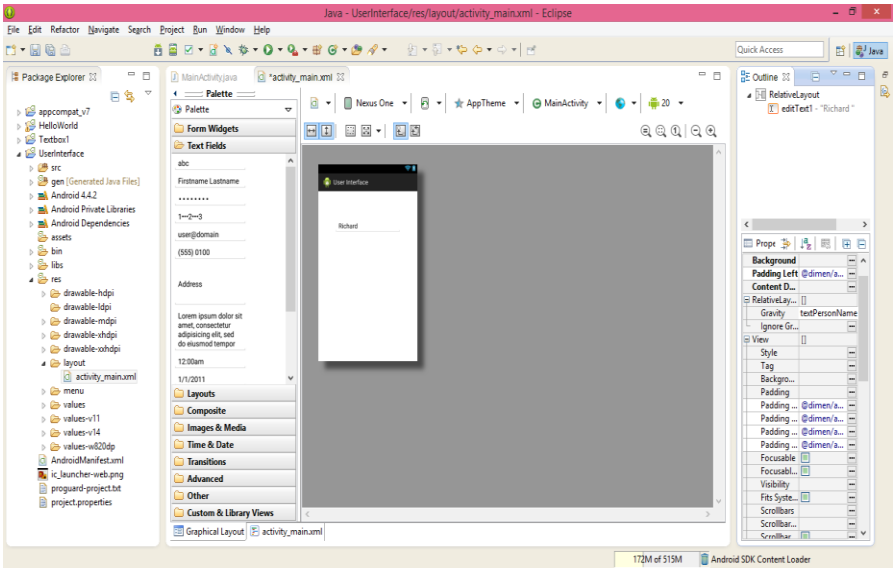
4. It will display Activity Name and Layout Name Click finish



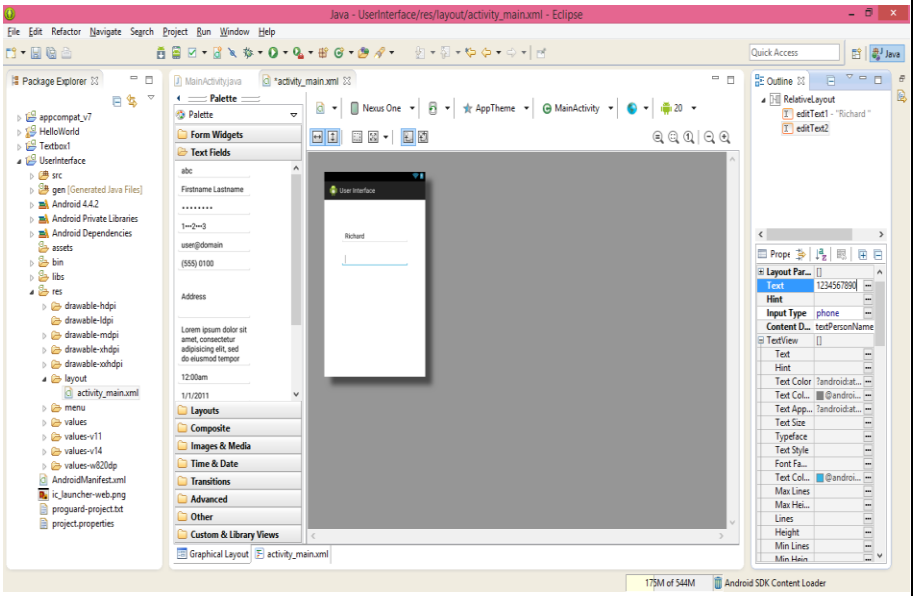
5. In Activity_main.xml file under text field folder we can see the different types of text fields for providing text, password, numbers, email-id etc.

