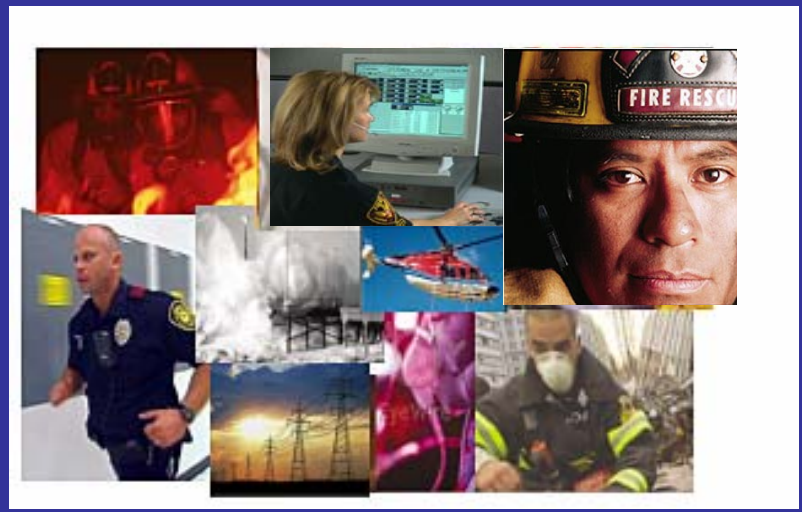
A Future Vision for Interoperable Homeland Security Communications

Presentation to the Office of Management and Budget
Washington D.C.
October 26, 2005



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The Questions We Have Been Asked to Address

- **What Is Our Recommended Solution To The Interoperability Problem?**
- **Describe The Elements That Are Essential To Achieving The Solution.**
- **Summarize The Optimal Technology Roadmap To Be Followed Over The Next Five Years.**
- **What Are The Disruptive Technologies That We See In The Near Future?**
- **Suggest Metrics That The Government Can Use For Measuring Success In Its Funding Programs.**

Public Safety Interoperability: How the Problem Developed in the Past

- **Spectrum**
  - Fragmented Across Band
  - Insufficient in Amount
- **Technology**
  - Proprietary Systems Common in Past
  - Lack of Standards
- **No Incentives for Regional Planning**
  - Local Leadership Lacking
  - Federal Funding Absent
  - No Funding “Carrots”

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Public Safety Interoperability: Progress Is Being Made

- **Spectrum Fragmentation**
  - Narrowband/Wideband Spectrum allocated at 700 MHz
  - Multi-band Radios (700/800MHz Today)
- **Technology**
  - Open Standards Have Been Developed
  - Standards Process is a Continuing One
  - New Proprietary Systems Disfavored by DHS
- **Incentives Post-9/11**
  - Multi-jurisdictional Funding Under DHS Programs
  - Guidance and Support from DHS SAFECOM

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Metrics To Measure Success

- **Is Priority Given to High Risk Areas (Use Established Methodology Similar To UASI) On A Regional Basis?**
- **Has Applicant Completed A Planning Checklist Before Funding Is Provided (Including local DOD Facilities)?**
- **Is There A Strong Preference For Compliance With The Project 25 Standard?**
- **Does The Project Assure Voice Interoperability Because This Is The Critical Flaw In Disaster Response?**
  - Require Field Test Submission At Conclusion
- **Does The Project Promote High Speed Data Networks To Support Data, Video And Multimedia?**
  - Measure Efficiency: Cost Per Bit Per Unit Area.

Public Safety Interoperability: The Need For A Focused Federal Funding Program

- **A Focused Federal Program:**
  - Provides Certainty For The Lead Time And Planning That A Major System Upgrade Requires
  - Will Provide The Resources Necessary To Fix The Interoperability Problem
  - Will Be Crafted To Address High Risk Areas First
  - Will Require States And Cities To Plan Systems That Will Interoperate With Federal Systems (Including DoD Domestic Systems)
- **Without A Focused Federal Program It Is Estimated That It Will Take Up To 20 Years To Fix Interoperability.**

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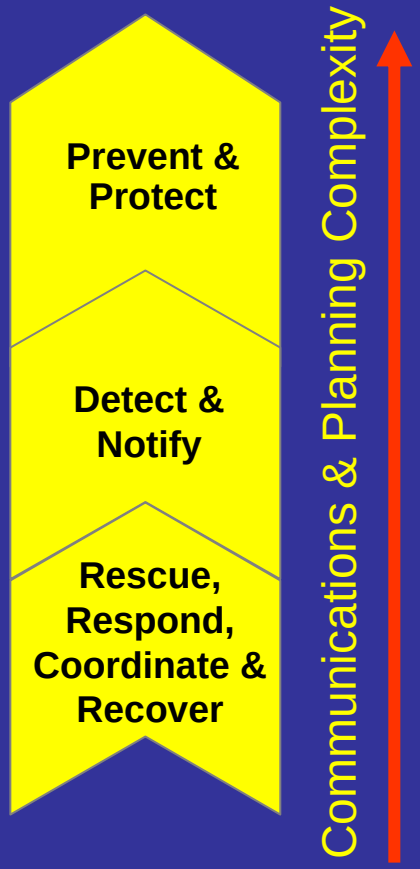
Funding - A Significant Barrier

