MODULE-I

INTRODUCTION TO MOBILE COMMUNICATIONS AND COMPUTING

Introduction to mobile computing :-

Mobile computing is an umbrella term used to describe technologies that enable people to access mobile services (Networking remotely).

Properties :-

(1) Fixed and wired (F & W)

Landline and Desktop etc...

(2) Mobile and wire (M & W)

Laptop

(3) fixed and wireless (F & W/L)

Desktop with wireless media, printer

(4) Mobile & wireless (M & W/L)

mobile, tablet.

Def 2 :-

A set of distributed systems, participating, connecting and synchronizing through communication protocols.

Not restricted to voice.

Pervasive (handheld and something thay will be invisible)

Novel Applications

(1) Vehicles

Ambulance - Medical Emergencies Domain

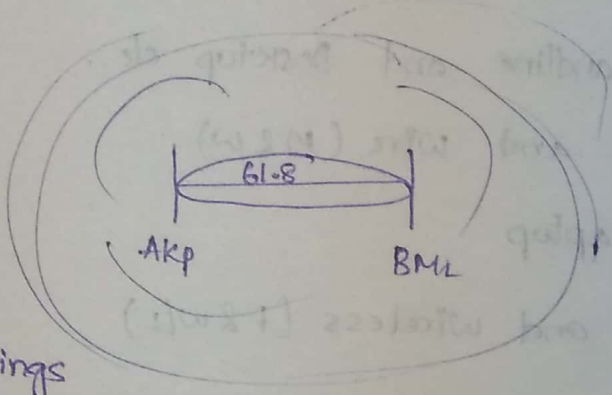
(2) Natural Disasters :-

Tsunami in japan - December 26, 2004

To be general.

cyclone will have an eye where we have higher intensity where as in Tsunami we have we have small eye distance but its effect will be alound outside the eye

Hudood



Japan - Ball Bearings to the pillars in the buildings.

Weather Doplex Centre - Visakhapatinam.

(3) Business

→ cost optimisation

→ Advertisement

(4) Infotinement

↳ Information + Entertainment

Eg: A car with touch screen.

Limitations :-

(1) resource

↳ constraints ↓

Power and Computing Capacity.

(2) Computational Capacity

↓

A system with 4GB Ram is better than 16GB.

2.78 Gttertz — Mobile

(3) Interference

disturbance by an external agent

(4) Bandwidth

Interference is inversely proportional to

Bandwith

(5) Dynamic issues

(6) Network issues

* Inter Operability

Privacy & Security

Malware Ransomware Vanachran Attack

27/12/2019

MOBILE COMPUTING - ARCHITECTURE

Generally viewed as a three-tier system.

- Programming languages
- O.S
- Middleware

Languages we employed in mobile computing

→ J2 SE
→ J2 EE
→ J2 ME → Java optimised for microprocessors.
↓
Micro
→ J.card

C, C++, VB are base

card is something which has. Sensors and microprocess
with some language

OS for mobile computing
Symbian.
Mac → Mechanism for Apple Computers.
Windows.

Macintosh
MAC

Functionalities of OS:

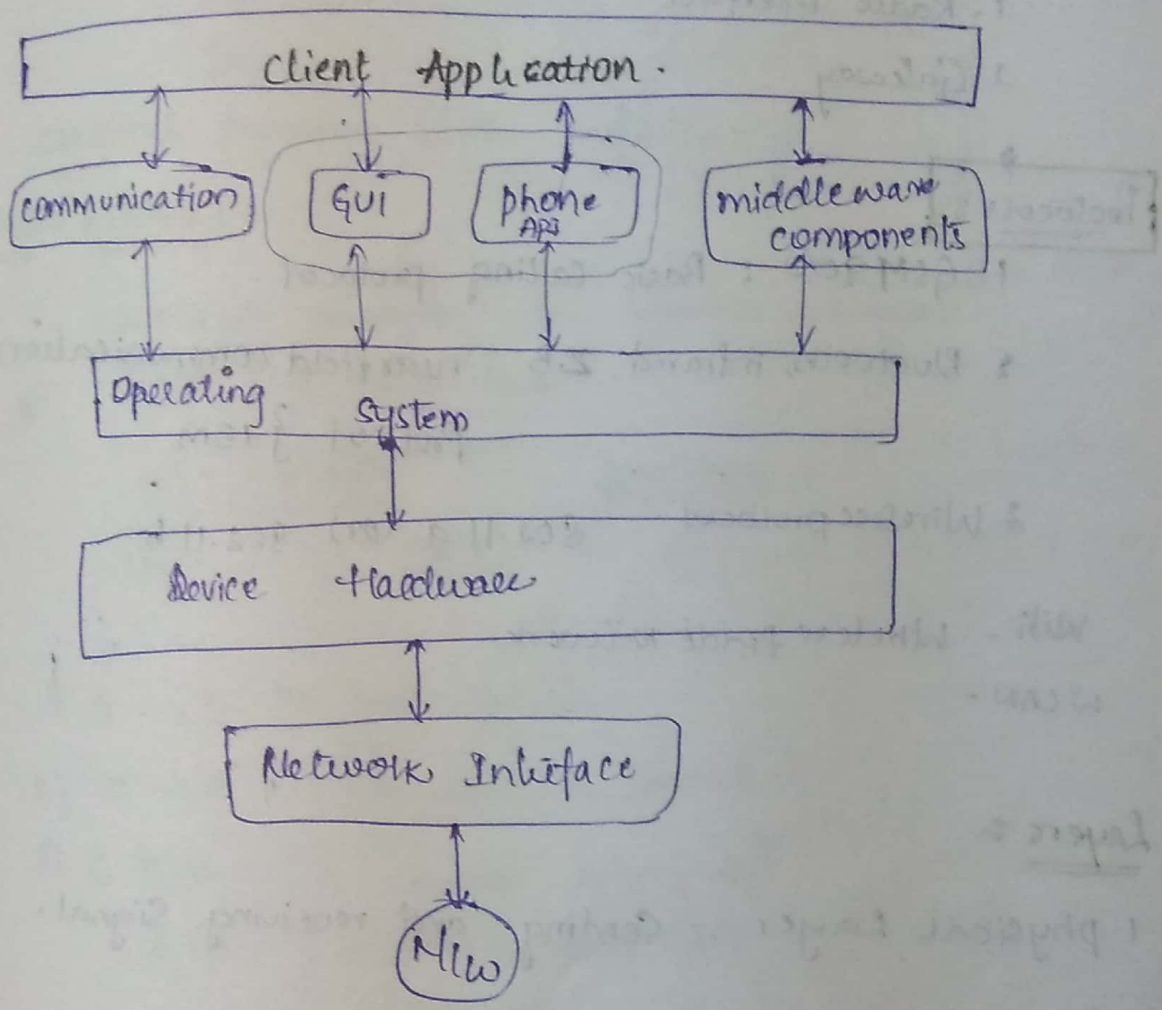
→ which provides Synchronization.
→ Threading
→ Management
→ Interface
→ Execution
→ Configuration.
→ Hardware support

Middleware :

It has software components that link the application with the network.

used mostly for discovery.

Retrieving and adaptation.



Communication API :

1. email
2. Internet
3. SMS.
4. MMS.
5. PIM. (personal information manager)
6. Bluetooth

Middleware components :

1. Service discovery
2. Device management
3. Network Database

Device Hardware

1. display
2. keypad
3. RAM.
4. Flash memory
5. Processor
6. media processor.

Network Interface

1. Radio interface
2. Gateway.

Protocols :

1. GSM900 : Basic calling protocol.
2. Bluetooth, infrared, ZB — nearfield communication Protocol } 15M
3. Wireless protocol. — 802.11 a (or) 802.11 b

Wifi - Wireless fidelity Network.
WLAN -

Layers :-

1. physical Layer :- Sending and receiving signal.
2. Datalink layer : multiplexing.
3. Network Layer : linking the destination.
4. Wireless transport layer : for end to end connectivity
5. Wireless transaction protocol.
6. Wireless Session protocol
7. Wireless Application Environment

30/11/2017

Motivation Specialised MAC:-

CSMA/CD : doesnot hold good in Wireless because

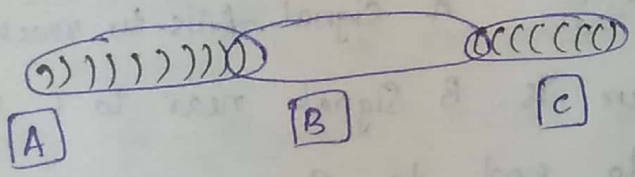
$S \propto 1/d^2$

Signal strength is indirectly proportional to the square of the distance between the terminals

classical problems with CSMA/CD:

Hidden Terminal:

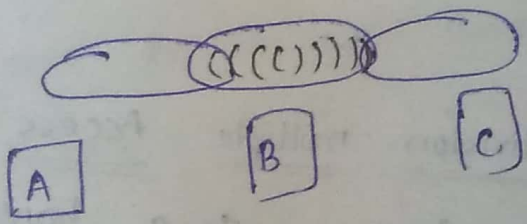
classical problem in Wireless networks.
CSMA/CD fails here



1) A → B (A sends to B)
2) C → B (C also wants to send to B)
3) C X A, (C cannot hear A)
   A X C (A cannot hear A)

Collision occurs at B

Exposed Terminal:



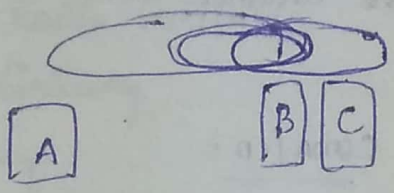
1) B → A (B wants to send to A)
2) C → ex (C wants to send signal to an external which is outside of the ABC arena.

