Call flow in wireless network

PROJECT REPORT

SUBMITTED IN PARTIAL FULFILLMENT

OF THE REQUIREMENTS FOR

INDUSTRIAL INTERNSHIP TRAINING IN

ADVANCED TELECOM

By;

ANUBHAV DASH

REGD NO: 2202070026

COLLEGE: Veer Surendra Sai University Of Technology,Burla

REGIONAL TELECOM TRAINING CENTRE

BHUBANESWAR, ODISHA, PIN:751007

List of topics:

1. INTRODUCTION TO MOBILE COMMUNICATION

2. DUPLEXING METHODOLOGY

3. MULTIPLE ACCESS TECHNOLOGIES

4. GEOGRAPHICAL AREAS OF THE GSM NETWORK

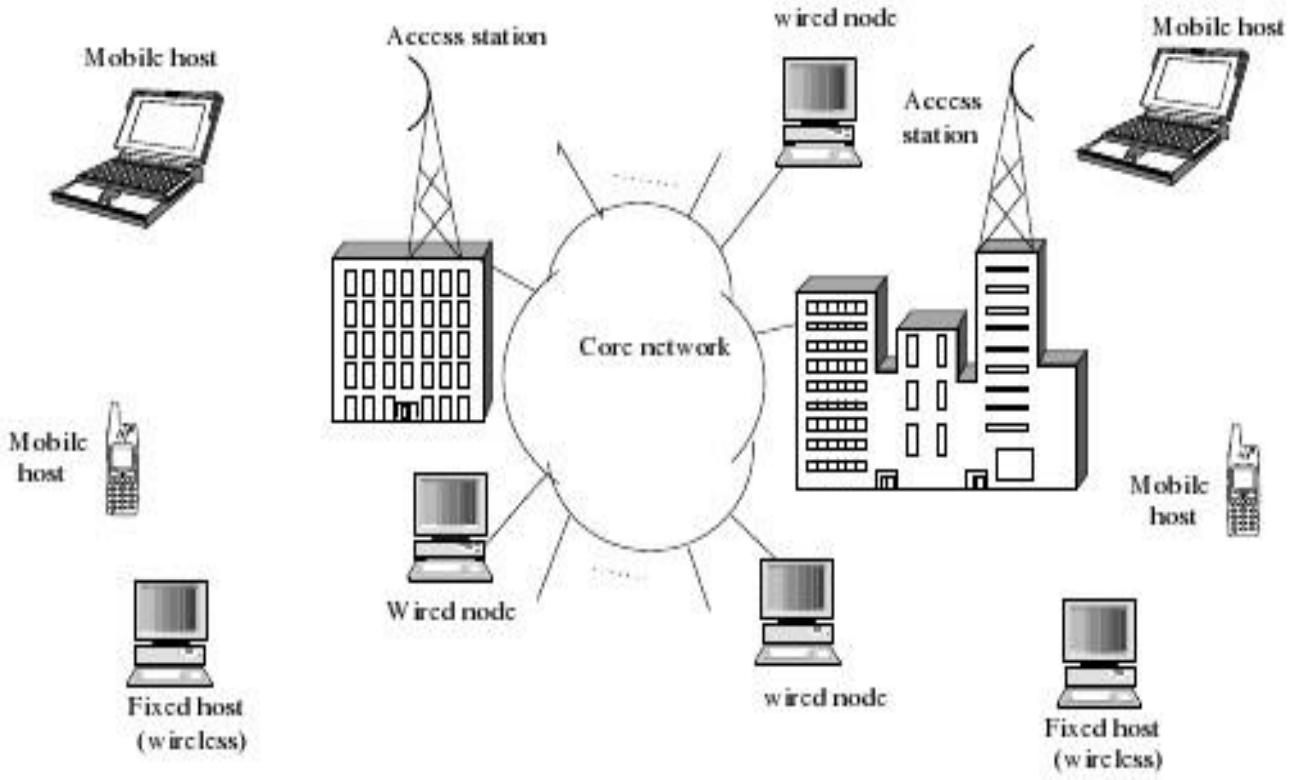
5. GSM ARCHITECTURE

6. CONTROL CHANNELS

7. TELECOM SIGNALING MECHANISM

1. INTRODUCTION TO MOBILE COMMUNICATION

In Telecom network conventionally each user is connected to the Telephone exchange individually. This dedicated pair starts from MDF(Main Distribution Frame), where it is connected to the appropriate Equipment point and ends at the customer premises Telephone.



The connectivity from exchange to customer premises is called “Access Network or Local Loop”, and mostly comprises

of underground cable from exchange up to DP(Distribution Point) and insulated copper wires (Drop Wires). Later on this type of Access Network does not require separate authentication of customer before extending services. Whenever the cable capacity has reached the maximum, additional cable is laid to augment the capacity. Even though there are advantages in introducing wireless connectivity in Subscriber's loop.

