OVERVIEW OF WIRELESS N/W

* EVOLUTION OF MOBILE RADIO COMMUNICATION

- In 1934, AM mod. first used for public safety in US
- In 1935, FM mod. first demonstrated by Armstrong.
- Tech improved by world war II
- In 1946, 1st public mobile telephone service in 25 major US cities introduced.
- Late 1940s, FM push-to-talk with half-duplex and 120 KHz RF bandwidth developed.
- In 1960s, improved mobiles telephone system (IMTS) with full duplex, autodialing, auto-trunking introduced.
- In 1968, AT & T Bell labs proposed concept of cellular mobile systems to FCC in US.
- In 1983, Advanced Mobile Phone Systems (AMPS) was devel. by Ameritech in US.
  - 666 Duplex channels
  - 800 Mhz band
  - 30 KHz each channel bandwidth
- In 1984, 25,000 cellular telephone users introduced in US.
- In 1994, 16 million users.
- By 21st century, no of wireless customers will be equal throughout the world.

* THE WIRELESS VISION

- communication anywhere, anytype, anytime.
- Increase demand for wireless services
- Unique Problems compared to wireline communications

Benefits of wireless cellular :
- not depleting
- security
- customers (increase)
- reachability
- coverage (to be improved)
- accessibility (no installation problem)

It has (includes) :
- Global communication
- Cellular telephony
- Personal communication services
- wireless LAN.

"Any where Any time Any device"

* COMPONENTS OF A CELLULAR COMMUN^{n}. SYSTEM

- components :
  - MS : Mobile Station
  - BTS : Base station Transciver
  - BSC : Base Station Controller
  - MSC : Mobile Switching (center.) office
  - MTSO : Mobile Telephone Switching office (mobile for switching. It houses MSC)
  - PSTN : Public Switched Telephone N/w. (made up of local N/w, exchange area N/w & other communi^{n} devices)

MSU (Mobile station unit) consists of:
- control unit
- transceivers.

3 types avail:
- mobile
- portable
- transportable.

- Links :
  - UPLINK : A communication link where MS transmits and BTS receives.
  - DOWNLINK : A communication link where BTS transmits and MS receives.

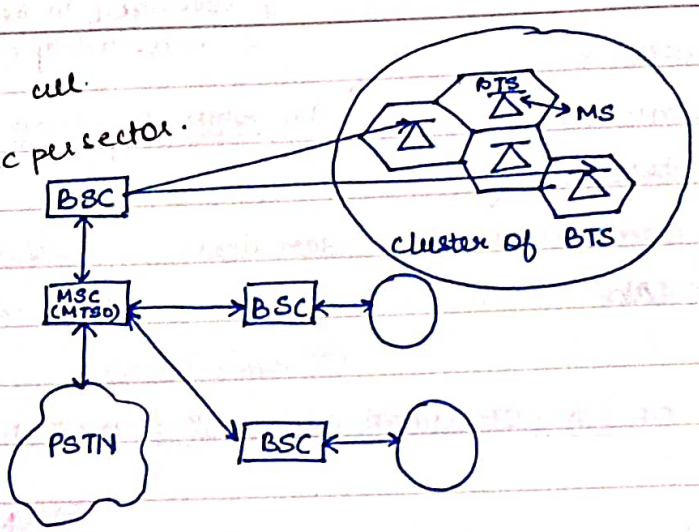
- Transmission Scheme :
  - TDD (Time Division Duplexing)
    Transmission in the uplink and downlink use the same carrier frequency but diff. time intervals.
  - FDD (Freq. Division Duplexing)
    transmission in the uplink and downlink use diff. carrier freq. but may occur at same time intervals.

(transmit & receive frequencies should be isolated.)

7 cell structure

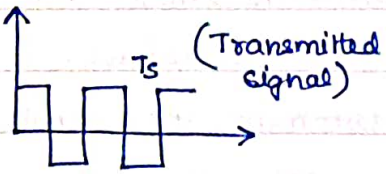
$\therefore \frac{21}{7} = 3$ cc per cell.

1 cell → 3 sector → 1 cc per sector.



* WIRELESS MEDIUM

- Scarce Radio Spectrum
- Co-Channel Interference
- Multipath
  - Diff. times of arrival at the receiver.
- Coverage / Range
  - Propogation loss.