3) C waits for B → A completion which is not at all necessary.

Conclusion:-

B is exposed to C. This causes the delay

Near and far Terminals:-



$S \propto \frac{1}{d^2}$

1) A → B (A Wants to send to B)

2) B → C (B Wants to send to C)

3) Based on the $S \propto \frac{1}{d^2}$ ∴ A Signal fails to reach C as it is faraway and there is B Signal near to C and also want to send to C

↔

SDMA :-

Space Division Multiple Access :-

→ Allocating separate space to users in Wireless network

*→ SDMA is never used in isolation (i.e., Should be used along with TDMA, FDMA, CDMA)

↔

FDMA :-

Frequency division multiple Access :-

→ Assigns certain frequency to a transmition channel between a Sender and a receiver.

Successfully employed in Aviation (in Airport Arrays)

(3) TDMA :-

Time Division Multiple Access :-

* It can be viewed as a modified FDMA

→ assigns fixed sending frequency to a Transmission channel for a certain amount of time

→ Two kinds of TDMA

1) Fixed TDMA / Static TDMA

2) Dynamic TDMA

→ Fixed TDMA : A fixed bandwidth for each channel assigned by a base station

→ Dynamic TDMA : Also called as "ALOHA"

ALOHA is a communication protocol used in university of Hawaii called as ALOHA NET

ALOHA MECHANISM :-

Random

Distributed (in these each node is a master)

Time multiplexing

and Slotted

→ ALOHA neither co-ordinates nor resolves contention (collision) on the MAC

→ It just works for a light load.

→ Throughput :- 18%

→ Slotted ALOHA :-

All the centers need to be synchronized.

Transmission channel is divided into slots.

→ Transmission should start only at the beginning of a slot.

→ Throughput : 36%.

Padding
↓
Supported for the actual data.

thopec, 2017

Reservation
↓
In this we can achieve upto 80% efficienty.

Explicit Resenation &
- ALOHA MODE : Competition for small Data slots collisions are possible.
- Reserved mode : No collisions are possible

Implicit Reservation :-

A C D A B A _ F
↳ space

→ All the senders compete for that empty slot
→ Once allocated the station sense the data.

A C _ A B A Q _

→ Q has won the competition for the first slot and D, F have completed their transmission Hence by using a coded pattern slots are reserved.

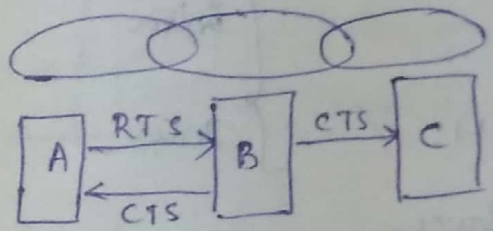
→ TDMA :
Each slot is further divided into mini slots

Multiple Access with collision Avoidance (MACA)

→ Solves both hidden and exposed terminal problems.
→ Does not need a base station.
→ Random Access and Dynamic Reservation
→ Two signals [RTS → Request to send
CTS – clear to send.

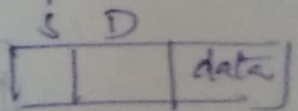
→ Signalling packet
↓
. It contains Sender Address, receiver Address and packet size.

Solution for Hidden Terminal :-



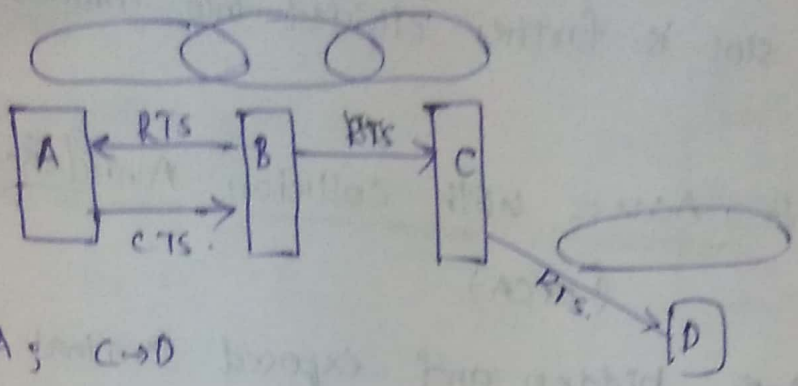
1) A → B , C → B
2) A sends RTS first
3) C also sends sends RTS.
4) B issues CTS to A

CTS packet will be like



The desination will check for the the Desination address of in the Signalling packet Send by A
If it belongs to it then it will take otherwise discard