1. Duplexing methodology.
2. Multiple Access methods.
3. Cellular principle or reuse concept.
4. Techniques to cope with "mobile" environment, there are certain issues to tackle

2. DUPLEXING METHODOLOGY

Duplexing is the technique by which the send and receive paths are separated over the medium, since transmission entities (modulator, amplifiers, demodulators) are involved.

There are two types of duplexing:

- Frequency Division Duplexing (FDD)
- Time Division Duplexing (TDD)

Frequency Division Duplexing (FDD):

Different Frequencies are used to send and receive paths and hence there will be a forward band and reverse band. Duplexer is needed if simultaneous transmission (send) and reception (receive) methodology is adopted .Frequency separation between forward band and reverse band is constant

Time Division Duplexing (TDD):

TDD uses different time slots for transmission and reception paths. Single radio frequency can be used in both the directions instead of two as in FDD. No duplexer is required. Only a fast switching synthesizer, RF filter path and fast antenna switch are needed. It increases the battery life of mobile phones.

GSM and CDMA systems use Frequency Division Duplexing and corDECT uses Time Division Duplexing.

3. MULTIPLE ACCESS TECHNOLOGIES

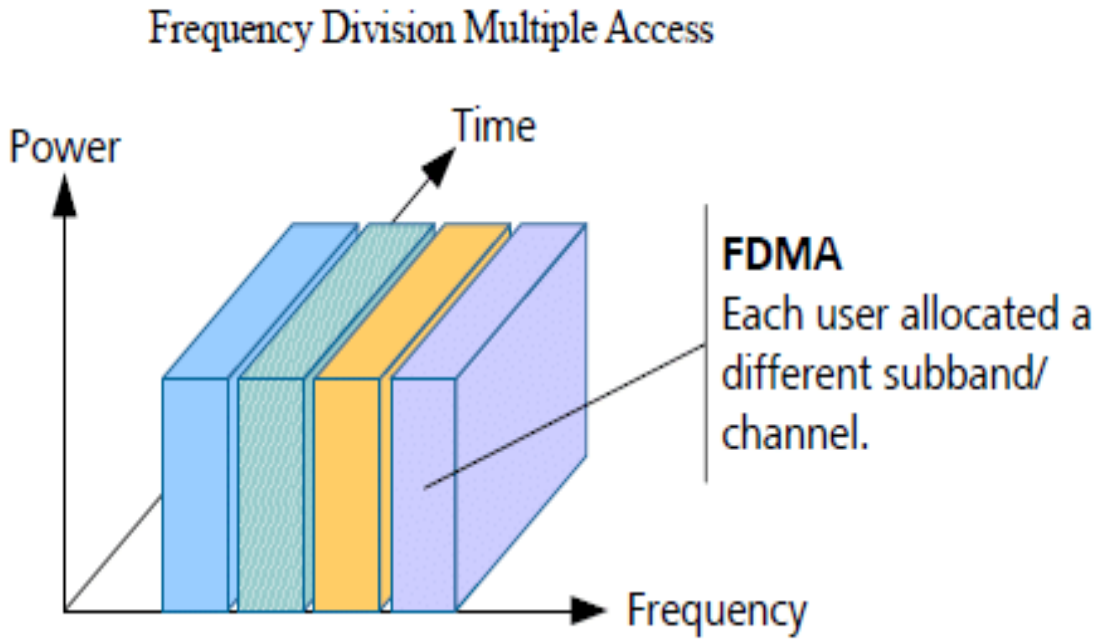
The technique of dynamically sharing the finite limited radio spectrum by multiple users is called Multiple Access Technique. By adopting multiple access techniques, all users cannot get the services simultaneously and some amount of blocking is introduced by the system. This is known as GOS (Grade of Service). Generally there are three different types of multiple access technologies.

They are-

- Frequency Division Multiple Access (FDMA)
- Time Division Multiple Access (TDMA)
- Code Division multiple Access (CDMA)

