

## History of Cellular Telephony

Mischa Schwartz,  
Charles Batchelor Professor Emeritus of Electrical Engineering

October 23, 2007

### *Beginnings, Mobile Wireless Telephony, 1919–1940*

- First application, mobile telephony: Ship-to-shore communication  
Experimental service, coastal steamers, Baltimore—Boston, 1919  
Commercial service, 1929; AM, 4.2 and 8.7 MHz (AM broadcasts, 550–1600 kHz)
- Land mobile communications, Detroit police, small rugged radios  
By 1934, 5,000 police cars throughout U.S.; used AM band, 35 MHz  
*But*, communications between autos unsatisfactory—much fading and noise
- Signal propagation studies carried out, urban areas, 1926–1932, 40 MHz  
1935, Boston, studies at 35 MHz, 150 MHz: FM much better, more reliable  
Much better understanding gained of signal propagation phenomena

### *Post-WWII, First Commercial Mobile Wireless Systems*

- 1946, FCC licenses land-mobile telephone system, St. Louis; by year's end—25 cities  
FM, 150 MHz band, 40 channels (carrier frequencies), 120 kHz apart (1950, 60 kHz)  
Antennas on towers spaced 20–30 miles apart  
Channels assigned ½ to telephone cos., ½ to new Radio Common Carriers (RCCs)  
Manual push-to-talk; operator connections  
Maximum no. of customers in given area, 800–1000; waiting lists, priority to doctors.
- 1962–1965, semi-conductor era: development of Improved Mobile Telephone Service  
Automatic dialing, two-way communication, *but* long waiting lists (25,000 common!)  
Poor service—"busy signal" common
- Need for more capacity—Possible solutions: proposed in 1947!
  1. Move to higher frequency band
  2. Cellular geographic structure—frequency channels divided among cells, reused.

### *1949–1983: Move to Advanced Mobile Phone Service (AMPS)*

- 1949, Bell System requests 470–890 MHz band—denied (intended for TV)
- 1958, Bell System requests 764–840 MHz band, no action by FCC  
Cellular concept under intensive study, Bell Labs
- 1968, FCC decision, allocate 840 MHz band, asks for proposals
- 1971, Bell System proposes "High-Capacity Mobile Telephone System," incl. cells
- 10-year conflict—broadcasters, communication manufacturers, fleet operators, RCCs  
*all opposed!*
- 1981, FCC allocates 50 MHz in 800–900 MHz band, half to Telcos, half to RCCs

### *1983–1991, AMPS in service, First-generation cellular system, U.S.*

- 1978–1983, AMPS tests, Chicago, 8-mile radius cells
- AMPS: two 25-MHz bands, one each for up/down, FM, 30 kHz/channel  
Get 832 channels/direction, split 1/7 per cell (about 119 channels/cell), reused
- 1985 on—capacity problems, major cities (NY, LA). Studies by cellular industry
- 1988—decision, move to digital system

### *Second-generation systems, U.S.*

- Digital-AMPS, in operation, late 1991 (AT&T system), capacity tripled (now defunct)
- CDMA (code-division multiple access) developed by Qualcomm  
1986, trials with NYNEX, Pacific Bell: capacity greater than D-AMPS(?)  
1993, commercial deployment (currently, Verizon)

### *European systems*

- 1981, Scandinavian countries; 1982–1985, 7 other countries, systems all different!
- 1982–1990, plans for European-wide system; study group—*Groupe Spatiale Mobile (GSM)*

- 1991, 1992, GSM in operation:  
digital system, two 25-MHZ bands, 890–915 MHz and 935–960 MHz  
(later, 1.8 GHz band as well)
- GSM as well in U.S. (currently AT&T), plus systems in 2GHz band—  
we now have at least four systems, all incompatible!