* SPECTRUM ALLOCATION AND STANDARDS

- Spectral allocation in US controlled by FCC.
- FCC sells spectral blocks for particular applications via auction.
- World wide spectrum controlled by (ITU)
- Standardisaⁿ is req. to deploy interfacing / interacting wireless systems built by diff. companies.

* MOBILE RADIO STD. AROUND THE WORLD :

- Spectrum currently allocated for 850 MHz band use

	Channel no	Center freq
Reverse	$1 \le N \le 799$	$0.030N + 825.0$
	$990 \le N \le 1023$	$0.030(N-1023) + 825.0$
Forward	$1 \le N \le 799$	$0.030N + 870.0$
	$990 \le N \le 1023$	$0.030(N-1023) + 870.0$

824 - 849 MHz 869 - 894 MHz

channels (800 - 989 → unused)

* EXAMPLES OF WIRELESS COMMUNICAⁿ SYSTEM :

eg. garage door openers, remote controllers, cordless telephones etc.

MOBILE: It is used to classify any radio terminal that could be moved during operation.

SUBSCRIBER: It is often used to describe a mobile or portable user.

SUBSCRIBER UNIT: It is user's communicaⁿ system device for which he pays a subscription fee.

MODES OF COMMUNICAⁿ :

- SIMPLEX : communication is possible only in 1 direction.
- HALF-DUPLEX : allows 2 way communicaⁿ but a user can only transmit or xceive info. at a time.
- FULL-DUREX : allow simultaneous radio transmiⁿ & recepⁿ

BASE STATION: A fixed station in a mobile radio system used for radio communicaⁿ.

CONTROL CHANNEL: Radio channel used for transmission of call requests, call initiation etc.

FORWARD CHANNEL: Radio channel used for tramissi" of info from base station to mobile.

HAND-OFF: The process of transfering a mobile station from 1 channel to another.

MOBLE STATION: A station in cellular radio service intended for use while in motion.

MOBLE SWITCHING CENTER: Switching center which co-ordinates routing of calls in large service area.

PAGE: A brief msg which is broadcast over entire service area.

REVERSE CHANNEL: Radio channel used for transmission from mobile to base station.

ROAMER: A mobile station which operates in a service area other than that from which service has been subscribed.

TRANSRECEIVERS: A device capable of simultaneously transmit" and receiving radio signals.

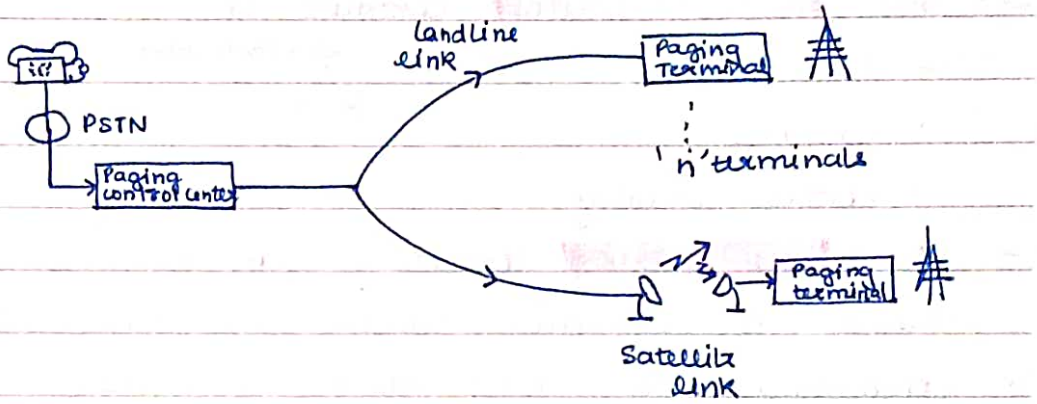
* PAGING SYSTEM:

They are communication systems that send brief message to the subscriber.

They are usually used to notify a subscriber of the need to call a particular telephone no. Or travel to known loca".

The message may be either numeric, alphabetic etc.
A message is sent to a paging subscriber via the paging system access no.. This issued message is called a PAGE.