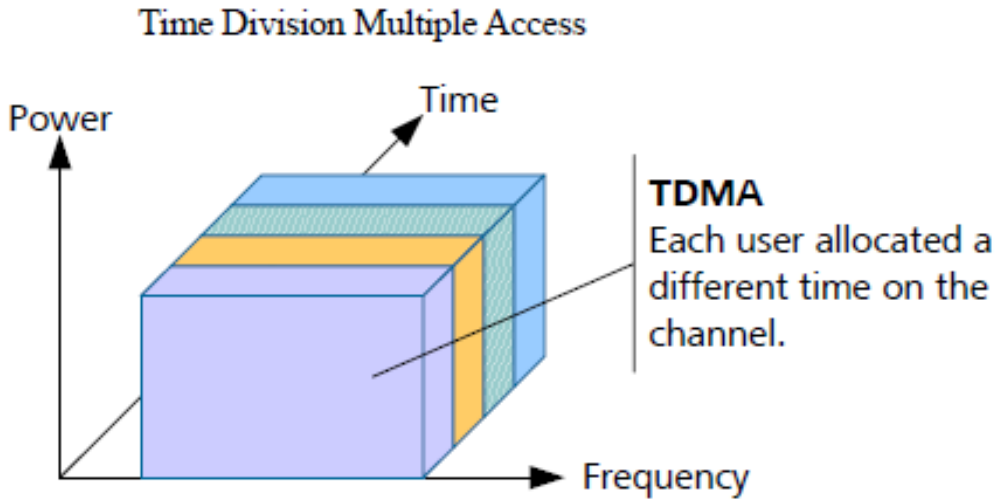
Frequency Division Multiple Access (FDMA):

FDMA is a familiar method of allocating bandwidth, where a base station is allowed to transmit one or more number of preassigned carrier frequencies and a mobile unit transmits corresponding reverse channels. No other base station within range of the mobile will be transmitting on the same forward channel, and no other mobile within range of the base station should be transmitting on the same reverse channel. Both the base station and the mobile usually transmit continuously during a conversation, and fully occupy their assigned forward and reverse channels. No other conversation can take place on these channels until the conversation is completed.



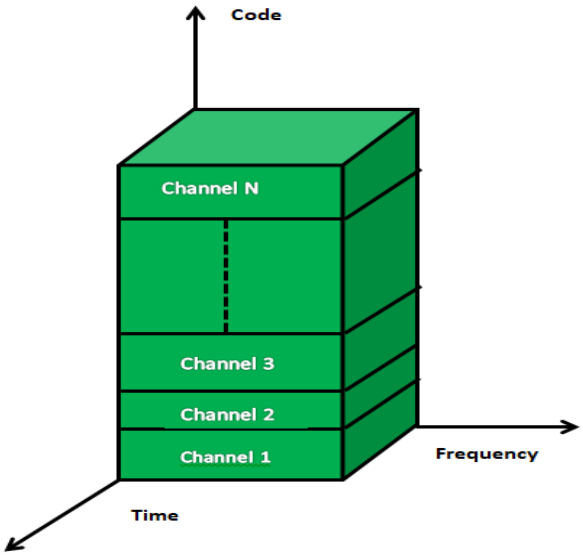
Time Division Multiple Access (TDMA):

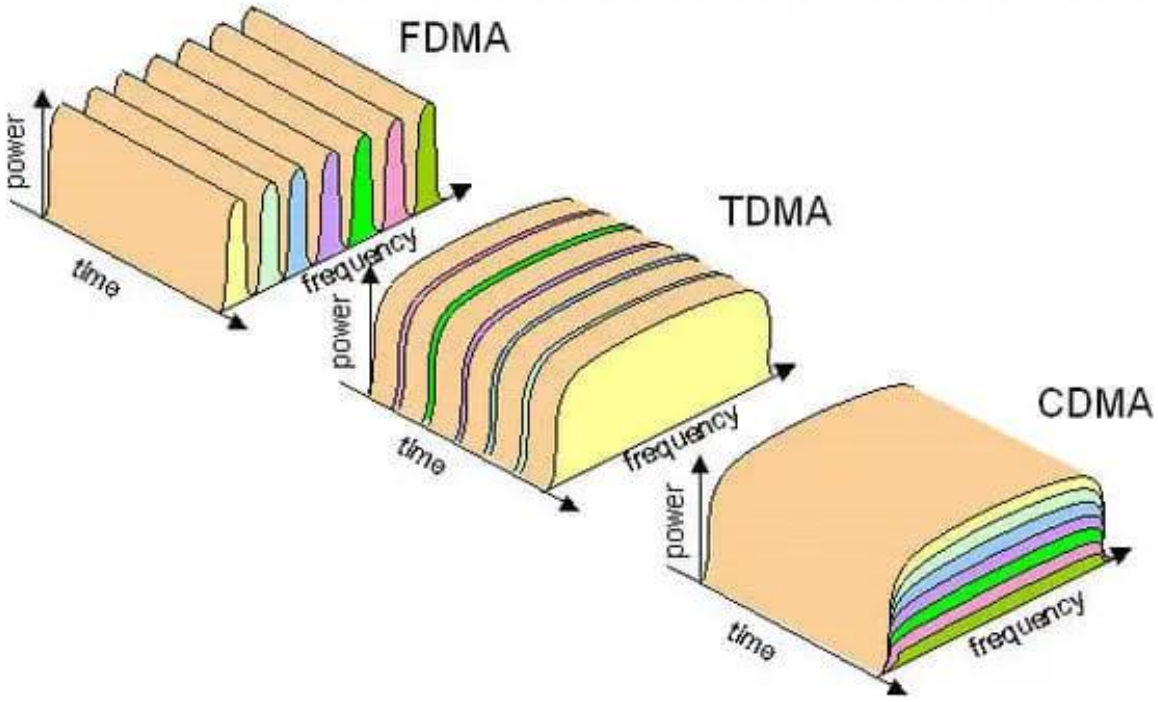
TDMA is a more efficient but more complicated way of using FDMA channels. In a TDMA system, each channel is split up into time segments and a transmitter is given exclusive use of one or more channels only during a particular time period. A conversation, then, takes place during the time slots to which each transmitter (base station and mobile) is assigned. TDMA requires a master time reference to synchronize all transmitters and receivers.