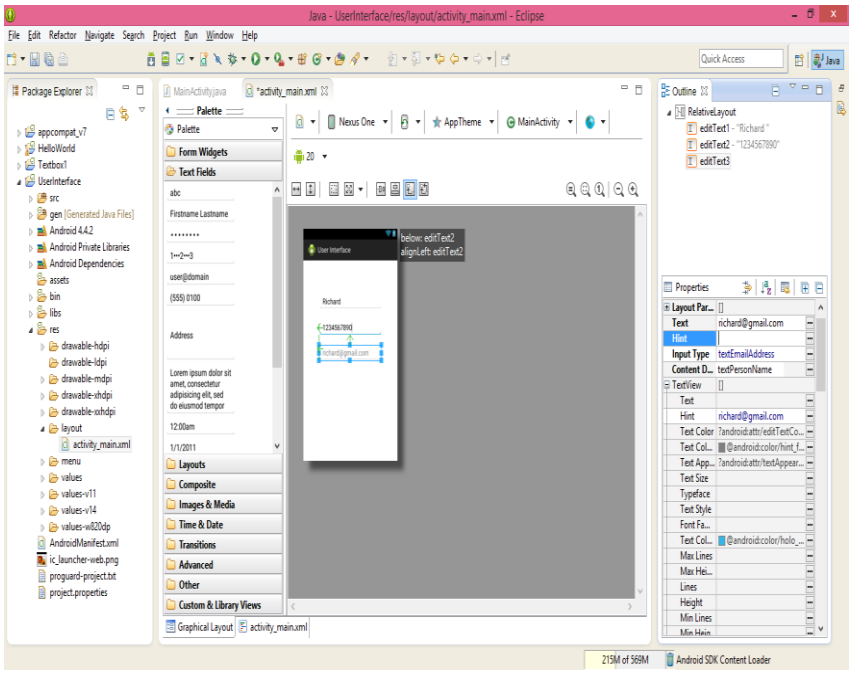


6. Drag the desired text field on the graphical layout of the GUI and enter the desired input in respect to the type of text filed

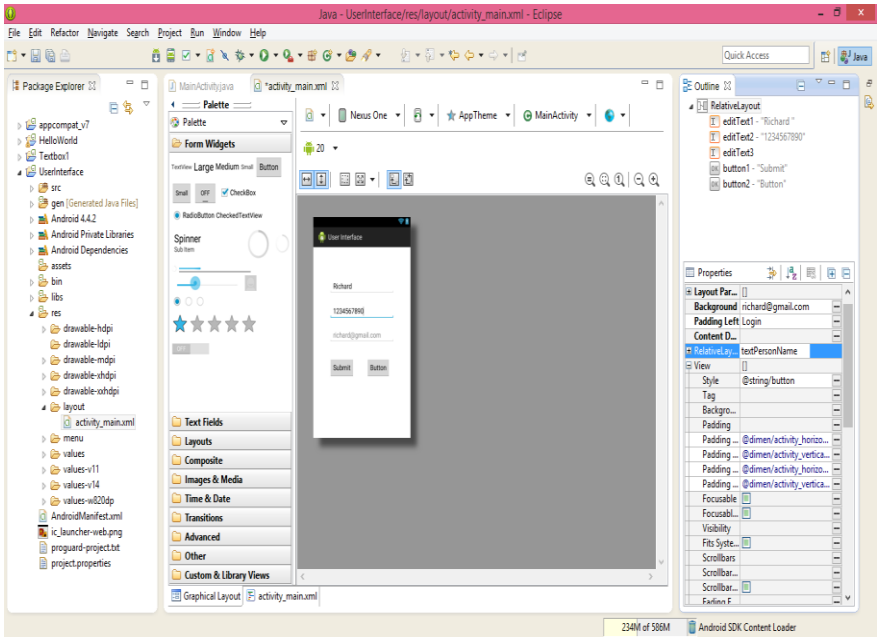


7. Select another text filed and provide the input





8. From the form widgets menu select the buttons you want and rename it as required

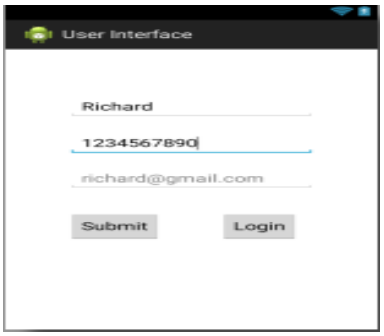


Output: To run User **Interface** application launch **AVD (Android virtual Device)**

Open project's activity files from eclipse and click Run icon from the toolbar. Eclipse installs the app on your AVD and starts it and if everything is fine with your setup and application, it will display following Emulator window.