- **Estimates Of Total Cost Vary Depending Upon Assumptions Made In Calculation But $15 – 60 Billion Is Reasonable Range.**
- **Current Funding Levels Will Not Fix Problem Within Next Ten Years.**
- **Examples Of Public Data On Cost Of New Systems:**
  - New York State - $2 Billion
  - Commonwealth of Virginia - $329 Million
  - Illinois State Police - $50 Million
  - Westchester County, NY - $12 Million
  - Detroit - $130 Million

Increasing Recognition of the Mission's Complexity



What we've learned:

- 9/11 - importance of interoperable communications
- Katrina - importance of proper system design, incident planning and preparation
- London Bombings – key role of new multimedia and video services, and improved information flow
- Overall - importance of well-planned dedicated networks that give control to the agencies to ensure mission critical operation and security

True complexity of the Homeland Security mission is just now being fully recognized

"After each major event in recent history, the most glaring indication of success or failure by responding agencies has been their ability to effectively communicate with each other."

Law Enforcement's Role in Combating and Preparing for Domestic Terrorism
IACP Project Response - Leading From the Front

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Why Dedicated Mission Critical Networks?

- **Public networks are the first networks to fail in major incidents because they are not designed for mission critical operation**
- **Public networks cannot be adequately secured and controlled**
- **Public Networks can still supplement dedicated networks and can be very useful for non-guaranteed coverage expansions and reverse 911 services**

	Public Cellular Networks	Dedicated Public Safety Networks
Coverage	• cover populated areas only • could be used for opportunistic capacity and coverage support to supplement dedicated public safety network	• must cover all geography regardless of population density
Capability	• not designed for redundancy; first systems to go down in disaster • Emerging simple group voice services but without performance guarantees • Cannot support full-time video streaming	• designed for high availability • provide essential group voice PTT communications with joined user guarantees • Currently lagging cellular in broadband deployments
Control	• Public user interference; overloaded in emergencies • priority service only for telephony • Lack rapid, dynamic user provisioning and disaster planning capability • Difficult to completely secure	• exclusive licensed band operation • User and group priorities for all services • Full provisioning and disaster planning • Dedicated security features with full agency control

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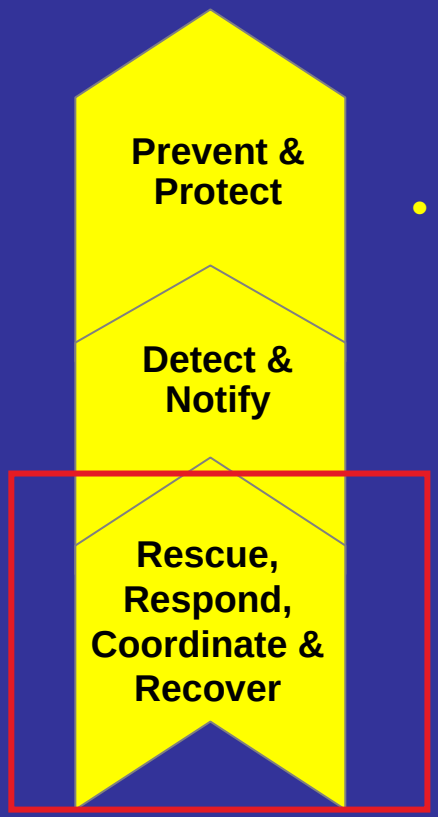
Interoperable Voice and Low Speed Data Communications is Fundamental



- **Voice services (both group and individual PTT calls), as well as a basic data service to support critical information transfer is a fundamental requirement for the response portion of the public safety mission**
- **What is the most economical means of providing this service with full interoperability across agencies?**

"Communications interoperability refers to the ability of public safety agencies to talk across disciplines and jurisdictions via radio communications networks to exchange voice and/or data with one another on demand, in real time, when needed."

When They Can't Talk, Lives are Lost. What Public Safety Officials Need to Know About Interoperability. February 2003 National Institute of Justice. Office of Science and Technology Program

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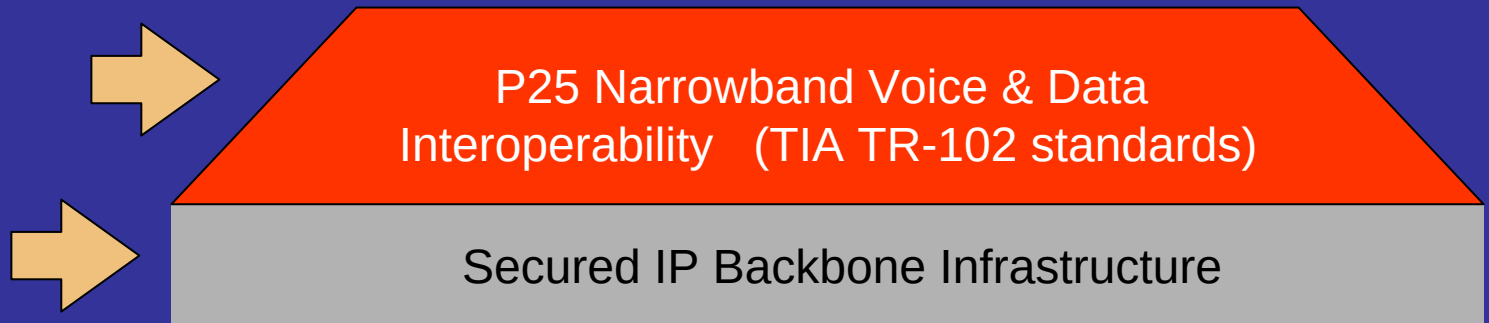
Step 1: Build a Sound Foundation for Interoperability

