Public Safety Communications Interoperability in Maryland

Report of the
Interoperability Project Team
to the
Public Safety Communications
Interoperability Governance Work Group

MD-IPT-RPT-R2C7

28 February 2005

Acknowledgements

Public safety is one Governor Robert L. Ehrlich, Jr.'s priorities. Under his direction, the Governor's Office of Homeland Security, the Maryland Association of Counties (MACo) and the Maryland Municipal League (MML) have been working collaboratively on the issue of interoperability since the December 2003 creation of the Public Safety Communication Interoperability Governance Work Group and an "Interoperability Project Team" (IPT).

This report and the work of the IPT could not have been completed without the strong support of the Governance Working Group (GWG) and the invaluable contributions and coordination provided by both the MACo and the MML. The GWG provided insight and guidance at each review point during the process of developing the survey and the report. Both MACo and MML were instrumental in coordinating survey responses from their respective constituencies and in participating in the IPT recommendation development process.

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ATTACHMENT 1 INTEROPERABILITY PROJECT TEAM

*** Appendices and Attachment 1 are bound separately.**

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Executive Summary

In an effort to improve public safety communication systems, processes, and infrastructure in Maryland, the State of Maryland has formed a Public Safety Communications Interoperability Governance Work Group (GWG) of State, County, and Municipal government officials to oversee the state's initiative to provide voice and data communications across agencies, departments, and government levels. An Interoperability Project Team (IPT) consisting of professional public safety representatives from State, County and Municipal agencies support the GWG. This unique collaboration was brought about by cooperation between the Maryland Municipal League (MML), the Maryland Association of Counties (MACo), and State of Maryland agencies. This document is the Report to the GWG on the IPT efforts, findings, and conclusions to date.

Traditionally, jurisdictions and agencies have built standalone systems to meet their individual needs. This stove piped environment has left Maryland without sufficient regional or statewide interoperability, which, as a result of events related to September 11, 2001, has become more critical. This report discusses recommendations to enhance Maryland's capabilities to provide statewide secure, coordinated, interoperable[1], real-time voice and data communications to facilitate the sharing of emergency services information across jurisdictions and agencies. This will enhance performance for major events, task force communications, and routine day-to-day coordination. As a result of this work, the IPT has adopted conceptual models for public safety voice communications interoperability, operations, partnering for governance, improving system coverage and capacity, and information sharing. The challenge was defining objectives and actions to realize these concepts, while striving to identify existing best practices projects that could be leveraged toward achieving the identified goals.

ISSUES

To determine the current status of public safety communications technology and interoperability within Maryland, the IPT conducted a User Needs Survey of key agencies, counties, and municipalities. Responses were received from 11 agencies, all 23 counties, and 28 municipalities. Survey responses show that the need to improve communications interoperability, training, governance, security, and operational standards (including a common vocabulary) exists throughout Maryland, and that Agencies at all levels of government are attempting to address these needs in many ways. Survey analysis yields the following concerns and challenges:

- Funding limitations hamper most agencies in improving systems
- Many existing systems have limited capability to be interoperable
- State agencies have older existing systems and will soon need to replace them

[1] Interoperability is the ability of public safety providers to exchange voice and data communications on demand (as authorized and required), in real time. It describes how radio communications systems should operate between and among agencies and jurisdictions that respond to common emergencies.

- Insufficient radio channels and system coverage limitations
- FCC authorized mutual aid channels are under utilized
- Lack of a common statewide public safety frequency band
- Requirement for a robust statewide infrastructure
- Limited use of wireless data systems.

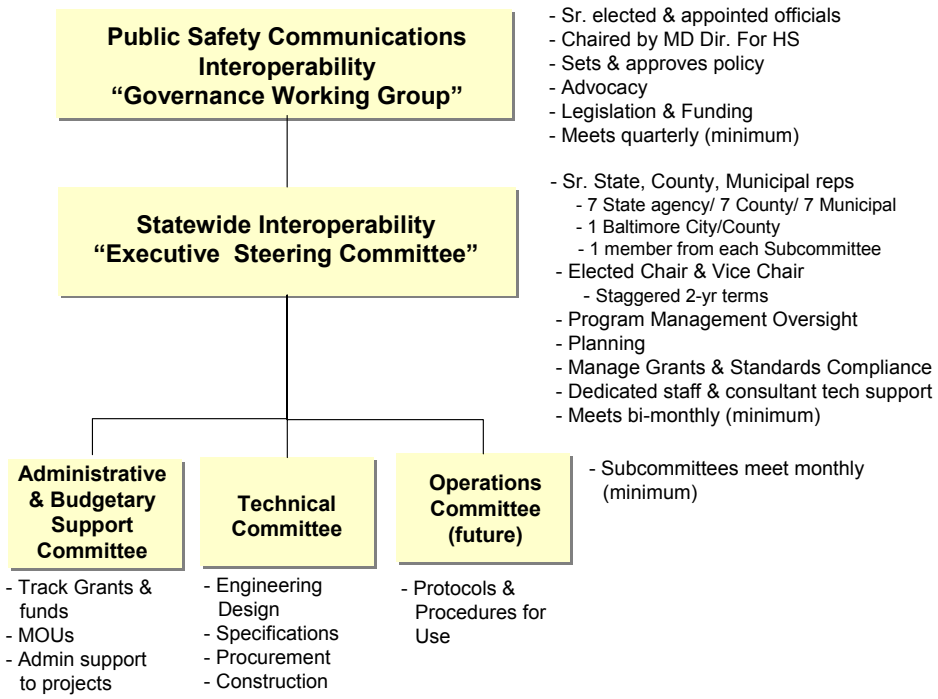
Recognizing the convergence of voice and data communications, the IPT's recommended long-term solution focuses on standards-based, open architecture systems. These systems will be secure and accessible by users from State, County, Municipal, and Federal agencies. Success will be enhanced by the continued cooperation and sharing of technological expertise by all stakeholders.

RECOMMENDATIONS

There are several short-term projects already underway within the State to address various aspects of our public safety communications goals. The recommendations of the IPT utilize these initiatives to achieve goals that support partnering, capacity, interoperability, information sharing, and positioning for the future.

Interoperability: ***Recommend that funding be made available to create a statewide multi-band mutual aid channel infrastructure***. Many county, municipal, and especially state agency radio systems are older and do not use the same protocols (speak the same language) limiting their ability to interconnect. There are also system coverage limitations. When radio users are at the edge, or beyond the boundaries, of their system coverage area the user's radio signal received or sent are weaker, and their radios don't work. Over the next 1 to 3 years it will be feasible to create a statewide multi-band mutual aid channel infrastructure by integrating the Central Maryland Area Radio Communication (CMARC), Maryland Eastern Shore Interoperability Network (MESIN), and Maryland Incident Management Interoperable Communications System (MIMICS) programs into a network of networks. The resulting architecture will provide near-term voice interoperability to a majority of the state jurisdictions and a significant majority of the population. Combined with the fiber and microwave infrastructure projects, this network would provide for the realization of a significant portion of our envisioned voice communications conceptual model. This integrated network will also serve as the foundation for the development of an enterprise architecture for the remainder of the state, including the expansion of a Maryland voice and data intranet network.

Partnering: ***Recommend creation of a formal multi-tiered partnering structure.*** The IPT has proposed a partnering structure to continue the State, County, and Municipal partnerships that have produced this study and several of the interoperability initiatives currently being deployed. The proposed partnering structure for public safety communications and interoperability in Maryland should be implemented by June 2005. At each level in the Governance structure, the primary goal is to coordinate efforts and reach consensus on efforts to achieve Maryland's vision for Interoperable Public Safety Communications systems across all levels of government. The organization of the proposed partnering structure is shown in the figure below:



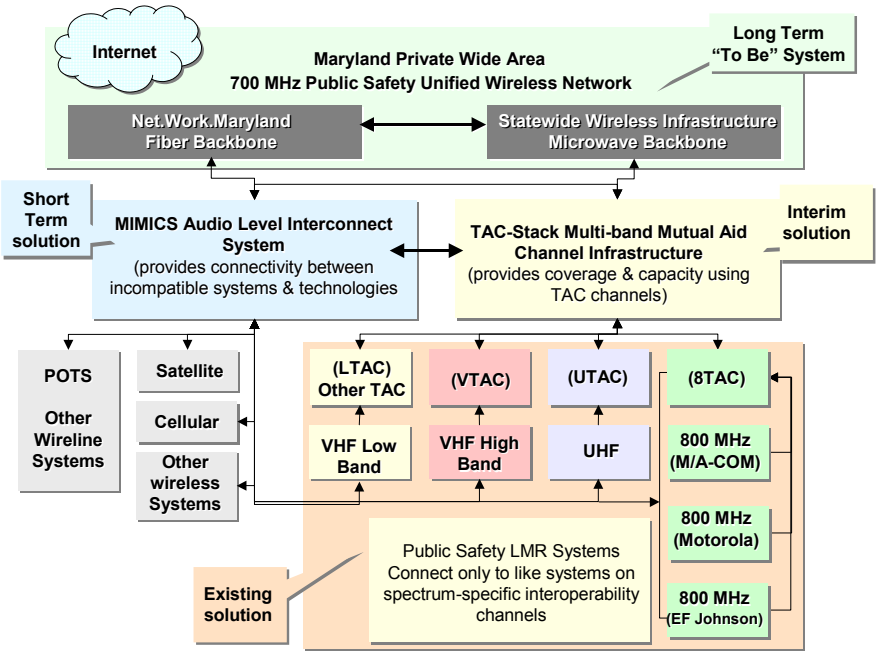
The proposed partnering structure will support the implementation of public safety communications plans statewide, facilitate communications, mediate disputes, ensure oversight, explore technical options, and track finances for public safety communications. This partnering structure will provide administrative, technical, and operational efficiencies in designing, procuring, implementing, and maintaining a statewide public safety communications infrastructure and network. It will:

- Provide economies of scale in procurements
- Sustain the commitment, vision, and direction of the effort over the long term
- Assist in bridging organizational boundaries
- Help in obtaining a greater share of Federal grant funds for public safety communications and interoperability voice and data projects.

The proposed partnering structure provides a forum to address cross-regional (both internal to Maryland as well as external between Maryland and other Regional organizations, States, Counties, or Municipalities) issues by bringing together technical and political leadership and by converging potentially fragmented efforts. Projects with statewide scope – like the multi-band mutual aid project – need a partnership forum such as this to facilitate program and project management.