The Paging system then transmits the page through the service area using base stations.
Simple paging systems may cover a limited range of 2 to 5 km.

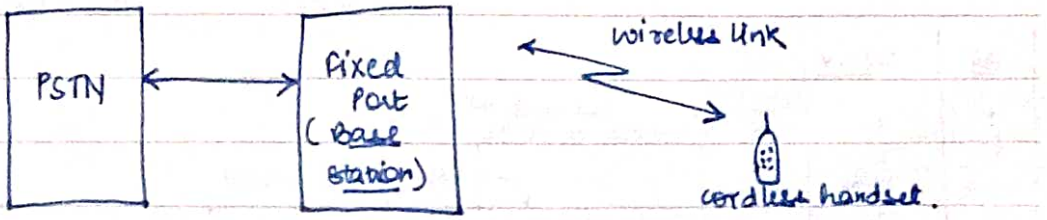


* CORDLESS TELEPHONE SYSTEMS :

They are full-duplex communication systems that use radio to connect a portable handset to a dedicated base station, which is connected to dedicated telephone lines with a specific tele no on PSTN.

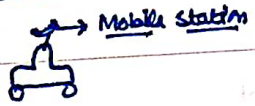
In 1st genera^{n} phones only limited distance communica^{n} was available.

Cordless telephone system provide the user with limited range & mobility.



* CELLULAR TELEPHONE SYSTEMS :

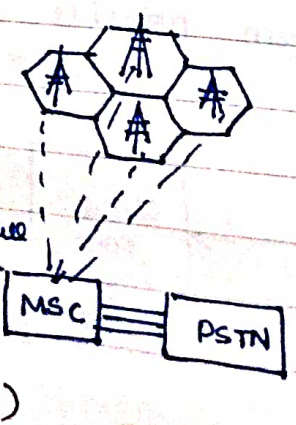
- High capacity is achieved by limiting the coverage of each base station transmitted to a small geographic area called a CELL.
- A sophesticated switching technique called a HAND-OFF enables a call to proceed uninterrupted when the user moves from 1 cell to another.
- Each mobile communicates via radio with one of the base stations.
- The mobile station contains a
  - Transreceiver
  - antenna
  - control circuitry



- The base station consists of many transmitters & receivers which simultaneously handle full duplex communicaⁿ.
- Communicaⁿ b/w base station & mobile is defined by 'COMMON AIR INTERFACE' that specifies diff. channel.
  - Forward voice channel: Channel used for voice transmissi from base station to mobiles.
  - Reverse voice channel: from mobile to base station.
- The 2 channels responsible for initiating mobile calls are:
  - Forward voice control channel
  - Reverse control channel.

provide Mobility → BTS, BSC (Base station controller), MS, MSC

1G	2G	>2.5G	
1	1	1	GMSC
10's	100's	1000's	MSC
100's	1000's	Lacks	BTS
	10's	100's	MS
			BSC



ROAMING: This allows subscriber to operate in service area other than the one subscribed.

landline → mobile

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Mobile SC	Base station	Mobile
receives call from PSTN → sends req. MIN to all base stations	Transmits page MIN for specified (FCC) user →	Receives page & matches MIN with (FCC) own MIN
verifies whether mobile has valid MIN, ESN pair ←	receives ESN, MIN, SCM & passes to MSC (RCC) ←	Ack receival of MIN and sends ESN & SCM (RCC)
Request BS to move to unused voice channel / Transmit data →	Transmitt data msg for mobile (FCC) →	Receive data msg to move (FCC)
connects the mobile with calling party →	(FVC) Begin voice x^n (RVC) Begin voice Recep^n	(FVC) Begin voice y^n (RVC) Begin voice x^n

mobile → landline.

