16/03/2024

Different gens of Wireless Cellular Networks.

1. 1G.
2. 2G.
3. 2.5G.
4. 3G.
5. 4G.
6. LTE.

1) 1G (Advanced Mobile Phones) [AMPS]

→ Analog freq modulation → ASK.

→ Dual band → Uplink (Reverse Band)
→ Down link. (Forward band).

Frequency Division Duplex. FDD.

→ To increase system capacity, FDMA is used.

→ Uses 800 MHz band. (Allotted by FCC & ITU)

A — 333 Channels. B — 333 Channels. → 666 [416 – Traffic, 250 – Control]

Control is used for → Setting up a call.
→ Clear a call.
→ Call handoff.
→ M/c operation.

ID Numbers:

→ MS — (1) ESN (Electronic Serial No.)
(2) MIN (Mobile Identification No.) (34 bit)
↓ Derived by 10 digit No.

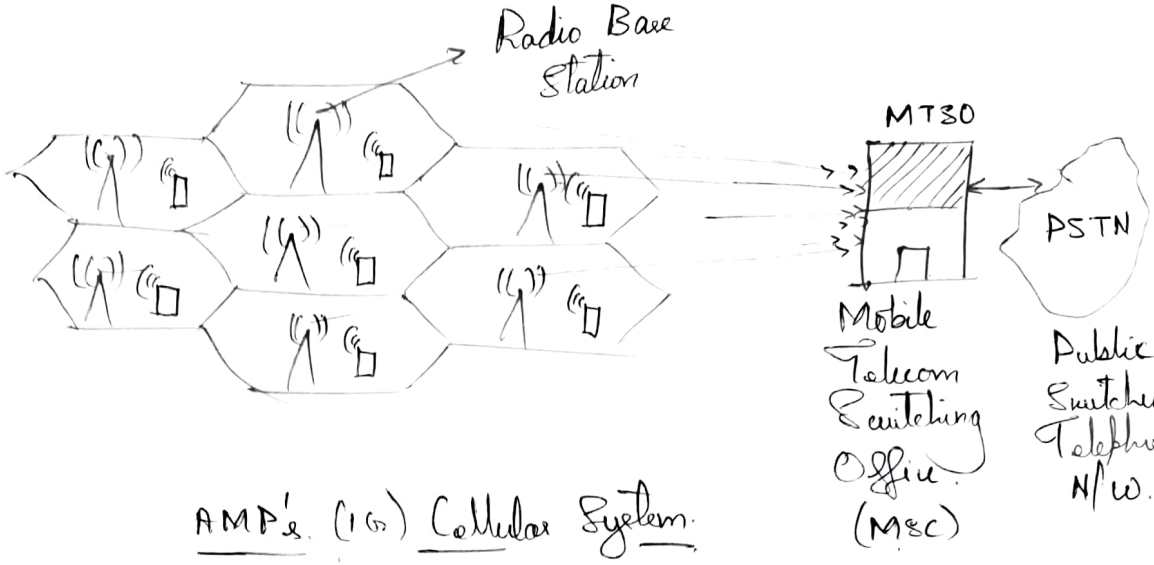
→ BTS — 15 bit binary No. (SID)
(Base Transceiver System) [Service Provider ID]

MS → BBS → MTSO (MSC) → PTSN.

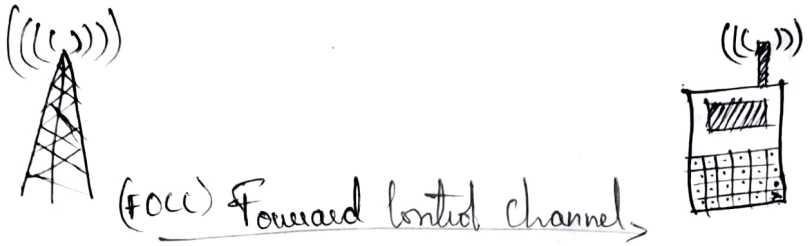
Downlink 824 to 849 MHz.

Uplink 869 to 894 MHz

Channel spacing 30 KHz.



AMP's (1G) Cellular System.



(FOCC) Forward control channel → Signalling info, control messages.. DCC ...

DCC → Digital Color Code.

SAT → Supervisory audio tone.

ST → Signalling Tone. (10 KHz)

SAT → 5970 Hz
6000 Hz
6030 Hz.

