The Future of Wireless and First Responders

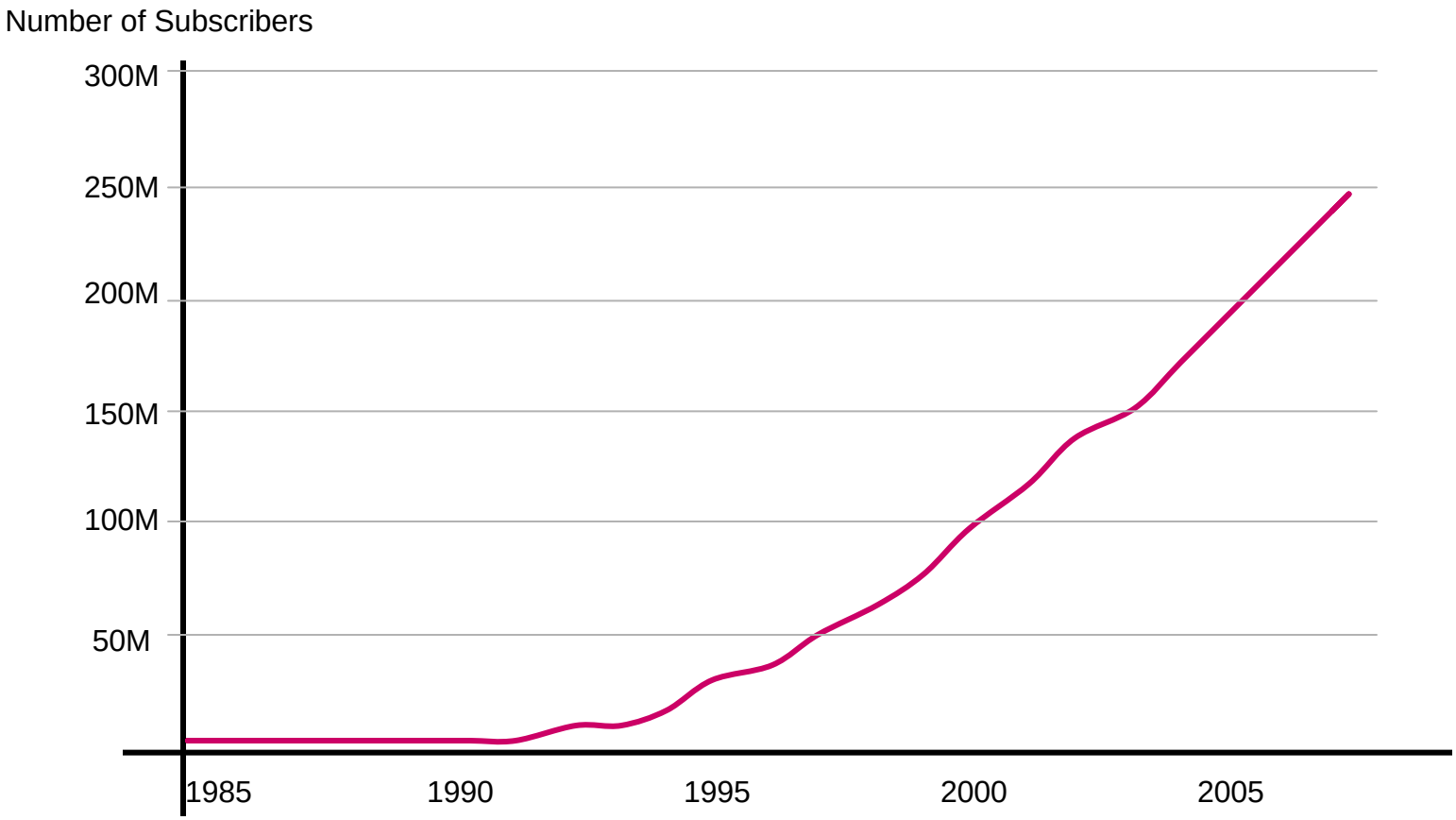
Juan Deaton
Cellular Systems Engineer
National and Homeland Security Directorate
Idaho National Lab
Phone: (208) 526-8589
Email: juan.deaton@inl.gov
Web: www.inl.gov

INL/CON-08-13699

Wireless Technology and First Responder

- Wireless Past and Present
- Wireless Future
- First Responders and Wireless

Subscriber Growth



Idaho National Laboratory

Source: CTIA

Cellular Statistics

Average Life of a Cell Phone :