MSC	Base station	(RCC) Mobile.
Receives call initia^n req. & verify validation of MIN, ESN pair. ←	receives MIN, ESN SCM (RCC) ←	sends a call initia^n along with subscriber MIN & number of called party.
Instructs FCC of originating Base station to move mobile to a pair of voice channels. →	(FCC) Page for called mobile, instructing to move to voice channel →	(FCC) Receives Page & matches the MIN and own MIN.
connects the mobile with called party on PSTN.	(FVC) (RVC) Begin voice x^n	(FVC) (RVC) Begin voice y^n

Comparison of various wireless comm. system

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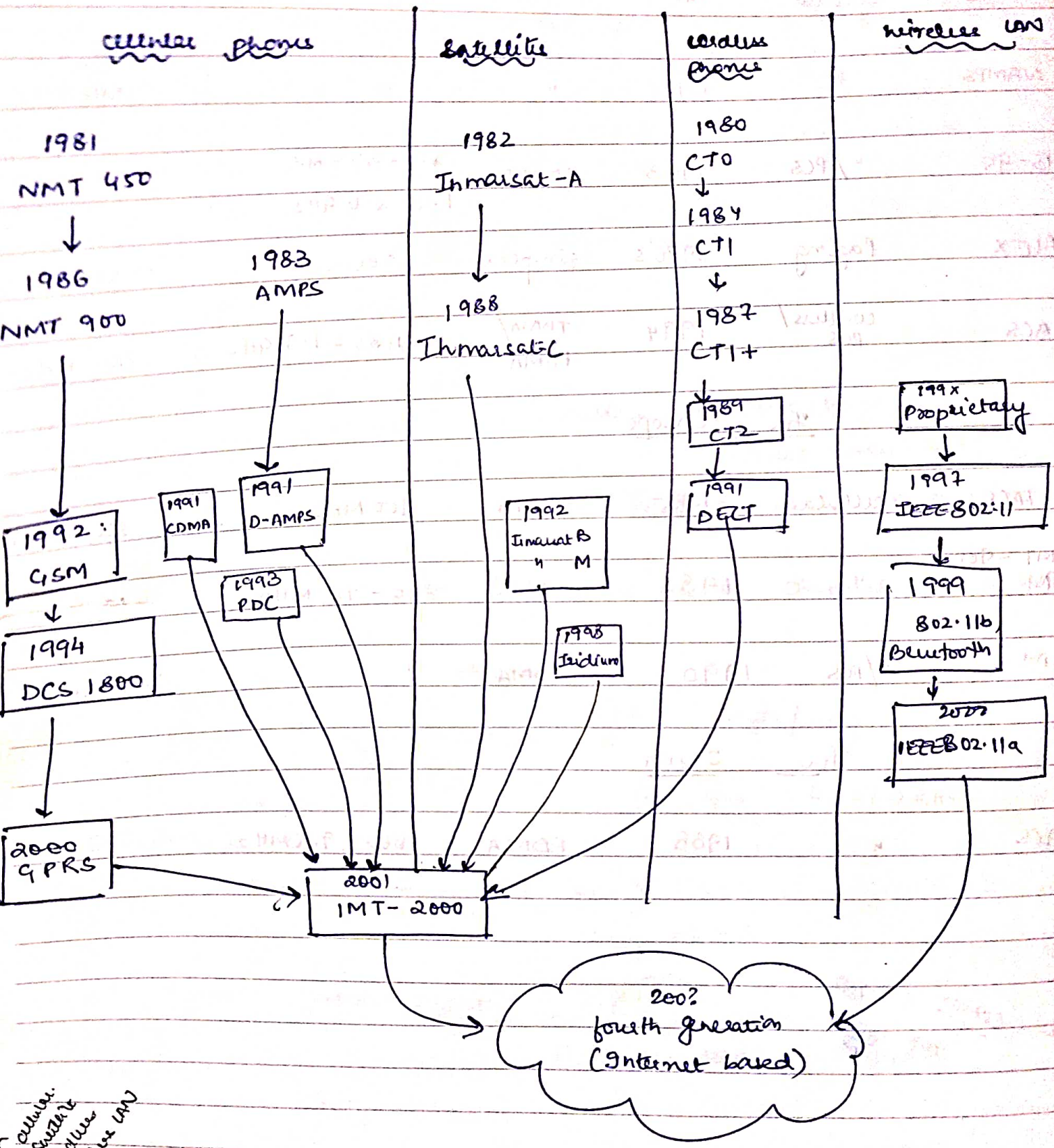
Mobile station