← Reverse Control Channel (RECC)
Signalling info, control message DCC...

AMP's dedicated ctrl channel used to setup & clear calls. & other n/w operations.

Forward voice channel (FVC) →
Voice, SAT & ST, Digital message.

← Reverse voice channel (RVC).
Voice, SAT, ST. Digital messages.

AMP's voice channels used to Tx voice & messages & needed signalling info.

19/03/21.

Basic Amps Operation:

1. Mobile Phone initiallization.
2. — " — Originated Call. (MS ↔ MS) (MS ↔ PSTN).
3. Mobile terminated Call. (Incoming Call).
4. Handoff operation. (BS1 - BS2)

→ Ordering Messages: [Ordis.

1. Alert order message.
2. Audit — " —
3. Change Power — " —
4. Intercept — " —
5. Maintainance — " —
6. Release — " —
7. Stop alert — " —
8. Address — " —

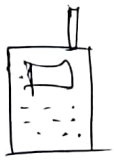
Signalling Tone messages. (10KHz)

Typically the Base Station in a amps system controls the mobile phone by sending order messages to the mobile. at 10 KHz Signalling Tone (ST) can be Txed over a voice channel to confirm orders and various signal requests.

Some of these order messages are [Orders.]

1. Alert that there's incoming phone call.
2. Sent by BS to determine the mob is still active in system.
3. Used to alter the mobile RF o/p power.
4. Used to inform the user that a procedureal error has been made. to place a call.
5. Used to check the operation of a mobile.
6. — " — Disconnect a call.
7. Stop alerting / ringing.
8. BS received a 10 digit / dialed digit information.

Mobile Phone initiallization (Only control channel).



Control channels are Txed by BTS.

Control channels are Rxed by MS

← Control messages are Txed by MS.

Control messages are Rxed by MS.

AMPS's phase initiallization.

Task 1 : Mobile Phone powers up.

T2 : Mobile scans control channels & selected system.

T3 : — " — updates cellular system info.

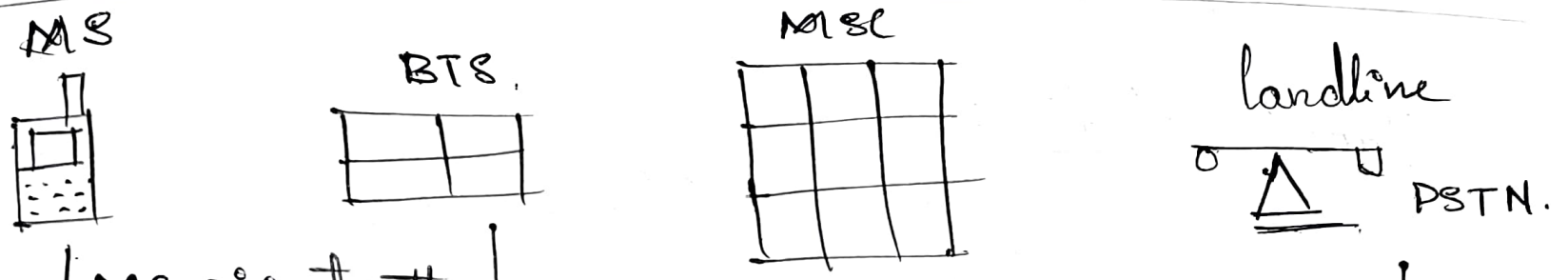
T4 : — " — established paging channels.

T5 : — " — registers with cellular system.

T6 : — " — station authorization.

T7 : — " ——————— verified.

T8 : — " — Enters idle stage.



MS originate the call.

Request is passed to MSC

Mobile is authenticated.

Channel assignment is passed to MS

Radio channel is assigned.

Call setup b/w MSC and PSTN.

SAT are used exchanged

Call status is relayed to BSC

Ring back.

ST alert is sent to MS.

Connection b/w PSTN & BSC

Called party answers.

Alert is removed

Conversation on FVC

Conversation on RVS

ST & release

Disconnect.

Mobile terminate call.

