Wireless Mobile Communication

Lecture 11,12

- Analog Cellular System & Digital Cellular System

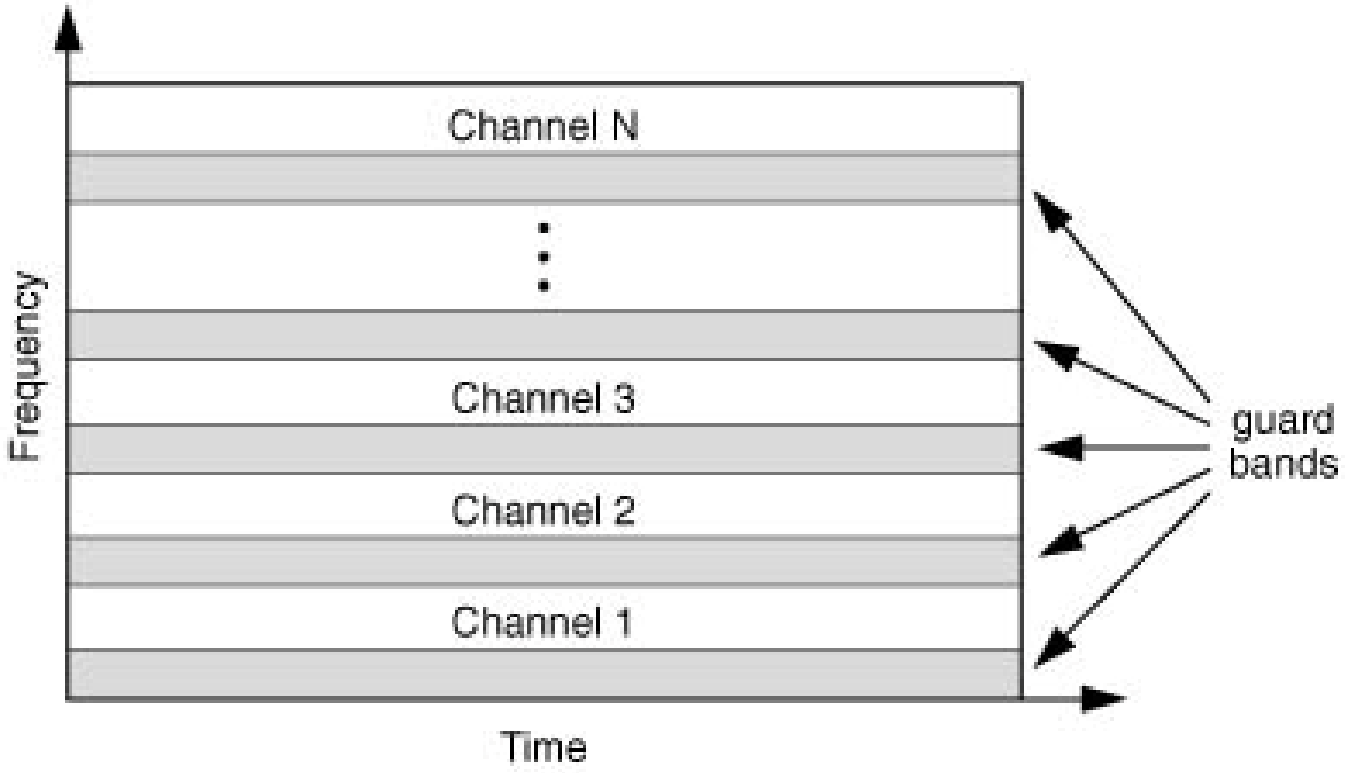
Topics to be Covered

- Analog Access
- FDMA
- Digital Access
- TDMA
- CDMA
- Spread Spectrum

Analog Access

- Analog Cellular Systems
  - First generation system
  - Based on FDMA (Frequency Division Multiple Access), where frequency band is divided into a number of channels. Each channel carries only one voice conversation at a time.
  - AMPS operates on 800 MHz or 1800 MHz
  - Advantages:
    - Widest coverage
  - Limitations:
    - Inadequate to satisfy the increasing demand
    - Poor security
    - Not optimized for data