14-18 Months

Cellular Users

~250 Million

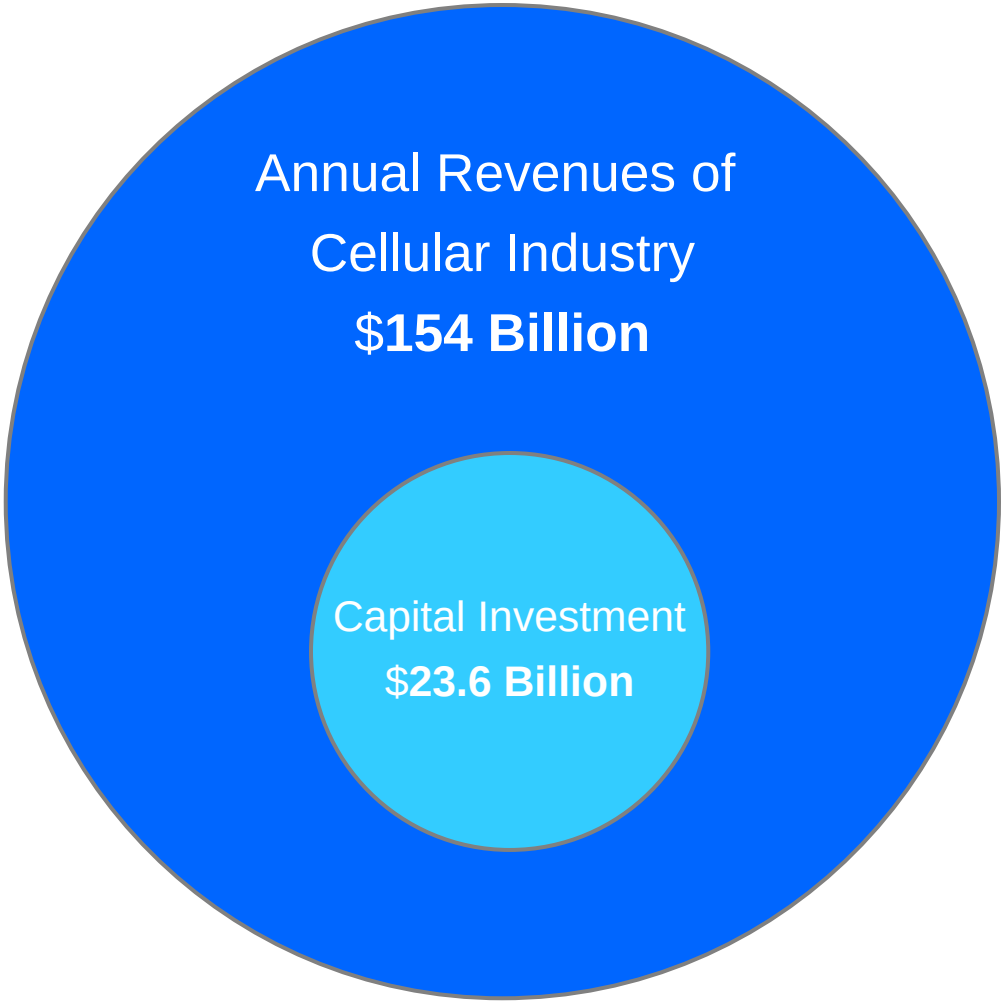
~81% Penetration

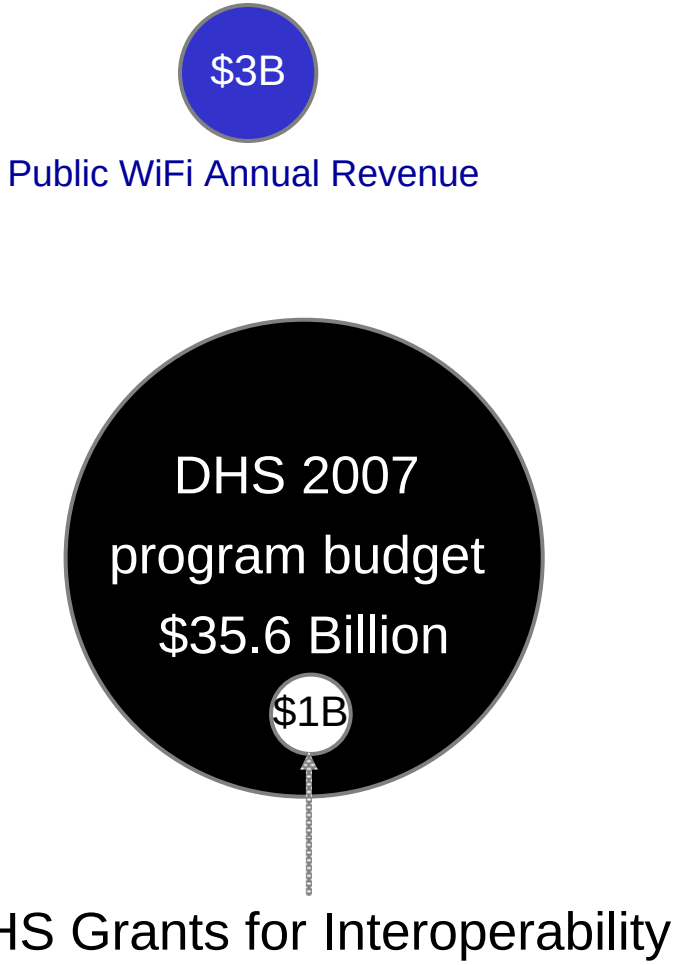
First Responders in US

~2.5 Million

Source: CTIA, WiFi Alliance

2007 Financial Comparison

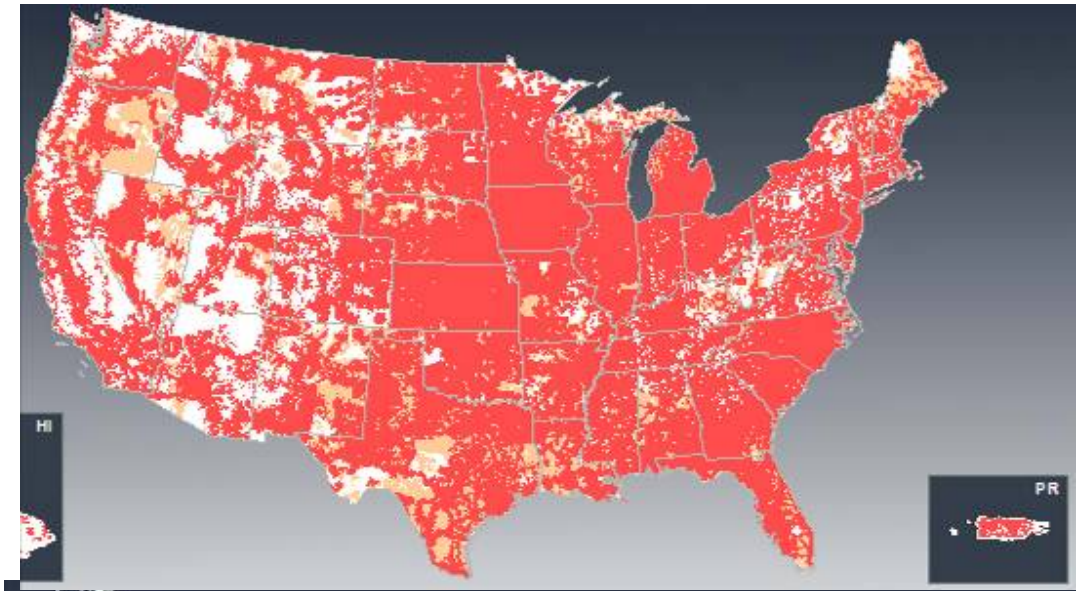




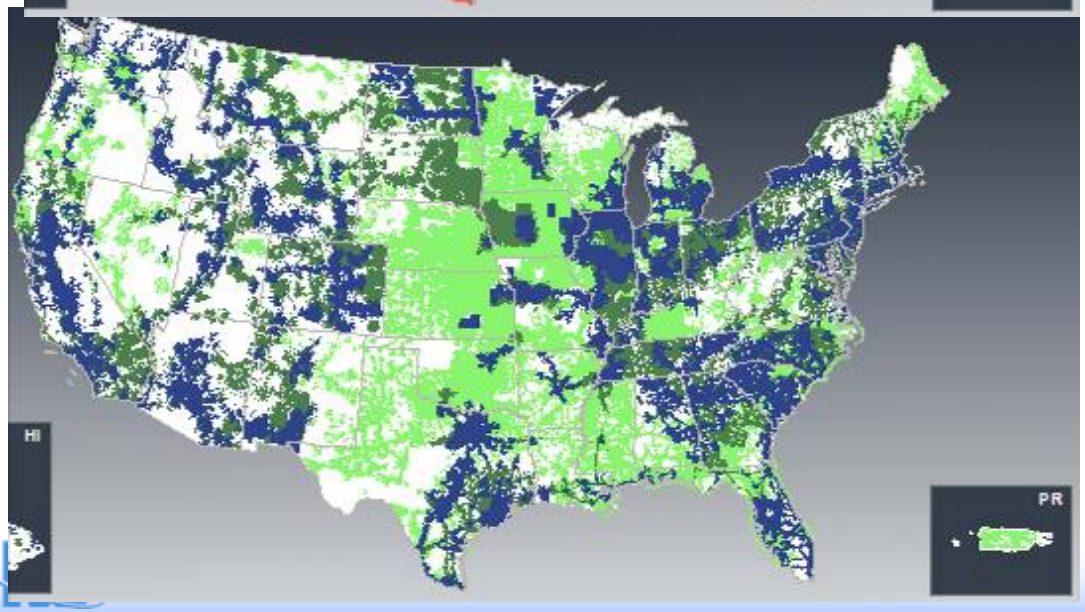
Idaho National Laboratory

Source: CTIA, Homeland Defense Journal, WiFi Alliance

CDMA Cellular Coverage



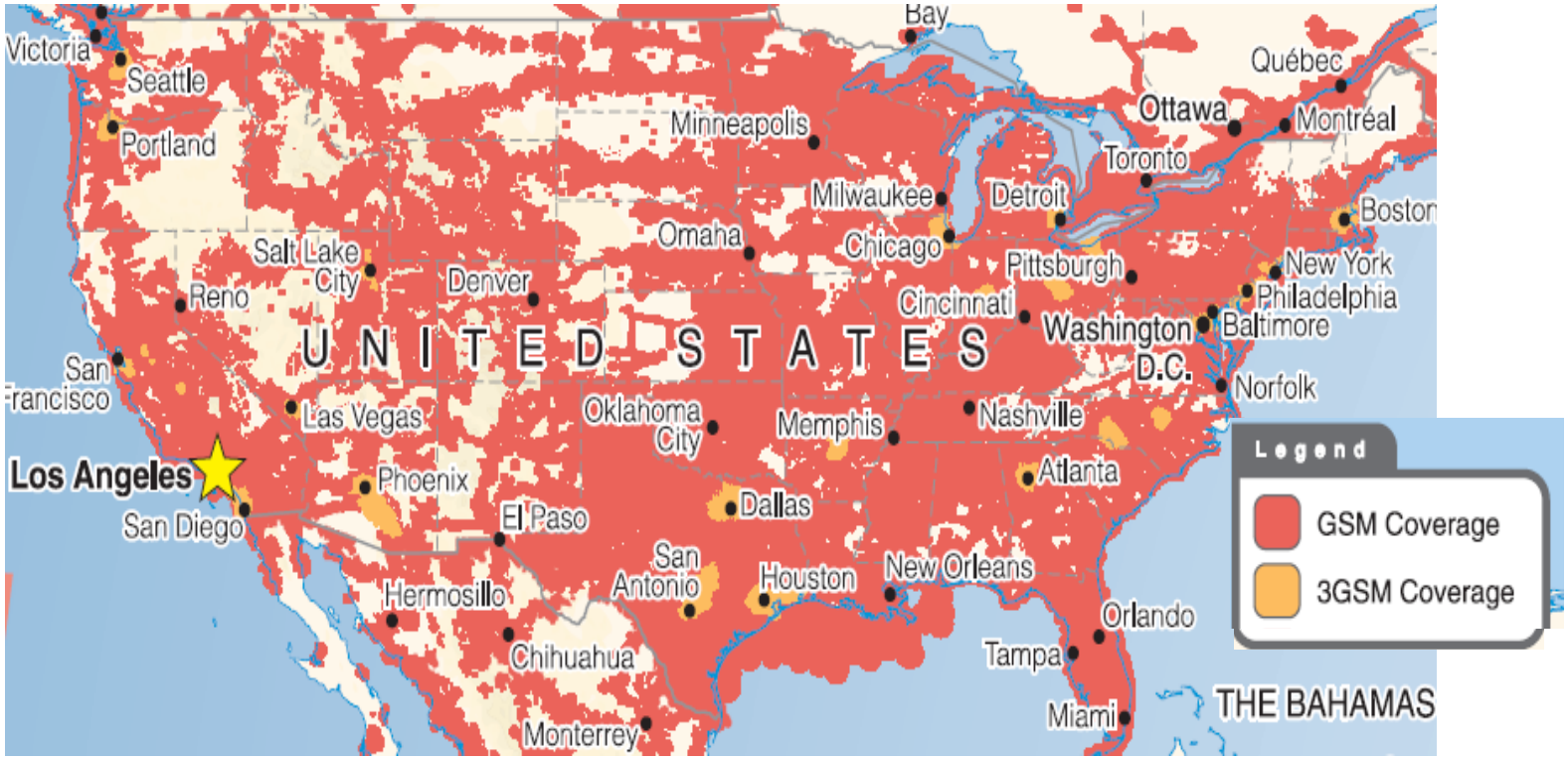
Map Legend
- Digital Coverage
- Analog Coverage
- No Coverage



Map Legend
- Broadband
- Enhanced Services
- Extended Enhanced Services
- No Coverage