Capacity: ***Recommend funding to support build-out of statewide infrastructure.*** The IPT findings from this study indicate that it is necessary to complete the build-out of the statewide infrastructure (i.e., towers, microwave, and fiber networks) and migrate applications running over it to an open standards-based Internet Protocol (IP) system. A high capacity wireless and fiber infrastructure is a core element of a statewide interoperable system. Systems installed to date must be adapted to allow for the increased requirements of a statewide voice and data

enterprise architecture.[2] The infrastructure must be scalable and designed for high availability, stability, and quality of service. A robust statewide system would provide a common platform to provide radio system coverage and wireless data to most corners of the state using state, county, and municipal towers and system components. Below is the conceptual voice interoperability model.



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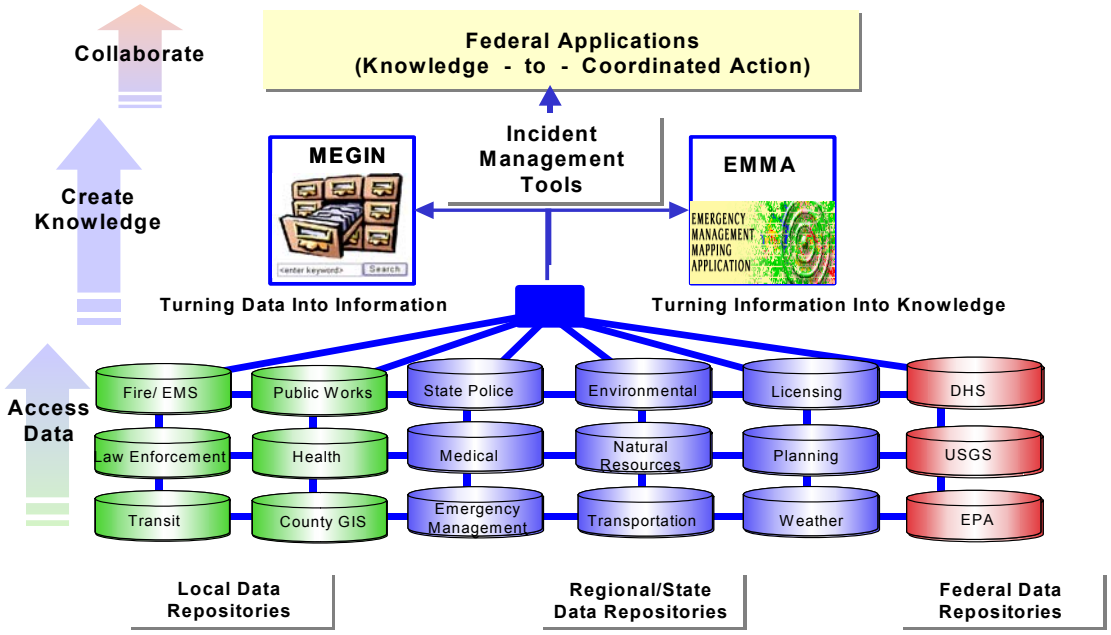
*TAC-Stack refers to the hardware associated with the VHF, UHF and 800MHz mutual aid interoperability channels. Along with audio interconnect to devices (i.e. MIMICS ACU 1000's), will add coverage and connect existing systems.

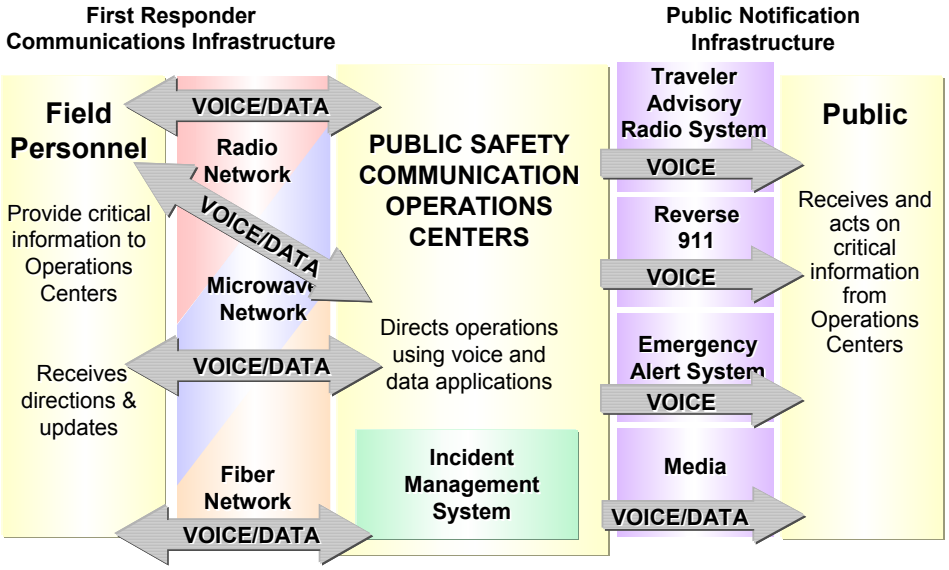
This infrastructure will also support our migration to a statewide 700 MHz system, as the current most feasible future technological option. Regular assessments should be planned, and adjustments made as needed of capabilities, technological changes, and requirements. To ensure the long-term viability of this network, sufficient *capacity* must be maintained, *open standards* must be embraced, and *maintenance* programs must be established. Technologies that enhance the efficiency and value of existing radio/frequency channels (i.e., provide more than one talk path per channel) must be evaluated and, if deemed of value, utilized.

Information Sharing: ***Recommend expanding current mobile data capabilities to public safety responders.*** Mobile data capability in the hands of responders will deliver improved public safety services and enhance the effectiveness and efficiency of the response and reduce the amount of voice traffic required to respond to some incidents. Data sharing initiatives will require significant bandwidth and the need will grow in the future as more individuals use the systems and become advocates for more information in a timely fashion.

[2] *The National Association of State CIOs defines enterprise architecture as "an overall plan for designing, implementing and maintaining the infrastructure to support the enterprise's business functions and underlying networks and systems."*



There are efforts underway within the State to increase coordination and information flow during emergencies through the use of information technologies. Getting the right information to the right individuals at the right time is vital to achieve the best possible outcome. There are three facets to this effort including: 1) Improved information flow; 2) Data development; and 3) Tools for mining and viewing data.



The *enhanced network capacity* and *interoperability* achieved will provide the ability to more readily share available information. Progress in this area includes the significant award of an Information Technology Evaluation Program (ITEP) DHS Grant (for $1M) in September 2004 for further development of distributed data sharing through a secure network. The data required to support these efforts must be identified, prioritized, secured, and, where necessary, developed. Steps towards this effort have been taken by surveying state agencies and local governments for data available to support coordination during emergencies. Data sharing initiatives include

development of tools to help first responders and the emergency management community to make the most informed decisions possible. These tools include the Maryland Emergency Management Agency's (MEMA) rollout of open standards-based incident management software and Towson University's Emergency Management Mapping Application (EMMA) to emergency operation centers statewide. This type of information sharing will allow information to be shared from operations centers through to field personnel as well as allow direct access by field personnel.

Position for the Future: ***Recommend complete planning for a 700 MHz statewide system***. Current interoperability projects lay the foundation for state-of-the-art standards based, voice and data systems that will have the necessary capacity to meet operational needs. The FCC must be actively encouraged to release the 700 MHz spectrum needed for the statewide system. Planning must begin in detail for a statewide architecture using the new frequencies scheduled to become available. This plan will provide additional urgency to release these frequencies and allow for adjustments to the core subsystems in a timely and cost effective manner. To gather and maintain momentum moving forward, it will be necessary to take steps to communicate and share this plan with a wide audience throughout the State. The IPT is planning to launch a web site to share information with the public as well as outreach to Public Safety organizations, Municipalities, and Counties.

CONCLUSION

Maryland has several public safety communications challenges it must overcome. With the roadmap defined, to realize continued progress, coordination between State, County, Municipal, and where applicable, Federal agencies, will be necessary. Leveraging active projects will optimize contributions toward initiatives and minimize duplication of effort. Interoperability, by definition, involves many different entities and cannot be accomplished through the efforts of any single agency.

1.0 Interoperability Project Description

1.1 INTRODUCTION

Public safety is the result of the combined efforts of law enforcement, fire departments, emergency medical services, and a host of other agencies including public works. Following September 11, 2001 homeland security and domestic preparedness became part of public safety. Congress provided an expanded definition of first responders in the Homeland Security Act of 2002, which defined "emergency response providers" as including "Federal, State, and local emergency public safety, law enforcement, emergency response, emergency medical (including hospital emergency facilities), and related personnel, agencies, and authorities."

As a result, the missions of Public safety providers have changed. New mission requirements and the addition of homeland security responsibilities expand the scope of public safety. Non-traditional organizations such as public works and utilities are now part of the public safety sphere. In order to effectively and proactively provide public safety services, agencies need to work more closely with one another, coordinate efforts, and share information. **Figure 1-1** depicts the diversity of public safety providers.

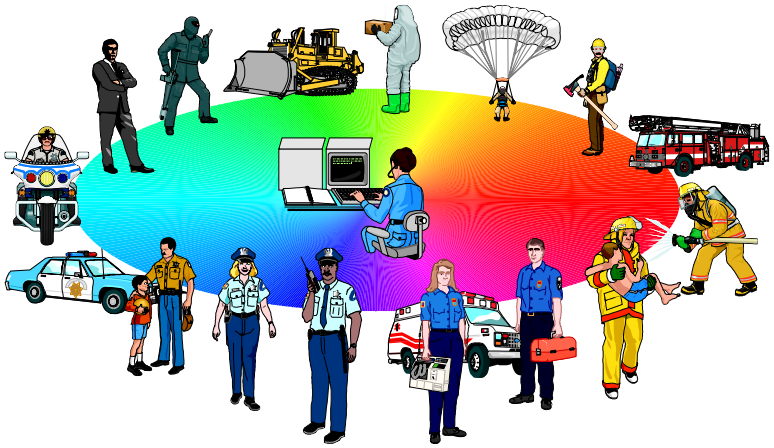


Figure 1-1. Spectrum of Public Safety Providers

Public safety providers are highly mobile -- covering a municipality, a county, a region, or a State. Personnel depend heavily on wireless communications for every aspect of their work - to obtain notification, guidance, and information as well as to request assistance, data, or clarification. Emergency response and recovery typically involves several agencies that need to work closely with one another and communicate. The changing mission requirements of public safety have increased emphasis on joint operations and joint task forces, thus increasing the need for interoperability. New public safety mission requirements for video, imaging, and high-speed data transfers, new and highly complex digital communications systems, and the use of commercial wireless systems are potential sources of new interoperability problems.