FDMA


Channel N
Channel 3
Channel 2
Channel 1
guard
bands
Frequency
Time

Digital Access

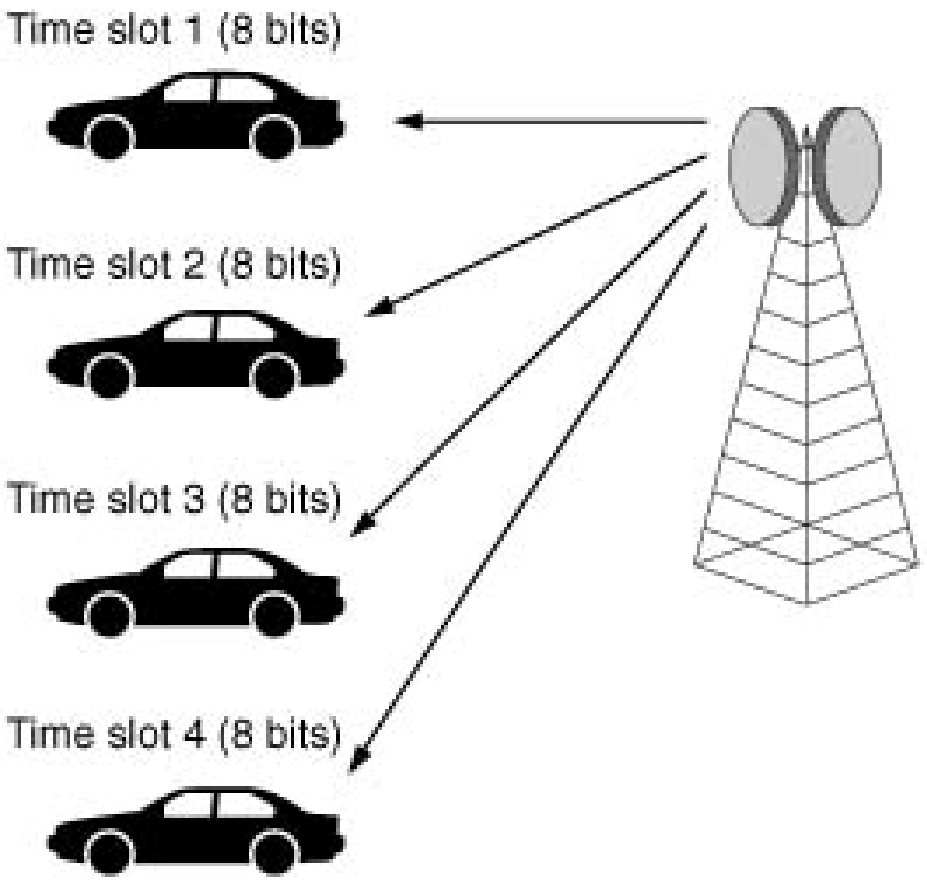
- D-AMPS (Digital-AMPS)
- TDMA (Time Division Multiple Access)
- CDMA (Code Division Multiple Access)

Digital wireless technologies provide greater system capacity.

TDMA

- TDMA
  - Second generation system
  - Enables users to access the whole channel bandwidth for a fraction of the time, called *slot*, on a periodic basis
  - Has applications in satellite communications
  - Advantages
    - Improved capacity

TDMA


Time slot 1 (8 bits)
Time slot 2 (8 bits)
Time slot 3 (8 bits)
Time slot 4 (8 bits)

CDMA

- CDMA
  - Third generation system
  - Separates users by assigning them digital codes within a broad range of the radio frequency
  - First technology to use *soft-handoff*
  - Employs *spread spectrum* technique
  - Advantages
    - Improved capacity, coverage, voice quality, and immunity from interference

An Overview of Cellular Technologies

Cellular System Generation	Technology	Operating Frequency	Advantages	Disadvantages
First Generation	AMPS based on FDMA	800 MHz or 1800 MHz	✦ Widest coverage including rural areas	✦ Poor security ✦ Not optimized for data ✦ Limited capacity
Second Generation	TDMA	800 MHz or 1900 MHz	✦ Better security ✦ Higher capacity	✦ May experience an interruption during handoff
Third Generation	CDMA	800 MHz or 1900 MHz	✦ Very high security ✦ Improved capacity ✦ Greater immunity from interference ✦ Soft handoff with no interruption	✦ Limited coverage at this time

Spread Spectrum Technique: FHSS

- Frequency Hopping Spread Spectrum (FHSS)
  - Resists interference by jumping rapidly from frequency to frequency in a pseudo-random way
  - Advantage
    - Increases the total amount of available bandwidth through the assignment of multiple hopping sequences within the same physical area
    - More flexible than DSSS
  - Application
    - In large facilities especially with multiple floors

Spread Spectrum Technique: DSSS

- Direct Sequence Spread Spectrum (DSSS)
  - Resists interference by mixing in a series of pseudo-random bits with the actual data
  - Advantage
    - If bits are damaged in transmission, the original data can be recovered as opposed to having to be retransmitted
  - Application
    - Is substituted for point-to-point or multi-point connectivity to bridge LAN segments
  - Limitation
    - Roaming capabilities are less robust

Spread Spectrum Technique: CDPD

- Cellular Digital Packet Data
  - Allows for a packet of information to be transmitted in between voice telephone calls
  - Enables data specific technology to be tacked onto existing cellular telephone infrastructure

Time Division Multiple Access (TDMA)

