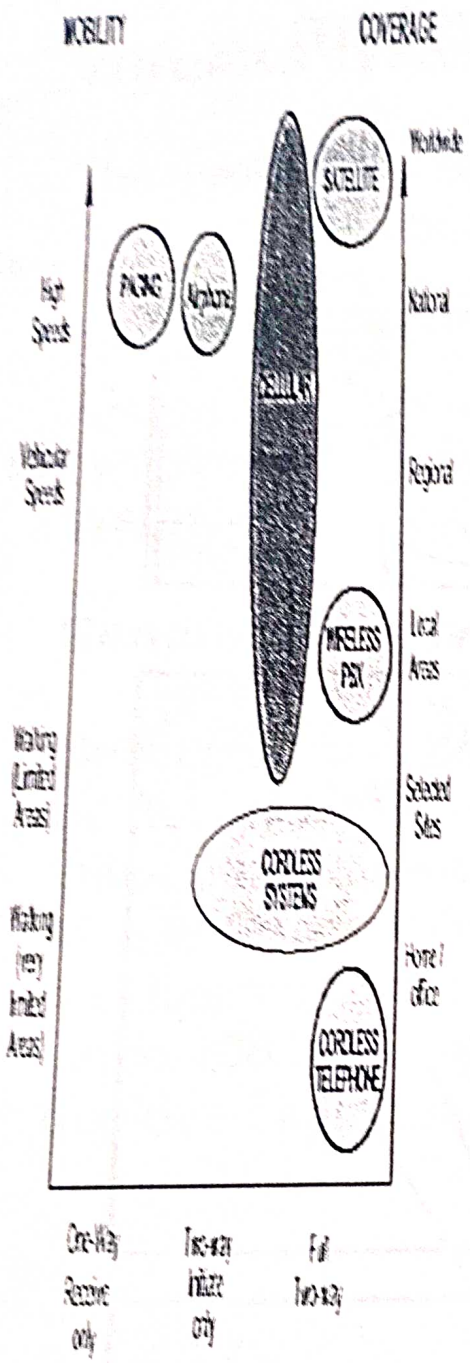
Wireless

&

Mobile Computing

(B.Tech. CSE)



Various types of wireless services are :

- Cordless telephone

The basic cordless telephone (CT0, CT1) provides a wireless counterpart to the standard telephone. The handset typically operates within 50 to 100 m of the user's base station, which is connected to the (PSTN).

- Cordless systems

Cordless systems with enhanced functionality (DECT, PHS) have been developed that can support higher data rates and more sophisticated applications such as use of multiple handsets with one home base station. Cordless tele-2, also a digital cordless system, has less functionality as DECT or PHS, the user is not capable of moving out of his home base station range and roam in the public network as is possible with PHS (future enhancement for DECT). To setup a call in the public network the user needs to be in the area of special base stations.

Wireless PBX

Wireless PBX have similar functions as PHS and DECT but limited to the premises of PBX owner.