Operationally and organizationally it is critical that these agencies identify ways and means to cooperate through Memorandums of Understanding (MOUs) and through joint governance organizations to overcome the political and functional barriers that have historically impeded interoperability.

The focus of this study is on communications interoperability - more specifically public safety wireless communications interoperability. For purposes of this study we rely on the definition of interoperability provided by SAFECOM, APCO, and most other public safety organizations:

> *Interoperability is the ability of public safety providers – law enforcement, firefighters, EMS, emergency management, public utilities, transportation and other personnel – to exchange voice and data communications on demand (as authorized and required), in real time. It describes how radio communications systems should operate between and among agencies and jurisdictions that respond to common emergencies.*

For many reasons, organizations face difficulty in communicating with one another. The operational barriers and technological barriers are equally important to address and overcome. Forward motion on the operational/organizational front and related movement on the technological front must be addressed together to ensure that any solutions fit the requirements and that they are used to address real needs.

Big events and emergencies dramatically underline the need for interoperability, but readily available interoperable communications are equally important for routine public safety operations that occur every day. Public safety agencies communications systems must support coordination among agencies at multiple levels:

- *Day-to-day* -during routine operations such as a vehicle chase
- *Mutual-aid* - in the joint and immediate response to a catastrophic event such as a hurricane
- *Task-force* - for proactive and targeted operations

Experience has shown that in each of these event classes, first responders require improved wireless communications to enable:

- Platforms to share information across jurisdictions and disciplines
- The ability to communicate across organizational and jurisdictional boundaries
- The ability to access and share data across organizational and jurisdictional boundaries
- The ability to transfer actionable useful information
- The ability to access and use tools to manage a growing incident
- The ability to collaborate effectively to preserve the public safety – saving lives and property.

The goal of the IPT is to develop a plan to implement a solution to provide statewide, secure, coordinated, real-time voice and data communications to facilitate the sharing of emergency services information across jurisdictions and agencies. This will enhance performance for routine day-to-day coordination, major events, and task force communications. When public

safety agencies and personnel cannot communicate with one another by radio at accident or disaster scenes, the result is a lack of coordination that may result in unnecessary damage to property or loss of life.

The communications equipment itself is a means to an end. Government agencies at all levels are increasingly developing partnerships to support shared communications systems that improve interoperability, and lower costs. The goal of interoperable communications is to facilitate interoperability and coordination between public safety agencies, and across jurisdictional boundaries. Increased sharing of information and coordination of activity will ultimately benefit the citizenry of Maryland through improved public safety and homeland security. It is necessary to identify a solution that will support and allow management of communications between different radio systems and between radios and other communications technologies such as cell phones.

This study provides a roadmap for reaching Maryland's interoperability goals and brings government and public safety officials together under a common mission. It provides the public safety community in Maryland with a shared vision for wireless voice and data communications interoperability, and provides the architectural framework for future interoperable public safety communications in Maryland. The Vision and architecture are based on the needs of the user community.

Figure 1-2 illustrates the SAFECOM Interoperability Continuum. The Continuum identifies critical success factors that communities must consider as they work to improve communications interoperability. It provides guidance for increasing *Frequency of Use* of interoperable communications equipment; creating a joint *Governance* structure; developing *Standard Operating Procedures*; integrating *Technology* solutions with existing systems, and conducting *Training and Exercises* to ensure personnel and organizations are familiar with the tools and procedures and can work together smoothly and efficiently. The Continuum illustrates five areas that must be addressed in moving forward:

- Governance ranges from agencies working independently at the minimal level through to having a Regional Committee working with a Statewide Interoperability Committee. The current efforts of the IPT and GWG coupled with implementation of the IPT recommendations for Governance should position Maryland close to the optimal level on the Governance continuum (see Figure 1-2).
- Technology to enable interoperable communication ranges from exchange of radios and carrying radios from multiple agencies through to working together on a standards based shared system. Maryland's current status on the Technology continuum varies. While some agencies and jurisdictions rely on radio swap, some have gateways, shared channels, and shared systems. The goal of the IPT is to improve the overall level of all public safety agencies at all levels of government on the Technology continuum.
- Standard Operating Procedures are key to successful collaboration and interoperation and range from a minimum of Agency SOPs through to adoption of National Incident Management System Integrated SOPs. As with the Technology continuum, Maryland's public safety agencies are spread between Joint SOPs for planned events and Regional Communications SOPs.

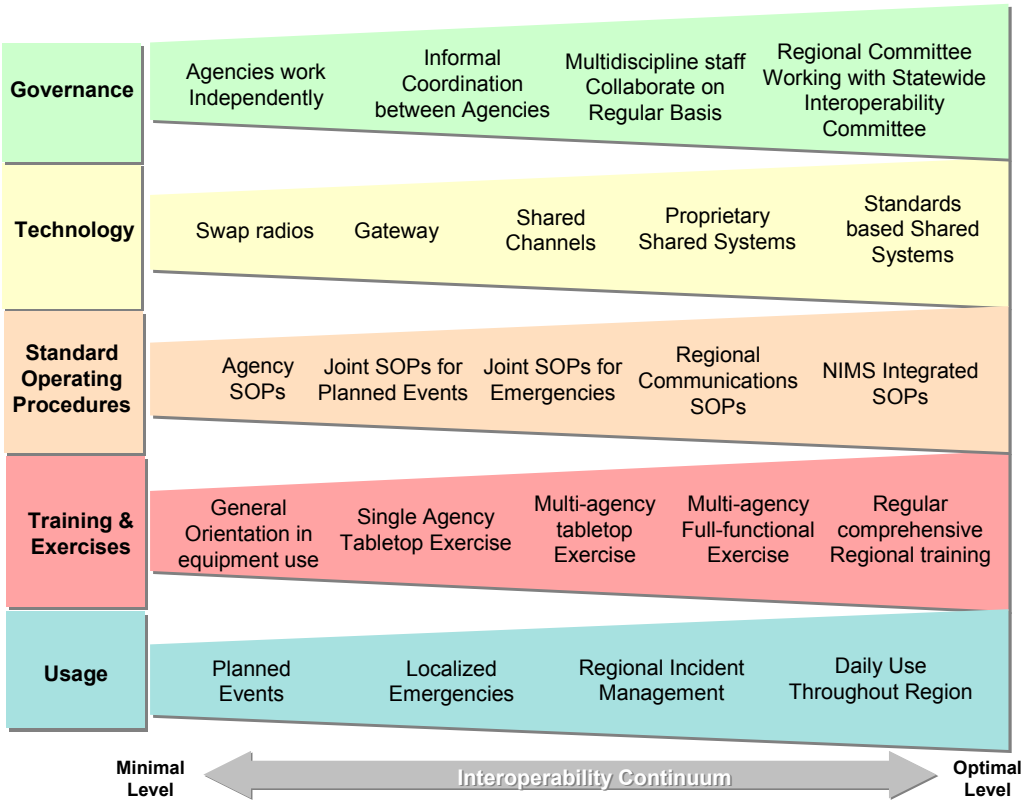


Figure 1-2. Interoperability Continuum

- Training & Exercises are important tools in ensuring that personnel and agencies are familiar with the tools available to them and are able to collaborate smoothly to respond to a situation. The continuum ranges from a minimum of General orientation in equipment use to Regular comprehensive regional training. In moving forward with plans for interoperability and development of a statewide public safety communications concept of operations it will be necessary to develop and implement regular comprehensive regional training.
- Frequency with which public safety personnel utilize equipment or capabilities to enable interoperability. At the minimal level, agencies and personnel enable interoperability only in planned events. Optimally, agencies and personnel would use interoperable communications on a daily basis. At this time, Maryland's frequency of use is roughly in the middle of the Frequency of Use continuum.

The IPT and GWG seek to move Maryland's public safety community to the Optimal level on the Interoperability Continuum by the time the FCC releases the 700 MHz spectrum for use enabling Maryland to create a statewide standards based shared system using a commonly accepted set of SOPs under the governance of a State Public Safety Communications Interoperability Committee enabling daily use of interoperable communications statewide.

1.2 THE INTEROPERABILITY CHALLENGE

The Challenge in interoperability is twofold:

- On the Operational level, the challenge is to enable meaningful communication, coordination, and cooperation between agencies
- On the technological level, the challenge is to facilitate or enable exchange of information without compromising security, and enabling management of talk so that individuals can communicate without overwhelming and talking over one another

Both the Operational and the Technological challenges are sizable and difficult to overcome. A balanced Governance structure, a clear Enterprise Architecture or CONOPS -- indicating what the responsibilities of each organization are and who needs to talk to whom, when and what types of information are required -- and a technological solution to facilitate the exchange of voice and data communications are critical.

Interoperability problems between public safety providers have been documented nationwide for some time and have received significant attention in the wake of notable regional and national incidents. The interoperability of first responders –anyone who, by specialty or profession normally arrives first on the scene of an emergency incident to assess or take action to save lives, protect property, and/or mitigate the situation – has been pivotal in the success of each response regardless of its magnitude.

State and local first responders, including law enforcement, fire service, emergency medical service, and hazardous materials personnel, are widely acknowledged as being an invaluable homeland security resource. State and local public safety personnel and agencies provide the first line of defense in protecting critical infrastructure and public health and safety. State and local personnel are the first to respond to an emergency and the last to leave the scene.

Maryland is part of the National Capital Region and hosts more than its share of critical infrastructure. Maryland has a major international airport, an active commercial and military) harbor, and straddles a major transportation corridor (I-95) with busy bridges and tunnels, as well as railway and other long distance transport of goods and people. Maryland is a coastal state in the hurricane lane and has also experienced tornados. In just the last two years, Maryland's first responders have dealt with natural disasters (Hurricane Isabel), roadway incidents (Tunnel Fire), and inter-jurisdictional crime (Sniper Incident) among others without the benefit of significant interoperable public safety communications. First responders needed the ability to share information and communicate with counterparts outside their home agencies or jurisdictions in all these incidents. Lack of communications interoperability severely undermines the capacities of law enforcement, firefighters, and other first responders to respond to and manage emergency situations.

Figure 1-3 illustrates an incident scale that illustrates the ability and preparedness of public safety agencies and personnel to communicate with one another and manage response to an incident as it grows from a local to a regional, then statewide to national proportions.

All incidents take place in a locality. Most incidents fall within the day-to-day and are dealt with by local response personnel within several hours. Local public safety personnel have plans and procedures in effect to handle these situations. As the scale indicates, as scope, complexity and/or duration of an incident increase and response personnel from multiple agencies, jurisdictions, as well as State and federal agencies become involved preparedness and tools to manage and coordinate are lacking.