Highest priority for addressing most basic mission:

- **Deploy P25 TIA standard networks for essential voice and lower speed data service interoperability**
  - Most optimized and cost effective solution to mission critical service with wide area coverage
- **Deploy dedicated Internet Protocol (IP) backbones with secured Internet connectivity**
  - IP provides a future-proof foundation for transporting P25 voice and data, and all future higher speed data/ multimedia traffic



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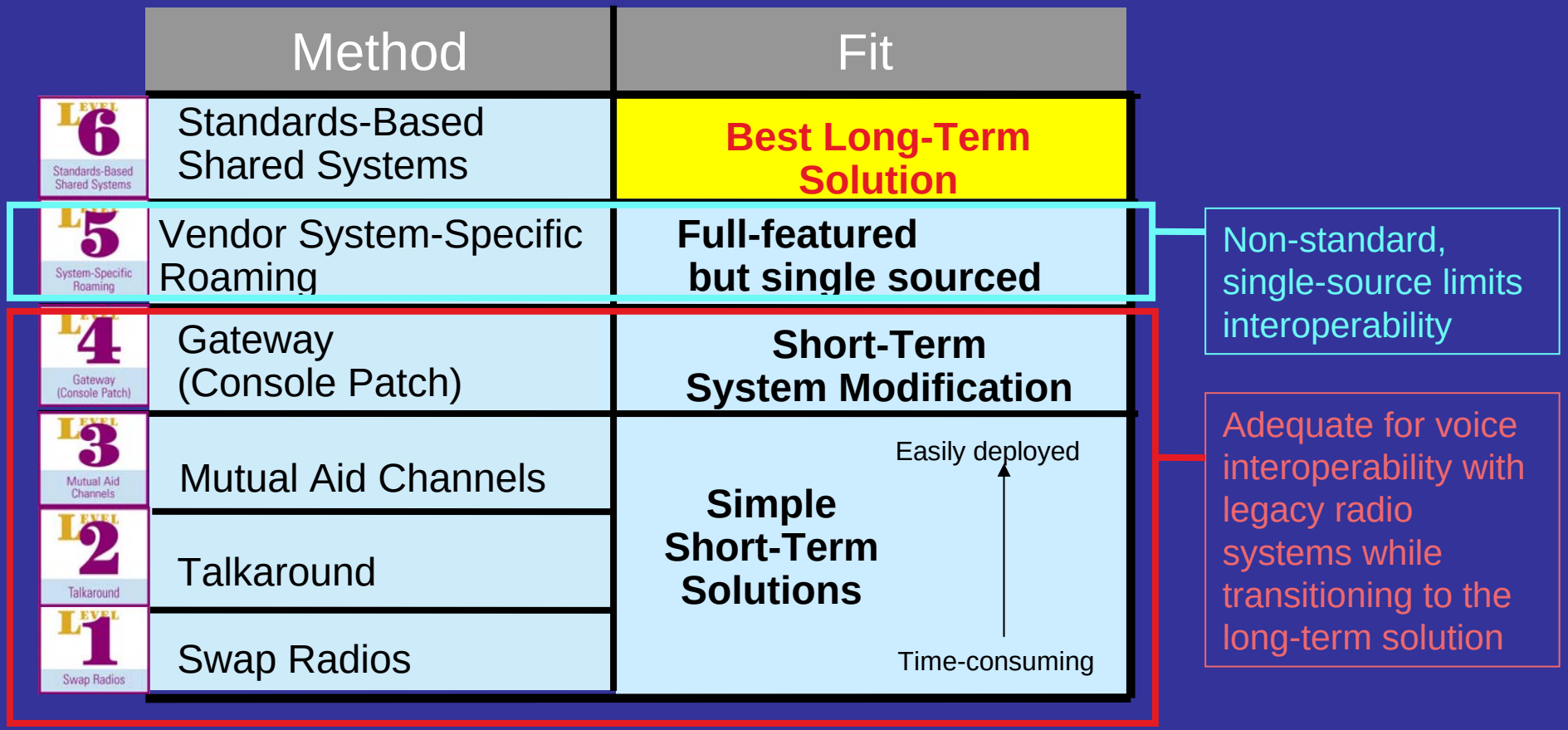
APCO Supported Interoperability Options



Source: APCO Homeland Security Task Force White Paper

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P25/TIA Public Safety Voice Interoperability Standards

Standard	Status	Purpose
P25 Phase 1	Completed	Voice/data Interoperability
P25 Phase 2	Mid-2006	Greater Spectral Efficiency
P25 ISSI	Late 2006	Std. Inter-System Connectivity

	Committee	Air Interface (TDMA)	Inter SubSystem Interface	Fixed Station Interface	Console Interface
TR-8	Land Mobile Radio	Yes	Yes	Yes	Yes
8.1	Performance	Yes	Yes	Yes	Yes
8.3	Encryption	Yes	Yes	Yes	Yes
8.4	Vocoders	Yes	Yes	Yes	Yes
8.5	Data				
8.6	Measurement methods	Yes	Yes	Yes	Yes
8.7	Software defined radio				
8.8	Broadband				
8.10	Trunking and Conventional control	Yes			
8.11	Antennas				
8.12	Two-slot TDMA	Yes			
8.14	Four-slot TDMA				
8.15	Common Air Interface	Yes			
8.17	RF EYesposure	Yes			
8.18	Systems compatibility	Yes			
8.19	Wireline interfaces (ISSI ,Console)		Yes	Yes	Yes