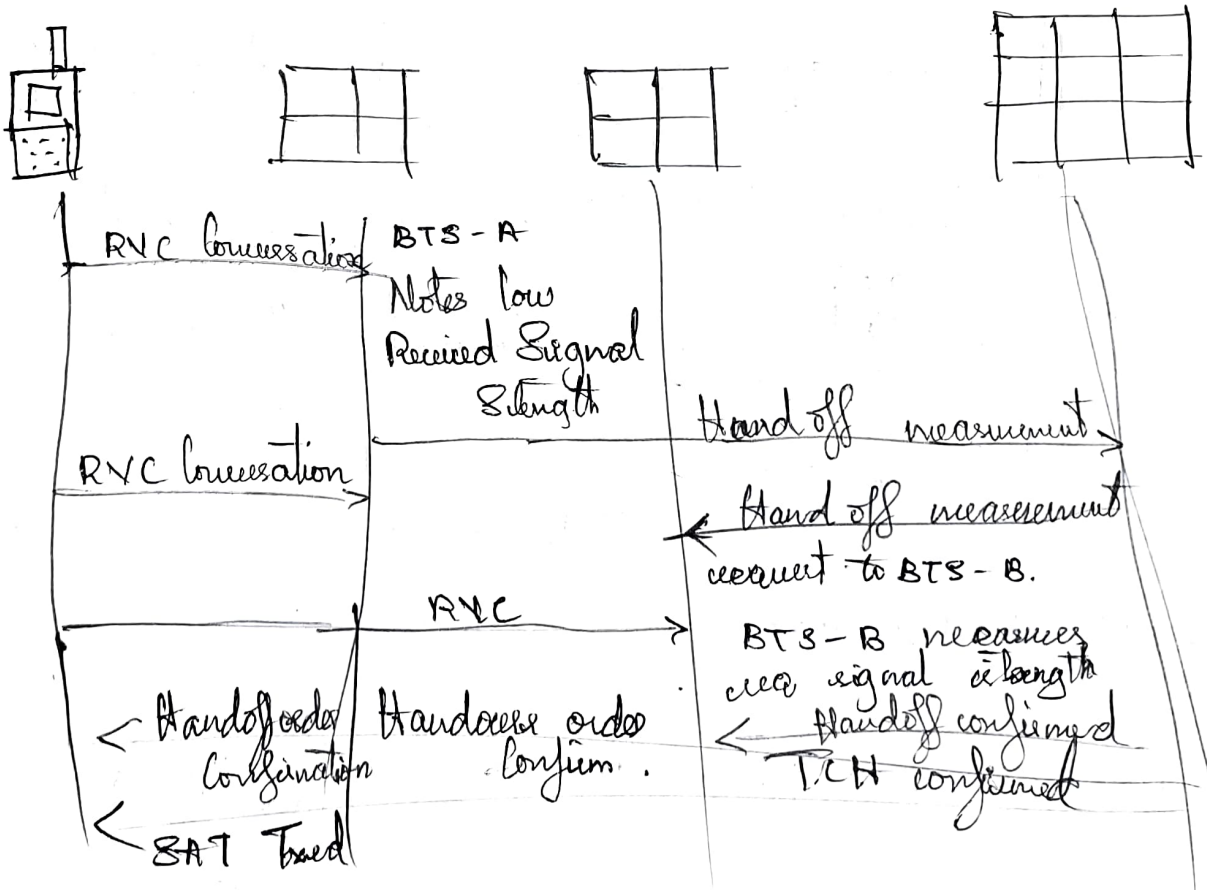
Mobile n/w operation for mobile to land calls.

The mobile subs wants to make a call, several hand shaking messages must be exchanged b/w BS & the MSC. & b/w MSC and the PSTN. The Inter system standard TIA/EIA-634B is used b/w MSC and PSTN. o base statio After the Radio link b/w mobile station & BS is confirmed, the Telephone call is connected to the called party over the PSTN. The called party answers, the alert ring back signal is removed & a conversation exists on the forward & reverse voice channels.

Either the called party / MS may terminate the call.

Handoff Operations:

It occurs in a cellular system, & a mobile station moves to another cell.



The fig depicts the handshaking operations for handoff to occurs. In this case an MSC connected to 2/more BS within some geographic area. Consider that BS-A is handling an active call from an MS within its area & coverage. Now the MS is in transit & is moving away from BS-A & towards BS-B's coverage area.