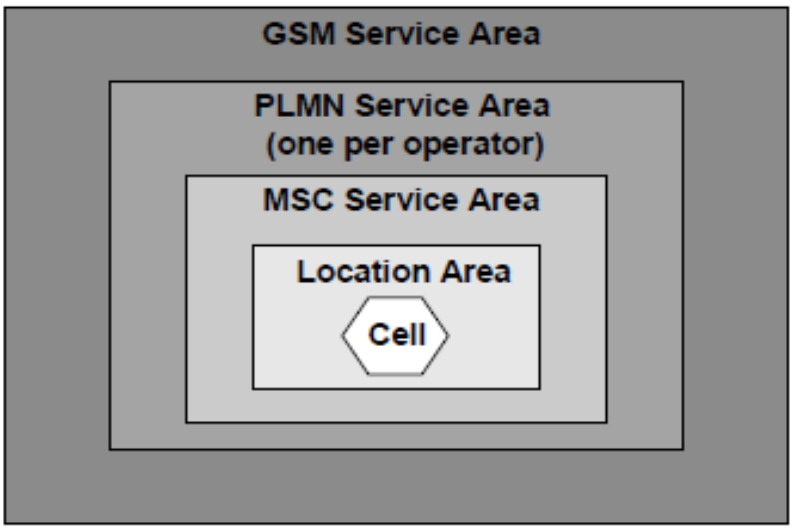
Code Division Multiple Access (CDMA):

CDMA is fundamentally different than TDMA and FDMA whereas FDMA and TDMA transmit a strong signal in a narrow frequency band but CDMA transmits a relatively weak signal across a wide frequency band. Using a technique called direct sequence spread spectrum, the data to be transmitted are combined with a pseudo-noise code (a pre-determined binary sequence that appears random) and transmitted broadband. CDMA under Interim Standard 95(IS-95) uses a bandwidth of 1.25MHz.