Source: Verizon Wireless

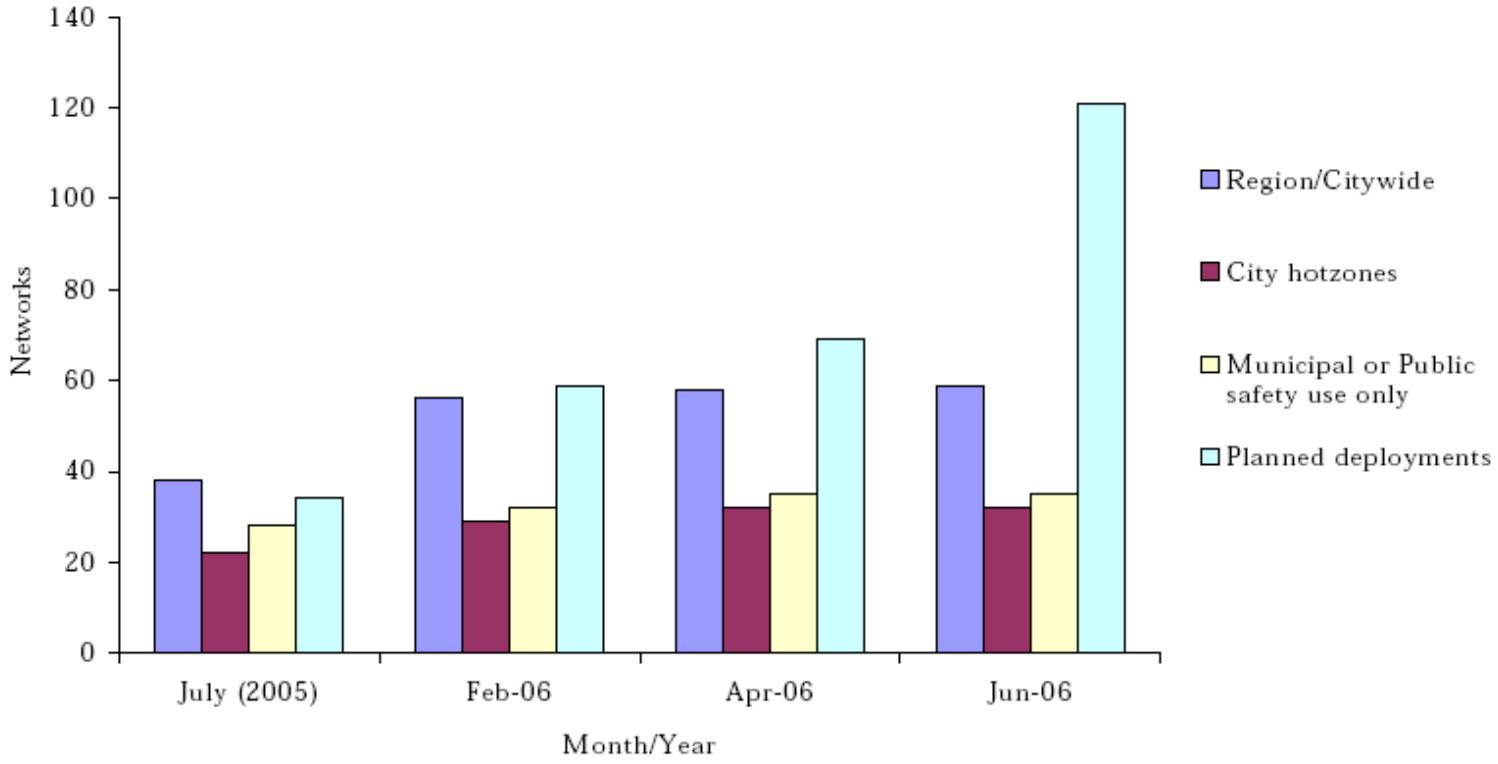
GSM and 3G Coverage



Idaho National Laboratory

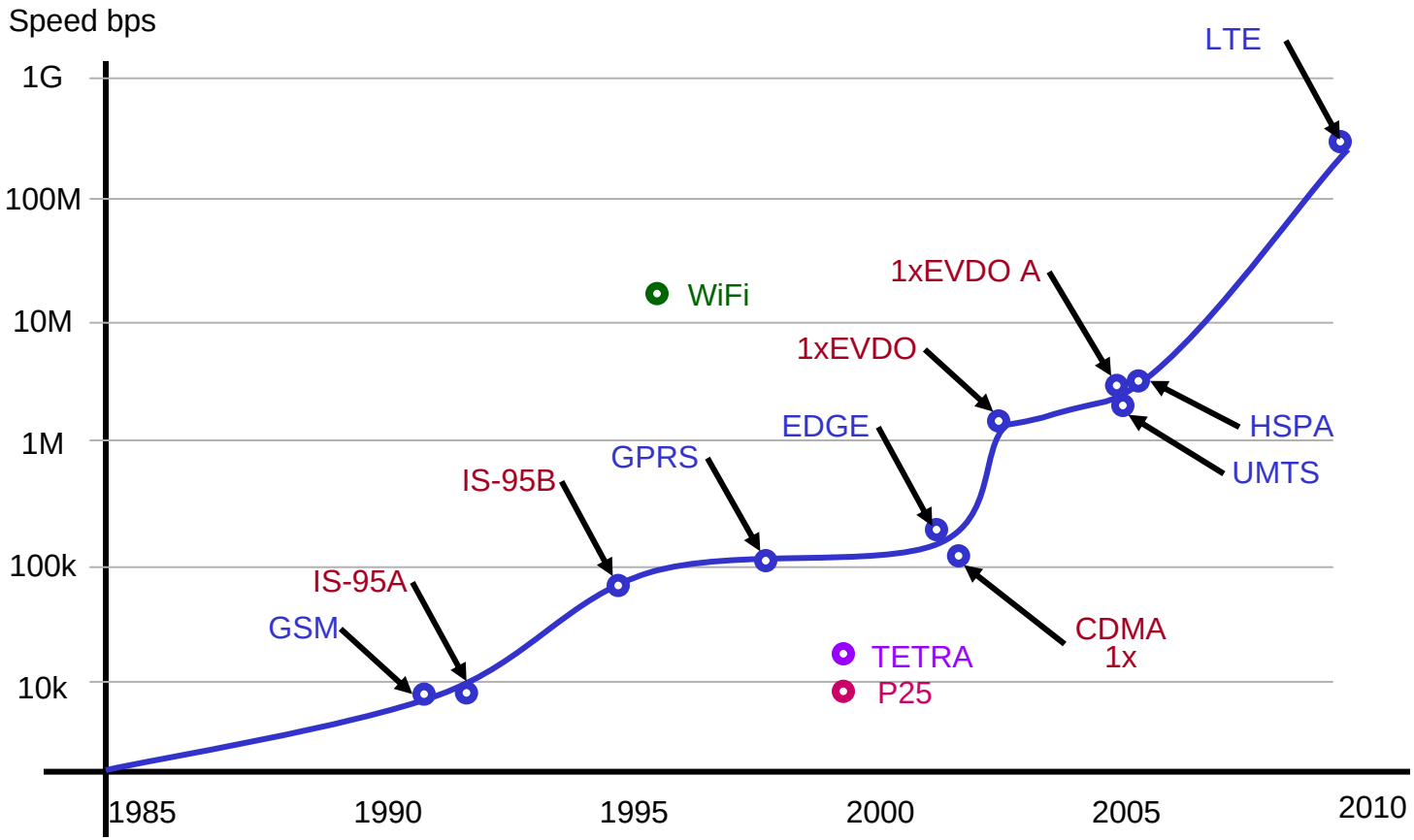
Source: GSM Association

WiFi Coverage



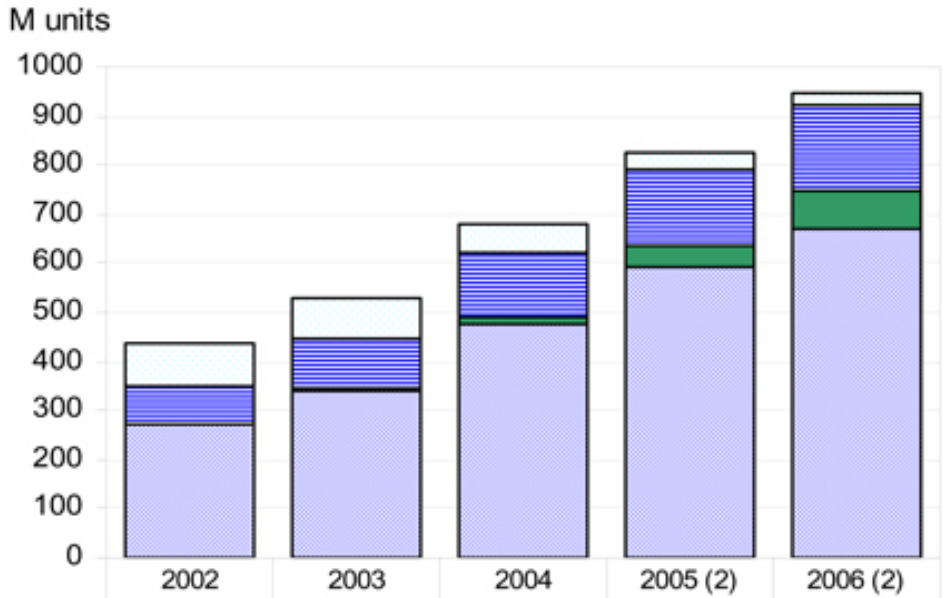
Source: Frost & Sullivan

Data Rates Evolution



Handset Sales

Global Handset Sales by Technology (1)

