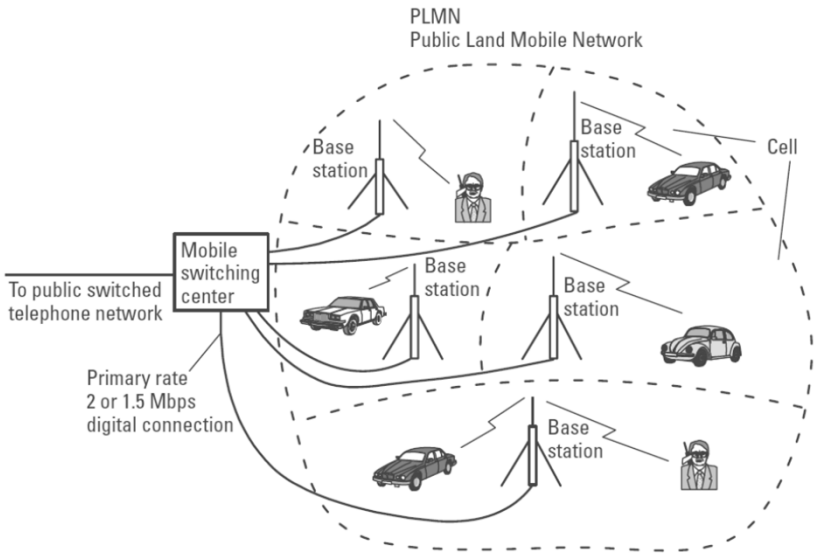
MOBILE COMMUNICATIONS

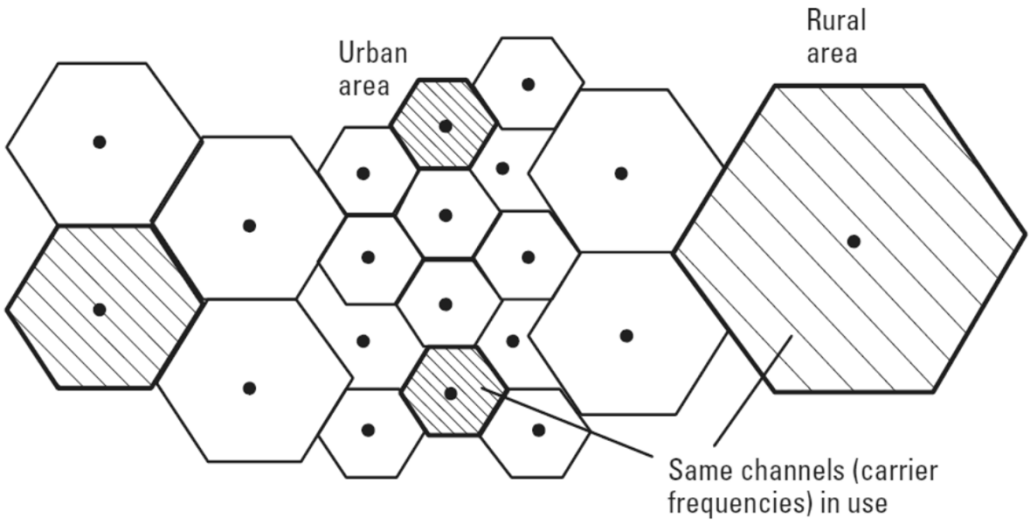
Cellular Radio Principles

- A list of the most important common characteristics of cellular systems:
  - Frequency reuse provides a much larger number of communication channels than the number of channels allocated to the system.
  - Automatic intercellular transfer, or a handover, ensures continuity of communication when there is a need to change BSs.
  - Continuous monitoring of communication between the mobile and BS verifies the quality and detects the need for a cell transfer.
  - Automatic location of mobile stations within the network ensures that calls can be routed to mobiles.
  - Mobile stations continuously listen to a common channel of the network in order to receive a call.