TIA TR-8.x committees and coverage of P25 interface standards

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Today's P25 Interoperability Scenario

- **700/800MHz multi-band P25 radios available for State & Local interoperability**
- **Interoperability via basic gateways to Federal VHF users**

State & Local

P25 → 800 MHz / 700 MHz

L1-L4 Gateways for cross-agency system interoperability

Federal

P25 → 150 MHz (VHF)

Spectrum

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2007 P25 Interoperability Scenario

- **All-band (V/U/7/8) P25 radios available via Software Defined Radio (SDR) technology for full roaming interoperability**
  - SDR is flexible radio hardware that can support multiple frequency bands and multiple wireless protocols via software images
- **Level 6 Interoperability via P25 ISSI specification**

P25 → 800 MHz / 700 MHz

- all-band P25 radios
- Level 6 P25 ISSI gateways

P25 → 150 MHz (VHF)

Spectrum

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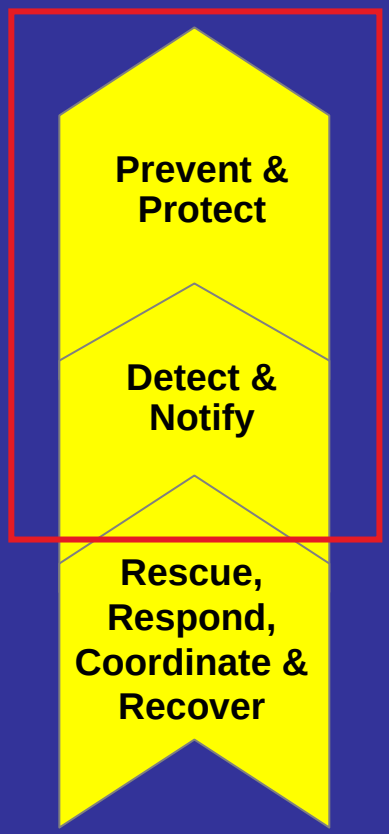
Voice Interoperability Alone Is Not Enough



- **Expanding mission to prevention, detection and public notification requires new high speed data networks to support bandwidth intensive data, video and multimedia**
- **Need spectrum allocation to Homeland Security to guarantee Federal agency data interoperability**
- **Federal, State, County, and Municipal Agencies have radically different user densities and anticipated data traffic profiles**
- **What is the most economical means of providing wideband and broadband data services with appropriate roaming interoperability across agencies?**
- **What technologies will improve the economics, performance, and robustness of these networks?**

"Voice communications are critical, but voice communications requirements are not the only issue.....public safety agencies are increasingly dependent on the sharing of data, images, and video."
-- DHS SAFECOM Program, Statement of Requirements, March 2004

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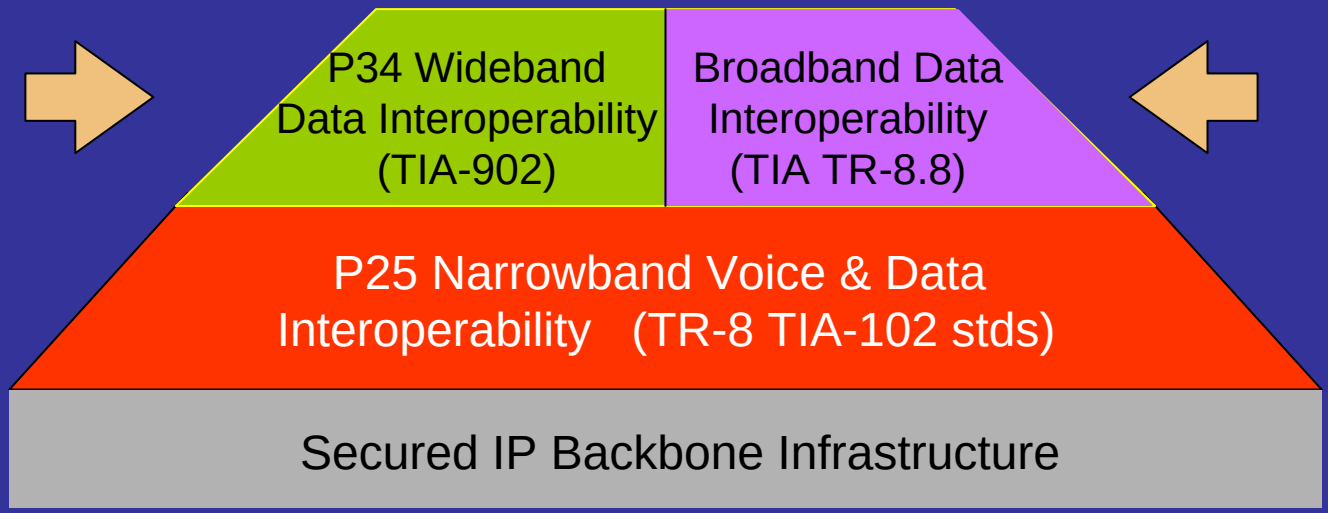
Step 2: Enable Spectrum and Deploy High Speed Data Networks