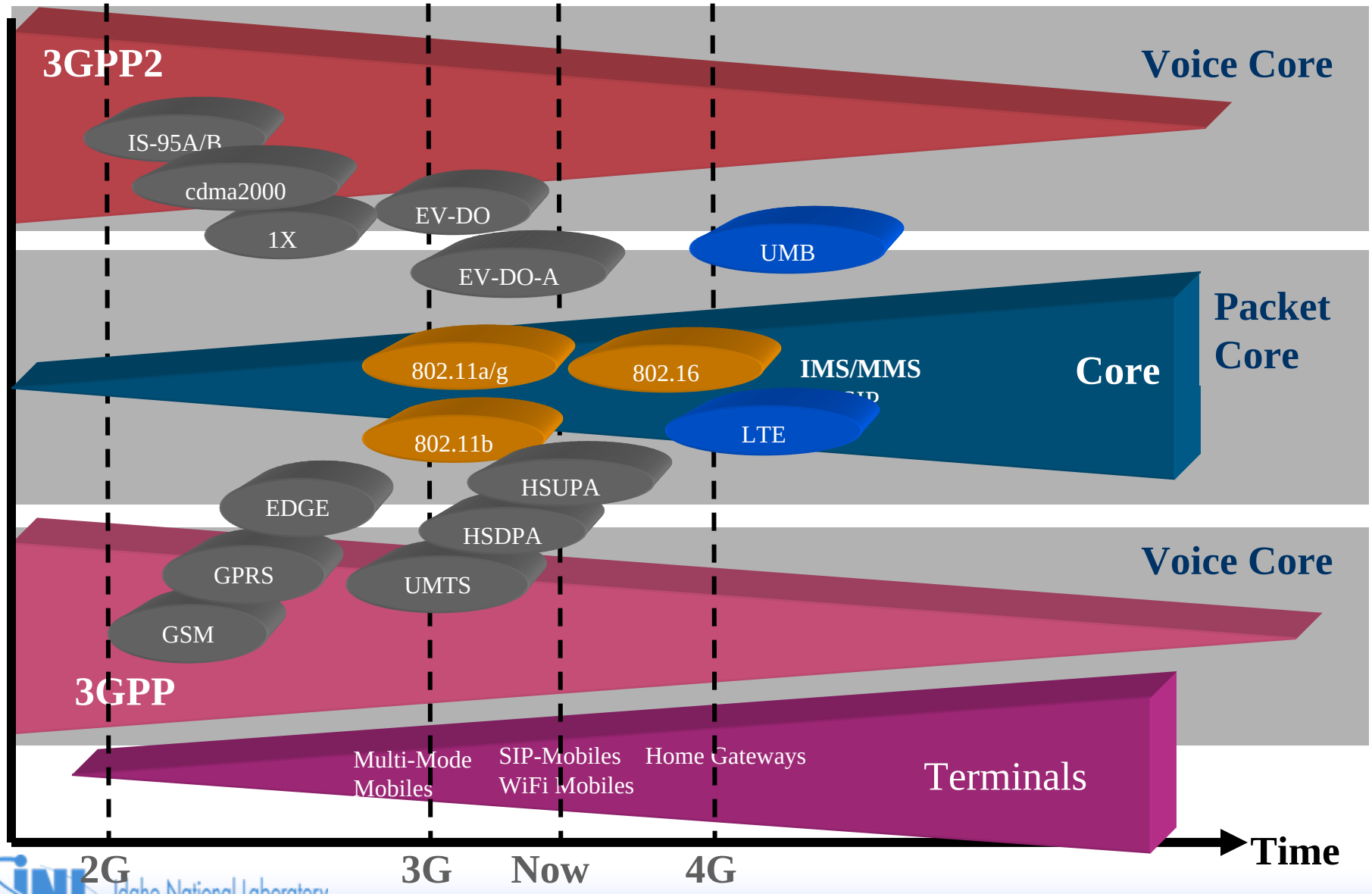


	2002	2003	2004	2005 (2)	2006 (2)
Other (3)	86	84	57	32	21
CDMA One, CDMA2000 1x, 1xEV	76	102	132	153	177
WCDMA	0	3	17	44	79
GSM, GPRS, EDGE	273	341	475	594	668
Total Handsets	435	530	681	823	945

Idaho National Laboratory

Source: Strategy Analytics, Inc. - January 2006

Technology Families/Trends



Major US Operators (October 2007)

Operator	Technology	Subscribers (millions)
AT&T	HSDPA, UMTS, EDGE, GPRS, GSM, TDMA	65.7
Verizon Wireless	CDMA2000 1xEV-DO, CDMA2000 1x, CDMA	63.7
Sprint Nextel Includes Sprint Network, Nextel Network, and Boost Mobile Prepaid	CDMA2000 1xEV-DO, CDMA2000 1x, CDMA (Sprint PCS), WiDEN, iDEN (Nextel)	54.0
T-Mobile	UMA, EDGE, GPRS, GSM	26.9
Alltel	CDMA2000 1xEV-DO, CDMA2000 1x, CDMA, AMPS	12.447
TracFone Includes NET10	GSM, CDMA, TDMA	8.803
U.S. Cellular	CDMA2000 1x, CDMA, TDMA	6.010
Virgin Mobile	CDMA2000 1xEV-DO, CDMA2000 1x, CDMA	5.2
MetroPCS	CDMA	3.66

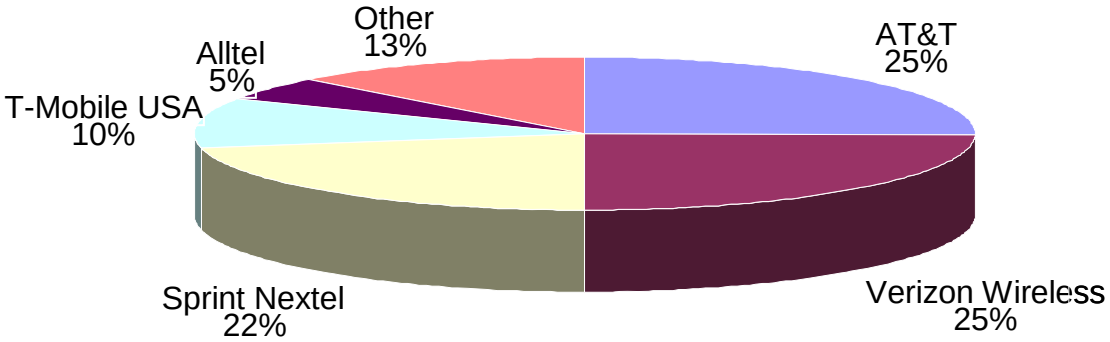
Source: Operator Quarterly Reports

Wireless Technology and First Responder

- Wireless Past and Present
- Wireless Future
- First Responders and Wireless

Operator Migrations

Operator	Current Technology	Migrating to:
at&t	TDMA, GSM, GPRS, EDGE, UMTS, HSDPA	LTE
verizon wireless	IS-95, CDMA2000 1x, CDMA2000 1xEV-DO	LTE
Sprint	IS-95, CDMA2000 1x, CDMA2000 1xEV-DO WiDEN, iDEN	WiMax
T-Mobile	GSM, GPRS, EDGE, WiFi	LTE ????
alltel wireless	IS-95, CDMA2000 1xEV-DO	????



Current Subscriber Market Share

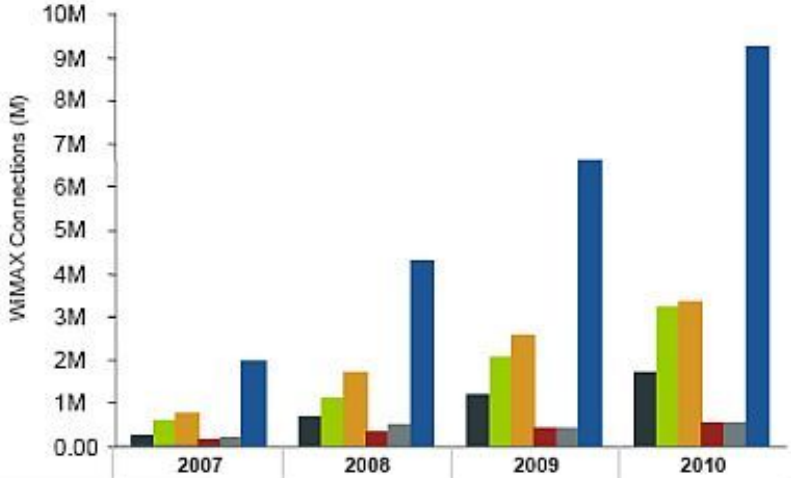
Idaho National Laboratory

Source: Carrier Press Releases

WiMax

Industry research analysts are bullish about prospects of WiMAX especially in Asia-Pacific and Europe

Derived from reports by:
Morgan Stanley
Gartner
Pyramid Research
iSuppli
IDC (chipset viewpoint)
Maravedis (09.2006)



	2007	2008	2009	2010
North America	0.25	0.69	1.18	1.73
Europe	0.60	1.09	2.07	3.19
APAC	0.76	1.72	2.55	3.32
Latin America	0.16	0.33	0.41	0.52
Middle East and Africa	0.20	0.47	0.41	0.52
Average connections (MM)	1.95	4.29	6.62	9.28

XOHM™

MOTOROLA · intel · SAMSUNG · Nokia Siemens Networks · Google · ERICSSON · ZyXEL · NOKIA Connecting People · ZTE中兴 · Alcatel·Lucent

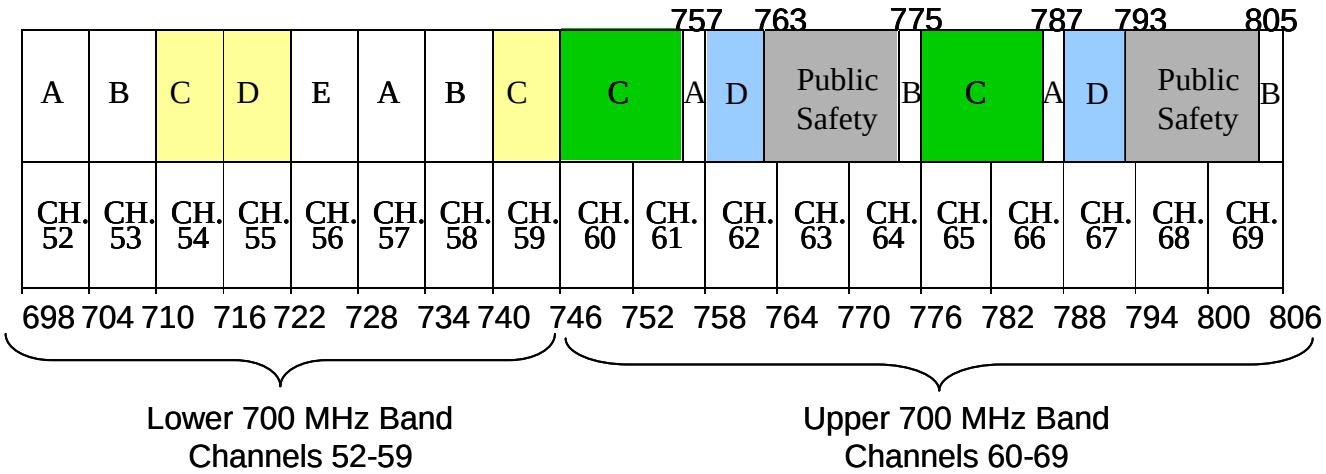
clearwire

258,000 Subscribers

Idaho National Laboratory

Source: Sprint, Clearwire and Analysts

700 MHz Auction



Block	Frequencies	Bandwidth	Pairing	Area Type	Licenses
A	698-704, 728-734	12 MHz	2 x 6 MHz	EA	176
B	704-710, 734-740	12 MHz	2 x 6 MHz	CMA	734
C	710-716, 740-746	12 MHz	2 x 6 MHz	CMA	734*
D	716-722	6 MHz	unpaired	EAG	6*
E	722-728	6 MHz	unpaired	EA	176
C	746-757, 776-787	22 MHz	2 x 11 MHz	REAG	12
D	758-763, 788-793	10 MHz	2 x 5 MHz	Nationwide	1**
A	757-758, 787-788	2 MHz	2 x 1 MHz	MEA	52***
B	775-776, 805-806	2 MHz	2 x 1 MHz	MEA	52***

*Blocks have been auctioned.
**Block is associated with the 700 MHz Public/Private Partnership
***Guard Bands blocks have been auctioned, but are being relocated

Idaho National Laboratory

Source: FCC

700 MHz Major players

- C Block

Google verizon at&t T-Mobile

- D Block

verizon ~~frontline WIRELESS~~

- What will 700 MHz Technologies be?
  - Likely LTE if cellular providers win
  - If Google Wins, WiMax?