You can also run this application directly on your android device instead of AVD, First you need to enable USB debugging on your phone, then connect it to your computer via USB. Then eclipse will automatically start debugging on your phone instead of the AVD

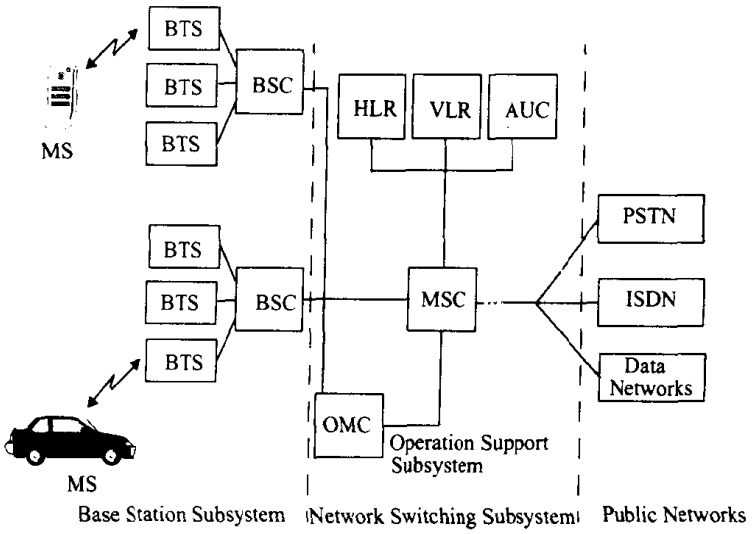
Output diagram:



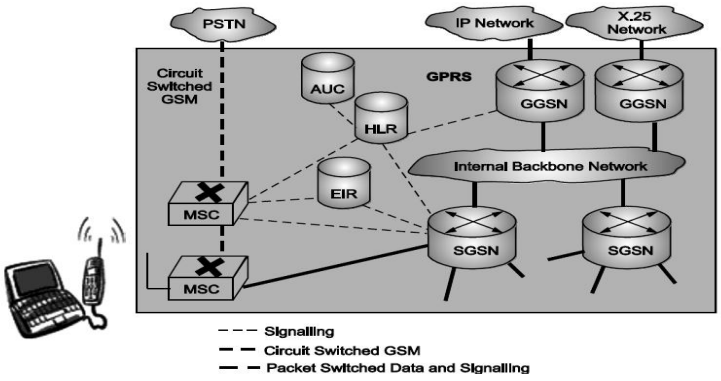
MODEL ANSWER

SUMMER – 2018 EXAMINATION

Subject: Mobile Computing **Subject Code:** **17632**

5.	**(a) Ans.**	**Answer any TWO of the following:** **Draw the neat diagram of GSM system architecture and explain.** The GSM network can be broadly divided into**:** • The Mobile Station (MS) • The Base Station Subsystem (BSS) • The Network Switching Subsystem (NSS) • The Operation Support Subsystem (OSS)  **Base Station System (BSS):** It consists of Mobile Station (MS), Base Station Controller (BSC), and Base Trans-receiver Station (BTS), the BSS and NSS connected to each other via interface (solid lines) and the connection to OMC via O interface (dashed lines). Base Station Subsystem (BSS): GSM system consists of many BSS; each one is controlled by Base Station Controller (BSC). BSS performs all the functions which are required to maintain connection to MS, coding/decoding of voice etc. BSS also contains Base Transreceiver Stations (BTS). **Base Transceiver Station (BTS):** BTS is responsible for handling radio interface to the mobile station. It is connected to MS via Um interface and it is also connected to BSC via the Abis interface. The Um interface contains all mechanism for wireless interface (TDMA, FDMA etc.). The BTS is a radio equipment (Transreceiver or	**16** **8M** ***Diagram 4M*** ***Explanation 4M***

