A cellular network

A cellular network is a radio network made of number of radio cells, each severed by fixed positioned based station. These cells stations cover several different areas and provide large radio coverage. In order for this to happen a variable number of portable transceivers can be used in any cell and moved through one cell during transmission. The use of multiple cells means that if the distributed transceivers are mobile and moving from one point to another point they should change also from cell to cell. This mechanism could be different according to the type of network and change of circumstances. In this case clear coordination between base station and mobile station is must in order to avoid communication interruption.

The most common example of cellular Network is a cell or mobile phone, which is a portable telephone that could be dialled or receives calls through base station or transmitting tower. Radio waves transfer signal to and from mobile phone. The coverage area of service provider sometime is split into small cells in order to prevent signal losses and also a large number of active phones in the area. The range of signals could be different in cities and rural areas. All base stations are connected to mobile phone switches centre, which connect to a public telephone network or to another mobile company switch. As the mobile consumer moves from one cell area to another cell, the switch automatically commands the handset and a cell site with a stronger signal (reported by each handset) to switch to a new radio channel (frequency). When the handset responds through the new cell site, the exchange switches the connection to the new cell site.

Modern cell phones networks use cell as radio frequencies are limited, shared resource, base stations and handsets change frequency and use low

power transmitters in order that limited number of radio frequency can be used at the same time by many users with less interferences.

To distinguish signals from a varieties of different transmitters, frequency division multiple access (FDMA) and code division multiple access (CDMA) has been developed.

Advantage of cellular Network over other alternative solutions is:
Increase capacity.

Power usage reduced.

Huge coverage area.

Interference from other signals reduced.

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The evolution of the cellular Network started to flourish during the last years in which several different systems were developed; as a result we have first generation (1G), second generation (2G), third generation (3G) cellular networks and the trend is continuously increasing. The first generation (1G) was used from 1970-1980 and now is retired. In 1990 the second generation (2G) of Networks were launched such as Global System for Mobile communications (GSM), Personal Communications Service (PCS), and Integrated Digital Enhanced Network (IDEN) and so on. The second generation (2G) of networks replaced the (1G) and became very popular with digital processing, enabling wireless transmission of voice as well as data and have different Variety of new features such as a Push to Talk, Short

Messaging service(SMS), caller ID, conference calling, voice mail, email messaging and so on.

After the ongoing success of 2G, carriers to respond to the worldwide demand of the speed trend, they developed a robust interim generation of cellular Networks which is the 2. 5G such as General Packet Radio Service (GPRS), Enhanced Data Rates for GSM Evolution (EDGE), High-Speed Circuit-Switched Data (HSCSD) and so on. This upgrade increase bandwidth needed to support a diverse variety of new applications including large email messages resourceful web browsing, navigation, basic multimedia faxing and different data at typical dialup speed. This generation of network become popular and supported many firm’s workers. Carriers continuously competing to add further enhancement to the new generation of Networks and from as a result we have the third generation (3G) with increased bandwidth to DSL with range of 144 Kbps to 2+Mbps are produced to provide support for more demanding multimedia applications such as video conferencing, voice over (VOIP), full motion video and streaming music to support television programs (satellite radio) and faster file downloads.

GSM

IT is standard mobile telephone system used across Europe and created in 1982. Global system for mobile communication (GSM) is one of the second generation (2G) of mobile Networks promoted by the GSM association, became the most popular standard mobile phone in the world with over 3 billion customers in more than 212 countries. GSM is a cellular Network and this means that mobile phones connect to it by searching for cells or nearest site. GSM has five different cell sites and its presents everywhere makes

international roaming very common between phones operator; also allow mobile users to use their device in many parts of the world and change carriers without changing phones. On the other hand GSM benefits Network operators who have the possibility to choose equipment from any worldwide vendors using GSM.

Features of GSM are:

Low cost alternative to voice calls.

Text messaging.

Worldwide emergency telephone number (112/999), which connects international travellers to emergency service without knowing the local emergency service number.

The GSM standard enhanced their services adding the general pocket radio service (GPRS), higher speed data transmission using enhanced data rates for GSM evolution (EDGE).

GSM Network operates in a number of different frequency ranges with continuously enhanced full rate coder-decoder (CODEC). One of the key features of GSM is the SIM card or subscriber identity model, which contains the user’s subscription information and phone book.

Finally the GSM system and service are governed by ETSI standard, which is a European telecommunication service institute.

BTS

BSC

MSC

GMSC

VLR

HLR

Access Network

MS

BSS

SMSS

OMC

EIR

AUC

OMSS

ISDNPSTN

GSM Sub Systems architecture

GSM is a part of 2nd Generation systems. GSM's purpose was to provide a circuit switched telephony service to mobile users. GSM uses Time Division Multiple Access. GSM has a different core network than 2. 5 Generation and 3rd Generation infrastructure. The Synchronous Digital Hierarchy (SDH) or Synchronous Digital Network (SONET) standards provide a conventional

transmission line in fixed connections as like from BSS to SMSS interfaces. Inside of the core network, Mobile Application Part signalling (MAP) is used.