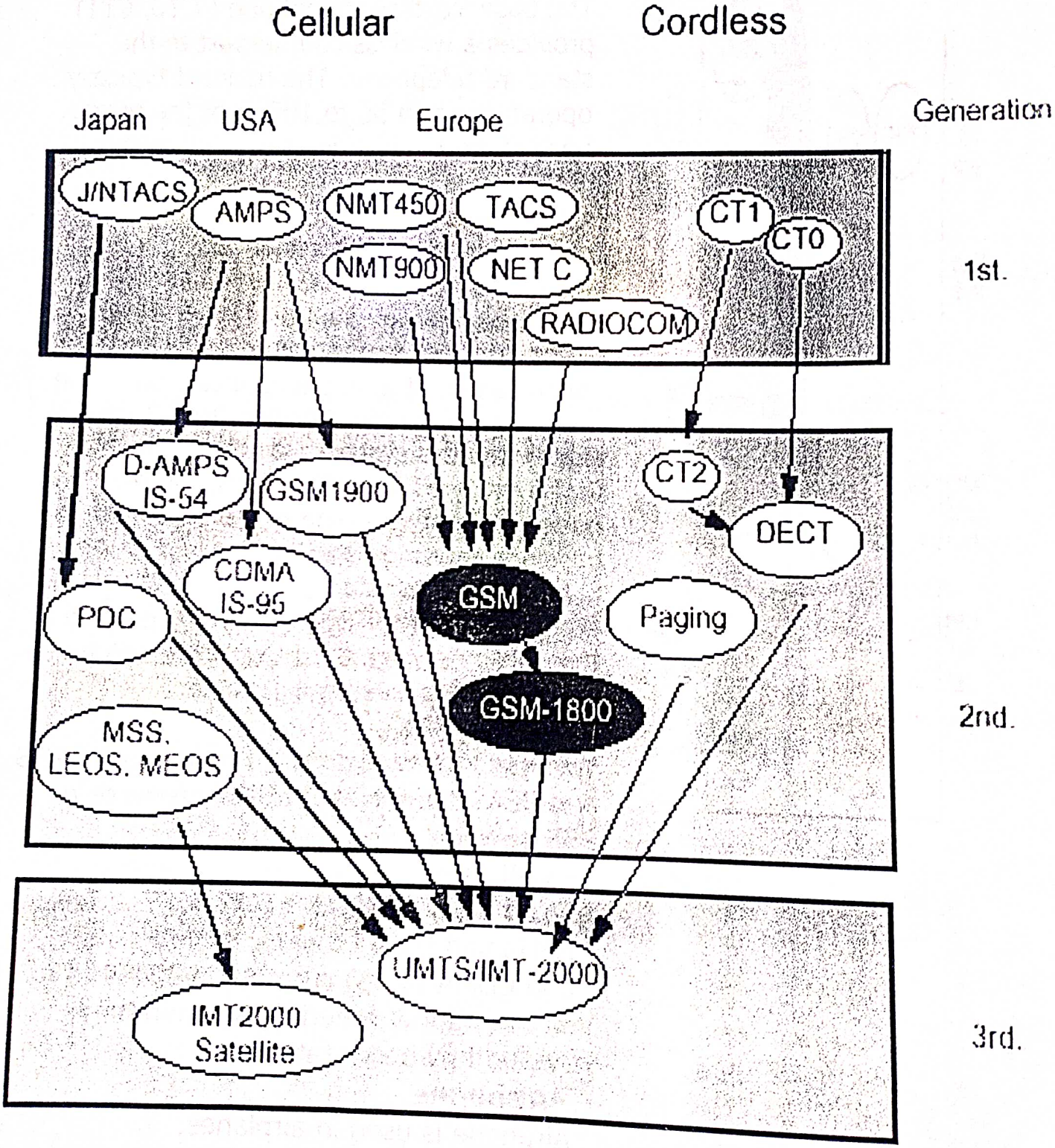
- Cellular systems

Analog Cellular systems (AMPS,TACS and NMT) and Digital Cellular systems (GSM and CDMA IS-95) currently are limited to voice and low-speed data within areas covered by base stations.

- Airphone

Airphone is used in airplanes.

Evolution of wireless system



Wireless systems Evolution

The evolution of wireless systems takes place in three generations:

Generation 1: Analog wireless systems

Generation 2: Digital wireless systems

Generation 3: Integration of all kinds of wireless systems into one universal mobile telecommunication system

Generation 1 Systems

Cellular system design was pioneered during the '70s by Bell Laboratories in the United States, and the initial realization was known as AMPS (Advanced Mobile Phone Service). The AMPS cellular service has been available in the United States to the public since 1983. Systems similar to AMPS were soon deployed internationally.

Generation 2 Systems

The development of low-rate digital speech coding techniques and the continuous increase in the device density of integrated circuits have made completely digital second-generation systems viable. Digital systems can support more users per base station per MHz of spectrum than analog systems, allowing wireless system operators to provide service in high density areas more economically. To meet the growing need to increase cellular capacity in high-density areas, different standardization bodies developed their own standard:

The Electronic Industries Association (EIA) and the Telecommunications
Industry Association (TIA) in USA adopted the IS-54 standard (D-AMPS) & later on the CDMA IS-95 standard.The European Telecommunications Standards Institute (ETSI) adopted the GSM standard.

Generation 3 Systems

Work is continuing in the European research consortium, RACE, and in ETSI towards developing UMTS (Universal Mobile Telecommunication System) on a joint European basis. At the same time, the ITU is working globally towards IMT-2000 (International Mobile Telecommunications-2000) with mutual agreementand information exchange.
Technically, these systems by offering bandwidths of more than 2 Mbit/s, open new possibilities for additional services in mobile communication networks, such as full motion picture transmission

Evolution of GSM Standards

- 1980s
  - Advanced Mobile Phone Service (AMPS), in America.
- Early 1980s
  - European nations were developing cellular solutions, but no common standard available.
- 1982
  - CEPT (Conference of European Posts and Telegraph) formed a study group called the Groupe Special Mobile (GSM).