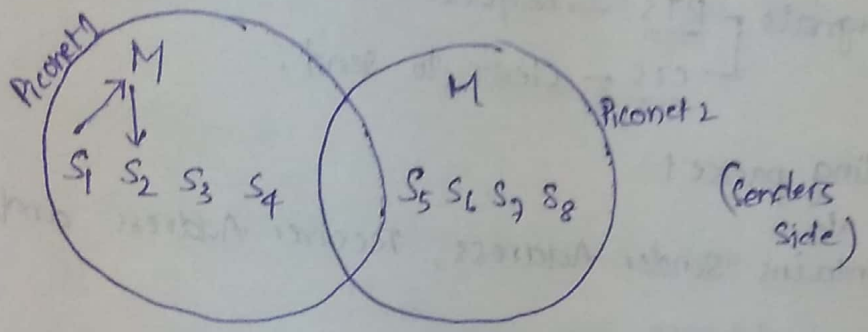
Exposed - Terminal Solution :-



1. B → A ; C → D

6/12/17

Polling :



1. No two Slaves can communicate with each other

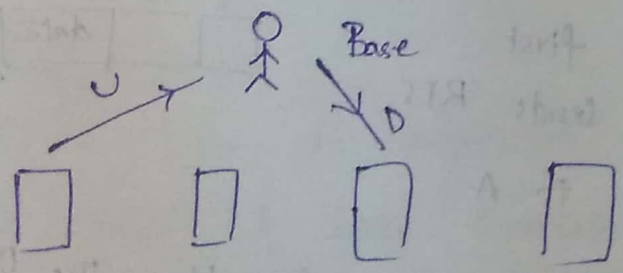
S → S : ✗

2. only slave to master S → M : ✓

3. Dynamic Selection of slaves.

} intra, Inter

ISMA :



→ Inhibit Sense multiple Access (ISMA)

→ Two protocols - Uplink & downlink

→ Among four terminals one is selected randomly and one station is granted downlink with data, rest of

the stations also gets downlink with no data and busy tone

CDMA :

Two key concepts

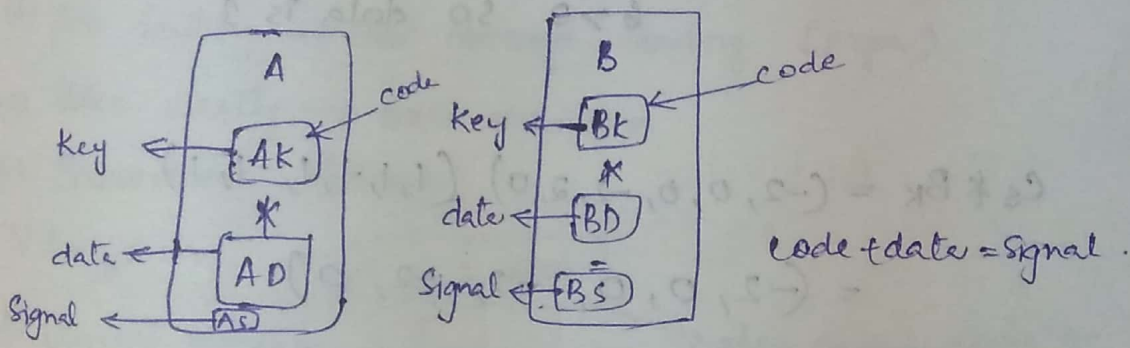
(1) Orthogonality - for two codes is cross product should be zero

$$C_1 * C_2 = 0$$

(2) Autocorrelation - for a code C_1 when multiplied by itself the value should always be greater than 0

$$C_1 * C_1 :> 0 \quad , C_2 * C_2 :> 0.$$

(3) Working - for sender A,



→ What if As and Bs need to send simultaneously

AK = 010011	BK = 110101
Ad = 1	Bd = 0.

Replacement schema :

0 : -1
1 : +1.

As = Ak * Ad
= 1 (0, 1, 0, 0, 1, 1)
= 1 (-1, 1, -1, -1, 1, 1)
= (1, 1, -1, -1, 1, 1)

Bs = Bk * Bd
= 0 (1, 1, 0, 1, 0, 1)
= -1 (1, 1, -1, 1, -1, 1)
= (-1, -1, 1, 1, -1, -1)

$C_s = A_s * B_s$

$= (-1, 1, -1, -1, 1, 1) + (-1, -1, 1, -1, 1, -1)$

$= (-2, 0, 0, -2, 2, 0)$

Demultiplexing

(Receivers side)

A: $C_s * A_k$; $C_s * B_k$: B

$\Rightarrow C_s * A_k = (-2, 0, 0, -2, 2, 0)\ (0, 1, 0, 0, 1, 1)$

↓replace

$= (-2, 0, 0, -2, 2, 0)\ (-1, 1, -1, -1, 1, 1)$

$= (2, 0, 0, 2, 2, 0)$

take non-zero entities and add them $2+2+2=6$

$6 > 0$ so data is 1

$C_s * B_k = (-2, 0, 0, -2, 2, 0)\ (1, 1, -1, 1, -1, 1)$

$= (-2, 0, 0, -2, -2, 0)$

$= -6 < 0$

data is 0.