Code
Channel N
Channel 3
Channel 2
Channel 1
Frequency
Time

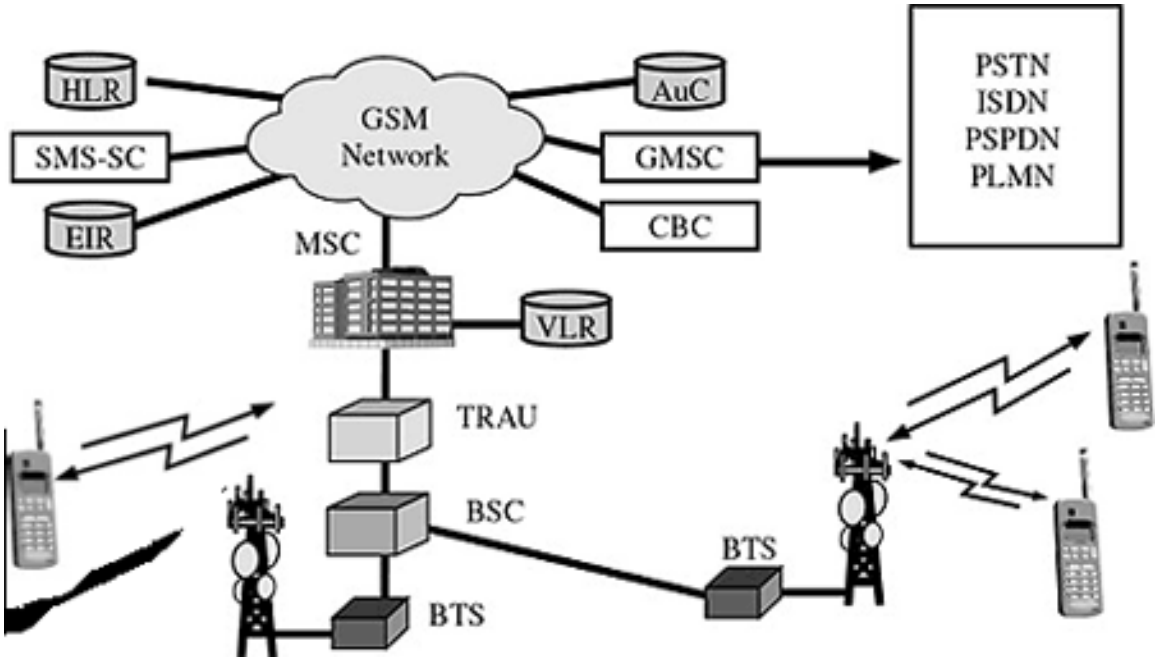

FDMA
power
time
frequency
TDMA
power
time
frequency
CDMA
power
time
frequency

4. GEOGRAPHICAL AREAS OF THE GSM NETWORK



A cell identified by its Cell Global Identity number (CGI) corresponds to the radio coverage of a base transceiver station. A Location Area (LA) is identified by its Location Area Identity (LAI) number which is a group of cells served by a single Mobile Switching Centre/ Visitor Location Register (MSC/VLR). A group of location areas under the control of the same MSC/VLR defines the MSC/VLR area. A Public Land Mobile Network (PLMN) is the area served by one network operator.

5. **GSM Architecture**:



The GSM network is divided into four major systems-

- Network and switching subsystem(NSS)
- Operation and maintenance centre(OMC)
- Base station Subsystem(BSS)
- Mobile station(MS)

Network and switching subsystem (NSS):

The NSS is responsible for performing call processing and subscriber-related functions.

The switching system includes the following functional units:

- Mobile Switching centre
- Home location register
- Visitor location register
- Equipment identity register
- Authentication centre

Mobile switching centre (MSC):

MSC performs all switching functions for all mobile stations located in the geographic area controlled by its assigned BSS's. Also it interfaces with PSTN(Public Switched Telephone Network) with other MSC's and other system entities.

Home location registers (HLR):

The HLR is the main database of permanent subscriber information for a mobile network. The HLR is an integral component of CDMA (code division multiple access), TDMA (time division multiple access) and GSM (Global System for Mobile communications) networks.

It contains

- The identity of mobile subscriber called IMSI
- ISDN(Integrated Services Digital Network) directory number of mobile station
- Subscription information on services
- Service restrictions

Visitor location registers (VLR):

The VLR always integrated with the MSC. When a mobile station roams into a new MSC area, the VLR gets connected to that MSC, which would request data about the mobile station from the HLR. Later, if the mobile station makes a call, the VLR will have the information needed for call setup without having to interrogate the HLR.

Equipment identity registers (EIR):

Equipment identity register consists of identity of mobile station equipment called IMEI(International Mobile Station Equipment Identity), which may be valid, suspect and prohibited.

The information is available in the form of three lists.

- White list - the terminal which is allowed to connect to the network.
- Black list - the terminal reported as stolen are not kept approved. They are not allowed to connect to the network.
- Grey list - The grey list consists of the IMEI numbers of the devices which are outside of the white and black lists and of which electronic communication connections are open.

Authentication Centre (AUC):

It is associated with the HLR. It stores an identity key called Ki for each mobile subscriber. This key is used to generate the authentication triplets.

- It is authenticated using a RAND(random number)
- It consists of SRES(signed response)-to authenticate IMSI

• Also, it has another key called Kc(Cipher key)- to cipher communication over the radio path between the MS and the network.

Operation and Maintenance Centre (OMC)

The OMC function allows the operator to monitor and control the system as well as to modify the conFiguration of the elements of the system. Not only the OSS acts as a part of the OMC but also the BSS and NSS participate in its functions as it is shown in the following examples:

• The components of the BSS and NSS provide the operator with all the information it needs. This information is then passed to the OSS which is in charge of analyzing it and control the network.

• The self-test tasks usually incorporated in the components of the BSS and NSS, also contribute to the OAM functions.

• The BSC, which is in charge of controlling several BTS's is another example of an OAM function performed outside the OSS.

Base Station Subsystem (BSS):

The BSS connects the Mobile Station and the NSS. It is in charge of the transmission and reception. The BSS comprises of BTS (Base Transceiver Station) and BSC (Base Station Controller).

The characteristics of the Base Station System (BSS) are

: • The BSS is responsible for communicating with mobile stations in cell areas.

• One BSC controls one or more BTSs and can perform inter-BTS and intraBTS handovers

• The BTS serves one or more cells in the cellular network and contains one or more TRXs (Transceivers or radio units).

• The TRX serves full duplex communications to the MS.