Functionality of Various Modules of the GSM System

There are three subsystems in GSM network . These are:
Base Station Subsystems (BSS)

Switching and Management Subsystems (SMSS)

Operation and Maintenance Subsystems (OMSS)

Base Station Subsystems (BSS)
In GSM networks, the access network plays a very important role to connect terminals to the network. The access network BSS is connected to the core network. The main purpose of BSS is to set the connection between a Mobile Station and the Base Station. The first component of a BSS network is the Base Transceiver Station (BTS), which is responsible from air interface and creating a bridge between the network and the Mobile Station (MS). The second component is the Base Station Controller (BSC), which is responsible from all the Base Transceiver Stations (BTS). Simply it is responsible to allocate and release channels at air interface. Base Station Subsystems are connected to SMSS and OMSS.

Switching and Management Subsystems (SMSS)
SMSS is divided into two components. These are Mobile Switching Centre (MSC) and Gateway Mobile Switching Centre (GMSC). MSC is responsible for all the base stations which are connected onto Mobile Switching Centre (MSC) over Base Station Controller (BSC). The GMSC is responsible from the

external fixed network line. Whenever there is a phone call, it comes in or goes out from GMSC. All the incoming calls are directed to Home Location Register (HLR) to detect and look at the profile of subscriber in order to determine if the subscriber is able to make a phone call or not . If the call is accepted it goes to MSC, then from MSC the call goes into Visitor Location Register (VLR), VLR knows the location of mobile stations. Simply we can say that the VLR is responsible from the access network and also from MSC too.

Operation and Maintenance Subsystems (OMSS)

Operation and Maintenance Subsystems (OMSS) is mainly responsible for the security of the network. For example, if the phone is stolen or if the subscriber didn’t pay his bill. One of the important data bases in OMSS are Equipment Identity Register (EIR) and the Authentication Centre (AUC).

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Universal mobile telecommunications system (UMTS)

Universal mobile telecommunications system (UMTS) is one of the third generation (3G) mobile telecommunication technologies, which is also being designed in a (4G) technology. The name UMTS is introduced by ETSI and is usually used in Europe but adapt other names outside the continent, instructed by 3GPP and is a part of a global ITU IMT-2000 Standard. The most common form of UTMS Network uses Wideband Code Division Multiple Access (IMT direct spread) as the underlying air interface. The idea that lies behind the UMTS is to create a network component which is close to GSM/GPRS and also to be able to operate under this existing GSM/GPRS Network (GERAN). UMTS has an additional Access Network to GERAN. All the components in this new access network are totally different than the

components in GERAN access network. As it is mentioned before UMTS can work with both Circuit Switch (2G) and Packet Switch domain (2. 5G & 3G), therefore there are two access networks. One of these is called Radio Access Network (GERAN) and the second one is called UMTS Terrestrial Access Network (UTRAN).

Showing UTRAN infrastructure

The GSM network is a circuit switched network, which means, that there are no IP, high data rate or multimedia messages. UTRAN is a packet switched network, where everything is based on IP address, high data rate and many other facilities are available. In GSM infrastructure, we have got a Mobile Station (MS), Base Transceiver Station (BTS) and Base Station Controller (BSC). But this infrastructure is totally different in UTRAN infrastructure. In UTRAN, there is user equipment (UE) which is the same as Mobile Station in GERAN/BSS. Another component is Node B (NB). The Node B is the base station as BTS and this Node B (NB) is controlled by Radio Network Controller (RNC). RNC is the same as BSC in GERAN/BSS. The main differences are higher data rates, enhanced security, new protocols and signalization for enhanced service factors. These are all provided by the new components in an access network of UTRAN/RNC.

UMTS there are two core networks and two access networks. The advantage of UMTS is that it is very flexible. UMTS supports both circuit switch and Packet Switch Networks. One core network is designed for CS domain and the other one is designed for PS domain. Circuit switch is for the old generation mobiles but still in use. CS domain is not based on IP; we can simply say that CS domain is needed for GSM network. Packed switch

domain is based on internet protocol (IP) and has different new protocol and signalling. PS domain enables high speed data rate as a result of this is that video messaging and all these other internet based and high speed data rates can be obtained. PS domain is needed for GPRS and UMTS. In UTRAN/RNS, user wants to make a call. In this case the user equipment (UE) searches for the nearest Node B and sets the connection. Once the connection is set the call is transferred from Node B (NB) to Radio Network Controller (RNC), From RNC the call goes to PS domain Core Network in GERAN/BSS. Mobile Station (MS) searches for the nearest Base Transceiver Station (BTS) and from here the MS is directed to BSC, if the call is IP based from BSC then the call will be directed to PS domain core network, if the call is not IP based than it goes to CS Domain core network.

UMTS Block Architecture

Iub – This interface happens between the Node B and RNC. RNC is using I-ub interface to control one or more Node B. The I-ub interface is standardized interface; there is also a signalling protocol which uses NBAP.

Iur – This interface happens between the Radio Network Controllers (RNC). Iur helps the RNC to pass its information or data to another RNC. After this process, the user equipment is transferred to new RNC; the signalling protocol uses Radio Network Subscriber Application part (RNSAP).

There are two Iu interface for both PS and CS core networks, one for Iu CS another one is for Iu PS.

Iu CS – This interface happens between UTRAN/RNS and the circuit switch core network domain. Iu-CS carries voice and signalling between UTRAN/RNS and PS domain core network. The signalling protocol is called RANAP.

Iu PS – This interface happens between UTRAN/RNS and the packet switch core network domain. This core network is designed for UMTS and GPRS. Iu–PS carries voice and signalling between UTRAN/RNS and PS domain core networks. The signalling protocol is RANAP.