Response to a terrorist attack requires the participation and coordination of numerous public safety agencies. Weather incidents, transportation accidents, fires and chemical spills often require similar coordination of multiple agencies and jurisdictions. Interoperability among response agencies and interoperable communications among responding personnel and agencies is a critical success factor for any sizable response to ensure the safety of both life and property. The ability of current communications systems and capabilities within Maryland to support such interoperability are limited.

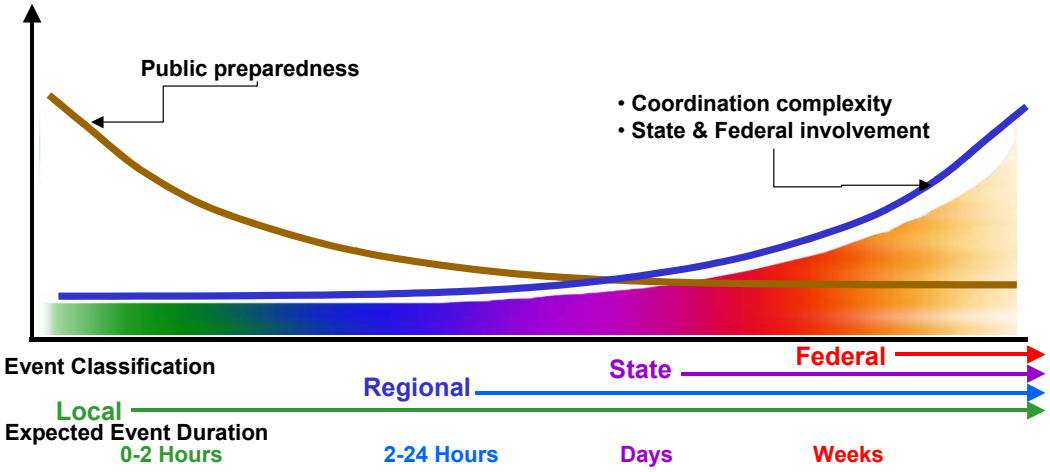


Figure 1-3. Incident Scale

As indicated in studies by AGILE, PSWN, SAFECOM, and other organizations studying communications interoperability, the challenges that Maryland's officials must address to achieve interoperability are:

- Incompatible and aging communications equipment
- Limited and fragmented funding
- Limited and fragmented planning
- Limited and fragmented radio spectrum
- Lack of coordination and cooperation

Public safety field personnel rely on their radios. When systems' incompatibility or deterioration results in an inability to exchange voice and data communications, Maryland's public safety personnel are in danger and its citizens are at risk, both in day-to-day and emergency operations.

Local, and county governments and state agencies face budget shortfalls, and competition for scarce resources. The IPT is seeking to identify short-term strategies to incrementally improve

existing radio communication systems with limited resources and to map out a plan to provide a coordinated transition to a statewide solution that will result in improved communication and coordination, will reduce redundant expenditures, and provide for economies of scale in procuring equipment.

Communications interoperability planning in Maryland has been fragmented in the past. Different agency and community funding priorities exacerbate the problem. Without a coordinated vision, strategic planning, and a roadmap to interoperable public safety communications investments are made in systems and equipment that are not interoperable. Limited federal funding and grant monies are spent in an uncoordinated manner that does not contribute to achievement of Maryland's goals for public safety communications interoperability. Maryland seeks to address this through incorporation of stakeholders representing various functional, operational, and jurisdictional interests in a coordinated planning effort.

Spectrum is the amount of bandwidth available for over-the-air communications, and it is a finite resource. An extremely limited amount of radio spectrum is reserved for public safety and it is inadequate to accommodate the increasing number of electronic devices that require more and more spectrum to operate. In response, FCC has assigned additional frequency bands for public safety, which now operates in 10 separate bands. However, these allocated frequencies are scattered across the spectrum, making "ad hoc" technical solutions more difficult for different agencies and jurisdictions. The IPT seeks to facilitate communications between existing systems in the existing bands in the short term and transition to a statewide system utilizing the new 700MHz spectrum.

Any interoperability among agencies and jurisdictions requires coordination and leadership. Establishing shared communications systems and sharing of information among agencies and jurisdictions will require shared management, control, policies, and procedures. While it may appear to be a technical issue, interoperability has more to do with establishing trust and buy-in among stakeholders. The IPT is proposing a plan for coordination and governance to address this challenge.

Figure 1-4 illustrates these challenges in terms of the barriers to communications interoperability resulting from differing:

- Political strata (Federal, State, County, or Municipal) with different priorities, requirements, jurisdictions, budgets, and timetables. Political differences, agendas, and budget control often are problems impeding solutions to interoperability.
- Within the political strata there is further segmentation or, functional separation due to varying mission requirements (such as law enforcement, fire, EMS, public service). Different cultures, procedures and 'languages' can inhibit interoperability.
- Finally, Technological differences such as: system type, technology, frequency, or even age between systems impede the ability of personnel to interoperate.

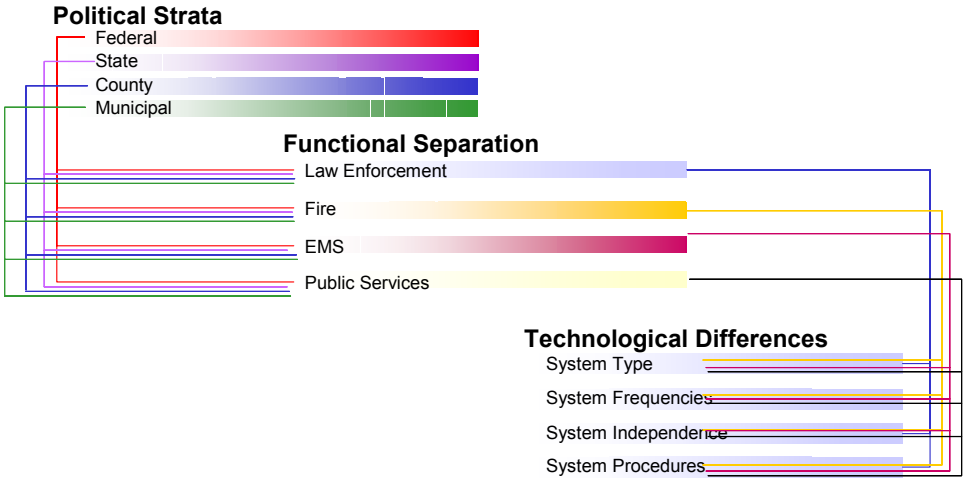


Figure 1-4. Barriers to Interoperability

In the wake of recent national events, first responders are also now seen as the first tier of Homeland Defense. In order for first responders to provide effective, cohesive defensive capabilities, they need to integrate their activities and collaborate – share information and knowledge that supports decision-making and coordinated response actions for the protection of lives, property, and critical infrastructure. The need for local, regional, State, and Federal agencies to communicate on secure channels across multiple systems outside their own is more critical than ever. It is essential that all radio networks be able to host visiting users so that responders from multiple agencies and different networks are able to communicate with one another.

1.3 ADDRESSING INTEROPERABILITY IN MARYLAND

Maryland is undertaking the effort to establish a statewide wireless infrastructure to support interoperable voice and data communications, provide data access, incident management tools, and facilitate the sharing of information across jurisdictions (between municipalities, counties, State boundaries as well as with Federal agencies).

In the late 1980's, Maryland officials recognized the need for a statewide network to support public safety. Their vision was to construct a statewide 800 MHz system, but due to inability to obtain sufficient frequencies, this goal was not achieved. The 800 MHz spectrum the State had acquired for that system was freed for use by the counties and municipalities to allow the upgrade of public safety communications infrastructure in many jurisdictions.

During the late 1990's a new task force readdressed the issue of building a statewide public safety network outlined a strategy to build out a statewide infrastructure that would be available to support the deployment of a 700 MHz public safety network when the FCC makes that frequency band available during the first decade of the 21st century (2005 – 2010).

As a follow-up to the 1999 effort, and in light of the heightened need for interoperability in a post September 11, 2001 world, Maryland established a Public Safety Communications

Interoperability GWG of State, County, and Municipal government officials to oversee the state's initiative to provide voice and data communications across agencies, departments, and government levels. An IPT consisting of representatives from State, County, and Municipal agencies support the GWG. This unique collaboration was brought about by cooperation between the MML, MACo, and State of Maryland agencies with a common goal to improve public safety communication systems, processes, and infrastructure in Maryland.

Key objectives of this effort are to:

- Assess current communications systems across agencies and jurisdictions charged with emergency management and public safety
- Address the challenges to improving communications among Maryland's emergency response and public safety agencies
- Create a strategy, framework, and roadmap for secure, coordinated, real-time voice and data communications for emergency services across jurisdictions and agencies throughout the State.

This roadmap establishes a clear direction to enhance future interoperability efforts across the State. The framework includes a menu of solutions robust enough to meet a variety of needs with a bias towards solutions based on open architectures. It also recognizes the convergence of voice and data communications due to the development of digital and wireless technologies and leverages the strength of this convergence. Finally, the framework is constructed with the fiscal awareness to leverage available funding from all sources (State, Local, Federal, and Private), statewide cooperation, and existing technology.

1.4 PURPOSE OF THIS DOCUMENT

This Document covers:

- ***Current Public Safety Communications Environment*** discussing projects in other States to achieve interoperable public safety communications; National efforts and programs (such as SAFECOM) to establish guidelines, standards, and requirements for public safety communications and interoperability (See **Appendix C** for Regulatory Issues Affecting Interoperability); and an overview of the "As Is" Public Safety communications environment in Maryland based on results from the *Interoperability Survey* (May-June 2004). The Maryland Interoperability Survey, distribution, process, and results are detailed in **Appendix A**.
- ***Active Public Safety Communications Efforts*** discussing national and regional projects (such as DMIS and CAPWIN), and ongoing Maryland projects to achieve interoperability. Detailed descriptions of the ongoing projects of interest in Maryland are provided in **Appendix B**.
- ***Vision for Public Safety Communications*** outlining the IPT's 'Vision' for public safety incorporating: Interoperability (facilitating communications between agencies); Partnering (governance to address operational issues); Capacity (addressing system infrastructure requirements); Information Sharing (addressing data for public safety);

and Positioning for the Future. **Appendix E** provides an overview of Technologies of Interest.