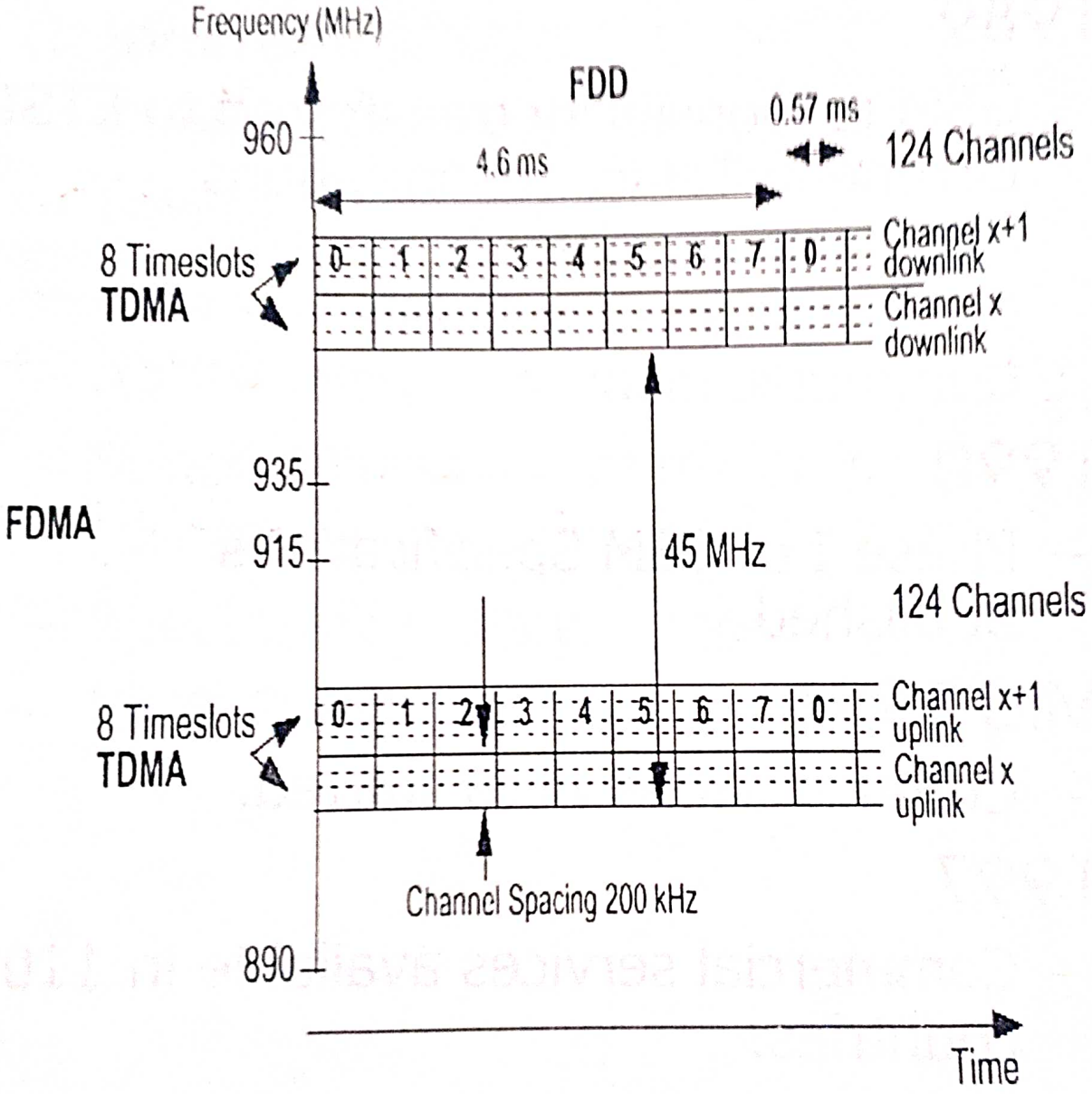
Evolution of GSM Standards

- Objective of GSM
  - Good speech quality.
  - Low terminal and service cost.
  - Support for international roaming.
  - Ability to support handheld terminals.
  - Support for range of new services and facilities.
  - Spectral Efficiency.
  - ISDN Compatibility.

Evolution of GSM Standards

- 1989
  - GSM responsibility transferred to ETSI (European Telecommunications Standards Institute).
  - Global System for Mobile Communication.
- 1990
  - Phase I of GSM Specifications published.
- Mid 1991
  - Commercial services started.
- 1997
  - Commercial services available in 110 countries.