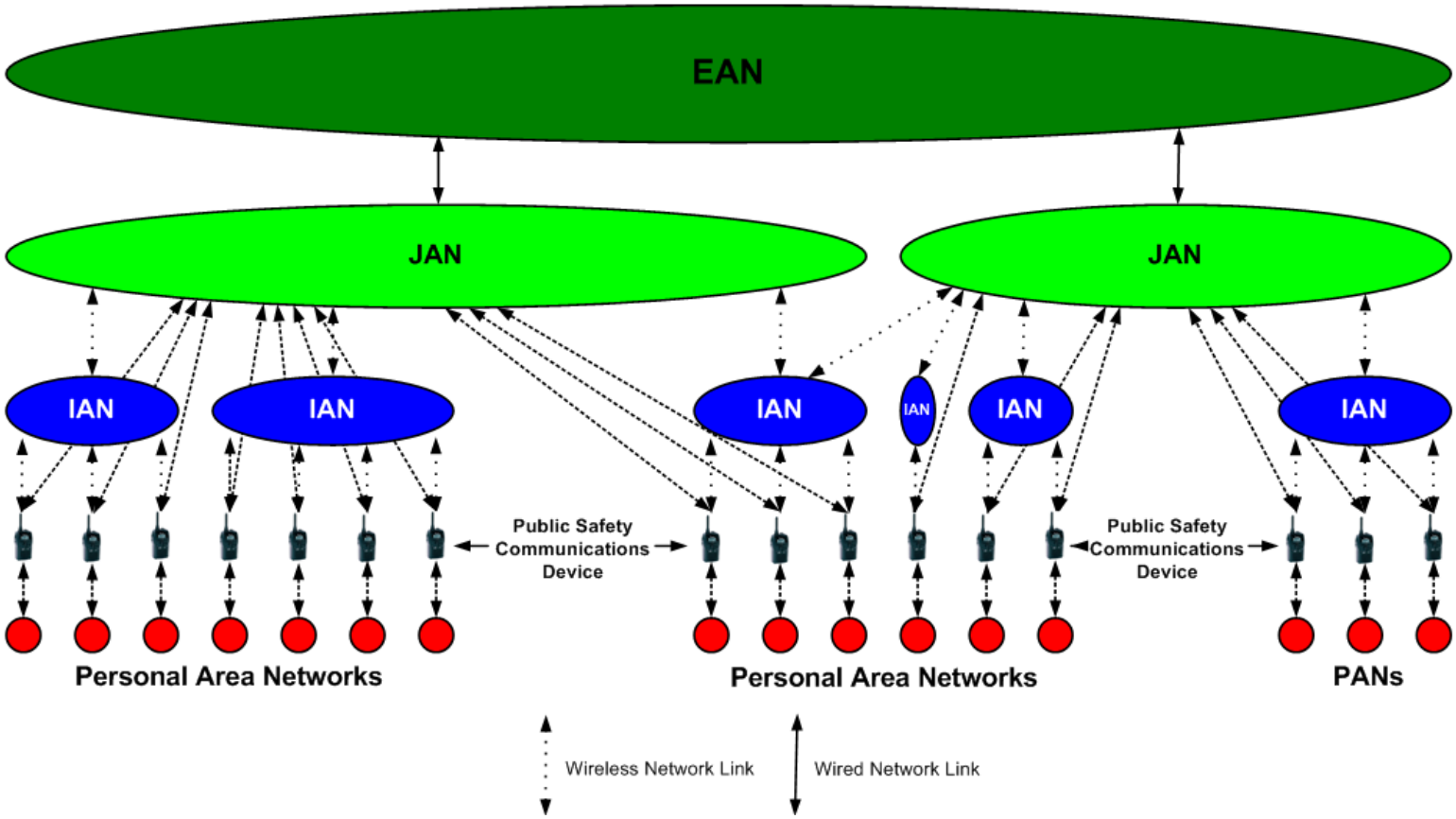
Source: RCR Wireless

Wireless Technology and First Responder

- Wireless Past and Present
- Wireless Future
- First Responders and Wireless

System of Systems

EAN: Extended Area Network
JAN: Jurisdictional Area Network
IAN: Incident Area Network
PAN: Personal Area Network



Idaho National Laboratory

Source: SAFECOM SoR v1.1

Public Safety Communications Device

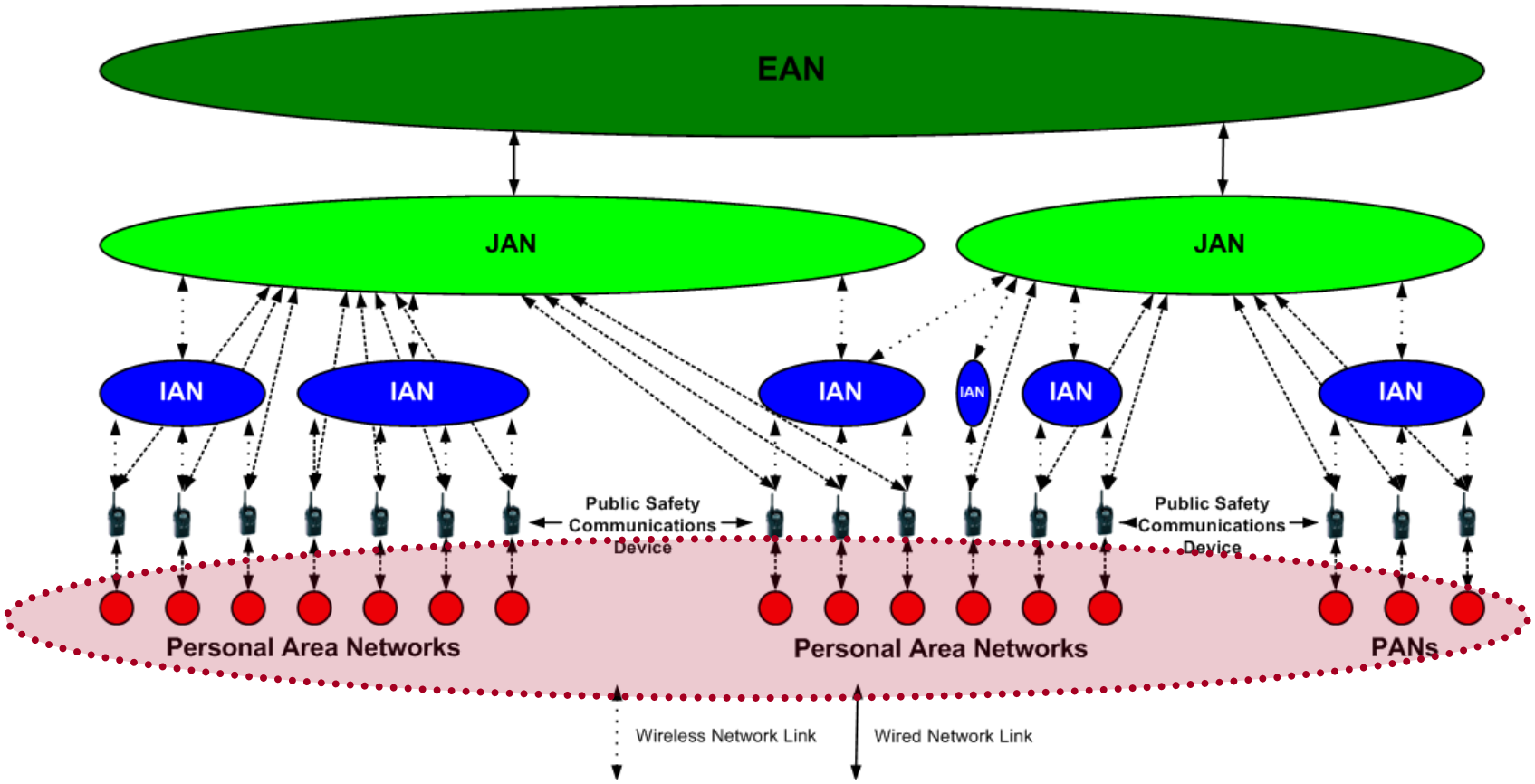
- **Interface capability**
  - Qwerty Keyboard, real or virtual
  - Camera
  - Adequate Screen Size
  - Stylus/Touch Screen
- **Wireless Capabilities**
  - Wireless Broadband (3G or 4G)
  - WiFi
  - Bluetooth
  - GPS Receiver
- **Estimated Future Expected Cost***
  - ~$500 Device
  - ~$50-$100 Monthly Service/Device

Idaho National Laboratory

**Based on current services and estimates for additional services*

System of Systems

EAN: Extended Area Network
JAN: Jurisdictional Area Network
IAN: Incident Area Network
PAN: Personal Area Network