- ***Engineering Master Plan for Public Safety Communications*** outlining the short term, transitional, and long term plans and priorities for realizing the 'Vision' for Public Safety Communications. **Appendix D** provides a detailed description of the TAC-Stack concept.
- ***Acronym List*** provides a list of acronyms used in this document

2.0 Current Public Safety Communications Environment

This Section provides an overview of the general public safety communications environment. It includes information on some of the more relevant Federal government programs; efforts underway in other states, and the current environment in Maryland. In preparing Maryland's public safety communications plans to address both the operational and technological challenges of interoperability, the IPT sought guidance from Federal and professional resources relative to operational and technical standards, regulations and methodologies. After reviewing external efforts, the IPT completed a survey of the Maryland public safety community to assess statewide interoperability.

2.1 NATIONAL ENVIRONMENT

There are areas in which the federal government can provide leadership, such as developing national requirements and a national architecture for public safety interoperable communications, national databases, and common, nationwide terminology for communications. In October 2002 the House Committee on Government Reform issued a report entitled *How Can the Federal Government Better Assist State and local Governments in Preparing for a Biological, Chemical, or Nuclear Attack?* The Committee's first finding was that, incompatible communication systems impede intergovernmental coordination efforts. The Committee recommended that the federal government take a leadership role in resolving the communications interoperability problem.

In its documentation of the testimony before and reports to the United States Congress, the Government Accounting Office (GAO) has provided explanations of the many challenges facing communications interoperability. The GAO has gone on to show the significant role that states can fill in meeting the needs of public safety interoperability, document the various Federal programs already mentioned and give recommendations for improving the interoperability environment. The July 2004 GAO report, "*HOMELAND SECURITY Federal Leadership and Intergovernmental Cooperation Required to Achieve First Responder Interoperable Communications*", provides a series of recommendations, which have been integrated into this report when applicable.
http://www.gao.gov/new.items/d04740.pdf

In the July 2004 Report, the GAO identified three principal challenges to improving interoperable communications for first responders:

- Clearly identifying and defining the problem
- Establishing national interoperability performance goals and standards that balance nationwide standards with the flexibility to address differences in state, regional, and local needs and conditions
- Defining the roles of federal, state, and local governments and other entities in addressing interoperability needs.

GAO noted that the fundamental barrier to addressing all of the long-standing problems in interoperable communications is the lack of effective, collaborative, interdisciplinary, and intergovernmental planning. *(Note: Since publication of the GAO Report some issues have already been addressed.)*

GAO Findings:

- No one group or level of government could "fix" the nation's interoperable communications problems. Success would require effective, collaborative, interdisciplinary, and intergovernmental planning.
- The present extent and scope nationwide of public safety wireless communication systems' ability to talk among themselves as necessary and authorized has not been determined.
- Data on current conditions compared to needs is necessary to develop plans for improvement and measure progress over time. However, the nationwide data needed to do this are not currently available. The Department of Homeland Security (DHS) intends to obtain this information by the year 2005 by means of a nationwide survey.
- The federal government can take a leadership role in support of efforts to improve interoperability by developing national requirements and a national architecture, developing nationwide databases, and providing technical and financial support for state and local efforts to improve interoperability.
- DHS has recently announced it is establishing an Office for Interoperability and Compatibility (OIC) to coordinate the federal response to the problems of interoperability in several functions, including wireless communications.
- State and local governments can play a large role in developing and implementing plans to improve public safety agencies' interoperable communications.
- State and local governments own most of the physical infrastructure of public safety communications systems, and states play a central role in managing emergency communications.
- The Federal Communications Commission recognized the central role of states in concluding that states should manage the public safety interoperability channels in the 700 MHz communications spectrum.
- States, with broad input from local governments, are a logical choice to serve as a foundation for interoperability planning because incidents of any level of severity originate at the local level with states as the primary source of support. However, states are not required to develop interoperability plans, and there is no clear guidance on what should be included in such plans.

GAO Recommendations:

- The Secretary of DHS
    - Continue to develop a nationwide database and common terminology for public safety interoperability communications channels
    - Assess interoperability in specific locations against defined requirements

- Through federal grant awards, encourage state action to establish and support a statewide body to develop and implement detailed improvement plans
- Encourage that grant applications be in compliance with statewide interoperability plans, once they are developed.

- Director of OMB work with DHS to review SAFECOM's functions and establish a long-term program with appropriate authority and funding to coordinate interoperability efforts across the federal government.

2.1.1 Federal Agencies and Programs

Public safety, homeland security, and in particular interoperable communications have become somewhat of a focal point for legislators and politicians in the wake of September 11, 2001. There is significant federal activity and interest in this area and it appears that over the next few years significant 'guidance' will be emerging that will impact states in this area. Keeping aware of the federal position and plans for public safety, homeland security, and communications interoperability will help the State position itself to maximize grant opportunities as well as to ensure that plans, procurements, and implementations are compatible with emerging federal standards, guidance, and requirements for receiving funding and grants.

The federal model recommended by the GAO for SAFECOM may also be helpful for use by the State in moving forward. In this manner, the State may establish the vision, direction, and standards for public safety communications and facilitate positive movement toward achieving its goals and vision. As is indicated in several reports, public safety interoperability within the State is a laudable goal, but achieving regional interoperability with federal counterparts and neighboring states is the real issue to be addressed. At this juncture, the State can easily take steps to address emerging federal goals and align itself to benefit from any federal or regional plans, projects, or spending. Following the federal model will also position the State well to respond to federal requests for information.

The following sections provide some insight into the major federal thrusts in public safety communications and interoperability.

2.1.1.1 Department of Homeland Security (DHS) The DHS has absorbed the primary responsibility for homeland security, domestic preparedness, critical infrastructure protection, public safety, and interoperable communications. As the majority of the critical infrastructure and domestic preparedness resources is owned, operated, and protected by State and local government and private industry, many of DHS's programs involve standards setting, establishment of requirements, and 'suggestions', which are reinforced by funding through grant programs. DHS has several agencies and programs involved with addressing first responder interoperable communication barriers, including the SAFECOM program, the Federal Emergency Management Agency (FEMA), and the Office for Domestic Preparedness (ODP).

2.1.1.1.1 The Wireless Public SAFEty Interoperable COMmunications Program, (SAFECOM). SAFECOM was created to unify the federal government's efforts to help coordinate the work at the federal, state, local, and tribal levels to establish reliable public safety communications and achieve

national wireless communications interoperability. OMB officials are currently in the process of refocusing the mission of the SAFECOM program into three parts:
http://www.safecomprogram.gov/SAFECOM/

- Coordination of federal activities through several initiatives, including participation in the Federal Interagency Coordination Council (FICC) and establishment of a process for federal agencies to report and coordinate with SAFECOM on federal activities and investments in interoperability
- Developing standards
- Developing a national architecture for addressing communications interoperability problems.

The SAFECOM program is attempting to coordinate federal grant funding to maximize the prospects for communication interoperability grants across federal agencies by means of interagency guidance. The GAO surveyed three grant agencies and found that COPS (with DOJ) and FEMA (within DHS) used this guidance, at least in part, in their coordinated 2003 Interoperable Communications Equipment grants, and ODP used the guidance in its 2004 Homeland Security and Urban Areas Security Initiative grant programs. COPS and FEMA officials said that it was difficult to incorporate SAFECOM's recommended criteria for planning public safety communications systems into their joint guidance because statutory language for their grant programs focuses on the purchase of equipment without specifically addressing planning.

SAFECOM released its *"Statement of Requirements for Public Safety Wireless Communications & Interoperability (Version 1.0)"* In March 2004. The goal of the "SoR" is to establish standards and improve the ability of public safety personnel to communicate among themselves, with the non-public safety agencies and organizations with whom they work, and with the public that they serve. The SoR is focused on the functional needs of public safety First Responders to communicate and share information when it is needed, where it is needed, and in a mode or form that allows the practitioners to effectively use it. This includes voice, data, image, video, or multimedia communications.
http://www.safecomprogram.gov/files/PSCI_Statement_of_Requirements_v1_0.pdf

The emphasis of the SoR is on functional requirements; a conscious effort is made to avoid specifying not only technologies but business models as well. The SoR strives to enhance interoperability by delineating the critical operational functions and interfaces within public safety communications that would benefit from research and development investment and standardization. The SoR can assist public safety practitioners in developing a comprehensive vision for public safety communications and as such is used as a reference in this report.

In December 2003, the SAFECOM and the AGILE program within DOJ issued a joint report in which they established a series of initiatives and goals extending over the next 20 years. The report concludes that a continuous and participatory effort is required to improve public safety communications and interoperability. In June 2003, SAFECOM partnered with the National Institute of Standards and Technology (NIST) and the National Institute of Justice (NIJ) to hold a summit that brought together over 60 entities involved with communications interoperability

policy setting or programs. According to NIST, the summit familiarized key interoperability players with work being done by others and provided insight into where additional federal resources may be needed.

The Directorate of Science and Technology (S&T) within DHS has been tasked to lead the planning and implementation of the OIC. The new office is responsible for coordinating DHS efforts to address interoperability and compatibility of first responder equipment, to include both communications equipment and equipment such as personal protective equipment used by police and fire from multiple jurisdictions.

- **Public Safety Wireless Network (PSWN) Program.** Now part of SAFECOM, the PSWN program developed the Public Safety WINS: Wireless Interoperability National Strategy to serve as a framework for improving interoperability among public safety wireless networks. It focused on solutions to both the technical and policy issues critical to improving interoperability. http://www.safecomprogram.gov/index.cfm

2.1.1.1.2 National Incident Management System (NIMS). On February 28, 2003, the President issued Homeland Security Presidential Directive (HSPD)-5, Management of Domestic Incidents, which calls for the Director of Homeland Security to develop and manage a NIMS. NIMS serves as the Nation's first standardized management approach that unifies Federal, State, and local lines of government for incident response. NIMS establishes standardized incident management processes, protocols, and procedures that all responders – Federal, State, tribal, and local – will use to coordinate and conduct response actions. Standardized procedures allow a full emphasis on incident management when an incident occurs and preparedness and readiness in responding to and recovering from an incident is enhanced by using a common language and set of procedures. The conceptual model developed by NIMS was initially introduced in the report, "National Incident Management System" in March of 2004, this document serves as a reference to this report and a guideline in its recommendations.
http://www.fema.gov/nims/ **Figure 2-1** below illustrates the NIMS System and its relationship with the National Response Plan (NRP).