Basic Structure Of A Cellular Radio Network



Cellular Structure Of A Mobile Radio Network

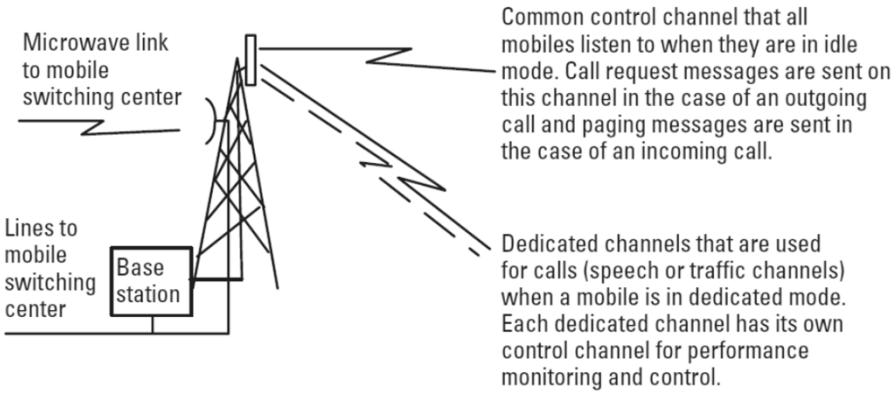


Home Location Register and Visitors Location Register

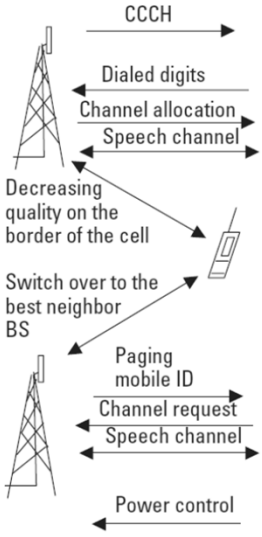
- The HLR stores their up to date subscriber information such as :
  - where (in the area of which VLR) they are located presently
  - what services they have the right to use
  - a number where she has transferred calls.
- VLR stores information about every subscriber in its area.
- It also contains more accurate information of where to connect incoming calls directed to a certain subscriber.
- The VLR is usually integrated into a mobile telephone exchange but the HLR is usually a physically separate efficient database system.

Radio Channels

HLR, home location register, stores subscriber information and updated location information (VLR address). Each subscriber is registered in one fixed HLR.
VLR, visitors location register, stores subscriber information of each MS located in its area.



Basic Operation Of The Cellular Network



In idle mode the mobile station listens to the common control channel, CCCH.

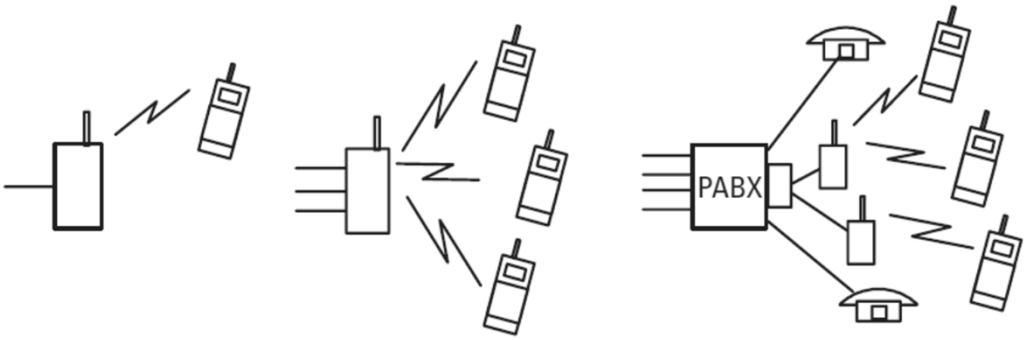
Outgoing call: The dialed digits are sent to the network and a voice channel is allocated.

Handover: When the MS moves towards the edge of the base station area, communication quality is decreased. A new cell is selected with the help of measuring results of the neighbor cells. A new channel is then allocated and BS and MS switch to it at the same time.

Incoming call: Paging message is sent over the common control channel. When MS receives its own identification, it requests a traffic or voice channel, which is then allocated.

Transmission power is controlled to be as low as possible to minimize interference with other cells.

Cordless Telephones

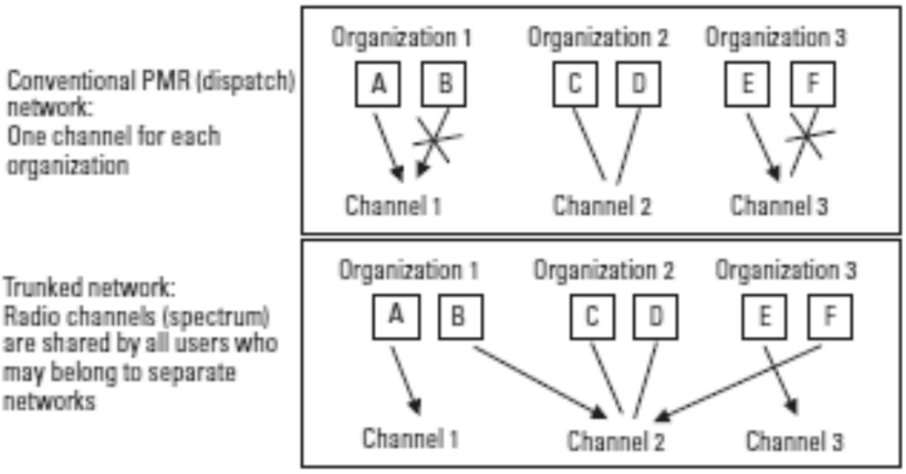


Residential use

Telepoint or wireless local loop, WLL

Cordless corporate network

Professional or Private Mobile Radio (PMR)