- **Clear TV from 700MHz spectrum**
- **Deploy P34 (P25 Phase 3) TIA-902 SAM standard for 700MHz data networks to support interoperable wideband data services for states and counties**
  - most optimized and cost effective solution for covering large geographies with lower user densities and more modest traffic profiles
- **Deploy TR-8.8 standard for 4.9GHz broadband data networks for municipalities and for fixed and deployable networks in states and counties**
  - Highest bandwidth and capacity to support highest user densities and extreme broadband traffic profiles with heavy fixed and mobile video



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Why Multiple Data Networks?
Optimizing Cost to Provide Required Capacity

	P25 Voice & 9.6kb/s data (3W Portable)	Wideband (150kHz) TIA-902 (improved) @ 700 MHz (10W Mobile)	Broadband 802.16e (Wi-Max) @ 700 MHz (10W Mobile)	Broadband 802.11 Mesh (anticipated TR8.8) @ 4.9 GHz (1W Mobile)
9.6 kbps everywhere	**Cost: reference (x)** **# of Sites: reference** **Capacity: reference**			
Min. 76.8 kbps at cell edge (145 kbps avg)		**Cost: 1x (if integrated with P25 sys)** **# of sites: same (ref)** **Sys Capacity: 14x**		
Min. 76.8 kbps at cell edge (600 kbps avg)			**Cost: 3x** **# of sites: 1.6x** **Sys Capacity: 96x**	
Min. 500 kbps at cell edge (1.25Mbps avg)				**Cost: 25x** **# of sites: 100x** **Sys Capacity: 1200x**

- **Only need high throughputs and capacity in more densely populated areas (large municipalities) where higher cost of broadband networks can be justified, or in smaller coverage areas where very cost effective**
- **States and semi-rural and rural counties don't need high capacities and can save cost with less expensive wideband data standards**

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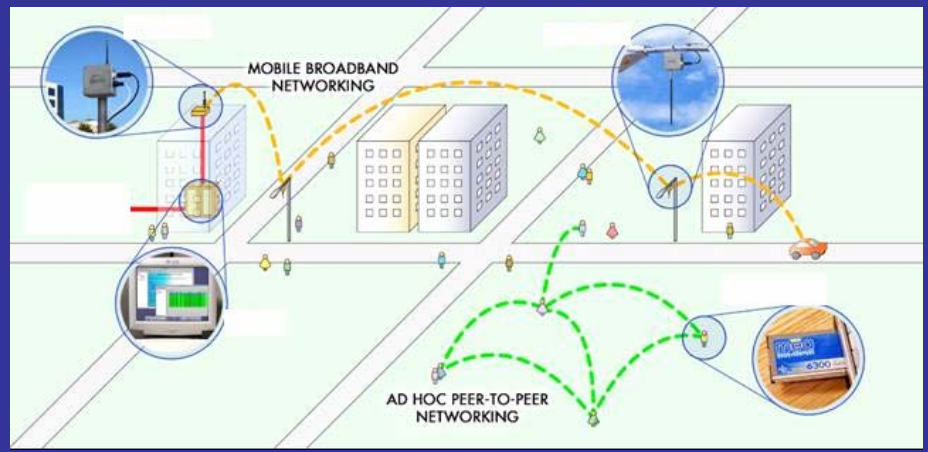
Mesh Networking Technology –
Ultimate Evolution of Wireless Communications

- **Physics limits the range of broadband speed wireless communications**
  - –Higher bit rates mean shorter range at equivalent transmit power as the energy per bit diminishes
- **The most practical way to extend the range of broadband wireless communications in a power restricted environment is to hop through intermediate wireless routers which can receive and retransmit the signal**
- **Lower power wireless routers supporting dynamic ad-hoc routing algorithms can achieve:**
  - –Highest possible delivered capacity and throughput over a wide area
  - –Most robust operation due to the multiple alternative routes available for any packet when organized in a mesh topology (like the Internet's router topology)

- **Enables camera integration on street light mounted mesh access points**
- **Motorola leads in driving the 802.11s mesh networking standard**