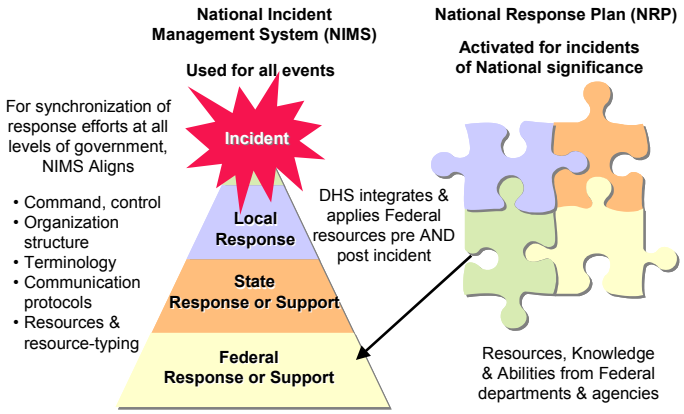


Figure 2-1. NIMS System and its relationship with the National Response Plan

2.1.1.1.3 Joint Regional Information Exchange System (JRIES)/ Homeland Security Information Network (HSIN). The JRIES is the secure collaborative system used by the DHS Operations Center to collect and disseminate information to Federal, State, Local, and Tribal agencies. JRIES:

- Supports information exchange and real time collaboration between Federal, State, Local, and Tribal authorities
- Includes information analysis tools and capabilities to support distributed collaborative analysis and reporting across Federal, State, Local, and Tribal law enforcement and intelligence
- Meets all applicable security requirements and is accredited by the Intelligence Community

As part of its Homeland Security Information Network initiative, DHS is expanding its computer-based counterterrorism communications network to all 50 states, five territories, Washington, D.C., and 50 other major urban areas to strengthen its two-way flow of threat information. The Homeland Security Information Network will deliver real-time interactive connectivity among state and local partners and with the DHS Homeland Security Operations Center (HSOC) through the JRIES. Other DHS agencies participate through seats at the HSOC and their own operations centers. This increased connectivity will result in more effective communications and more efficient responses to deter, detect, prevent, or respond to terrorist actions. Objectives of this expanded information exchange system include:

- Focusing more power on combating terrorism, capitalizing on thousands of capable, motivated state and municipal police
- Leveraging federal, state, local, urban, and rural anti-terrorism intelligence assets
- Performing secure, real-time collaboration and information sharing

The HSIN initiative is a computer-based counterterrorism communications network designed to strengthen the two-way flow of threat information. The HSIN communications system delivers real-time interactive connectivity among State and local partners and with the DHS Homeland Security Operations Center through the JRIES. JRIES, as the core system within HSIN, is a secure network and composed of a suite of applications currently operating at the sensitive but unclassified level. The prevention of terrorist attacks is the primary mission of the expanded JRIES network, and it may also be used as a collaboration, planning, and communications tool for facilitating the general homeland security mission across all jurisdictions nation-wide. JRIES also serves as a means for supporting crisis management and recovery operations after a terrorist attack, as well as during and after a natural disaster.

As a Homeland Security program focused on monitoring, preventing, and responding to potential terrorist threats, this expanded JRIES network will also share information with other communications tools used by law enforcement and other communities. The Homeland Security Information Network will post its daily reports and warnings directly to RISS.Net via a JRIES interface. Combining JRIES' real-time collaboration capability and state-of-the-art portal technology with RISS.Net's legacy databases will enhance the capabilities of Homeland Security

law enforcement partners. Priority capabilities of this expanded information exchange system will include:

Communications

- Low-cost, always-on connectivity
- End-to-end encrypted communications

Collaboration / Analysis

- Secure e-mail
- Interactive collaboration tool (real time text or voice)
- Supports requests for information, exchange, and cross-reference
- Search and Link/Timeline analysis, map/imagery displays

Information

- Daily, periodic, and ongoing report sharing
- Suspicious incident/pre-incident indicator data
- Media studies and analysis
- Mapping and imaging (national, state, county, city)
- Critical Infrastructure Protection (CIP) repository
- Strategic analysis of terrorist threats, tactics and weapons

2.1.1.1.4 Office of Interoperability and Compatibility (OIC): Announced the October 1, 2004, was the DHS launch of the OIC, along with the release of tools designed to help state and local public safety practitioners improve communications interoperability. OIC is part of the Science & Technology directorate. It is tasked to oversee public safety interoperability programs and efforts currently spread across Homeland Security. These programs address critical interoperability issues relating to public safety and emergency response, including communications, equipment, training, and other areas as needs are identified.

The OIC is intended to ensure that Homeland Security is exercising its leadership role to bring local, state, and federal efforts together in a partnership. Specific responsibilities for the OIC include:

- Supporting the creation of interoperability standards;
- Establishing a comprehensive research, development, testing, and evaluation (RDT&E) program for improving public safety interoperability;
- Identifying and certifying all DHS programs that touch on interoperability;
- Integrating coordinated grant guidance across all DHS grant making agencies that touch on public safety interoperability;
- Overseeing the development and implementation of technical assistance for public safety interoperability;
- Conducting pilot demonstrations;
- Creating an interagency interoperability coordination council;
- Coordinating and working closely with the new NIMS Integration Center.

2.1.1.1.5 Urban Area Security Initiative (UASI): The UASI is not specifically related to public safety communications and interoperability programs, but they may benefit from the funding. DHS awarded the State of Maryland three grants totaling more than $58 million for first responders, mass transit, and increasing the preparedness of the City of Baltimore and its surrounding

jurisdictions. The grant for mass transit totals more than $1.8 million and may be used to install physical barriers, area monitoring systems such as video surveillance, motion detectors, thermal; and infrared imagery and chemical/radiological material detection systems, lighting, integrated communications systems as well as prevention, planning training and exercises. The Maryland Transit Administration is required to conduct an assessment and preparedness plan.

The funds, which are allocated through three programs will be used for training, equipment, exercises and planning to help first responders better secure and protect their communities. More than $31.3 million has been allocated for the State Homeland Security Program, which benefits first responders; more than $9.2 million for the Law Enforcement Terrorism Prevention Program; and approximately $654,000 for the Citizen Corps Program.

Under the Urban Area Security Initiative, Baltimore City and its surrounding jurisdictions will receive more than $15.8 million. The funds were provided to assist those jurisdictions in developing a regional approach to preparedness through mutual aid agreements, interoperable communications, statewide intelligence centers, and community and citizen participation. The Urban Area Security Initiative for the National Capital Region, which also includes several Maryland jurisdictions, will receive more than $29 million.

2.1.1.2 Department of Justice (DOJ). The Department of Justice and its 6 component agencies are significant users of wireless communications and have actively been pursuing a solution to facilitate nationwide interoperable communications to support their missions.

2.1.1.2.1 Integrated Wireless Network (IWN). DOJ, Treasury, and DHS are working together to implement the Integrated Wireless Network (IWN). The vision for the IWN is to "Provide secure consolidated nation-wide seamless, interoperable and reliable wireless communications in support of the federal Agents and Officers engaged in the conduct of the law enforcement, protective services, homeland defense, and disaster response missions of the Departments of Homeland Security, Justice and Treasury."

The IWN is designed to replace bureau legacy land mobile radio (LMR) systems with a single integrated trunked network. The IWN 'As Is' Architecture:

- The P25trunkedsystem provides features that address mission requirements and enhance operations, including
  - **Standards-based technology** that supports improved **interoperability at federal, state, and local levels**
  - Intra-system and inter-system roaming that requires little or no user interventions
- To ensure communications security, the IWN will employ **Advanced Encryption Standard (AES) encryption** and **over-the-air rekeying (OTAR)**
- To capitalize on existing equipment and frequency resources, the IWN will operate in the federal **VHF band** in **multicast** and **simulcast** configurations
- The P25trunkedsystem provides distinct advantages
  - Segregation of communications by talk groups and encryption keys
  - Greater channel efficiency

  - More user friendly to field operators
  - Scalable for future upgrades and expansion
- Consolidating multiple legacy networks would enhance operational effectiveness through increased cumulative coverage and capabilities
- Reducing the number of sites from legacy standalone systems will reduce the number of site leases and circuits, infrastructure maintenance, and overall costs
- IWN provides a single gateway for interoperability among other federal, state, and local law enforcement agencies
- Centralized program management, implementation strategies, and consolidated acquisition activities will continue to provide more efficient and consistent implementations
- IWN provides greater spectral efficiency through narrowband and the application of trunked technology

The IWN is being pilot tested in the Blaine/Seattle area.

Other key Justice programs include:

2.1.1.2.2 CommTech. The National Institute of Justice's CommTech Program has a mission to assist State and local law enforcement agencies to effectively and efficiently communicate with one another across agency and jurisdictional boundaries. It is dedicated to studying interoperability options and making valuable information available to law enforcement, firefighters, and emergency technicians in different jurisdictions in communities across the country. Through CommTech, NIJ hopes to solve both short- and long-term interoperability problems involving wireless public safety telecommunications and information technology applications. CommTech is helping bridge the gap in emergency communication by identifying, adopting, and developing interoperability solutions that include open architecture standards for voice, data, image, and video communication systems. These solutions will allow multiple parties to exchange information on the spot—no matter where that "spot" is. It will let users exchange information among fixed facilities, mobile platforms, and even personal devices. CommTech also researches new technology solutions when existing technologies used in an emergency response fall short, and aims to raise the awareness of interoperability issues through various outreach programs so that policymakers and public safety leaders can make informed and cost-effective decisions. CommTech consolidates efforts addressing interoperability issues within the NIJ and was designed to avoid work that may duplicate SAFECOM's but will serve as a reference to SAFECOM for policy, coordination, and technology development activities. The CommTech Standards Project will focus on providing interoperability and information sharing among heterogeneous public safety wireless (radio) and information technology (IT) systems. The project will identify a suite of relevant standards developed by standards development organizations (like the Telecommunications Industry Association (TIA), the Institute of Electrical and Electronics Engineers (IEEE), etc.) and adopt them as NIJ interoperability standards.

- **Advanced Generation of Interoperability for Law Enforcement (AGILE)** Now part of CommTech. AGILE was the Department of Justice program to assist state and local law enforcement agencies to effectively and efficiently communicate with one another across

agency and jurisdictional boundaries. It is dedicated to studying interoperability options and advising state and local law enforcement agencies.

2.1.1.2.3 National Task Force on Interoperability (NTFI). The NTFI was composed of 18 national associations representing State and local elected and appointed officials and public safety officials. NTFI developed a guide for public officials to raise awareness about the importance of interoperability, to provide the basic information that is necessary to understand the impact of this issue on their constituencies, and to provide guidance about the initial steps to take in developing interoperable public safety radio communication systems. One of these guides "Why Can't We Talk – Working Together to Bridge the Communications Gap to Save Lives" serves as a starting point for those dealing with the issue of interoperability and serves as a reference for this report. http://www.agileprogram.org/ntfi/ntfi_guide.pdf

2.1.1.2.4 National Institute of Standards and Technology (NIST). The NIST, Electronics and Electrical Engineering Laboratory, Office of Law Enforcement Standards (OLES) supports the NIJ CommTech program. The OLES Public Safety Communications Standards program is developing standards for voice, data, image, and video transfers, utilizing existing standards, end user requirements, and participation in IT and wireless standards committees. The program is evaluating commercial devices and services that can provide interim interoperability until standards are in place to meet the needs of public safety agencies. Working within the public safety community the program has supported the development of the XML Justice Data Dictionary, a "living," evolving database, currently containing over 135 reconciled data elements enabling systems to share information.