The BSS can be divided into two parts:

The Base Transceiver Station (BTS):

The BTS corresponds to the transceivers and antennas used in each cell of the network. A BTS is usually placed in the centre of a cell. Its transmitting power defines the size of a cell. Each BTS has up to sixteen transceivers depending on the density of users in the cell.

The Base Station Controller (BSC):

The BSC controls a group of BTS and manages their radio resources. A BSC is principally in charge of handovers, frequency hopping, exchange functions and control of the radio frequency power levels of the BTSs. The BSS takes the authentication of OMCR (Operation Maintenance Control for Radio Network). It maintains the entire network elements. OMCR is a centralised monitor system for BSC, BTS and TCU(Transceiver Coding Unit).

Mobile Station (MS):

Mobile Station consists of two main elements:

The Terminal:

There are different types of terminals distinguished principally by their power and application:

• The 'fixed' terminals are the ones installed in cars. Their maximum allowed output power is 20 W.

• The GSM portable terminals can also be installed in vehicles. Their maximum allowed output power is 8W.

• The handheld terminals have experienced the biggest success in weight and volume, which are continuously decreasing. These

terminals can emit up to 2 W. The evolution of technologies allows decreasing the maximum allowed power to 0.8 W.

The SUBSCRIBER IDENTITY MODULE (SIM):

The SIM is a smart card that identifies the terminal. By inserting the SIM card into the terminal, the user can have access to all the subscribed services. Without the SIM card, the terminal is not operational. The SIM card is protected by a four-digit Personal Identification Number (PIN). In order to identify the subscriber to the system, the SIM card contains some parameters of the user such as its International Mobile Subscriber Identity (IMSI). Another advantage of the SIM card is the mobility of the users. In fact, the only element that personalizes a terminal is the SIM card. Therefore, the user can have access to its subscribed services in any terminal using its SIM card.

6.Control channels:

One or more logical channels can be transmitted on a physical channel. There are different types of logical channels. The type of logical channel is determined by the function of the information transmitted over it.

The following types of logical channels exist:

- Traffic channels
- Broadcast channels
- Common control channels
- Dedicated control channels Note that the first channel type carries speech and data, and the other types control information (signalling).

TRAFFIC CHANNELS (TCH):

The traffic channels are used to send speech or data services. There are two types of traffic channels. They are distinguished by their transmission rates. The following traffic channels are provided:

TCH/F (Traffic Channel Full rate):

The TCH/F carries information at a gross bit rate of 22.8 Kbit/s (after channel coding). The net (or effective) bit rate at the TCH/F is for speech 13 Kbit/s and for data 12, 6 or 3.6 Kbit/s (before channel coding). The transmission rates of the data services allow services which are compatible to the existing, respectively, 9.6, 4.8 and 2.4 Kbit/s PSTN and ISDN services.

TCH/H (Traffic Channel Half rate):

The TCH/H carries information at a gross bit rate of 11.4 Kbit/s. The net bit rate at the TCH/H is for speech 5.6 Kbit/s and for data 6 or 3.6 Kbit/s.

TCH/EFR (Enhanced Full rate):

The EFR provides a voice coding algorithm offering improved speech quality. The algorithm is fully compatible with a BSM(Base Station Manager) speech quality. The algorithm is fully compatible with a GSM 13 Kbit/s speech channel. The main benefit will be improved voice quality which offers prospects to compete with PSTN networks. A TCH/F or a TCH/H may also be used to send signalling information (for example call forwarding and short messages)

BROADCAST CHANNELS:

The information distributed over the broadcast channels helps the mobile stations to orient themselves in the mobile radio network. The broadcast channels are point-to-multipoint channels which are only defined for the downlink direction (BTS to the mobile station). They are four types:

BCCH (Broadcast Control Channel):

The BCCH gives information about the system configuration parameters (for example Local Area Identification, Cell Identity and Neighbour Cells) the mobile station. Using this information the mobile stations can choose the best cell to attach to. The BCCH is also known as beacon.

FCCH (Frequency Correction Channel):

To communicate with the BTS, the mobile station must tune to the BTS. The FCCH transmits a constant frequency shift of the radio frequency carrier that can be used by the mobile station for frequency correction.

