

Current Technology Developments in Wireless Communications and Mobile Computing

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Presentation Outline

- **Historical Overview**
- **Radio Fundamentals**
- **US Developments in PCS**
- **Mobile Data**
- **Satellite Systems**
- **Problems with existing schemes**
- **Wireless Overlay Networks**
- **US Government Research Initiatives**



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It Started with the Telegraph ...

“We call the electric telegraph the most perfect invention of modern times ... as anything more perfect than this is scarcely conceivable, and we really begin to wonder what will be left for the next generation, upon which to expend the restless energies of the human mind.” -- an Australian newspaper, 1853



Critical Attributes of Telecommunications Systems

- **Speed**
 - Ability to transmit information in *real-time*
 - Electronic transmission: faster than transportation
- **Coverage**
 - Beyond regional: national and international in scale
 - Metcalf's Law: the more connected, the more useful
- **Reliability**
- **Cost**
 - 1866: 20 word telegram cost \$100 (4 months wages)
- **Security**
 - Transmitted information as knowledge, news, secrets
 - Always an element of government oversight and control



Origins of Coded Transmission

- **1793, Revolutionary France**
 - Aerial Telegraph, invented by Claude Chappe
 - Extensive network throughout France
- **1840s, Samuel F. B. Morse**
 - Coded transmission via electronic means
 - Rapidly spread throughout US and Europe
 - International Telegraph Union (ITU) formed in 1865



Submarine Telegraphy: High Tech of the late 19th Century

- **1850: Dover-to-Calais, first submarine line**
- **1858: First transatlantic cable**
 - Breaks after 3 months!
 - President Buchanan & Queen Victoria exchange telegrams
- **1866: Relaid with higher quality cable**
 - Development of cable materials, technology of laying, repair
- **Typical “Performance”:**
 - 1870: London to Bombay in 4 minutes, 22 seconds
 - 1901: London to British Guiana, 22 minutes
 - 1924: Telegram around the world in 80 seconds!



Radio Telegraphy (also know as “Wireless”)

- **Radio technology**
 - Communicate with ships and other moving vehicles
 - Messages sprayed into the “ether” crossing natl boundaries
 - Downfall of the nationally supported monopolistic telegraph companies
- **1896: Guglielmo Marconi**
 - First demonstration of wireless telegraphy
 - Built on work of Maxwell and Hertz to send and receive Morse Code
 - Based on long wave ($\gg 1$ km), spark transmitter technology, requiring very large, high power transmitters
 - First used by British Army and Navy in the Boer War
 - 1899: Reported to shore America’s Cup yacht races



Wireless

- **1907: Commercial Trans-Atlantic Wireless Service**
 - Huge ground stations: 30 x 100m antenna masts
 - Beginning of the end for cable-based telegraphy
- **WW I: Rapid development of communications intelligence, intercept technology, cryptography**
- **1920: Marconi discovers shortwave (<100 m) radio**
 - Longwave follow contour of land
 - » Very high transmit power, 200 KW+
 - Shortwaves reflect, refract, and absorb, like light
 - » Bounce off ionosphere
 - » Higher frequencies made possible by vacuum tube (1906)
 - » Cheaper, smaller, better quality transmitters



Other Important Dates

- **1915: Wireless voice transmission NY to SF**
- **1920: First commercial radio broadcast (Pittsburgh)**
- **1921: Police car dispatch radios, Detroit**
- **1935: First telephone call around the world**
- **WW II: Rapid development of radio technology**
- **1968: Carterphone decision**
- **1974: FCC allocates 40 MHz for cellular telephony**
- **1982: European GSM and Inmarsat established**
- **1984: Breakup of AT&T**
- **1984: Initial deployment of AMPS cellular system**

