Chapter 1

INTRODUCTION TO WIRELESS COMMUNICATION SYSTEMS

- **Evolution of mobile radio communication.**
- **Mobile radio system around the world.**
- **Examples of wireless communication systems**

By Mr. Deshbhratar A. S.

Evolution of Mobile Radio Communications

- Major Mobile Radio Systems
  - 1934 - Police Radio uses conventional AM mobile communication system.
  - 1935 - Edwin Armstrong demonstrate FM
  - 1946 - First public mobile telephone service - push-to-talk
  - 1960 - Improved Mobile Telephone Service, IMTS - full duplex
  - 1960 - Bell Lab introduce the concept of Cellular mobile system
  - 1968 - AT&T propose the concept of Cellular mobile system to FCC.
  - 1976 - Bell Mobile Phone service, poor service due to call blocking
  - 1983 - Advanced Mobile Phone System (AMPS), FDMA, FM
  - 1991 - Global System for Mobile (GSM), TDMA, GMSK
  - 1991 - U.S. Digital Cellular (USDC) IS-54, TDMA, DQPSK
  - 1993 - IS-95, CDMA, QPSK, BPSK

Mobile Radio Systems around the world

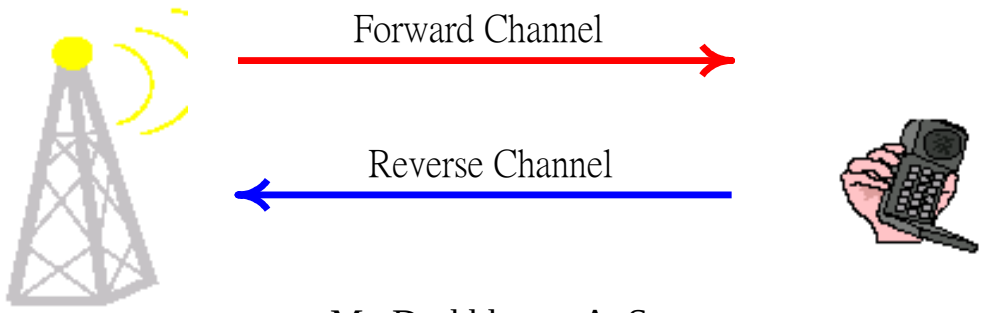
- **AMPS (Advanced Mobile Phone System):**
  - ✓ By Bell Lab in Chicago in 1977-78.
  - ✓ Licenses for 40 MHz spectrum in 800 MHz
  - ✓ The current spectrum allocation is 50 MHz in 824-849 MHz (Uplink) & in 869-894 MHz (downlink) in USA.
  - ✓ Channel BW=10 KHz.
  - ✓ Called as analog cellular system uses FM.
- **N-AMPS (Narrow band AMPS):**
  - ✓ First introduced in 1992.
  - ✓ 10 KHz channel standardized by Telecommunication Industry Association (TIA) of USA.
  - ✓ 824-894 MHz frequency band.
  - ✓ Also called North American TDMA or North American AMPS (NA-AMPS/NA-TDMA)

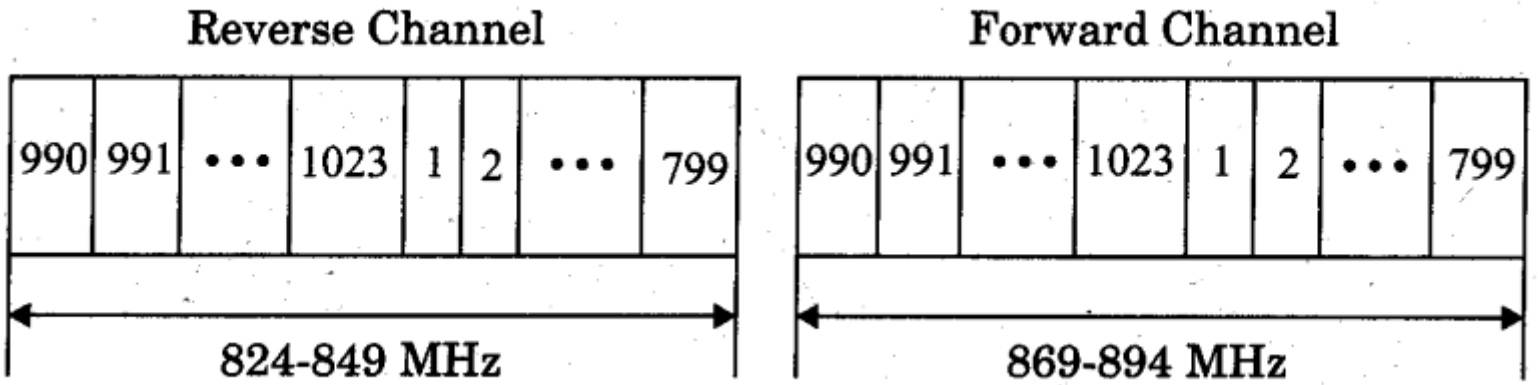
- **IS-95 (Interim Standard – 95):**
  - ✓ CDMA technology standardized in USA by TIA as IS-95.
  - ✓ First adopted in 1993.
  - ✓ Channel bandwidth = 1.25 MHz
  - ✓ 824-894 MHz / 1.8 – 2 GHz frequency band.
  - ✓ Supports short messages.
  - ✓ Supports paging & Over the air activation (OTA).
  - ✓ Support packet data.
- **GSM (Global System for Mobile Communication):**
  - ✓ Groupe Speciale mobile GSM was founded in 1982 & renamed as Global system for mobile communication.
  - ✓ Second generation system
  - ✓ Initially 890-915 MHz (Uplink) & 935-960 MHz (Downlink).
  - ✓ Called GSM 900
  - ✓ Nowadays 1.85 – 1.99 GHz frequency band with BW = 200 KHz.
  - ✓ Includes features emergency calling, voice messaging, SMS, packet data, etc