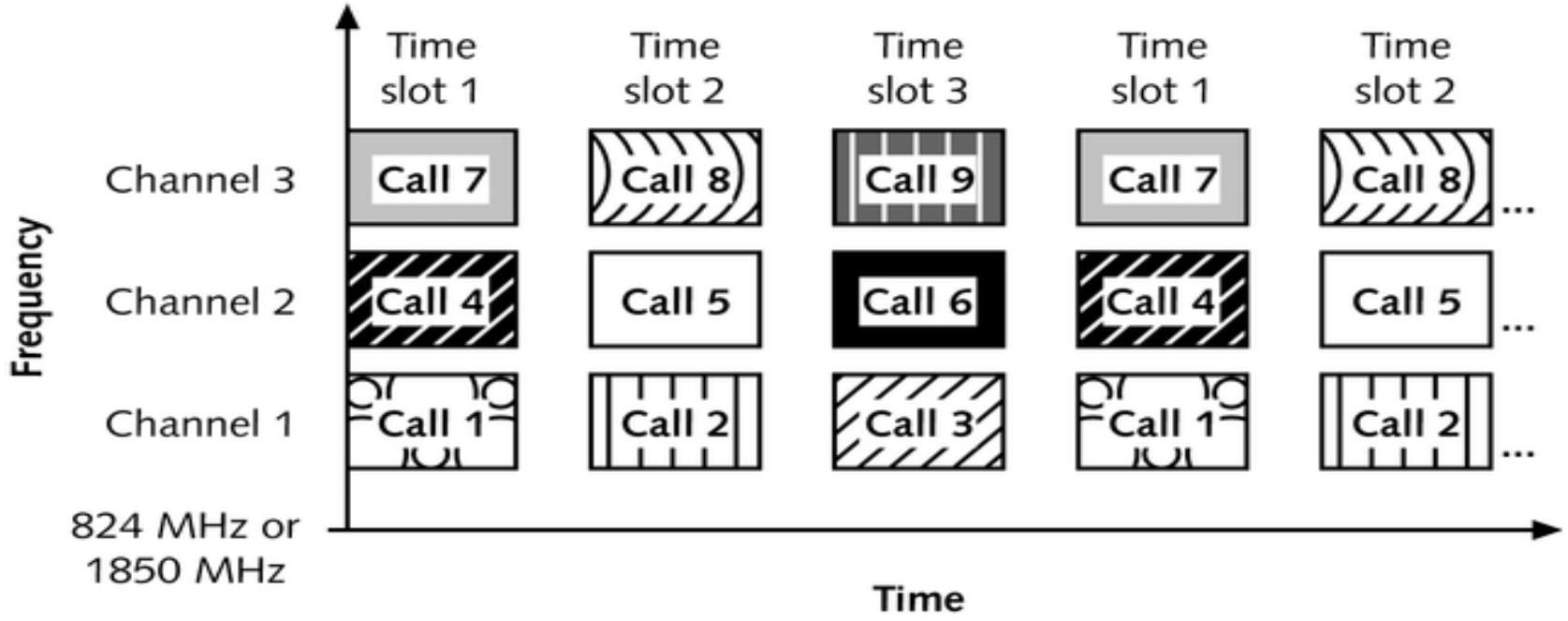


Figure 9-14 TDMA

Code Division Multiple Access (CDMA)

- Each voice signal is digitized and assigned a unique code, and then small components of the signal are issued over multiple frequencies using the spread spectrum technique.

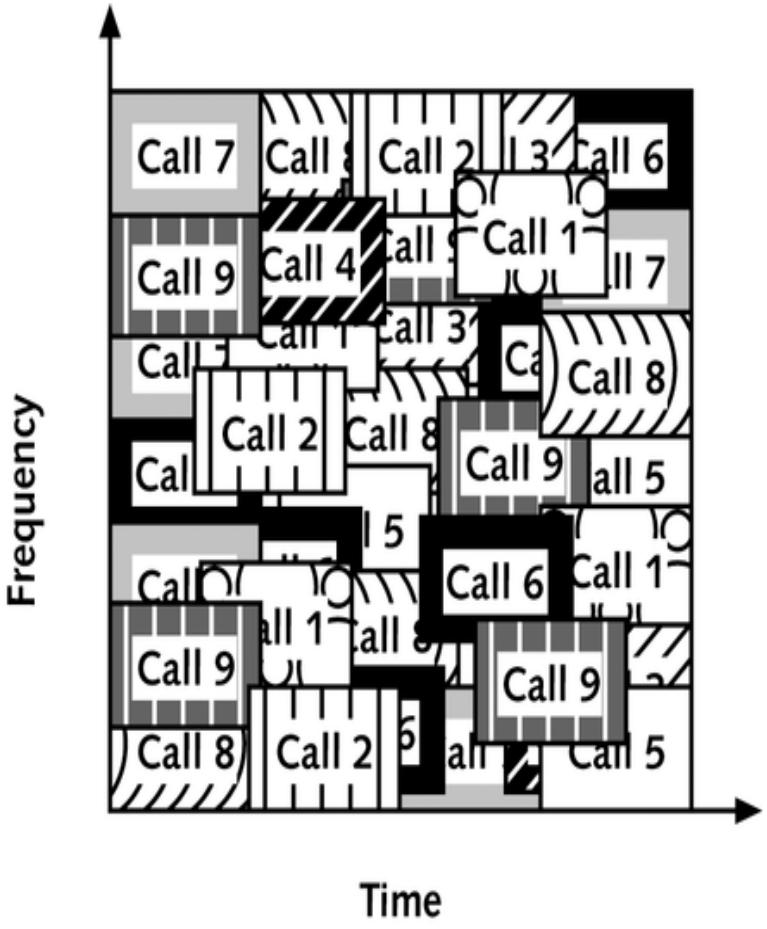


Figure 9-15 CDMA