UNIT-2

AMPS :-
Advanced Mobile phone System

TACS :-
Total Access communication System

} 1G (850 MHz)

1G → 2G (GSM)

(850 MHz) → (900 MHz), 1800, 1900

isolated

ADVANTAGES :-

(1) 2G is digital compared to 1G analog signal.

(2) SMS facility → Short Message Sending (pager)

(3) Voice clarity → noice reduction

(4) Environment friendly.

(5) Encryption ⇒ 2.5G : CDMA → also called CDMA 95

(6) Digital protocol - WAP protocol

(2) MMS facility.

(3) Email

(4) WWW

(5)** Voice and Data at the same time.

⇒ 2.75G - EDGE (Enchanced Data Rate for GSM Evolution)

Speed - 56 Kbps

(1) clear and fast termination of data

⇒ 3G (UMTS) (Universal Mobile Telecommunication System)

(1) 3GPP - (Generation partnership project)

(2) 42 Mbps

(3) Packet Switching Possible

(4) TV

(5) Media Streaming

(6) Simultaneous Videocall.

⇒ 3.5G — H+

(1) High Speed up link packet access and docon link Pack access

EVDO — Evolution in Data Optimization.

⇒ 4G — long term Evolution.

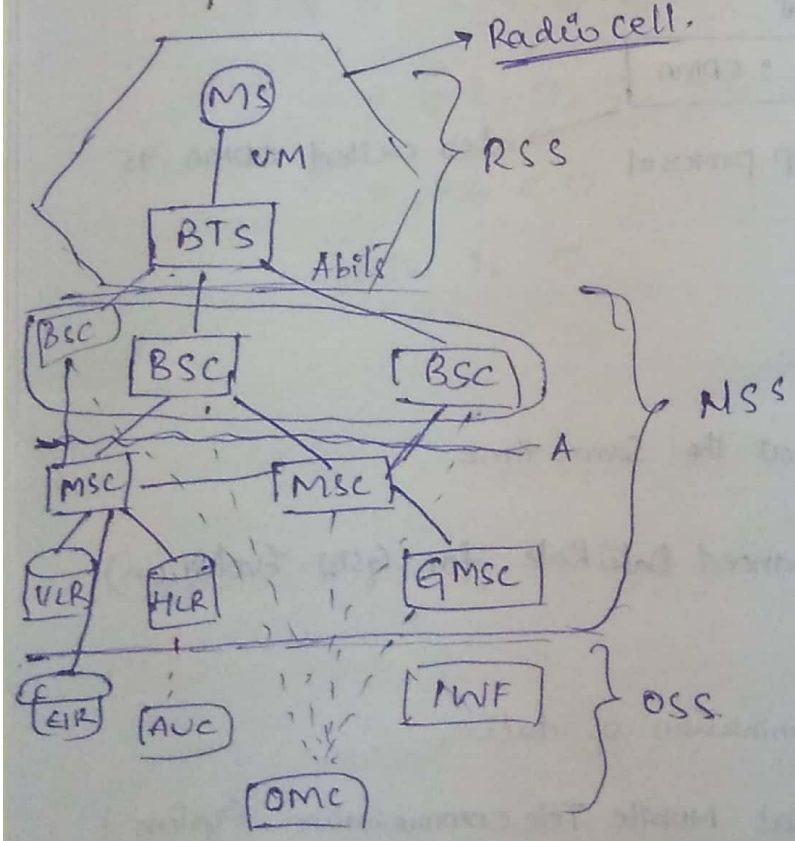
* → It uses OFDMA — Orthogonal four Division Multiple Access.

→ lower latency

→ World wide Intra Operability.

20/12/17

GSM — Architecture



MS - Mobile station

BTS - Base Transceiver Station

BSC - Base Station Controller (Telephone exchange)

MSC - Mobile service Switching Centre

VLR - Visitor Location Register

HLR - Home Location Register

Radiocell :- Nos of mobile stations are connected to the BTS.

UM : Interface blw MS and BTS.

Exchange ~~Interfaces~~ Networks

Abis - An interface blw BTS and BSC

A - An interface blw Bsc and MSC

EIR :- Equipment Identity Register

AUC : Authentication Center

OMC : Operation & maintainance center.

GMSC :- Gateway MSC

IWF : Interface ~~Data~~ Networking function.

RSS → Radio Subsystem

1) It deals with all radio specific entities.
2) Coding and decoding of voice.
3) Rate adaption

4)

BTS :-

→ Concept : Sectorized Antenna
→ Signal processing.
→ Amplification

Bsc :-

→ Controller of BTS.
* → Bsc resolves the frequency.
** → It handles the handover
→ Paging of MS.
→ Channel Establishment via "A" Interface

Railways
70, 90
110,
130
160 (132)

MS :-

→ A Valid Sim and IMA
↓ ↳
Subscriber Identity Module — International mobile equipment identity.