Some Related Definitions

- **Base Station (BS):** A fixed or non-moving station used for radio communication with mobile stations (MS).
- **Mobile Station (MS):** A station in the cellular radio service intended for use while in motion at unspecified locations.
- **Control Channel (CC):** Radio channel used for transmission of information from base station (BS) to mobile station (MS) or vice-versa.
- **Forward control channel (FCC):** Radio channel used for transmission of information from the base station (BS) to mobile station (MS).
- **Reverse control channel (RCC):** Radio channel used for transmission of information from mobile station (MS) to base station (BS).
- **Mobile Switching Center (MSC):** The center which is set up for co-ordinating the routing of calls, also called as mobile telephone switching office (MTSO).
- **Hand Off (HO):** It is the process of transferring a mobile station (MS) from one base station (BS) to another base station(BS) where mobile station (MS) is moving.
- **Pager:** A brief message which is broadcast over the center service area by many base station (BS) (called simulcasting) at the same time is called as pager.

- **Mobile** - any radio terminal that could be moves during operation
- **Portable** - hand-held and used at walking speed
- **Subscriber** - mobile or portable user
- Classification of mobile radio transmission system
  - **Simplex**: communication in only one direction
  - **Half-duplex**: same radio channel for both transmission and reception (push-to-talk)
  - **Full-duplex**: simultaneous radio transmission and reception (FDD, TDD)
- Frequency division duplexing uses two radio channel
  - **Forward channel**: base station to mobile user
  - **Reverse channel**: mobile user to base station
- Time division duplexing shares a single radio channel in time.





	Channel Number	Center Frequency (MHz)
Reverse Channel	$1 \le N \le 799$	$0.030N + 825.0$
	$990 \le N \le 1023$	$0.030\,(N - 1023) + 825.0$
Forward Channel	$1 \le N \le 799$	$0.030N + 870.0$
	$990 \le N \le 1023$	$0.030\,(N - 1023) + 870.0$

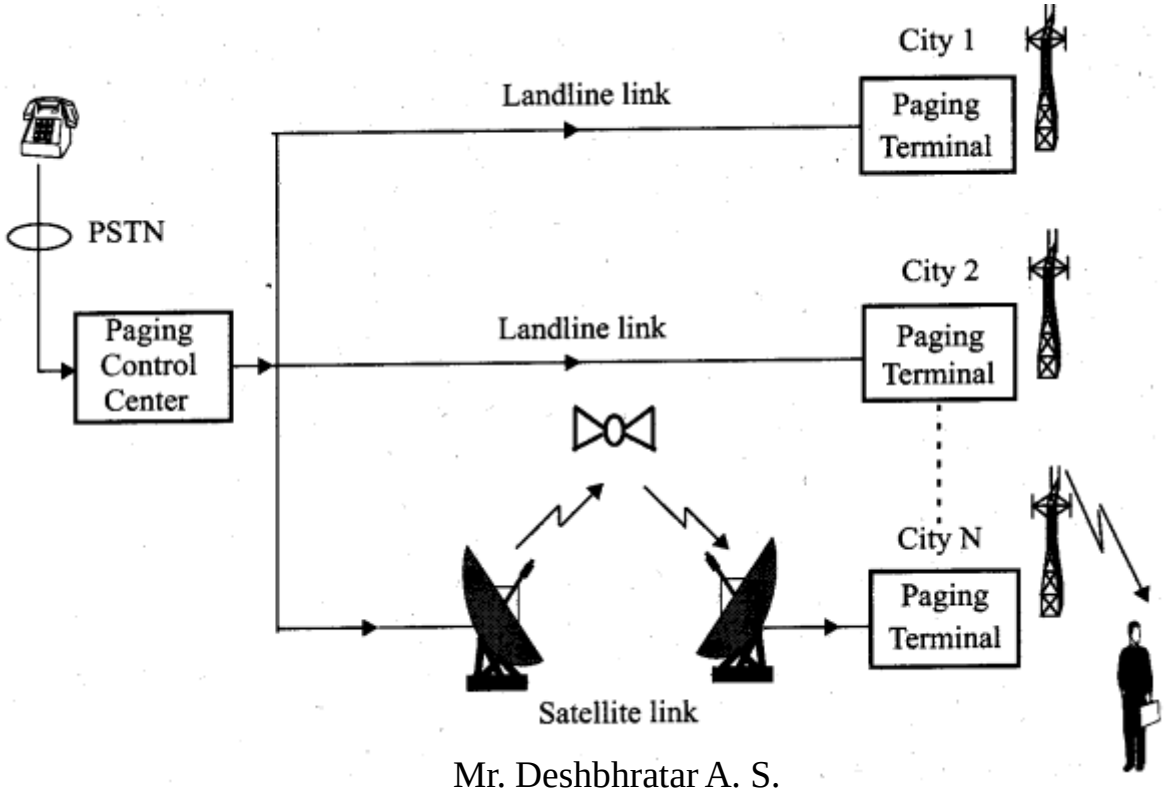
(Channels 800 - 989 are unused)

