Federal Law Enforcement Training Center
Technical Operations Division

Mobile Device Investigations Program (MDIP)

A Brief History of Wireless Technology

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Course Objective

Describe the evolution of wireless technology from its primitive genesis to 21st century application.

Prior To Late 1940's

In the Beginning….

- Two-Way Radio was the only wireless technology
- Technology very similar to modern two-way radio application

Late 1940's – Early 1960's

- Introduction of Mobile Telephone Service (MTS)
- Luggage-size Transceiver (Weight: 30 - 45 lbs.)
- Tube Electronics
- Required Operator Assistance
- VHF Frequencies (152Mhz – 159Mhz)
- Half-Duplex (Speak OR Listen – Not Both)
- Standard Lasted For 13 Years

1964 - 1969

- **New Standard: Improved Mobile Phone Service (IMPS)**
  - **No Operator Interface Required**
  - **Multiple Channels (allowing more users)**
  - **Weight: Typically, 25 lbs.**
  - **Frequency changed to UHF Spectrum (450Mhz – 460Mhz)**
  - **One Tower Per City (50 Mile Radius)**
  - **No Privacy (All Channels Were Public)**

1970 - 1983

Mobile signals became ‘duplex’ (send and receive simultaneously).

1974: The Federal Communications Commission (FCC) allocated frequency spectrums for cell technology…

…nine years before the first cellular service was implemented (November 1983).

1984 - 1990

- The FCC also in this period completed the definition of two general types of geographical regions:
  - Metropolitan Statistical Areas (MSA's). 306 areas defined.
    - FCC anticipated that MSA's would be the initial motivators since high volume areas were where most profits could be made
  - Rural Service Areas (RSA's). 734 areas defined.
    - FCC anticipated a slower evolution of these areas since they represented low population (and low profit) areas.
- See a map of designated FCC cellular areas.

1984 - 1990

- **The FCC divided cell service providers into two general categories:**

Question:
What Marketing Area are you now in?

Is it RSA or MSA?

- **Each cell area would be licensed to an ‘A’ and a ‘B’ provider.**

1984 - 1990

- The RSA/MSA's were assigned a frequency range in the 800Mhz spectrum.
- They are collectively referred to as Advanced Mobile Phone Service (AMPS).
- The vast majority of cell phone service today is in the AMPS spectrum.
- Although AMPS was designed as analog technology it has been 'overlaid' with digital capability.
- Today, in the US 98% of wireless use is digital (vs. analog).

1984 - 1990

- Nextel was founded in 1987 but was outside the normal cellular licensing system since it used a different technology (iDENT) and a different frequency spectrum.
- Nextel/iDENT's niche was 'Direct Connect' (aka: Push-to-Talk) which combined the technology of radio communications with normal cell technology.
- Nextel/iDENT became very popular with public service organizations (police and fire departments).

1991 - 1994

- Generally referred to as the birth of '2nd Generation' Cell Technology.
- Technology migrated from analog to digital.
  - TDMA, CDMA, GSM standards were introduced
  - GSM in 'the world'; TDMA/CDMA in the US
- Marked reduction in size from 'Bricks' to smaller handhelds
- Better batteries were developed to support newer phones.
- Towers became more dense facilitating higher traffic and better roaming service

1991 - 1994

- Because the 800Mhz spectrum was becoming too crowded, the FCC established in 1994 a new spectrum: the P
- S
- C s s
- S manufactured to support multiple spectrums.
- All major cell service providers offer support in multiple spectrums.

Question:

What spectrums does your cell phone support?