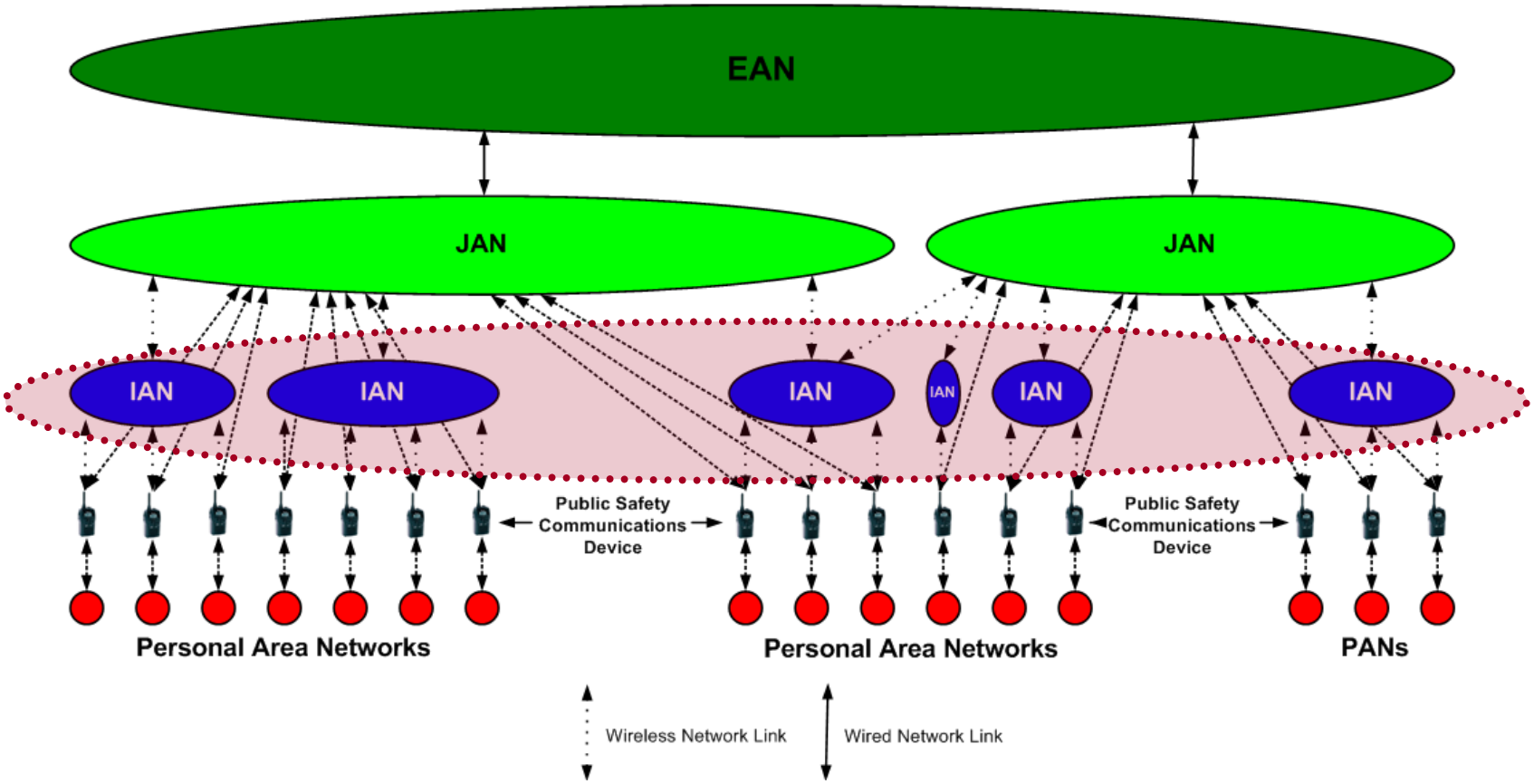
Idaho National Laboratory

Source: SAFECOM SoR v1.1

Personal Area Networks (PAN)

System of Systems

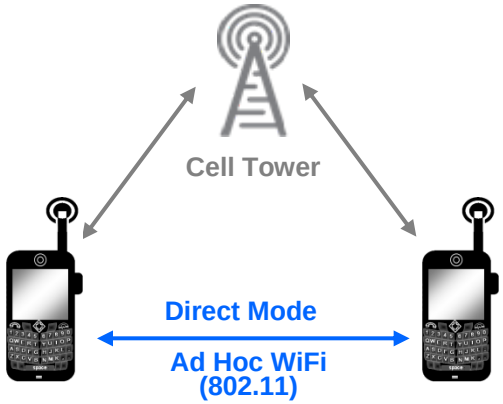
EAN: Extended Area Network
JAN: Jurisdictional Area Network
IAN: Incident Area Network
PAN: Personal Area Network



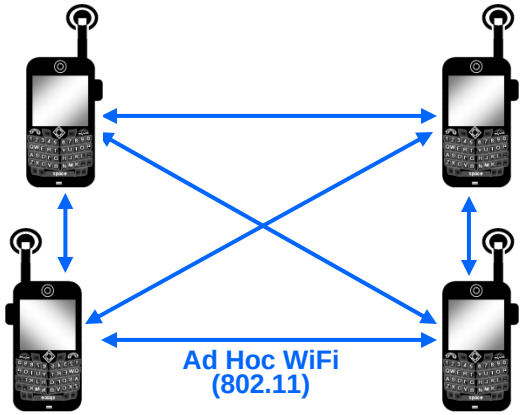
Idaho National Laboratory

Source: SAFECOM SoR v1.1

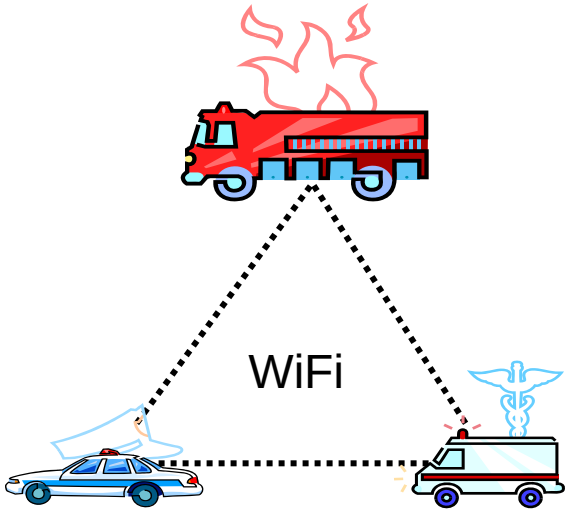
Incident Area Communications



Dual Mode Device Capabilities



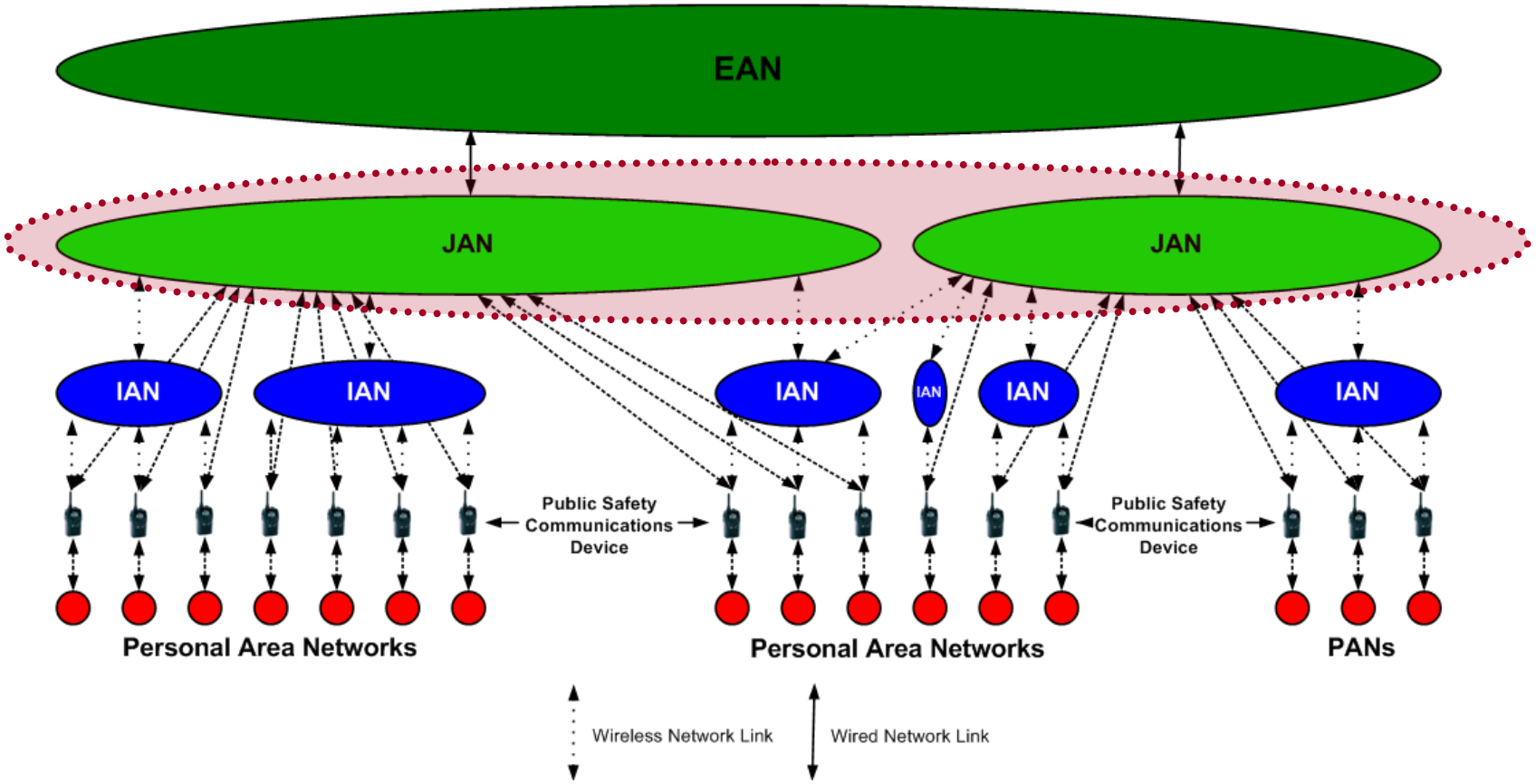
PTT Ad Hoc Network



Mobile Ad Hoc Network (MANET)