GSM Radio frequency spectrum



GSM TECHNICAL CHARACTERISTICS

- Radio frequency spectrum
  P-GSM-900: 890 - 915 MHz and 935 - 960 MHz
  E-GSM: 880 - 915 MHz and 925 - 960 MHz
  R-GSM: 876 - 915 MHz and 921 - 960 MHz
  GSM-1800: 1710 - 1785 MHz and 1805 - 1880 MHz.
  E-GSM and R-GSM bands include the primary frequencies. It depends on the current radio frequency spectrum usage in a specific area whether the extension can be used.
- Use of FDD (Frequency Division Duplexing), FDMA (Frequency Division Multiple Access) and TDMA (Time Division Multiple Access) techniques
- Digital cellular system

GSM 900 / GSM 1800

	GSM-900	GSM-1800
uplink band	890 - 915 MHz	1710 - 1785 MHz
downlink band	935 - 960 MHz	1805 - 1880 MHz
channel spacing	200 kHz	200 kHz
total # channels	124	374
duplex spacing	45 MHz	95 MHz
# time slots	8	8

GSM radio frequency spectrum

In the frequency range specified for GSM-900 System mobile radio networks, 124 frequency channels with a bandwidth of 200 KHz are available for both the uplink and downlink direction. The uplink (mobile station to BTS) uses the frequencies between 890 MHz and 915 MHz and the downlink (BTS to mobile station) uses the frequencies between 935 MHz and 960 MHz. The duplex spacing, the spacing between the uplink and downlink channel, is 45 MHz. The E-GSM band adds 50 frequency channels and the R-GSM another 20 frequency channels to the spectrum. In the frequency range specified for GSM-1800 System mobile radio networks, 374 frequency channels with a bandwidth of 200 KHz are available for both the uplink and downlink direction. The uplink uses the frequencies between 1710MHz and 1785 MHz and the downlink uses the frequencies between 1805 MHz and 1880 MHz. The duplex spacing is 95 MHz.

Multiple access techniques

Three main types of multiple access used to divide the radio frequency spectrum

- Frequency Division Multiple Access (FDMA):

Each call is carried on a separate frequency channel.

- Time Division Multiple Access (TDMA):

Each frequency channel is further divided into a set of timeslots, each timeslot carries the data of a voice call.

- Code Division Multiple Access (CDMA):

A spread-spectrum technology is used, in which the radio signals associated with a call are spread across a single broad frequency spectrum (1.25 MHz).

Multiplexing techniques

The two multiplexing techniques used in cellular and cordless terminology are:

- Frequency Division Duplexing (FDD)

In FDD two symmetric frequency bands used, one uplink other the downlink ch.

- Time Division Duplexing (TDD)

TDD means that the uplink of the voice call is time multiplexed on the same frequency channel as the downlink of the voice call.

Techniques used in GSM

In the GSM system, TDMA in combination with FDMA is used; the usage of each radio channel is partitioned into multiple (eight) timeslots, and each user is assigned a specific frequency/ timeslot combination. Thus, only a single mobile is using a given frequency/timeslot combination at any particular time.

Also the FDD technique is in use, that is two symmetric frequency band, one band containing the uplink channels and the other the downlink channels.

Features of Digital Cellular Systems:

- Small cells

- Frequency reuse

- Small, battery-powered handsets

- Performance of handovers

Characteristics of cellular System

Cellular radio systems allow the subscriber to place and receive telephone calls
over the wireline telephone network where ever cellular coverage is provided.
Roaming capabilities extend service to users traveling outside their "outside"
home service areas.

Characteristics of digital cellular systems

The distinguishing features of digital cellular systems compared to other mobile radio systems are:

- **Small cells**

A cellular system uses many base stations with relatively small coverage radii (on the order of a 100 m to 30 km).

- **Frequency reuse**

The spectrum allocated for a cellular network is limited. As a result there is a limit to the number of channels or frequencies that can be used. For this reason each frequency is used simultaneously by multiple base-mobile pairs. This frequency reuse allows a much higher subscriber density per MHz of spectrum than other systems. System capacity can be further increased by reducing the cell size (the coverage area of a single base station), down to radii as small as 200 m.

- **Small, battery-powered handsets**

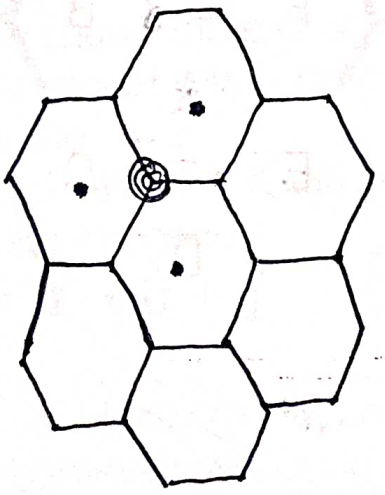
In addition to supporting much higher densities than previous systems, this

approach enables the use of small, battery-powered handsets with a radio

frequency that is lower than the large mobile units used in earlier systems.

- **Performance of handovers**

In cellular systems, continuous coverage is achieved by executing a “handover” (the seamless transfer of the call from one base station to another) as the mobile unit crosses cell boundaries. This requires the mobile to change frequencies under control of the cellular network.



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