Functionality of SIM :-

① Network Identification.
② Service Subscription.
③ Stores Dynamic Information.
*④ Contains cipher key.
↳ to unlock the digital signal.
⑤ user services.
⑥ → Microphone
→ Display.
→ Programmable Software Keys.
→ Bluetooth
→ Modem

NSS →

Heart of the GSM.
Handover blw various BSC.
World wide Localization
*Accounting & Roaming

MSC :-

Hyper performance Digital ISDN Switch.

GMSC :-

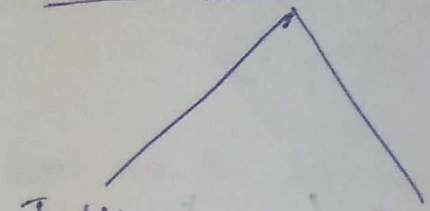
Additional Gateway among MSC

IWF :-

connection setup.
Connection release
Hand Over between MSC's.

27/12/17

CHANNELS :



Traffic
- voice
- fax
- data

Control
Control information

TCH/F : Traffic Channel with full data rate 22.8 kb/s.

Max data sent through a TCH/F channel is : 13 kbps.

9.2 → Error Correction - i,e remaining is used for error correction

TCH/H :

→ 11.4 Kb/s

→ 5.6 Kb/s → is used

remain → No error correction in this

5.6 (one data frame) , 5.6 (another data frame) } Two frames will be Send.

As there is no error correction a quality of the signal will be decreased.

STD. CODEC :

for full Rate : 13
for half Rate : 5.6
for Enhanced frame Rate : 12.2

} Voice fax.

HR → 4.8
FR → 9.6
EFR → 14.4
} data

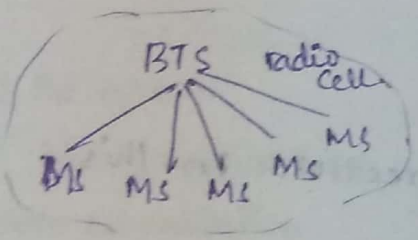
TANDOM FREE OPERATION :-

→ Instead of std.codec ((pcm)/(BTs)) we can go for gsm.codec so the signal is increased only in half ~~frame~~ Rate as there is no error correction.

Control Channel :-

① BCCH.
→ Broadcast Control channel.

(i) Simple BCCH :-
It is a from Bts to all Msc in it radio cell.

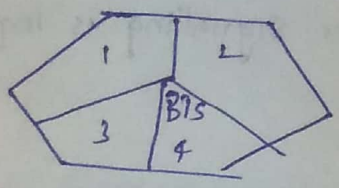


(ii) BCCH with FCH, SCH :-
↓ frequency ↓ synchronization

Eg: used for personilized msgs
Bts to particular MS with the use of FCH & SCH

② CCCH : Central Control Channel :-
It is a downlink channel from Bts to MS while giving a call.

Radio cell will be represented with pentagon



→ Pages are the Sectorized areas in a given radio cell.

→ PCH : BTS → MS (Incoming call)

→ RACH : MS → BTS (Outgoing call).
↓
Random Access Control channel

→ AGCH : If BTS is free BTS – MS
↓ (i.e Acknowledgement channel)
Access Grant Control channel.

③ DCCH
↳ Dedicated control channel :

① It is bidirectional control channel
ie, uplink & downlink happens to same channel.

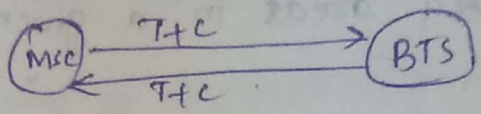
① SDCCH
↳ Stand Alone Dedicated control Channel.
→ Always used in combination with TCH.
→ used to setup a setup between MS and BTS
→ It is low signalling channel.
→ The capacity 782 B/s

② SACCH :
↳ either from BTS → MS or MS → BTS implies two properties
① Signal Power
② Channel Quality along with TCH

③ FACCH :