System of Systems

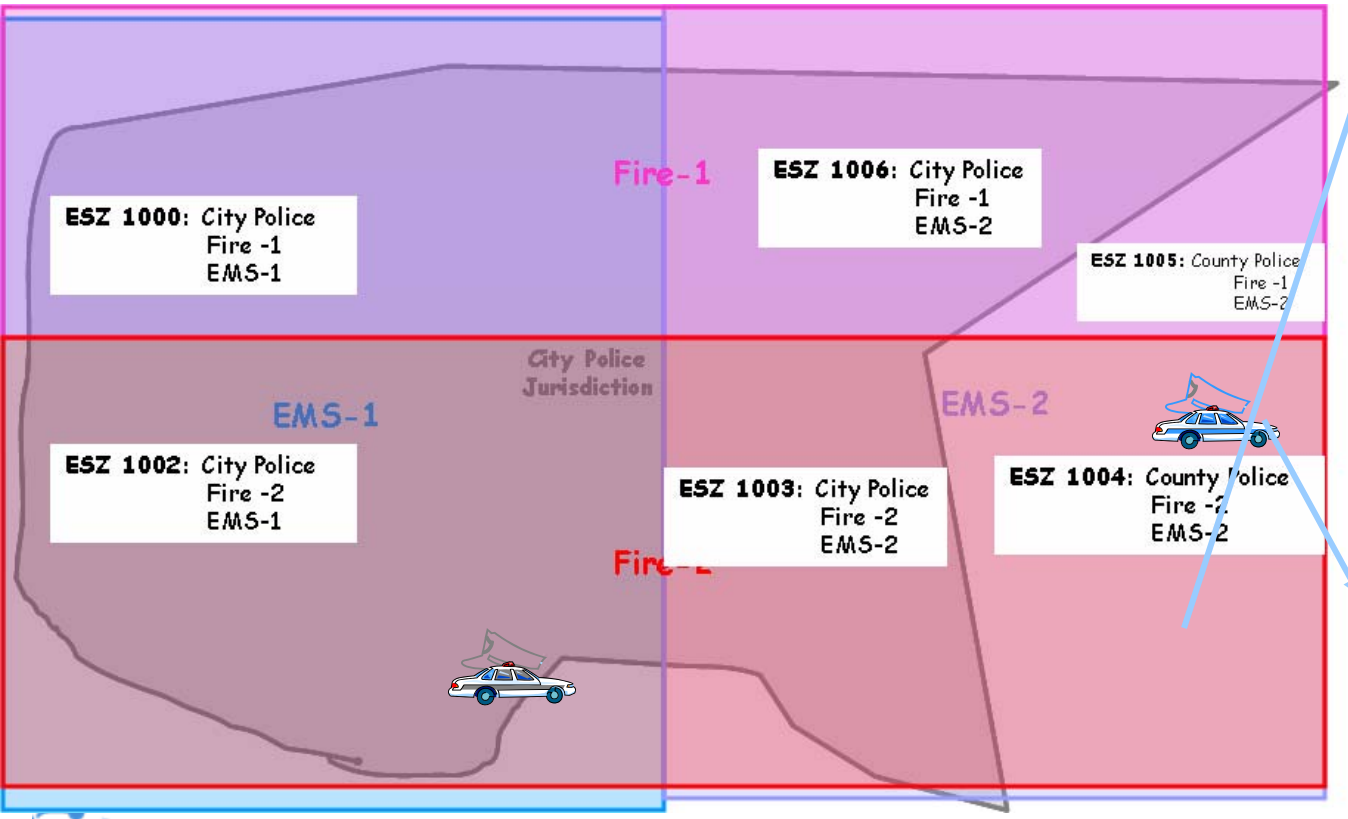
EAN: Extended Area Network
JAN: Jurisdictional Area Network
IAN: Incident Area Network
PAN: Personal Area Network