		antenna) needed to service each cell in the network. **Base Station Controller (BSC):** BSC provides all the control functions and physical link between MSC and BTS. BSC is connected to BTS and MSC (Mobile Switching Centre). The BSC manages the radio resources for one or more BTS. It handles radio channel setup, frequency hopping and handovers. The BSC is the connection between the mobile and the MSC. It assigns and releases frequencies and time-slots for the MS. The BSC also handles inter-cell handover. It controls the power transmission of the BSS and MS in its area. **Operation and Maintenance Center (OMC):** OMC is connected to all equipment's in switching system and to the BSC. Administration and commercial operation (subscription, end terminals, charging and statistics) Security management, Network Configuration, Operation and Performance Management, Maintenance tasks. **Network and Switching Subsystem (NSS):** NSS is responsible for performing call processing and subscriber related functions. It also includes Mobile Switching Center (MSC), Home Location Register (HLR), Visitor Location Register (VLR), Authentication Center (AUC), Equipment Identity Register (EIR) etc. Mobile Switching Centre (MSC): It is used to handle communication between different MS connected to different BSCs. MSC performs the switching of calls between the mobile and other fixed or mobile network users as well as the management of mobile services such as registration, authentication, location updating, handovers and call routing to a roaming subscriber.	
	(b) Ans.	**With neat diagram describe GPRS architecture.** GPRS is usually attempts to reuse the existing GSM network elements as much as possible. There are new entities called GPRS supports nodes (GSN) which are responsible for delivery and routing of data packets between mobile stations and external packets networks. There are two types of GSNs, 1. Serving GPRS Support Node (SGNS) 2. Gateway GPRS Support Node (GGNS) There is new database called GPRS register which is located with HLR. It stores routing information's and maps the IMSI to a PDN	**8M**

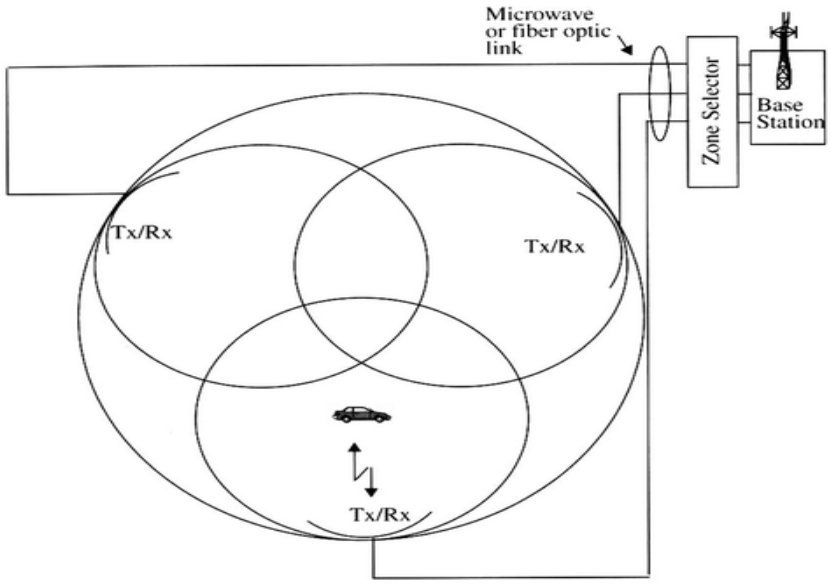
		address. Thus, GPRS Reference Architecture is shown as:  **GPRS Architecture** **SGSN**: It is at the same hierarchical level as the MSC. Whatever the MSC does for voice, SGSN does for Packet Data. The tasks of SGSN include packet switching, routing and transfer, mobility management and location management, logical link management and authentication and charging functions SGSN processes the registration of new mobile subscriber and keeps a record of the location inside a given service area. **GGSN**: It acts as an interface between GPRS backbone network and the external packet data networks. GGSN's function is similar to that of a router in a LAN. It maintains the routing information that is necessary to tunnel the protocol data units to the SGSNs. **GPRS Network enhancements**: Some existing GSM network elements must also be enhanced in order to support packet data. The BSS system needs enhancements to recognize and send packet data. This includes BTS upgrade to allow transportation of user data to the SGSN. Also the BTS needs to be upgraded to support packet data transmission between the BTS and the MS. HLR and VLR also require enhancements so the queries from GSNs may handled. MS also needs enhancements	***4M diagram*** ***4M Explanation***
	(c) Ans.	**Explain step-by-step procedure of RSA algorithm.** • **RSA Algorithm:** RSA is public key algorithm. The RSA scheme is a block cipher in which the plaintext and cipher text are integers between 0 and n-1 for some n. RSA algorithm is based on the mathematical fact that it is easy to find and multiply large	**8M**