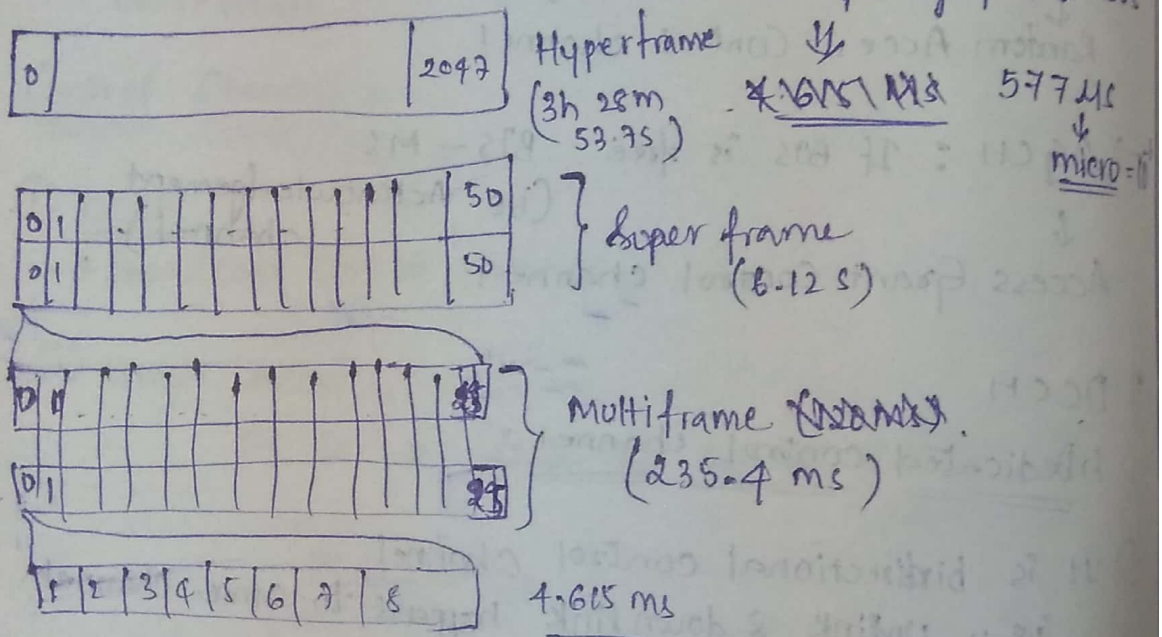
→ Used only when more signalling is required.

Basic senario



FRAME HIIERARCHY

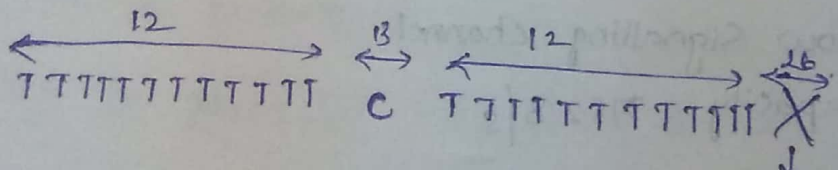
Time Capacity of One Burst



B

8B = 1C / 1F

→ 26 channels : Super frame



After this ↓ Backup will be taken by BTS.

(3h 28m 53.76s).

1 HyperFrame = 2,715,648 frames

In Data Analysis and Storage part takes place at Burst level i,e Bit level

This makes GSM → complex.

28/12/2013

: GSM PROTOCOLS :

Layer 1 : (physical layer)

→ It creates normal Burst in Bts.
→ Multiplexing the frame
→ It detects Ideal frames.
→ It measures the quality of a frame.
→ Error detection by GMSK (Gaussian Minimum Shift Key)
(forward Error correction).
→ channel encoding and Decoding.
→ The maximum coverage area for a Bts is 35kms.

Layer 2 : Data Link layer.

→ LAPD Link Access procedure for Data Channel.
↳ It deals with Traffic channel.
→ Link establishment, connection and termination done through this frames.
→ Segmentation (frames) reassembly.
→ flow of control
→ SS7 → Signalling Standard 7
↳ It deals control channel

Layer 3:-

It acts as all the five remaining layers of OSI.

RR – Radio resource
↳ Ms – BTS

RR' → The property of BTs i,e. from BT → MS.

BTSM → BTs ⇌ BSM

Um → Interface

M → Management

BSSAP → Base Stale Subsystem application part

It controls all the BSC's.

BSC is always in between BSC – MSC

MM → Mobile Management

Use the User registration, Authentication, identification and location updating.

CM → Call Management

Call control : incoming and outgoing.

SMS :

SS : Supplementary services

- call wait
- call hold.
- Block ...

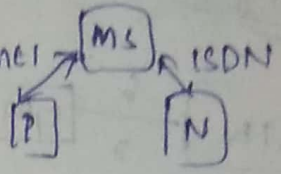
CC : point to point connection b/w terminals

call establishment, clearing and change.

LOCALIZATION AND CALLING:

MSISDN : ISDN → is also an network entity.

Mobile station integrated Services Digital network



Country code :

↓

+91 – 3 digits – 7 digits

C ↓ Subscriber ↓ Identity / user.

IMSI : (HLR)

Integrated Mobile Subscriber Identity.