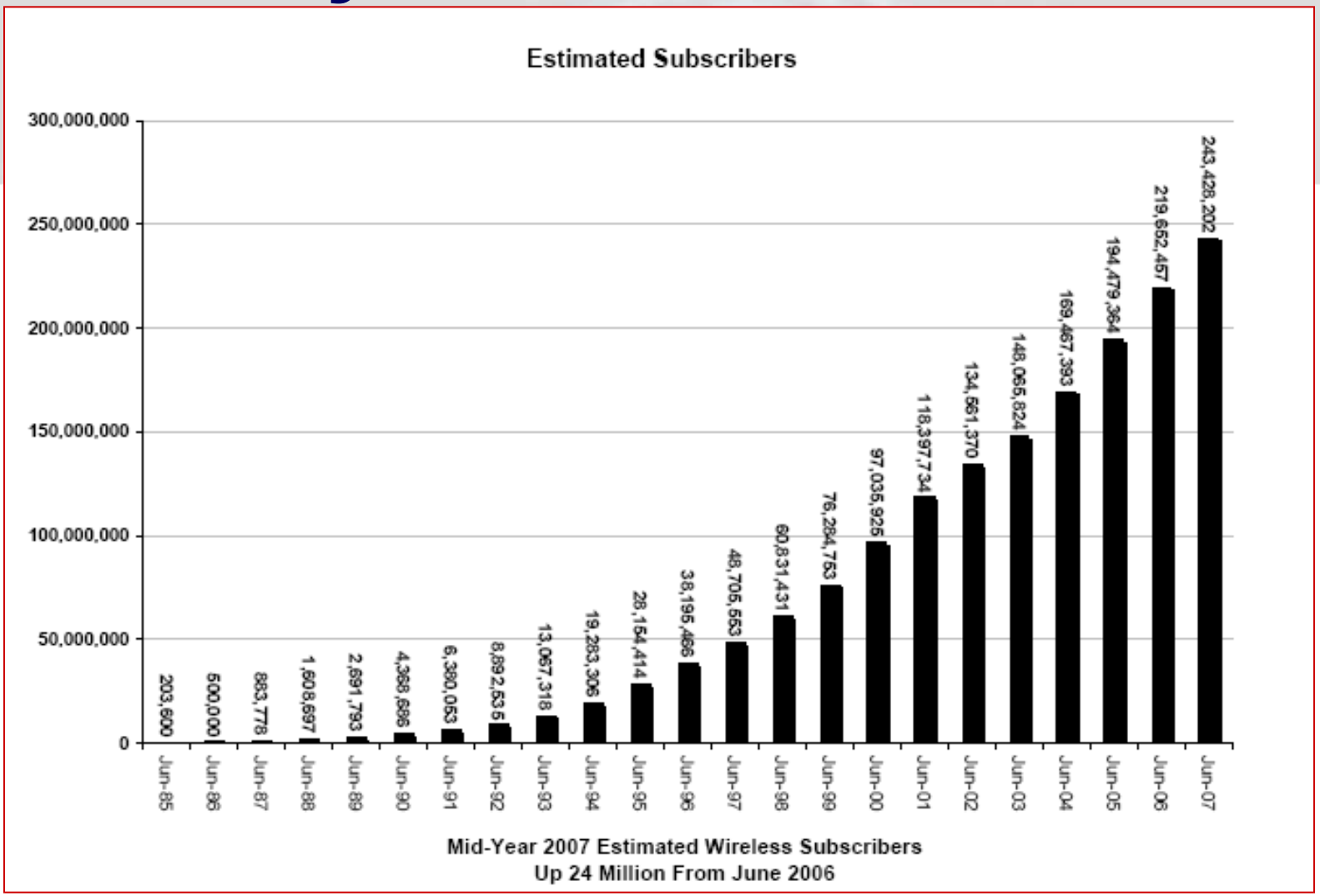
1995 - 2008

- 3rd Generation technology emerged
  - Allowed for non-aural communications:
    - SMS messaging
    - Internet Browsing
    - Introduction to reduced-scale Broadband:
      - Wireless Television, movies, etc

2008 -

- Advent of 4th Generation Cellular
  - Technology of 100Mb Broadband (while moving)
  - Technology of 1Gb Broadband (stationary)
  - On-Demand, High Quality Audio and Video
- Several competing technologies (none standard)
- Expect a plethora of new flashy, expensive hardware as this generation matures.

How Many Cell Phones in US?