		prime numbers together, but it is extremely difficult to factor their product The private and the public keys in RSA are based on very large prime numbers • Choose two large prime numbers P &Q • Calculate N = P x Q • Select the public key (Encryption Key) E such that it is not a factor of (P-1) and (Q-1) • Select the private key (decryption key) D such that the following equation is true (D x E) mod(P-1) (Q-1)=1 • For encryption, calculate the cipher text CT from the plain text PT as follows : $CT = PT^E \bmod N$ • Send CT as the cipher text to the receiver • For Decryption, calculate the plain text PT from Cipher text CT as follows: $PT = CT^D \bmod N$ **RSA Algorithm Example** 1. Choose p = 3 and q = 11 2. Compute n = p * q = 3 * 11 = 33 3. Compute φ(n) = (p - 1) * (q - 1) = 2 * 10 = 20 4. Choose E such that 1 < E <φ (n) and e and n are co-prime. Let e = 7 5. Compute a value for d such that (D * E) % φ(n) = 1. One solution is d = 3 [(3 * 7) % 20 = 1] 6. Public key is (E, n) => (7, 33) 7. Private Key is (D, n) => (3, 33)	***Step by step procedure 6M*** ***Example 2M***
6.	**(a) Ans.**	**Answer any FOUR of the following:** **Describe microcell zone concept.**	**16** **4M**

MODEL ANSWER

SUMMER – 2018 EXAMINATION

Subject: Mobile Computing **Subject Code: 17632**

		 **Fig: Microcell** When sectoring is employed, lot of handoffs is required due to this load on switching and control link element of the mobile system increases. To solve this problem, a microcell concept for seven cell reuse is used. In this method, each of three (possibly more) zone sites are connected to single base station. The zones are connected by a coaxial, fiber optic cable or microwave link to base stations. Multiple zones and single station make a cell. As mobile travels within a cell, it is served by zone with strong signal. As mobile moves from one zone to another zone in same cell, it uses same channel, thus like a sectoring, handoff is not required at mobile switching center (MSC) when mobile travels within the cell in different zone. The base station simply changes the channel from one zone to another zone, and channel is active in particular zone in which mobile is travelling, hence interference is reduced. The advantage of zone cell technique is that, cell maintains particular area of coverage the co-channel interference in cellular system is reduced, as larger control base station is replaced by zone transmitter on edge of cell.	***Diagram 2M*** ***Description 2M***
	(b) Ans.	**Write the procedure for GSM location tracking and call setup.** **Location Tracking:** A GSM network is divided into cells. A group	**4M**

		of cells is considered a location area. A mobile phone in motion keeps the network informed about changes in the location area. If the mobile moves from a cell in one location area to a cell in another location area, the mobile phone should perform a location area update to inform the network about the exact location of the mobile phone. The HLR maintains a database for the mobile subscribers. At any point of time, the HLR knows the address of the MSC VLR that controls the current location area of the mobile. The HLR is informed about a location area update only if the location area change has resulted in a change of the MSC VLR. Visitor Location Register (MSC VLR) is responsible to switching voice calls and it also keeps track of the exact location area where the mobile user is present **Call Setup in GSM:** 1. Channel Request: The MS requests for the allocation of a dedicated signaling channel to perform the call setup. 2. After allocation of a signaling channel the request for MOC call setup, included the TMSI (IMSI) and the last LA1, is forwarded to the VLR 3. The VLR requests the AC via HLR for Triples (if necessary). 4. The VLR initiates Authentication, Cipher start, IMEI check (optional) and TMSI Re-allocation (optional). 5. If all this procedures have been successful, MS sends the Setup information (number of requested subscriber and detailed service description) to the MSC. 6. The MSC requests the VLR to check from the subscriber data whether the requested service an number can be handled (or if there are restrictions which do not allow further proceeding of the call setup) 7. If the VLR indicates that the call should be preceded, the MSC commands the BSC to assign a Traffic Channel (i.e. resources for speech data transmission) to the MS 8. The BSC assigns a Traffic Channel TCH to the MS 9. The MSC sets up the connection to requested number (called party)	***GSM Location Tracking 2M*** ***Call Setup 2M***
	(c) **Ans.**	**State the procedure for Mobile originated call in GSM.** ***(Note: Figure shall be considered)***	**4M**