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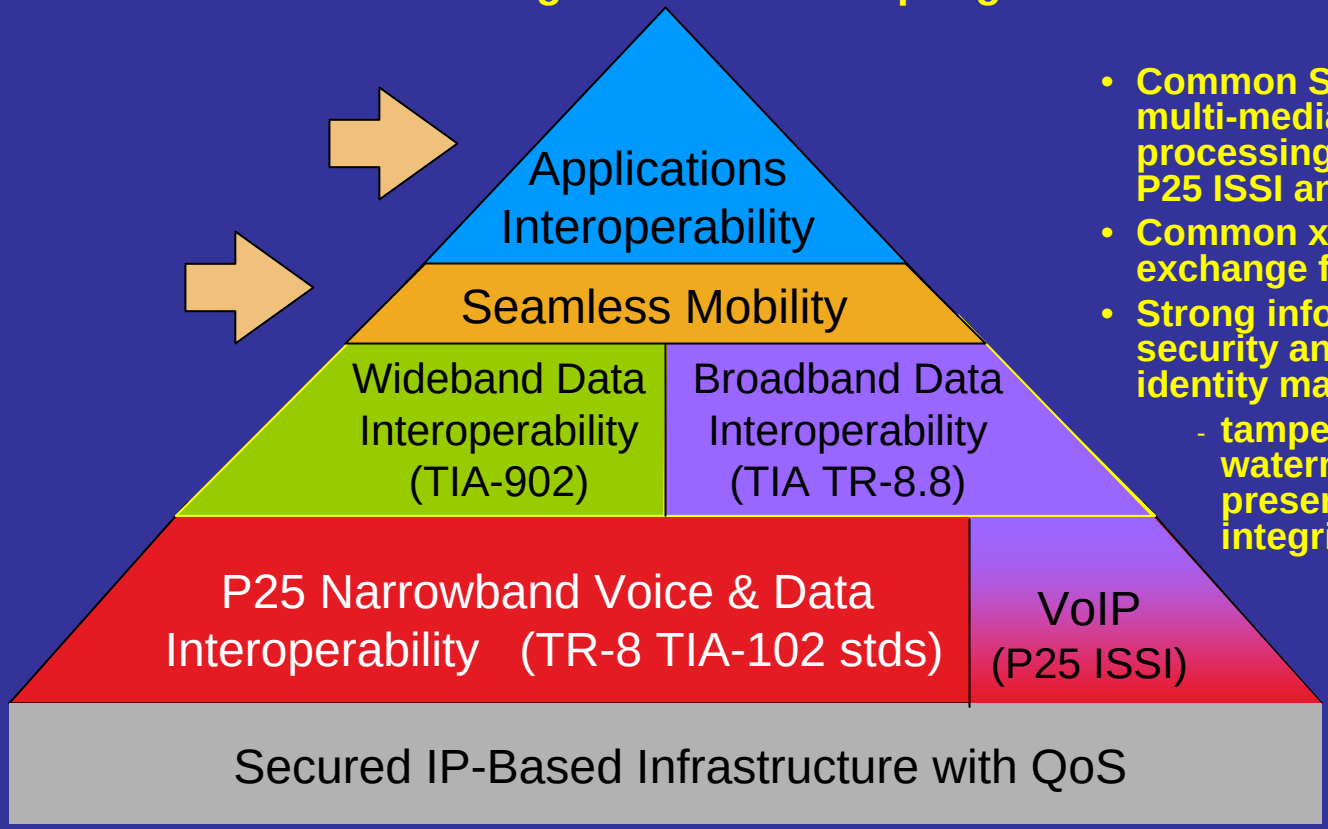
Step 3: Enable Seamless Mobility and Application Interoperability

- **Develop and deploy seamless mobility solutions that allow users to roam between diverse access networks**
- **Develop and deploy standards-based data, video and multimedia application data exchange formats, identity/security management**
- **Improve coordination of the organizations attempting these standardizations**



- **Common SIP/IMS based multi-media call processing (extending on P25 ISSI and Cellular IMS)**
- **Common xML based data exchange formats**
- **Strong information security and federated identity management**
  - **tamper proof watermarking for preserving video integrity**

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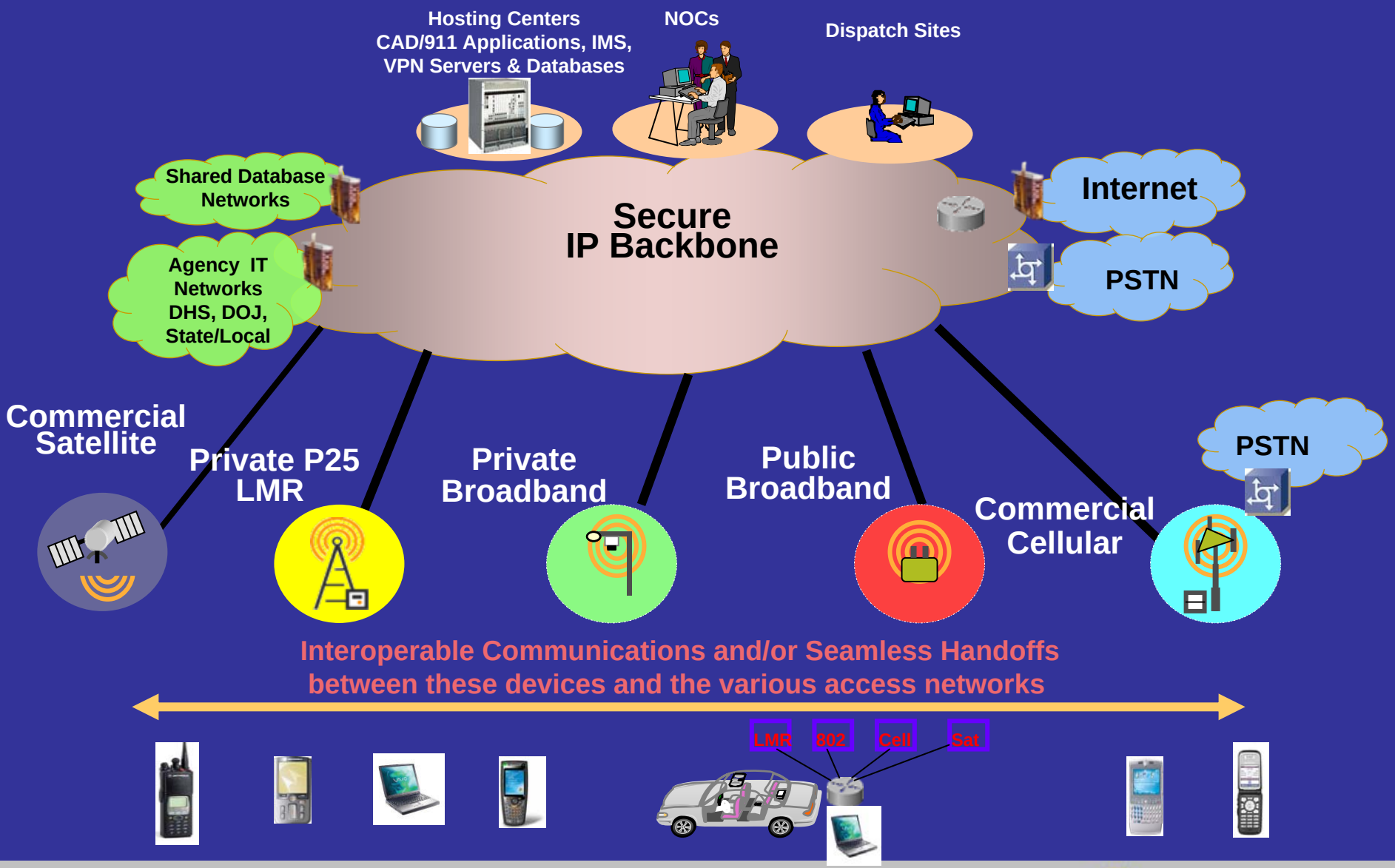
A Vision for Public Safety Seamless Mobility