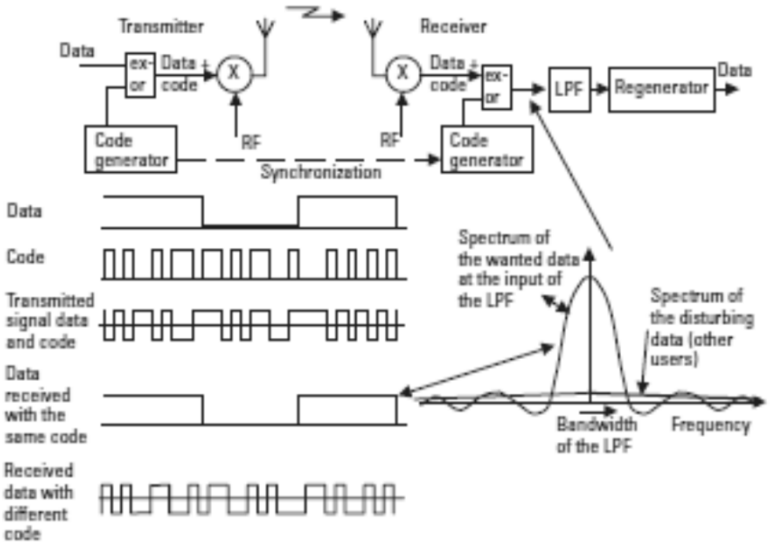
Analog Cellular Systems

- The first cellular technologies were analog and they became available in the first half of the 1980s.
- These systems are often referred to as first generation cellular systems and these are the most important analog cellular systems:
  - Advanced Mobile Phone System (AMPS) in the United States;
  - Nordic Mobile Telephone (NMT) used in Nordic countries;
  - Total Access Communications System (TACS) in the United Kingdom.
- Analog Cellular Systems are quite similar but incompatible.
- They use a frequency band in the range of 800 to 900 MHz (NMT uses 450 MHz as well) and frequency modulation.
- The frequency band is divided into channels and one of these is allocated for each call.
- We call this radio access principle frequency division multiple access (FDMA).

Digital Second Generation Cellular Systems

- GSM operates at the 900-MHz frequency band and it became the most widely used second generation cellular technology.
- Digital cellular system at 1,800 MHz (DCS-1800) is also known as GSM-1800.
- The personal communications network (PCN) and personal communications service (PCS) simply refer to microcellular systems that emphasize low-cost and high-capacity cellular service and a hand-portable terminal with a long battery life.
- The North American digital cellular (NADC) system implements digital radio communication in the frequency band of AMPS. It divides the channels of the analog AMPS into six time slots (TDMA).
- CDMA was selected in the early 1990s to become the main digital cellular standard in the United States.

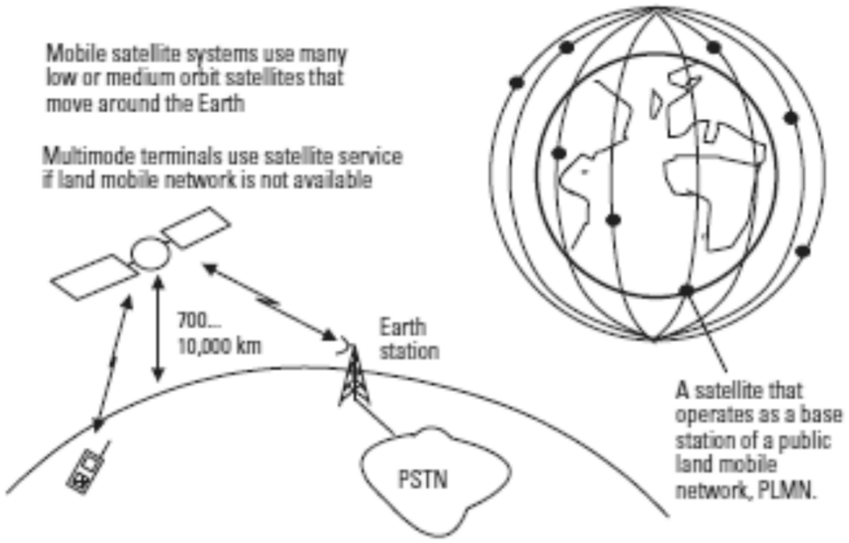
CDMA



Third Generation Cellular Systems

- The IMT-2000 system was designed to be a global system for third generation mobile communications.
- UMTS is a European concept for integrated mobile services and it is based on the GSM and GPRS.
- CDMA2000 is specified to use a sophisticated modulation scheme to increase the data rate over an ordinary 1.25-MHz CDMA channel.

Mobile Satellite Systems



WLANs

- A major step in the development of WLAN technology was Standard IEEE 802.11b, which was approved in 1999.
- Standard IEEE 802.11b uses a 2.4-GHz license free frequency band and its maximum data rate over the air interface is 11 Mbps.
- WLANs are actually designed to operate as wireless extensions to wire-line backbone Ethernet.
- WLAN technologies may be a solution for high-data-rate short-haul data services when integrated with third generation systems.

Bluetooth

- Bluetooth technology allows for the replacement of proprietary cables that connect one digital device to another with a universal short-haul radio link.
- A small wireless Bluetooth network connecting, for example, a user's computer to its peripherals is called a personal area network (PAN).
- Bluetooth systems use the same 2.4-GHz license free frequency band as WLANs and they can coexist in the same area.
- Bluetooth uses frequency hopping spread-spectrum (FHSS) technology.
- The number of devices in the Bluetooth network is very limited and data rate available for each device is quite low.