Used to identify MS in Network

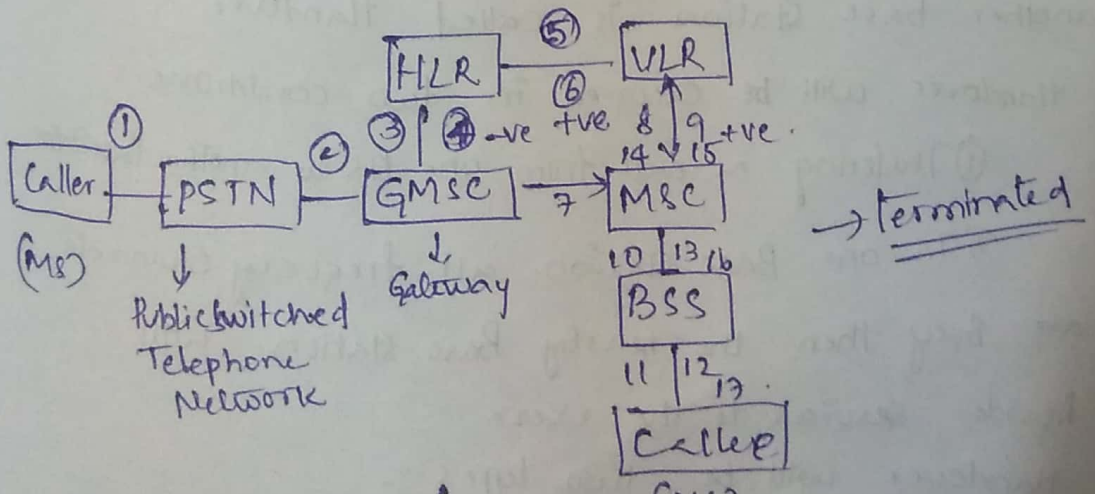
TMSI : (VLR)

Tempory Mobile Subscriber Identity

MSRN

Mobile Station roaming Number.

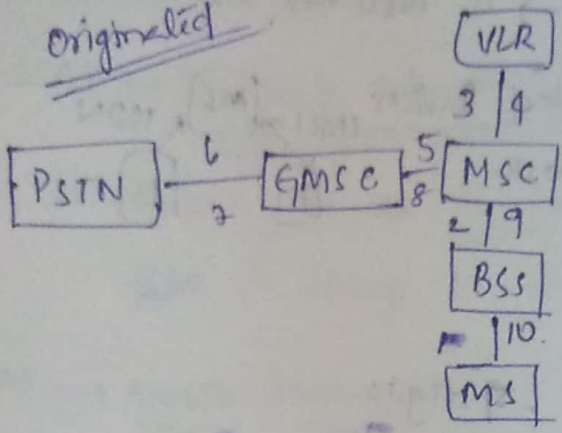
↳ International Number



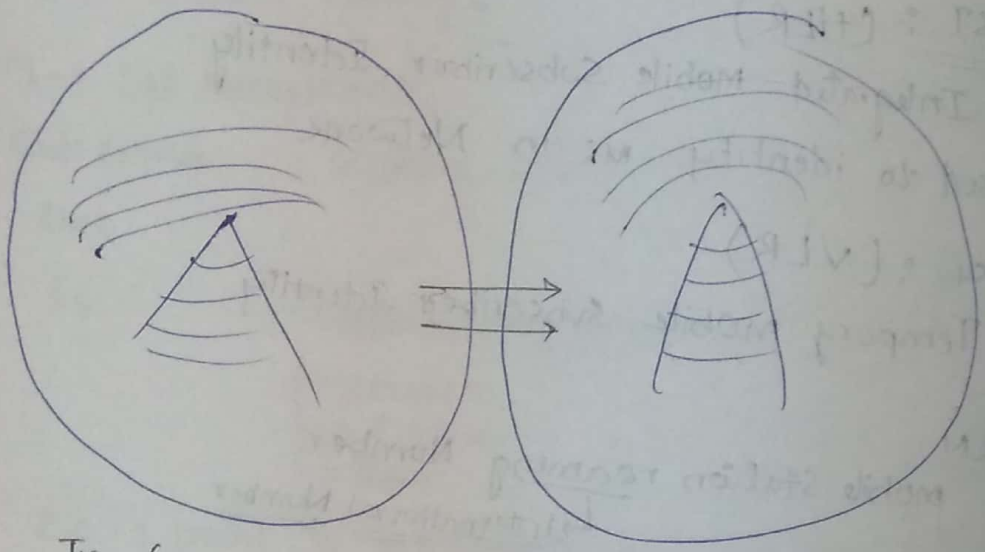
Mobile terminated / originated call.

↓ ↓

who receives. who originates



HandOver Concept



Transfering a call from one base station to the another base station is called HandOver.

Handover will be occored in two conditions

① Trafering ~ call from one BTS to another BaseStation

② In one Base station all frequecy channels are Busy then the nearBy Base station will Provide services to the User.

Handover will be two types :-

① Soft → No interppr will be there

② Hard → a little bit of interupt will be occured by disconnecting the call usually occurs in hillstations.

HandOver in GSM

- **Inter cell Handover**
  When a Mobile User moving from one BTS to another BTS
- **Intra cell Handover**
  In BTS if all the frequencies are Busy.
- **Inter-Bsc Handover**
- **Inter Msc Handover**