2.1.1.2.5 Interoperable Communication Technology Program. Administered by the Office of Community Oriented Policing Services (COPS). The Program provides funding to help communities develop effective interoperable communications systems for public safety and emergency services providers. Interoperable Communications Technology grants fund projects that explore uses of equipment and technologies to increase interoperability among the law enforcement, fire service, and emergency medical service communities. These projects are the result of thorough planning and demonstrate how new technologies and operating methods can help communities achieve interoperability.

http://www.cops.usdoj.gov/mime/open.pdf?Item=947

2.1.1.3 Federal Communications Commission (FCC). There are a number of actions taking place within the FCC related to interoperability and the radio systems used in Maryland. Most of these actions affect the use and availability of frequencies for use in public safety wireless communications systems. Each of the actions will have varying but significant impacts on the future of communications in Maryland and are discussed where appropriate in the remainder of the report. The most significant are anti-interference efforts and rebanding the 800 MHz spectrum to move Nextel; 700 MHz spectrum; and Narrowbanding initiatives.

The National Governors' Guide to Emergency Management noted that extensive coordination will be required between the FCC and the NTIA to provide adequate spectrum and to enhance shared local, state, and federal communications. However, the current legal framework for domestic spectrum management is divided between the NTIA within the Department of

Commerce, responsible for federal government spectrum use and the FCC, responsible for state, local, and other nonfederal spectrum use. In a September 2002 report on spectrum management and coordination, the GAO found that FCC and NTIA's efforts to manage their respective areas of responsibility are not guided by a national spectrum strategy. The FCC and the NTIA have conducted independent spectrum planning efforts and have recently taken steps to improve coordination, but have not yet implemented long-standing congressional directives to conduct joint, national spectrum planning.

The Department of Commerce said it had issued two spectrum policy reports on June 24, 2004, in response to the President's initiative, entitled *Spectrum Policy for the 21st Century*. The Department said the second report recommends an interagency effort to study the spectrum use and needs of the public safety community, a public safety demonstration program, and a comprehensive plan to address the spectrum shortage, interference, technology, and security issues of the public safety community. The Department also said that the DHS would be an integral partner in fulfilling its recommendations. A detailed synopsis of the significant actions and issues involving the FCC is given in **Appendix C**.

2.1.2 Other Programs

In addition to the many federal agencies and programs and organizations involved with shaping first responder interoperable communication policies, a range of public safety associations play a significant role in defining the problems and solutions to emergency communications interoperability:

2.1.2.1 US Conference of Mayors. The United States Conference of Mayors is an official organization of cities with populations of 30,000 or more each represented by its chief elected official, the Mayor. Following September 11, 2001, the Conference held a summit meeting regarding homeland security. The summit resulted in the drafting of a "National Action Plan for Safety and Security in America's Cities." One major issue identified in this plan concerned communications technology with a recommendation that communications interoperability must exist to ensure clear communications between first responders from various governmental levels during a disaster.
http://www.usmayors.org/uscm/news/press_releases/documents/securityactionplan_1025201.pdf

The Conference serves on the Executive Committee of SAFECOM. To "better understand and advocate for the needs of cities and first responders," they commissioned a survey on the issue of interoperability. The resulting survey provides a national baseline of interoperability in 192 cities that included Baltimore and Bowie, Maryland. This report serves as an additional reference in this report.
http://www.usmayors.org/72ndAnnualMeeting/interoperabilityreport_062804.pdf

The National League of Cities asked Congress to create a permanent public interest trust fund that would support grants to promote state and local interoperability among first responders. The interoperability trust fund would be built with proceeds from the auction of spectrum licenses to public airways. Joining the league in its request were the National Association of Counties and the U.S. Conference of Mayors. The recommendation is part of an urgent appeal

by 18 national associations to get Congress and the Bush administration to take swift action to improve public safety communications in the homeland security atmosphere.

2.1.2.2 National Governor's Association (NGA). The nation's Governors have a critical role to play in emergency management. As the state's chief executive, the Governor is responsible for the public safety and welfare of the people of his or her state or territory. During a declared emergency, a Governor has extraordinary powers to suspend authority, seize personal property, direct evacuations, and authorize emergency funds. The Governor also plays a key role in communicating with the public, requesting federal disaster assistance, and helping people and businesses cope with disasters.

In 2002, the National Governors Association released a report that recommended governors and their state homeland security directors:

- Develop a statewide vision for interoperable communications
- Ensure adequate wireless spectrum to accommodate all users
- Invest in new communications infrastructure
- Develop standards for technology and equipment
- Partner with government and private industry

2.1.2.3 National Association of Counties (NACo): The National Association of Counties (NACo) is an association of the nation's 3066 counties and seeks to ensure county officials' voices are heard and understood in the White House and the halls of Congress. NACo has four representatives on the National Task Force on Interoperability. NACo wants to raise awareness by showing counties the benefits of technology. Technology can help them provide those services that they don't have funding to hire a physical staff person for.
http://www.naco.org/

The issue of interoperability for first responders is important to NACo, and it is actively pursuing grant funding in this area. NACo has also invested substantial time and effort to ensure that as a group county officials' voices are heard and understood on this issue. This commitment is reflected in having several participating members of the U.S. Department of Justice's National Task Force on Interoperability. NACo is also represented on the SAFECOM Executive Committee.

The Government Open Application Sharing (GOAS) platform: NACo is developing a technology sharing initiative where all counties will have access to a portal for sharing technology-oriented information. County governments have the opportunity to tie into that network, access information and implement potential programs. GOAS is designed to let counties share a range of policy and technical resources. Member counties can use the portal to exchange business process maps, total cost of ownership reports, XML frameworks, application blueprints and application code. Sharing knowledge through the portal will help counties cut the cost of developing technology solutions and reduce deployment time, according to the association. The project is a partnership between NACo, HP, and Microsoft Corp.

In November 2003, the Honorable Marilyn Praisner Council Member, Montgomery County, Maryland provided testimony on behalf of NACo before the Subcommittees on National Security, Emerging Threats and International Relations and Technology, Information Policy, Intergovernmental Relations and the Census of the Government Reform Committee United States House of Representatives on November 6, 2003. Text of her testimony is available at: http://www.telecommunityalliance.org/testimony/interferencetestimony03.html

2.1.2.4 Communications for Coordinated Assistance and Response to Emergencies (ComCARE).

The ComCARE Alliance is a broad-based not-for-profit national coalition of more than 95 organizations representing nurses, physicians, emergency medical technicians, 9-1-1 directors, emergency managers, transportation officials, wireless, technology and transportation companies, public safety and health officials, law enforcement groups, automotive companies, consumer organizations, telematics suppliers, safety groups, and others. ComCARE is working to encourage the development and deployment of life saving communications technologies that will enhance America's emergency response capabilities. ComCARE's goal is to promote an integrated, coordinated approach to emergency communications and support the development of a comprehensive "end-to-end system" to link the public to emergency agencies, and to link those agencies together.
http://www.comcare.org/about/overview.html

2.1.3 Other States

Many states are actively engaged in addressing the requirements of improved public safety communications and interoperability. The primary drivers behind this are aging systems and equipment, lack of funding to continue supporting multiple networks, and a real need to achieve closer cooperation and coordination between local, county, and state public safety providers as well as closer coordination between different public safety functional agencies. The anticipated availability of 700 MHz spectrum for public safety is a factor that may allow many states to realize their visions for statewide integrated public safety wireless networks.

Many of Maryland's neighboring states have implemented, or are in the process of implementing statewide public safety communications systems that facilitate interoperability. Following are descriptions of some of these. Mature states are those that have obtained interoperability within their region through the development of statewide systems and are actively seeking ways to enhance or improve their systems' capability and include additional participants. Mature states include Delaware and Michigan.

Established states are advanced in the interoperability process. Many of these are in the process of implementing interoperable shared systems and have formalized sharing agreements with multiple levels of government. These states include Colorado, Florida, Iowa, Louisiana, Massachusetts, Minnesota, New York, North Dakota, Utah and Wisconsin.

Developing states are in the early phases of using their knowledge of interoperability by engaging legislators and public safety engineers and formulating strategic plans for system design and engineering. Most states are classified in this category including, Alaska, Arizona,

Arkansas, California, Connecticut, Georgia, Illinois, Indiana, Kansas, Maine, Maryland, Missouri, Nebraska, Nevada, New Hampshire, New Mexico, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, South Carolina, South Dakota, Texas, Vermont, Virginia and Wyoming. States that are relatively new to the interoperability process and are in the process of researching the six key interoperability areas are classified as new.

New states include Alabama, Hawaii, Idaho, Kentucky, Mississippi, Montana, New Jersey, Rhode Island, Tennessee, Washington, West Virginia and the District of Columbia.

2.1.3.1 District of Columbia

The District of Columbia public safety Wireless Networks Program is a 3-phase initiative, launched in April 2002. In Phase 1 (April 2002-September 2003), the District of Columbia Office of the Chief Technology Officer (OCTO) undertook a comprehensive upgrade and expansion of the District's wireless public safety infrastructure from 4 sites to 10, and from a conventional analog police network to a trunked digital network, to provide reliability and interoperability lacking in the previous system. In Phase 2 (September 2003- March 2004), OCTO completed the solution to the coverage gaps in the pre-existing wireless network by establishing, for the first time, public safety radio coverage in underground subway tunnels and integrating the new underground infrastructure with the above-ground network. In Phase 3 (January 2003-September 2005), OCTO obtained an experimental license from the FCC to deploy, on a pilot basis, the nation's first citywide broadband public safety wireless network.

