Wireless Concepts

- Cell site: transmitter, receiver, base station
- Mobile Switching Center
- Frequency reuse through separated cell sites
- Roaming & Location Management

Based on: Dell White Paper: Wireless Technologies
A Bit of History

• Cellular Technologies
  – 1991: Digital (2nd Generation, limited data transfer)
    • 800 and 900 MHz frequency bands
    • PCS in 1800 and 1900 MHz frequency bands
  – 2000: 3rd Generation (UMTS)

• Access Methods
  • Multiplex several calls onto single cellular channel
    – FDMA: Frequency Division Multiple Access (analog)
    – CDMA: Code Division Multiple Access (codes)
    – TDMA: Time Division Multiple Access (timeslots)
Multiplexing Technologies

Allow multiple calls to share a single connection

- **TDM Time Division Multiplexing (digital)**
  - Each path shared by several channels which have timeslots

- **SDM Space Division Multiplexing (analog or digital)**
  - Each channel allocated an exclusive physical path

- **FDM Frequency Division Multiplexing (analog)**
  - Each channel allocated an individual frequency

- **PDM Packet Division Multiplexing (digital)**
- **CDM Code Division Multiplexing (digital)**
  - Each channel allocated an individual code within same path

- **WDM: Wave Division Multiplexing (digital & analog!)
  - Each channel allocated an individual wavelength on a fiber**
1$^{st}$ & 2$^{nd}$ Generation Variants

- **Analog (1$^{st}$ Generation – 1G)**
  - AMPS used mainly in the US - also in Latin America, Australia, New Zealand, parts of Russia and Asia-Pacific.
  - ETACS used in Europe and Asia-Pacific.
  - NMT used in Scandinavia and some European countries, as well as parts of Russia, the Middle East and Asia.

- **Digital (2$^{nd}$ Generation – 2G)**
  - GSM 900 (900 MHz) - Europe; also used in Asia-Pacific.
  - GSM 1800 (1800 MHz) also used in Europe and Asia, not as widely adopted as GSM 900.
  - GSM 1900 (1900 MHz) GSM system used in Americas and Canada.
  - TDMA & CDMA digital standards used in US, also Latin America, New Zealand, parts of Russia and Asia-Pacific.
  - PDC digital standard used in Japan
CDMA vs. TDMA

CDMA (Carrier Division Multiple Access)
- Segment a single (1.25MHz) channel into (64) multiple channels using a code to identify users
- Spreads call over entire spectrum: more immune to interference than TDMA; potentially supports more users
- Capacity not fixed, depends on coverage, total voice bandwidth
- During peak periods, cell size reduces due to spectrum use

TDMA (Time Division Multiple Access)
- Segment a single (30KHz) channel into (3 x 8kbit/s) timeslots, carrying specific user information
- Cell phones for TDMA networks will not work with CDMA networks and vice versa
- Capacity dependent on number of available timeslots
GSM

- GSM: Groupe Speciale Mobile
- GSM: Global System for Mobile Communications
- TDMA-based technology developed in late 1980s
- Worldwide (outside N America) de-facto digital standard: 200m GSM users; 370+ operators
- Two variants:
  - GSM: Transmit 890-915MHz, Receive: 935-960MHz
  - PCN: Transmit 1850-1910MHz, Receive 1930-1990MHz
CDMA Technology

Cell Sites