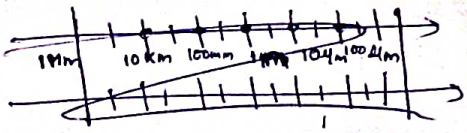
	Coverage	infra structure	complexity	H/w cost	Carrier freq	Func
TV remote control	low	low	low	low	infrared	Trans
Garage door opener	low	low	low	low	$<100MHz$	Trans
Paging system	high	high	low	low	$<1GHz$	Recei
Cordless phone	low	low	Moderate	low	$1-3GHz$	Trans
cellular	high	high	High	Moderate	$<2GHz$	Trans

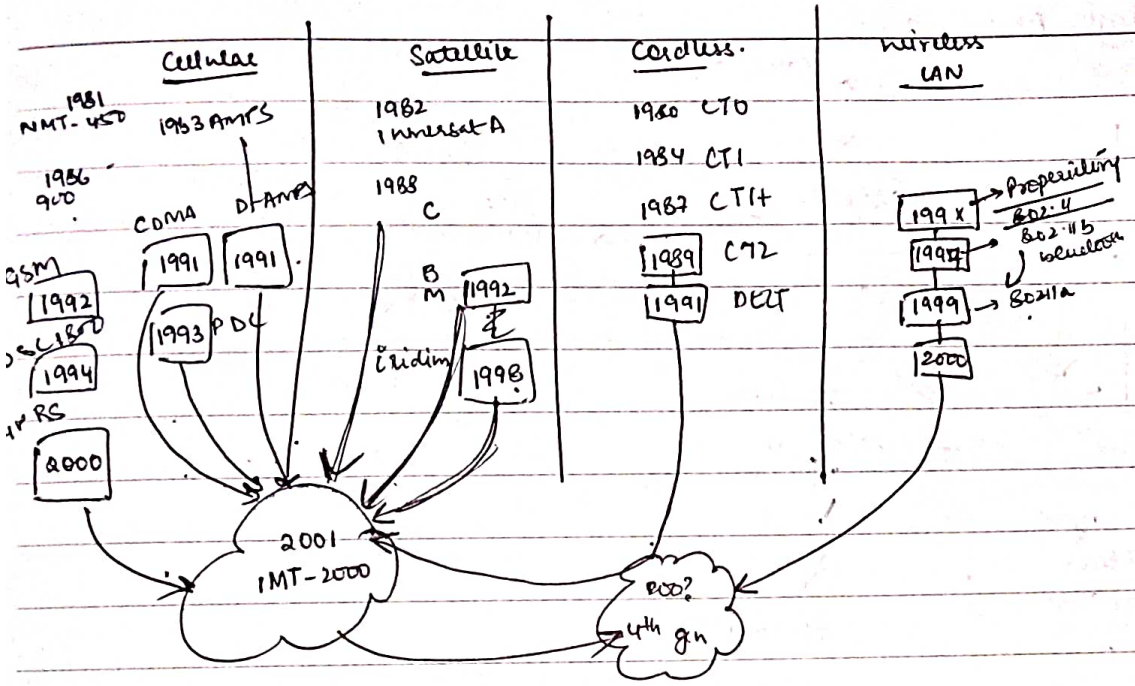
Base Station

	Coverag	infrast	Complexity	H/w cost	carrier freq	Func
TV	low	low	low	low	infrared	Rec
GDO	low	low	low	low	$<100MHz$	Rec
PS	high	high	high	high	$<1GHz$	TransX
CP	low	low	low	Moderate	$1-3GHz$	TransR
C	high	high	high	High	$<2GHz$	TransR