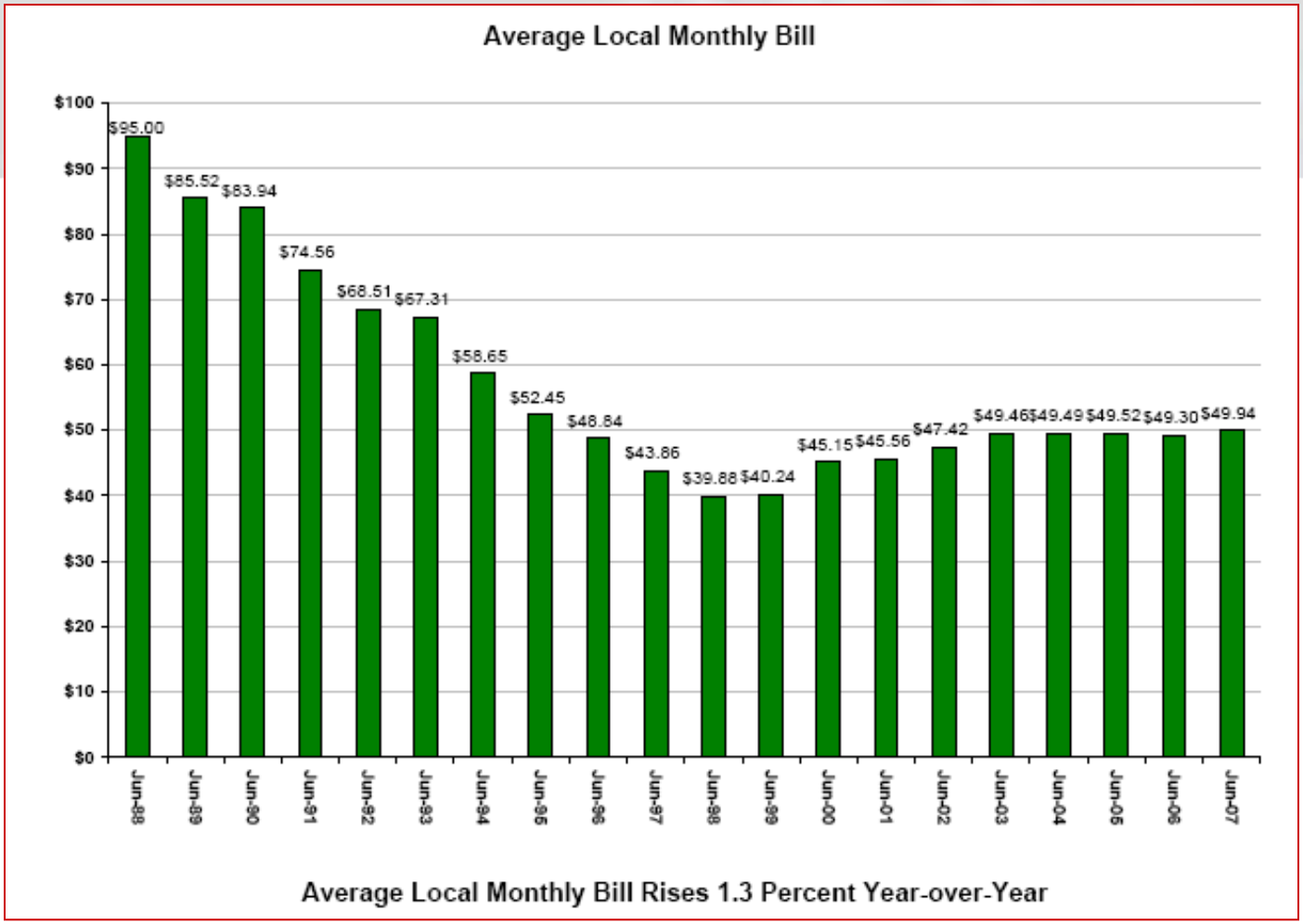
On 11/13/2007, cell phone subscriptions in US surpassed 250M

Source: CTIA

Pre-Paid Wireless Subscriptions

- In June 2006, there were 20M Pre-Paid Wireless subscriptions
- By January 2008 that number had doubled.

How Much Do You Pay For Cell Service?