SCH (Synchronization Channel):

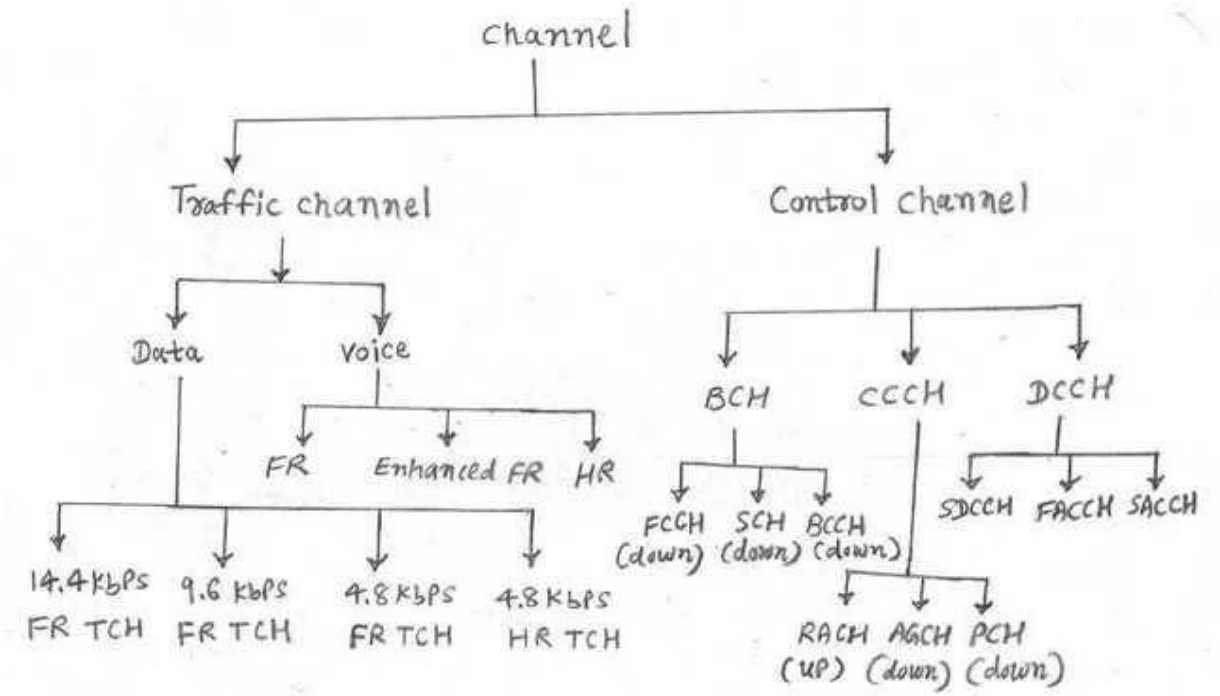
The SCH is used to time synchronize the mobile stations. The data on this channel carries the TDMA frame number and the BSIC (Base Station Identity Code).

CBCH (Cell Broadcast Channel):

The CBCH is used for the transmission of generally accessible information (Short Message Service messages) in a cell, which can be polled by the mobile station.

COMMON CONTROL CHANNELS:

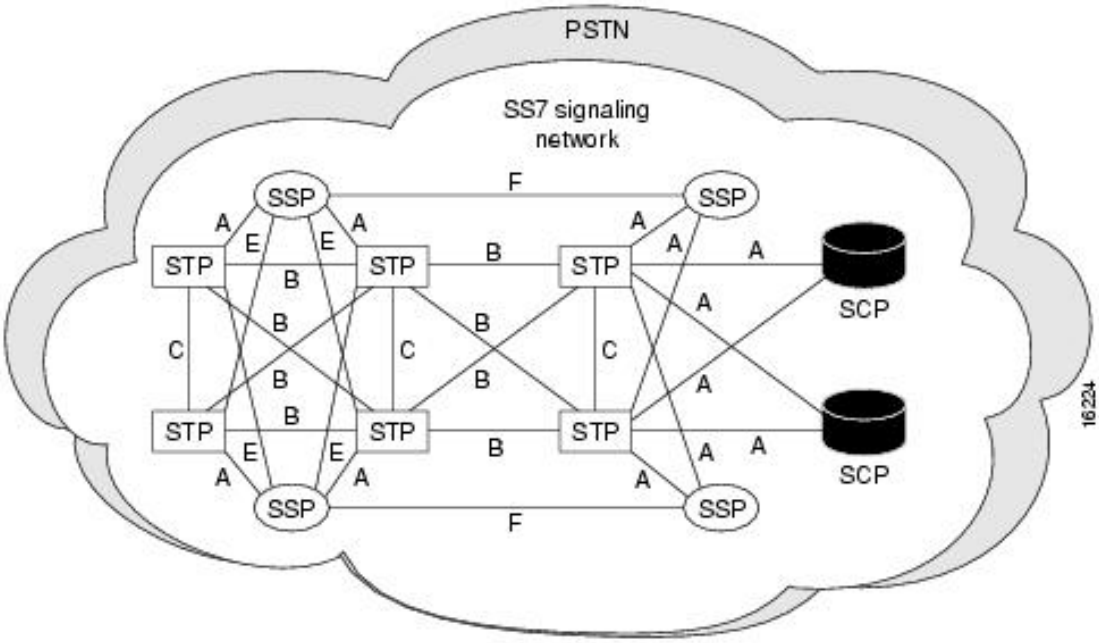
Common control channels are specified as point-to-multipoint channels which only operate in one direction of transmission, either in the uplink or downlink direction.