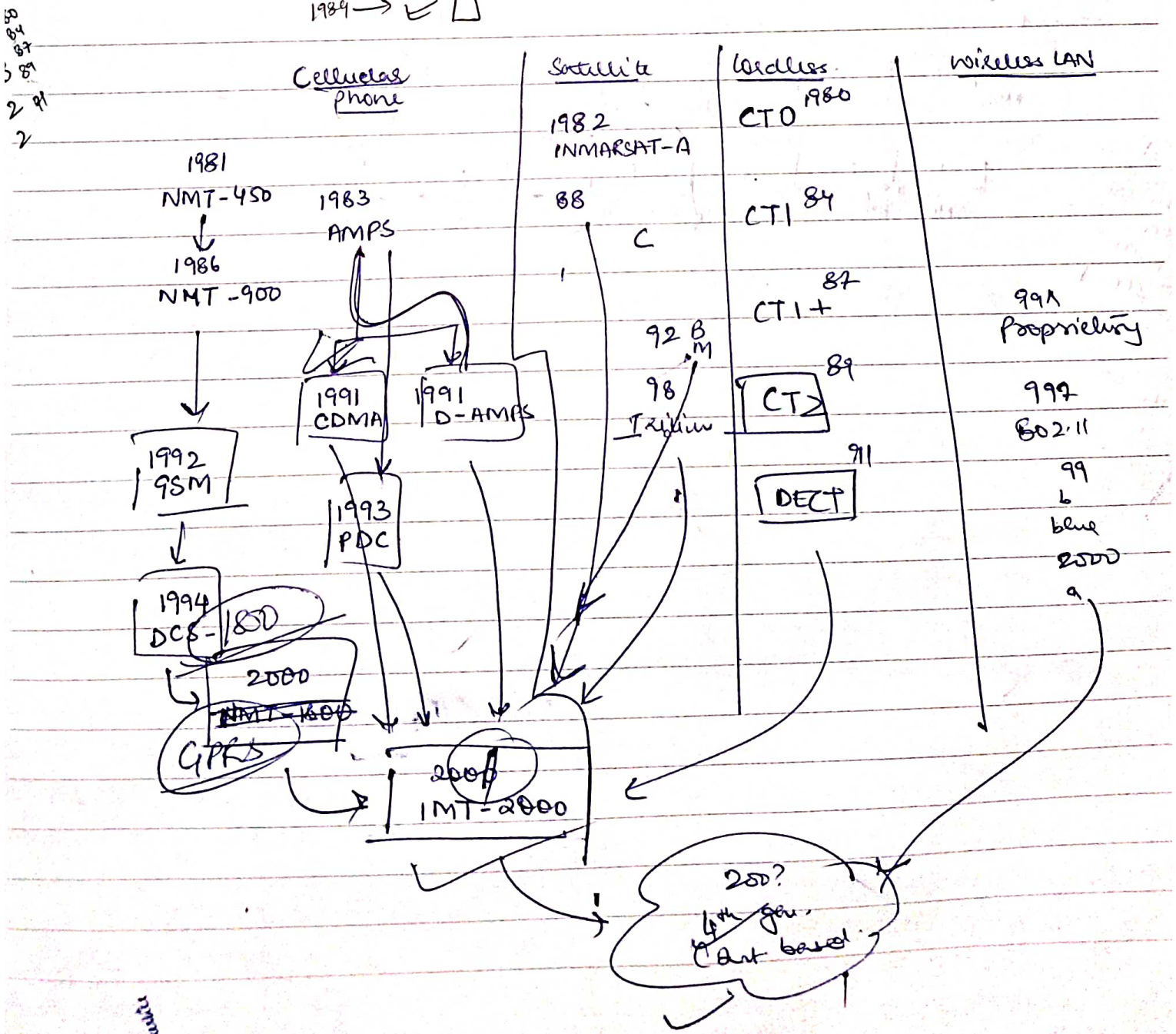
Overview of wireless comm. system




1Mm
10km
100mm
10cm
1m
100m
1km


Cellular
Satellite
Cordless
wireless LAN
1981
NMT-450
1986
900
1983 AMPS
CDMA
D-AMPS
1991
1991
1992
GSM
1993 PDC
1994
DCS-1800
2000
1992
1998
Iridium
1980 CTO
1984 CT1
1987 CT1+
1989 CT2
1991 DECT
199x
Proprietary
802.11
1997
802.11b
1999
802.11a
2000
2001
IMT-2000
B00?
4th gn

1984 →


Cellular phone
Satellite
Cordless
wireless LAN
1981
NMT-450
1986
NMT-900
1983
AMPS
1982
INMARSAT-A
88
C
1980
CTO
84
CT1
87
CT1+
92 BM
98
Iridium
89
CT2
91
DECT
991
Proprietary
997
802.11
99
blue
2000
1991
CDMA
1991
D-AMPS
1992
GSM
1993
PDC
1994
DCS-1800
2000
NMT-1800
GPRS
2000
IMT-2000
200?
4th gen.
Ant based