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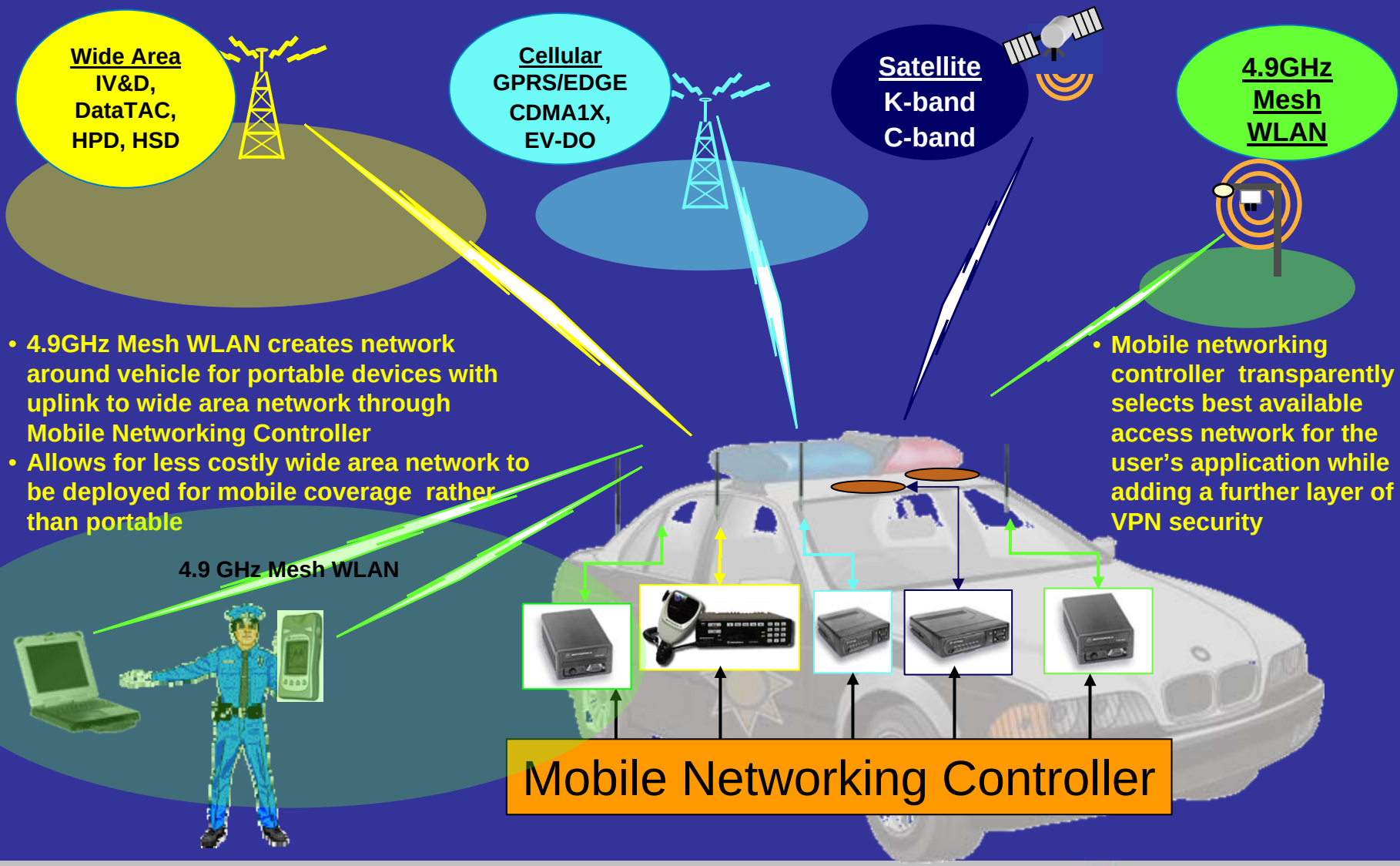
Seamless Mobility Use Case:

Seamless Data Connectivity to Multiple Access Networks



- 4.9GHz Mesh WLAN creates network around vehicle for portable devices with uplink to wide area network through Mobile Networking Controller
- Allows for less costly wide area network to be deployed for mobile coverage rather than portable

- Mobile networking controller transparently selects best available access network for the user's application while adding a further layer of VPN security

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Future Multimedia Applications

- **Push to Talk was just the foundation; Push to View (Images), Push to Video, Push to Locate, Push to Sense, etc. are all possible**
- **Intelligent (software-based) video and image recognition will be key to handling all the fixed and mobile video streams**
- **Recognition that media and data exchange formats (xML-based) must be standardized to guarantee long-term interoperability**

Improved Incident Response

Responder Location Tracking

Situation Escalation Notification

Enhanced Decision Making

Homeland Security Info Sharing

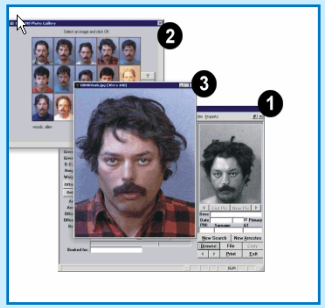

Image Processing

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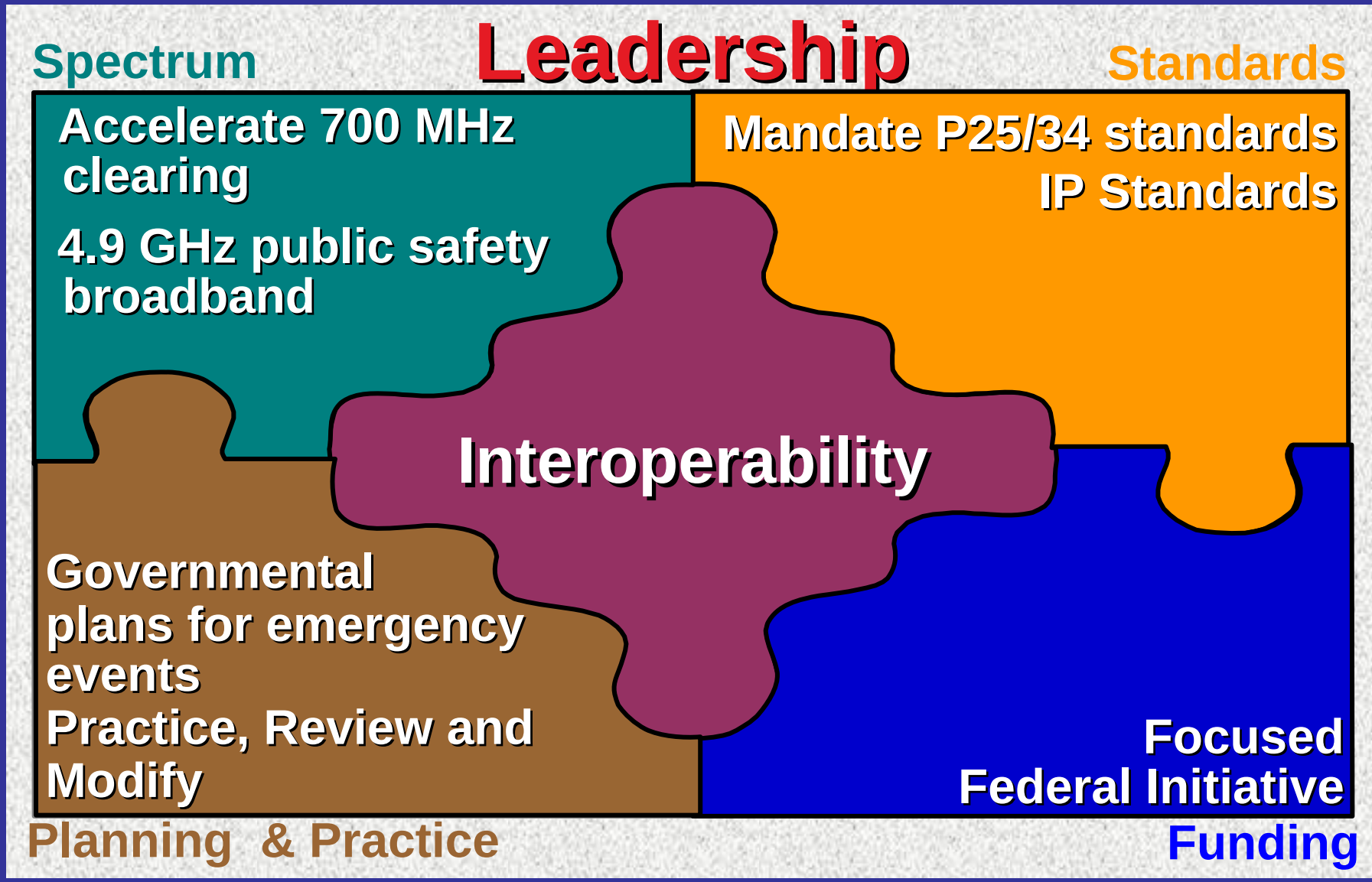
Critical Interoperability Enablers



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