Source: CTIA

12-yr Evolution of Cell Industry

	June 1995	*June 2007*
Wireless Subscribers	28.1M	243.4M
Wireless-Only Households	<None>	12.8%
Minutes of Annual Use	31.5M	1.95T
Annual SMS Messages	<None>	240.8B
Cell Sites (Towers)	19,844	210,360
Daily e-911 Calls	55K	291K

Source: CTIA

The Cell Industry Today

The Major Players and Primary Technologies

AT&T	(GSM/TDMA)
Verizon	(CDMA)
Sprint/Nextel	(PCS/CDMA/iDENT)
T-Mobile	(GSM)
Alltel	(CDMA)

The Major Providers (in US)

By Subscriber: June 2007

- AT&T (70.1M)
- Verizon (63.7)
- Sprint/Nextel (54M)
- T-Mobile (28.7M)
- Alltel (12.5M)
- TracPone (9.5M)
- US Cellular (6.1M)
- Virgin Mobile (5.1M)
- Metro PCS (3.7M)
- Cricket (2.9M)

Other Payers (sub-1M)

- Qwest
- SunCom
- Unicel
- Centennial Wireless
- Cellular South
- Cincinnati Bell
- nTelos
- Southern Linc

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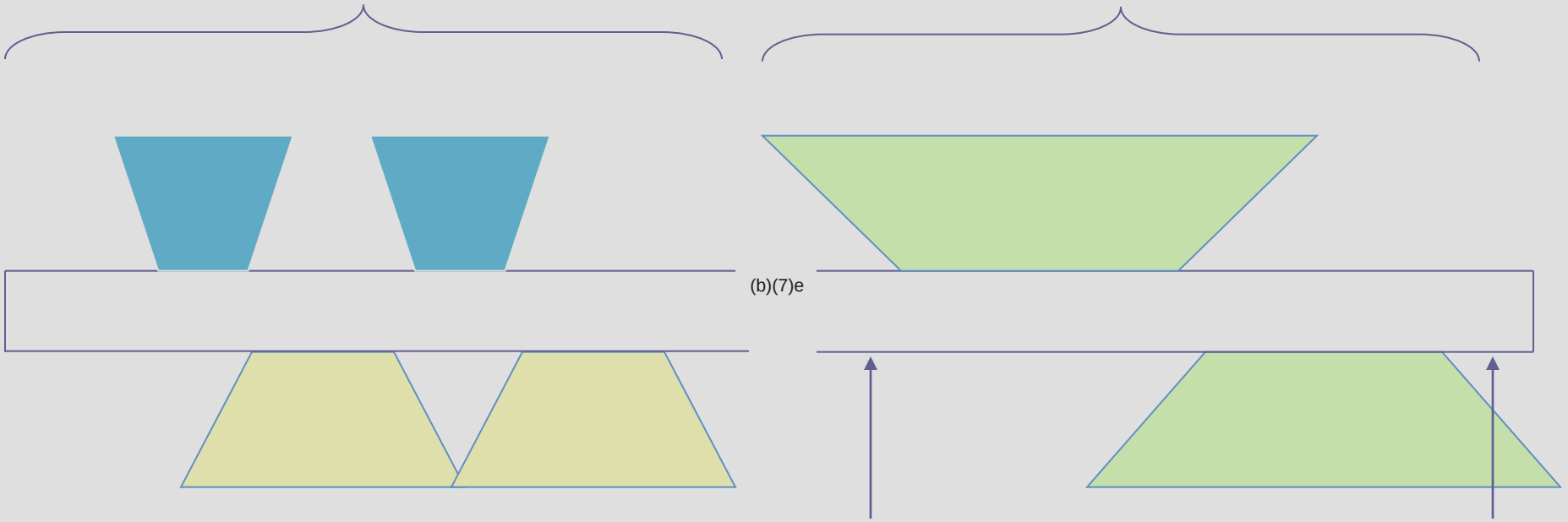
Three Wireless Services
Frequency Spectrum



CDMA Broadband Evolution

Enhancement standards to CDMA to optimize Broadband interface (VoIP, Internet, Multimedia)