Example of Wireless Communication Systems

- Examples:
  - Paging System
  - Cordless phone system
  - Cellular phone system
  - Remote controller
  - Hand-held walkie-talkies
  - Wireless LAN

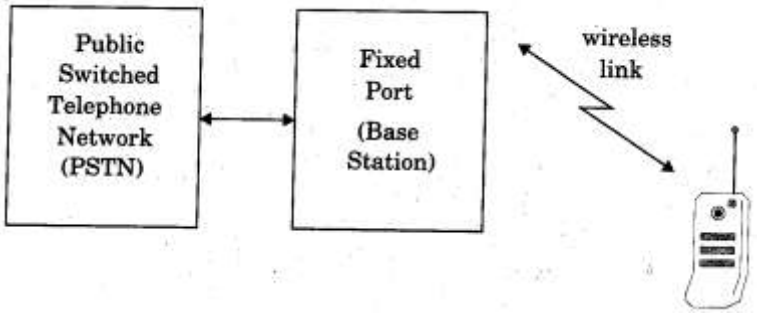
Paging Systems

- Conventional paging system send brief messages to a subscriber
- Modern paging system: news headline, stock quotations, faxes, etc.
- Simultaneously broadcast paging message from each base station (simulcasting)
- Large transmission power to cover wide area.



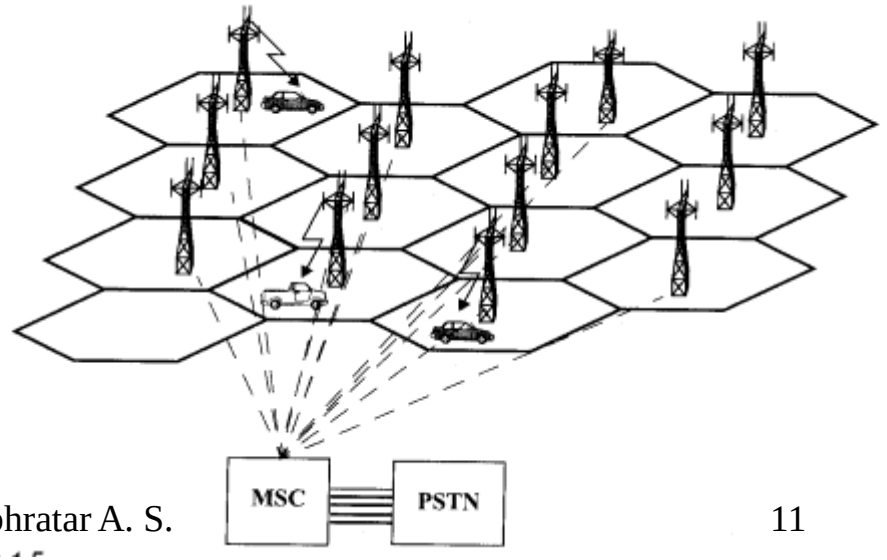
Cordless Telephone System

- Cordless telephone systems are full duplex communication systems.
- First generation cordless phone
  - in-home use
  - communication to dedicated base unit
  - few tens of meters
- Second generation cordless phone
  - outdoor
  - combine with paging system
  - few hundred meters per station



Cellular Telephone Systems

- Provide connection to the PSTN for any user location within the radio range of the system.
- Characteristic
  - Large number of users
  - Large Geographic area
  - Limited frequency spectrum
  - Reuse of the radio frequency by the concept of "cell".
- Basic cellular system: mobile stations, base stations, and mobile switching center.



- Communication between the base station and mobiles is defined by the standard common air interface (CAI)
  - forward voice channel (FVC): voice transmission from base station to mobile
  - reverse voice channel (RVC): voice transmission from mobile to base station
  - forward control channels (FCC): initiating mobile call from base station to mobile
  - reverse control channel (RCC): initiating mobile call from mobile to base station

THE END

Reference: Communication Electronics: Principle & Application 3/E

By Louis E. Frenzel

(Page No. 1-18)

Mr. Deshbhratar A. S. Lecturer in Institute of Technology, Junnar (Maharashtra)