Mobile Originating Call (MOC): Call setup is initiated by MS

1. Channel Request: The MS requests for the allocation of a dedicated signaling channel to perform the call setup.
2. After allocation of a signaling channel the request for MOC call setup, included the TMSI (IMSI) and the last LA1, is forwarded to the VLR
3. The VLR requests the AC via HLR for Triples (if necessary).
4. The VLR initiates Authentication, Cipher start, IMEI check (optional) and TMSI Re-allocation (optional).
5. If all this procedures have been successful, MS sends the Setup information (number of requested subscriber and detailed service description) to the MSC.
6. The MSC requests the VLR to check from the subscriber data whether the requested service an number can be handled (or if there are restrictions which do not allow further proceeding of the call setup)
7. If the VLR indicates that the call should be preceded, the MSC commands the BSC to assign a Traffic Channel (i.e. resources for speech data transmission) to the MS
8. The BSC assigns a Traffic Channel TCH to the MS
9. The MSC sets up the connection to requested number (called party)

Procedure 4M

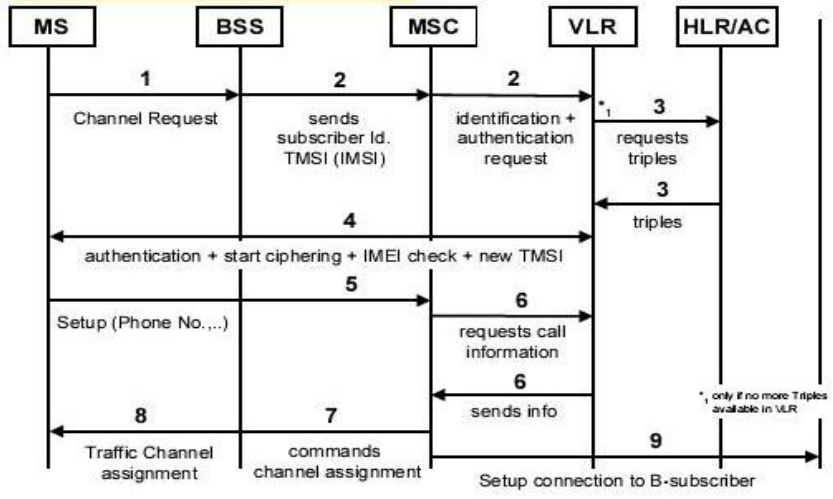
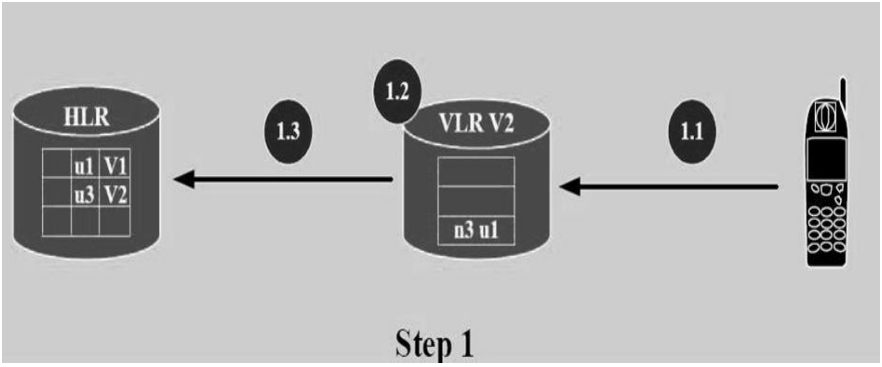
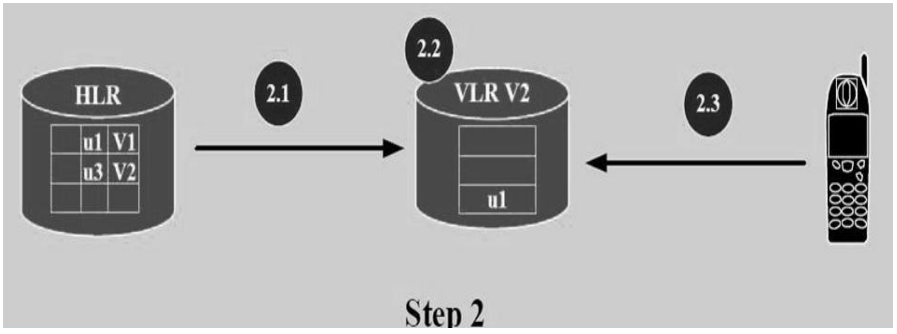