BS-A constantly monitors the Rxed signal power from the mobile station. When the signal from the MS goes below a pre determined threshold level. BS-A sends a handoff measurement request to MSC. The MSC requests that all the Base stations that are able to receive the Txns from the specified MS monitor its power level. It is determined that BS-B is receiving the strongest signal from the MS. The MSC assigns a TCH (traffic channel) to BS-B. BS-B responds and handover order is sent from the MSC to BS-A.

The BS-A sends a handoff control signal to MS with a necessary new CH information. And finally the mobile switches the the new voice channel with its newly described op powers. As before the MS receives SAT from BS-B. & returns it. If everything goes well the HO is successfull.

23/08/2022

Advanced mobile communication.

— generation 2 [2G]

→ Digital modulation

[GSM] TDMA, CDMA.

Second gen cellular systems.

Most basic diff is that, the first gen systems used analog modulation techniques for the Txn of subscribers voice over the traffic channel. All subsequent gen of cellular systems convert a users voice from an analog signal to digital form & then use some form of digital modulation to transmit the digital encoding of the voice message.

This conversion to a digital format accounts in the ability of a communication link (traffic channel) to accomodate more than 1 user at a time. This attribute is refered to as multiplexing. The 2 most popular forms of muxing used by 2nd gen cellular systems are TDMA & CDMA.

The control signals for 1st gen systems used SAT & ST tones. But now, not needed for 2nd gen systems.

By using digital encoding form user traffic, digital encryption may be employed that provides both security & privacy for mobile users. This wasn't possible in 1st gen cellular systems.

Digital encoding & modulation allows for the use of error detection & correction, the use of which to some extent

combats combats some fading & noise effects to the radio channel. The ability of 2nd gen cellular systems to support more than 1 user/radio channel is through the used of advanced digital multiplexing techniques. TDMA systems use time slots to allocate a fixed periodic time, when a subscriber has exclusive use of a particular channel. The GSM systems uses a Txn format with 8 time slots and ∴ the system can support 8 users/channel simultaneously.

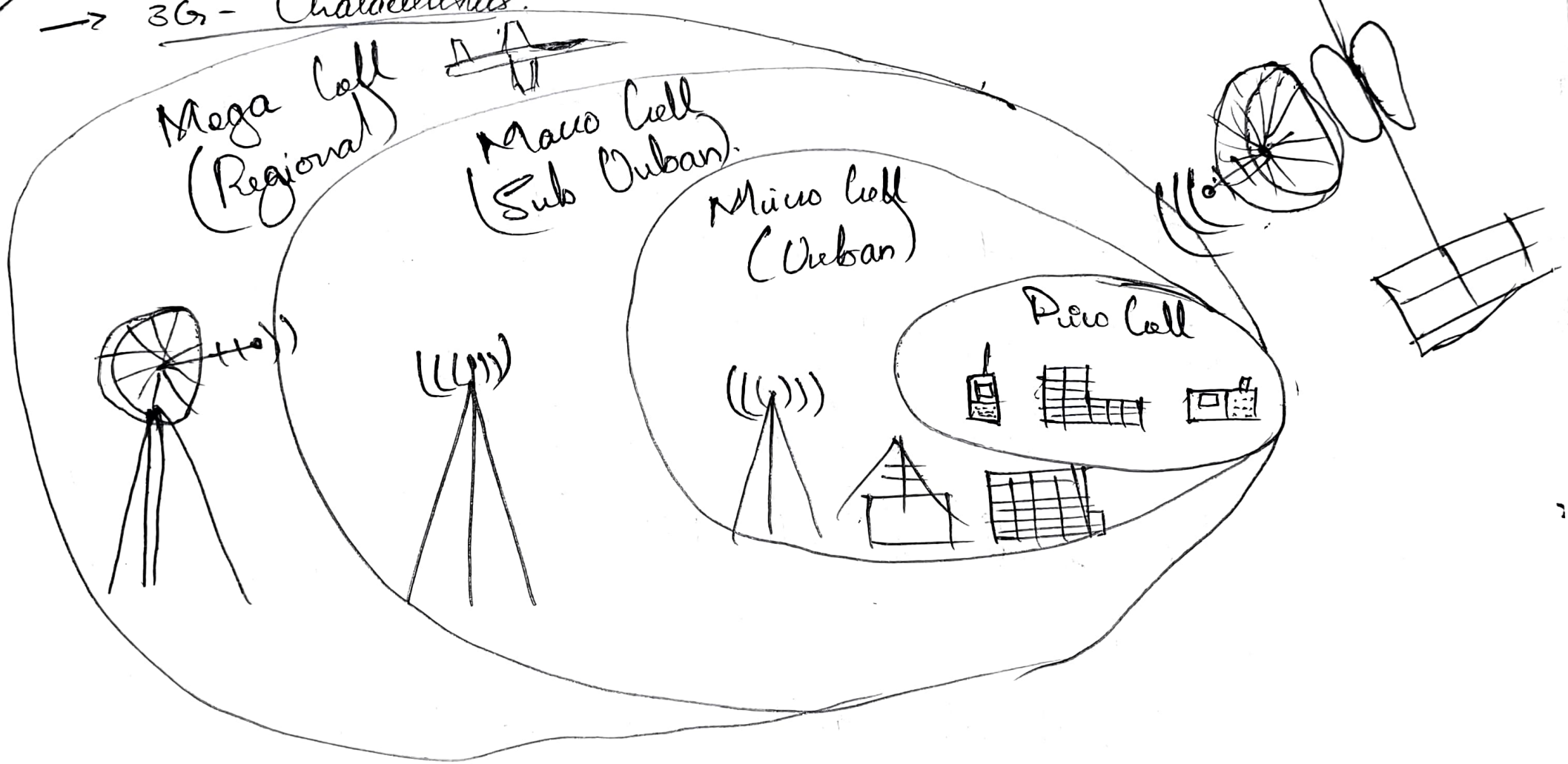
CDMA ~~cellular~~ cellular system use a digital mod. tech. known as spread spectrum. In this system, at the Txn each ~~user~~ user's digitally encoded signal is further encoded by a special code that converts each bit of the original digital message into many bits. At the receiver, the same special code is used to decode/recover the original bit stream.