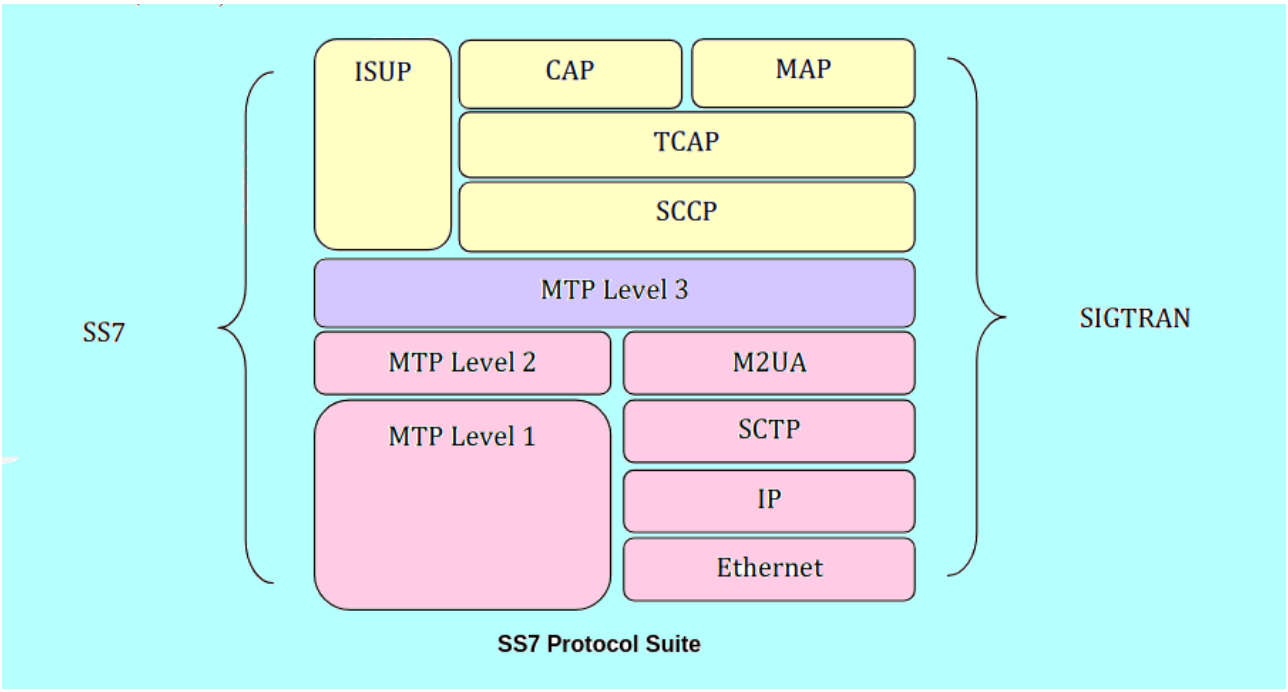


7.TELECOM SIGNALING MECHANISM

Before initiation of a call, signalling is the first process in telecom network. In wired network, signalling is the mechanism for end to end process. Signalling System7 (SS7) is architecture for performing out-of-band signalling in support of the call-establishment, billing, routing, and information-exchange functions of the public switched telephone network (PSTN). It identifies functions to be performed by a signalling-system network and a protocol to enable their performance. There are two types of signalling mechanism such as Common Channel Signalling(CCS) and Common Associate Signalling(CAS).

At present, CCS7 signalling is the leading signalling mechanism because traffic handling capacity is high since separate bandwidth is given for each process hence timeslot is not wasted.





SS7 Protocol Suite

The architecture of CCS7 protocol is based on the OSI layer whereas Level-1. Any node with the capability of handling CCS7 is termed a Signalling Point. The direct interconnection of two signalling points with CCS7 uses one or more signalling links. Level 1 of the 4-level structure defines the physical, electrical and functional characteristics of the signalling link. Defining such characteristics within level 1 means that the rest of the signalling system (level 2 to

4) can be independent of the adopted transmission medium. Any changes within level1 do not affect the higher levels and also the interface between levels 1 and 2 is kept constant.

In a 30 digital environment, usually the physical link is a 64 Kbps channel. This is typically within a digital transmission system using pulse-code modulation (PCM). Other types of link (including analogue) can be used without affecting levels 2 to 4.

CONCLUSIONS:

In this project,I have discussed about an overview of call flow in wireless network. I have divided the above topic in various sections also and discussed every subtopic in a detailed manner.

By going through the report, one can get the brief overview of the wireless network.

THANK YOU