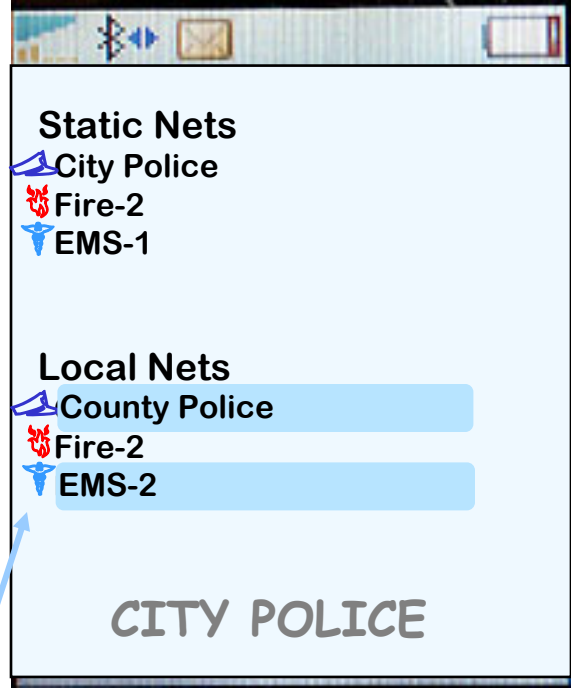


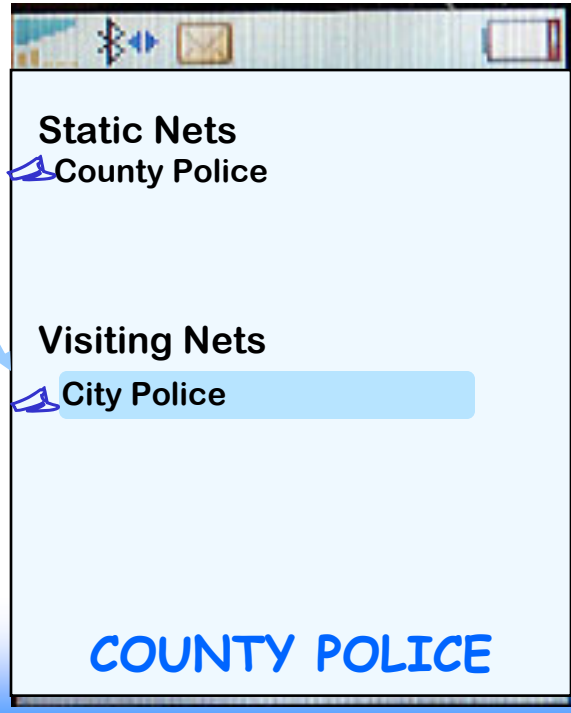
Idaho National Laboratory

Source: SAFECOM SoR v1.1

Jurisdictional Area Networks

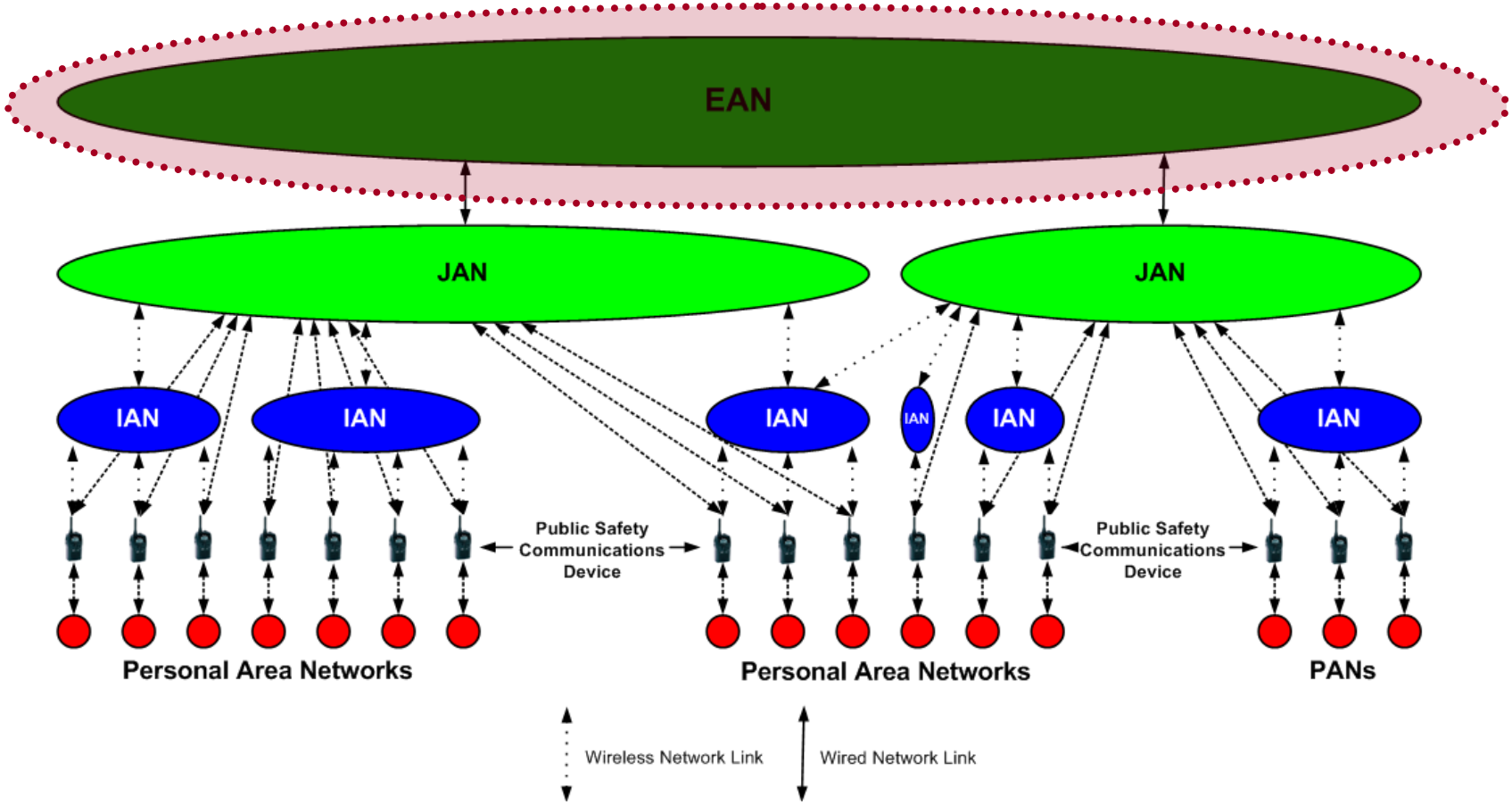






System of Systems

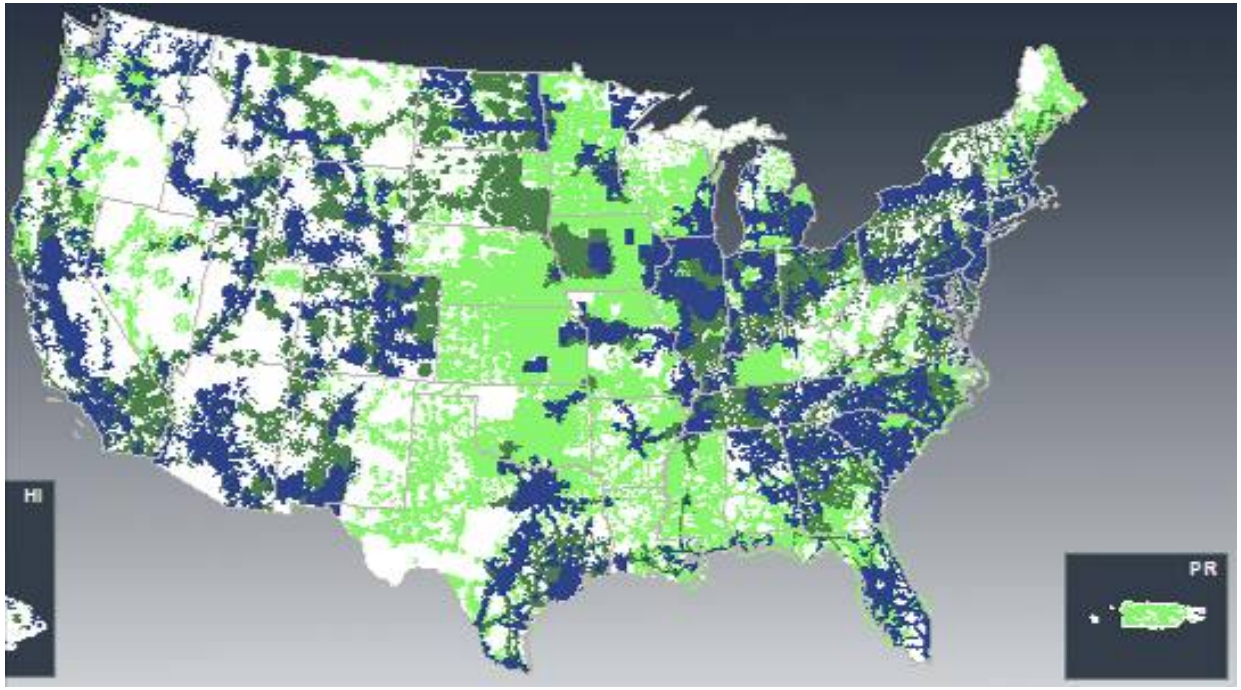
EAN: Extended Area Network
JAN: Jurisdictional Area Network
IAN: Incident Area Network
PAN: Personal Area Network



Idaho National Laboratory

Source: SAFECOM SoR v1.1

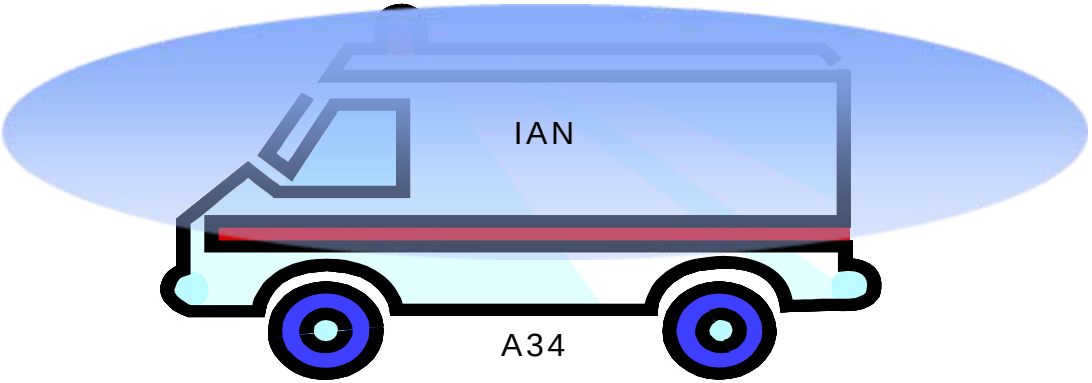
Extended Area Network

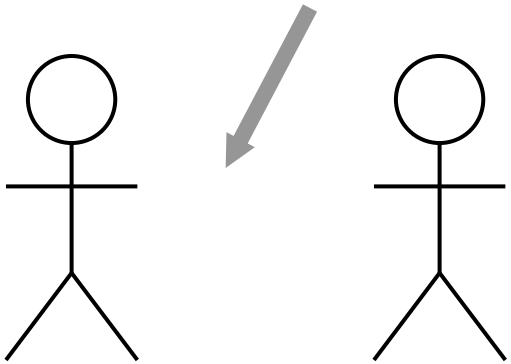


Basic Services you should expect

Service	Description
Push to Talk Voice	Common Net Traffic used in current LMR Systems
Status Data	Periodic updates to centeralized data base for biometrics, GPS Location Info, Equipment Data
Instant Messaging	Text Messages between responders
Streaming Video/Data	Still pictures or real streaming video. Real time biometric data feed.
E-mail	E-Mail w/ Attachments
Web Browsing	Access to Maps, Geolocation Data, Building Layouts, Medical and Criminal information
Full Duplex Voice	PSTN Phone Call

EMS Scenario

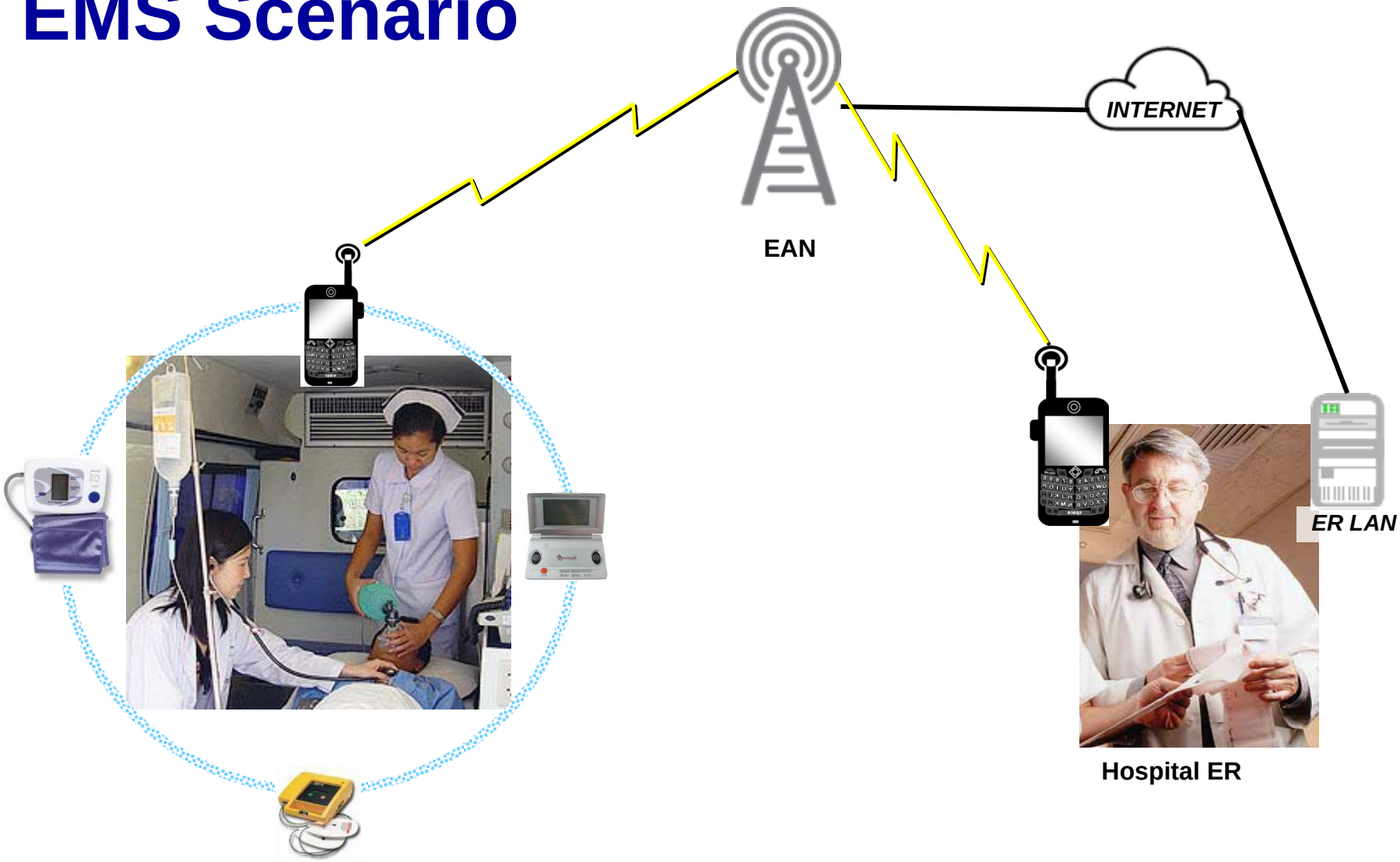




EMS Scenario

EMS Scenario

EMS Scenario



New Technology Concerns

- **Growing Pains**
  - Training, Initial Deployments
- **Costs vs. Benefits**
  - How will the costs be different?
  - What benefits will be provided me?
- **Service Provider?**
  - Full Package = Devices + Network + Host Based Services

Summary and Conculsions

- **Wireless Past and Present**
  - Size Matters
- **Wireless Future**
  - Major LTE deployments
  - Niche Markets for WiMax
- **First Responders and Wireless**
  - PANs, IANs, JANs, EANs