Special code used to perform this encoding/decoding func have a unique property that each Rxed signal looks like noise to a receiver that doesn't share the same code as the Txer of signal. ∴ In a CDMA sys. many radio sigs. can be simultaneously Txed at same channel without interference.

26/03/2021.

3G - Cellular Systems

→ 3G - Characteristics.



Cell Type	Global Cell	Mega Cell	Macro Cell	Micro Cell	Pico Cell.
Max Cell radius	1000s Km.	100 - 500 Km	35 Km	1 Km	50m.
Operating Environment.	Global	Regional	Suburban	Urban	In building.
Instlattation type	Satallite GEO, MEO, LEO	Satallite LEO, MEO	Tower	~~NA~~ Tower (Small)	Inside a building.
Data Rate	100s bps ~~to~~ Kbps or Mbps.	100s ~~of~~ Kbps. to several Mbps.	144 Kbps	384 ~~Kbps~~	2 ~~Mbps~~.
Maximum Mobile Speed	NA	NA	500 ~~mph~~ Km/hr.	100 Km/hr.	10 Km/hr.

The term 3-G mobile systems is used to represent a number of cellular systems and their associated standards. ~~They~~ That have the ability to support high data rate services, advanced multi media services, (voice data & video) & global roaming. These standards being facilitated by the ITU and other regional bodies. 3-G mobile n/ws need to be able to provide high speed data transfer from packet n/ws and to be able to permit global roaming.

Further more, they need to support advanced digital services and be able to work in various different operating environments. (~~low through hi~~ low to high mobility, global locations, etc).

In other words, anywhere the mob subscriber might be located (except for the most severe radio environments, should be supported by 3-G N/ws.)

These systems must be able to support varying data rates & by providing BW on demand to the subscriber. The 3-G characteristic with hierarchical cell structures, the corresponding size, mobility rate & supported data rate as shown in the table.

3G systems must be able to support multiple simultaneous connection like conference call, IP addressing & be backward compatible with 2-G n/ws.

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(19) Assume that the Tx antenna for the 1st mobile radio telephone system was located on a tower at a height of 250 feet. Determine range of this system, assuming LOS Tx & Rx antenna height of 6 feet.

$$D = \sqrt{2R}\left(\sqrt{h_t} + \sqrt{h_u}\right)$$

$R = 6350$

$h_t = 76.2\ m.$

$h_u = 1.828\ m.$

$= \sqrt{2x}$

$D = 35.926\ Km.$