Fig: Mobile originated call in GSM

	(d) Ans.	**Describe VLR overflow control algorithm for Registration.** When a VLR is full, the incoming mobile users cannot receive cellular services • To solve VLR overflow problem, overflow control algorithms O-I, O-II, O-III, and O-IV are presented. • An extra flag (1 bit) is required in the HLR records **Registration:**  **Step 1: Registration Request:** **Step 1.1** same as step 1 of the normal registration procedure **Step 1.2** V2 is full. V2 follows a replacement policy to select a record to be deleted (u3 in Fig.). The storage for the delete record is used to store u1"s information. The selected user (i.e., u3) is called overflow user. The replacement policy may be based on various heuristics **Step 1.3** V2 forwards the registration request to the HLR with indication that u3's record is deleted due to database overflow  **Step 2: Registration Response:** **Step 2.1** HLR update the location of u1, and sets the overflow flag in	**4M** ***Algorithm for registration 2M*** ***Diagram 2M***

		u3's record **Step 2.2** HLR acknowledges the registration operation and sends u1's profile to V2. **Step 2.3** V2 sends an acknowledgment to MS	
	(e) Ans.	**Describe GPRS network node.** **There are two Network Operation Nodes in GPRS** **1. GGSN:** The first is the access point for an external data network and is known as the gateway GPRS support node (GGSN). It contains the routing for GPRS-attached users. With this information, GGSN is capable of delivering the packet data units (PDU) to the user's current access point. The location information can be obtained from the HLR via the optional Gc interface, The Gateway GPRS Support Node (GGSN) is a main component of the GPRS network. The GGSN is responsible for the interworking between the GPRS network and external packet switched networks, like the Internet and X.25networks. From the external networks' point of view, the GGSN is a router to a sub-network, because the GGSN 'hides' the GPRS infrastructure from the external network. When the GGSN receives data addressed to a specific user, it checks if the user is active. If it is, the GGSN forwards the data to the SGSN serving the mobile user, but if the mobile user is inactive, the data are discarded. On the other hand, mobile-originated packets are routed to the right network by the GGSN. To do all this, the GGSN keeps a record of active mobile users and the SGSN the mobile users are attached to. It allocates IP addresses to mobile users and last but not least, the GGSN is responsible for the billing. **2. SGSN:** The second is the SGSN that serves the need of mobile users. When a user is GPRS-attached, the SGSN establishes a mobility management (MM) context containing information pertaining to routing, security and mobility, such as the identity of RA and LA where the MS is residing, and the MS's MM states, etc. The SGSN also ciphers PS traffic, given that the base transceiver station (BTS, in GPRS, BTS replaces the BS in GSM.) is only responsible to cipher CS traffic The Serving GPRS Support Node (SGSN) is a main component of	**4M** ***GGSN 2M*** ***SGSN 2M***

		the GPRS network, which handles all packet switched data within the network, e.g. the mobility management and authentication of the users. The SGSN performs the same functions as the MSC for voice traffic. The SGSN and the MSC are often co-located. The SGSN is connected to the BSC. The SGSN is the service access point to the GPRS network for the mobile user. On the other side the SGSN relays the data between the SGSN and relevant GGSN (and vice versa). The SGSN handles the protocol conversion from the IP used in the backbone network to the sub-network-dependent convergence protocol (SNDCP) and logical link control (LLC) protocols used between the SGSN and the mobile users. These protocols handle compression and ciphering. The SGSN is also responsible for the authentication of GPRS mobiles. When the authentication is successful, the SGSN handles the registration of the mobile to the GPRS network and takes care of its mobility management.	