The upgrade project filled all above-ground public safety radio coverage gaps in the city and integrated the city's 800 MHz and 460 MHz radio systems to establish interoperability among the city's various first responder agencies. Equally important, the project laid the foundation for broad regional interoperability between District first responders and over 35 local, state, and federal agencies. Phase 1 also added full alarm monitoring capability to the network to provide first responders immediate notification of problems. The project enhanced audio clarity by migrating the police force to digital communications, increased efficiency by expanding the number of public safety talk channels, and strengthened communications security by providing encryption capabilities for the police fleet. Finally, Phase 1 created a wireless network capable of supporting the broadband wireless emergency management applications that will be piloted and demonstrated in Phase 3.
http://www.nascio.org/scoring/files/Communications-DC-WirelessNetworks.doc

2.1.3.2 National Capital Region

In addition to the interoperability projects being undertaken by the District of Columbia, there are several interesting interoperability projects underway in the National Capital Region (NCR) where a plethora of Federal, State, and Local public safety agencies need to operate and interact. CapWIN is one of the most significant interoperability efforts currently underway in the NCR.

The National Capital Region will be the Home of the First DoD P25 Trunked IP Communication System, Providing Secure Base Communications and NetworkFirst Interoperability with First Responders. Deployed by the Army's DOIM (Department of Information Management) for Department of Defense (DoD) users, M/A-COM's P25IP Trunked IP Communications System, in combination with its NetworkFirst Interoperability System, will be the first deployment of its

kind in the nation's armed forces. This IP-based network solution will facilitate interoperable communications, via its NetworkFirst system with approximately 60 civilian public safety agencies located in both the National Capital Region and in suburban Maryland and Virginia. http://www.defencetalk.com/news/publish/printer_150.shtml

2.1.3.3 Virginia

The Statewide Agencies Radio System (STARS) is built on the foundation of the recognized needs for a shared statewide public safety grade radio system that facilitates law enforcement mobile data and interoperability with the localities. The current State Police LMR network will be upgraded with state-of-the-art, industry standard, TIA/EIA 102 technology (also known as APCO Project 25). The capacity of the network will be increased for a public safety grade of service. The microwave radio network's technology and capacity will be upgraded and disaster recovery alternate paths will be added.

Expenses and resources will be shared by the various participating agencies identified in Executive Order 28 for greater benefit and economy of scale. STARS will provide multi-channel trunked digital voice and data wireless communications that is specifically designed for public safety requirements. The tangible benefit of STARS is to provide essential public safety grade communications that can operate seamlessly throughout the Commonwealth for the 20 state agencies and facilitate interoperability with local governments and federal agencies. The interoperability solutions within STARS allow each locality, at the county and city level, to communicate with users independent of their technology or radio frequency band used. Direct interoperability can also be employed with compatible radios (STARS mobile and portable radios being used on a locality or federal radio network), based upon the situation and the needed on-scene command and control being available. STARS can also interconnect localities with each other if required.

Capitalizing on existing infrastructure and resources, whenever possible assists the Commonwealth in the ability to implement STARS in a cost effective manner. Finally, minimizing design risk through the use of Motorola, a proven system integrator and communications manufacturer, along with the use of a redundant, fault-tolerant, hierarchal design that allows for re-routing in case of single point failure. The wireless communications system for the Commonwealth of Virginia contains today's latest technology and will continue to provide updated technology at no additional cost throughout the STARS implementation. STARS allows the Commonwealth to retain a high level of service and security, plus flexibility to add additional users when additional radio frequencies are available. In all applicable design components, STARS has addressed safeguards to system security, including controlled system access, AES encryption, and multiple security layers.

STARS is designed around the premise that the operational needs of each participating agency can be substantially met within practical confines of system cost and radio spectrum limitations. Motorola's ASTRO 25 communication system, which integrates both voice and data, will greatly enhance the current ability for the Commonwealth's agencies to successfully communicate and experience the benefits and efficiencies of a shared wireless communication system. http://www.vsp.state.va.us/STARSContract/STARS - Executive Summary.pdf

2.1.3.4 Delaware

On October 15, 1993 the State of Delaware purchased a Statewide 800 MHz Digital Trunked Radio System to provide statewide communications for all state, county and municipal government agencies, fire and emergency medical services, and a select number of federal agencies. The system was designed to provide 95% in-street coverage using a portable radio. The State contracted with Motorola, Inc. for a digital system, which is compatible with the Association of Public Safety Communications Officials-International, Inc. - Project 25 (APCO 25) standards, such as the "common-air-interface" standard. Construction of the 18 original tower sites for the system infrastructure started in March 1996.

The system is sub-divided into three geographic regions, which corresponds to the three counties in the State, with fourteen channels in our New Castle County, and ten channels each in our Kent and Sussex Counties. The system design incorporates a digital microwave (6 & 10 GHz) infrastructure, which links the three sub-systems and the intra-county system sites together. To enhance operational capabilities the City of Wilmington's 800 MHz system was also modified to provide interoperability between the State's system and the City's system. There are three primary dispatch control points, one at each of the three 911 dispatch centers. The 911 dispatch center in Kent is connected to the system via fiber optics, versus microwave. The dispatch control consoles provide voice logging and instant playback recording and they interface with conventional radio systems in other frequency bands. In addition to these primary control points there are many other secondary console and radio frequency (RF) control stations located within other facilities such as, fire stations, police stations, and highway yards, etc.

In July 1998 the State accepted the New Castle County portion of the system. In September 1998 the Sussex portion was accepted and in October 1998 the Kent portion was accepted. Although all three phases of the project had been accepted the State's final acceptance was withheld pending resolution of coverage issues.

Motorola recommended and agreed, at no cost to the State, to upgrade portables and mobiles with newer software, lower power on mobiles to reduce the possibility of receiver desensitivity, and add four "Intellirepeater" (IR) sites containing the minimum equipment required to enhance coverage in the specific areas that did meet user expectations. These sites are connected to the system by phone lines instead of microwave. Due to a lack of available frequencies they also agreed to add one site in New Castle County using a bi-directional amplifier (BDA) connected to the system by fiber optics. The warranty period was placed on hold pending completion of these enhancements. Later, the State installed another BDA in New Castle County to further improve coverage. On June 6, 2001 the State granted final 800 MHz system acceptance and signed the Certificate of Acceptance.

Although the IR sites and BDA's improved coverage they created other operational issues. In July 2000 the State appropriated funds to resolve those issues and improve in-street coverage in the Rehoboth, Claymont and Hartly areas. The IR site in Rehoboth was converted to a full simulcast site and connected to the rest of the system by microwave. Another simulcast site was added in the Claymont area. The IR site in Hartly was connected to the rest of the system via microwave and another channel was added to reduce the potential for system busies. In

addition, an existing site in NCC was expanded to provide additional coverage in Kent County. These enhancements were operational by July 26, 2002. Final acceptance occurred on September 27, 2002.

Communications interoperability with surrounding States is now occurring. Communications between States, through mutual aid channels, has always been possible; however, by programming radios to work on each State's system our joint operations have improved significantly. The system's capabilities expand continuously...the number of users on the system grows....the future brings more.

2.1.3.5 Pennsylvania

M/A-Com short brochure on Pennsylvania solution
http://www.networkfirst.com/resources/pdf/macomreprint0303.pdf

Pennsylvania Acquisition Strategies for Telecommunications Services, Systems, and Infrastructure - Network Design and Interoperability Working Group
http://ltl13.exp.sis.pitt.edu/Website/Webresume/TelecomAcquisitionProceedings/Design.htm

Commonwealth of Pennsylvania Office of Information Technology Statewide Public Safety Radio System Project Review, Consulting Services Final Report August 31, 2004
http://www.radio.state.pa.us/radioproject/lib/radioproject/ixp_final.pdf

In 1996, the Commonwealth of Pennsylvania launched a multiyear project to modernize and integrate its two-way radio systems. The Commonwealth recognized that the existing, largely incompatible, systems limited communication among agencies and squandered opportunities for cost savings. The new radio system is an advanced wireless communications network for both voice and data. It comprises a statewide web of radio towers and smaller cell sites tied together with T1 fiber optics and microwave relays. Regional and master operations centers provide network monitoring and control. A digital voice gateway connects older radio systems with the new system, easing migration.

Making the system available to local governments as well as state agencies leverages the investment by providing a framework for shared communication among emergency service agencies across the state. An additional benefit is shared costs across a large pool of users for the system's state-of-the-art digital services.

OpenSky's IP-based communications network quickly, economically and effectively links 23 agencies and 7 Regional Operating Centers within the Commonwealth of Pennsylvania.

- Connects existing radio networks to the state's wide-area packet-switched network
- Enables unparalleled levels of interoperability among all the state's agencies, commissions and partners
- Provides a wide-area backbone that can be expanded to local and federal agencies by simply changing a policy decision
- Created the largest and only truly interoperable multi-agency statewide network in the nation
- Expanded from 25,000 to 150,000+ users

2.2 MARYLAND ENVIRONMENT

To ascertain the status of current technology and the present degree of interoperability within the State of Maryland, the IPT developed a Users Needs Survey, which was distributed beginning in May of 2004. Utilizing various methods, including fax, e-mail, and U.S. Post, the surveys were distributed to approximately 200 State and local agencies. The IPT worked closely with various organizations and groups to ensure a wide geographic distribution throughout the State and input from all political tiers.

The surveys were collected through July 2004. Each agency responding to the initial survey was sent a follow-up survey with the specific goal of determining the degree to which respondents were utilizing existing mutual aid frequencies in the various public safety communications bands. The total number of surveys collected is shown in **Table 2-1**.

Table 2-1. Survey Response Rate Statistics

	Number of Responses				
	Sent	Received	Response Rate	Follow-up	Response Rate
Municipalities	160	28	16%	8	32%
Counties*	24	24	100%	18	75%
State Agencies	30	11	37%	2	18%
Total	**213**	**60**	**28%**	**28**	**47%**

** Including Baltimore City*

The overall response rate was approximately 28%. One county provided two separate responses, one for each of the two radio systems it operated, causing the anomaly of the received responses being more than the sent surveys. The follow-up survey saw a return rate of approximately 47%. The response was significant enough to display trends for each geopolitical subdivision and it is the consensus of the IPT that additional surveys would not alter but follow the trend of the data already provided.

The complete details of the survey are provided in **Appendix A** with a synopsis as it relates to each technical subsystem provided here:

2.2.1 Radio Systems

2.2.1.1 Radio Systems Have Public Safety Orientation. The majority of the public safety communications occurring in Maryland involves voice communications over wireless radio systems. This is typical of both the national and local environment, and as a result the majority of the questions in the user needs survey involve land mobile radio and other wireless voice systems. As verification of the public safety nature of the survey responses, Section 2 survey results show that the respondents' top six uses for their radio systems involve public safety and infrastructure support functions. These uses ranked as shown in **Figure 2-2**.

1. Law Enforcement
2. Fire
3. EMS
4. Emergency Management
5. Public Works
6. HAZMAT.

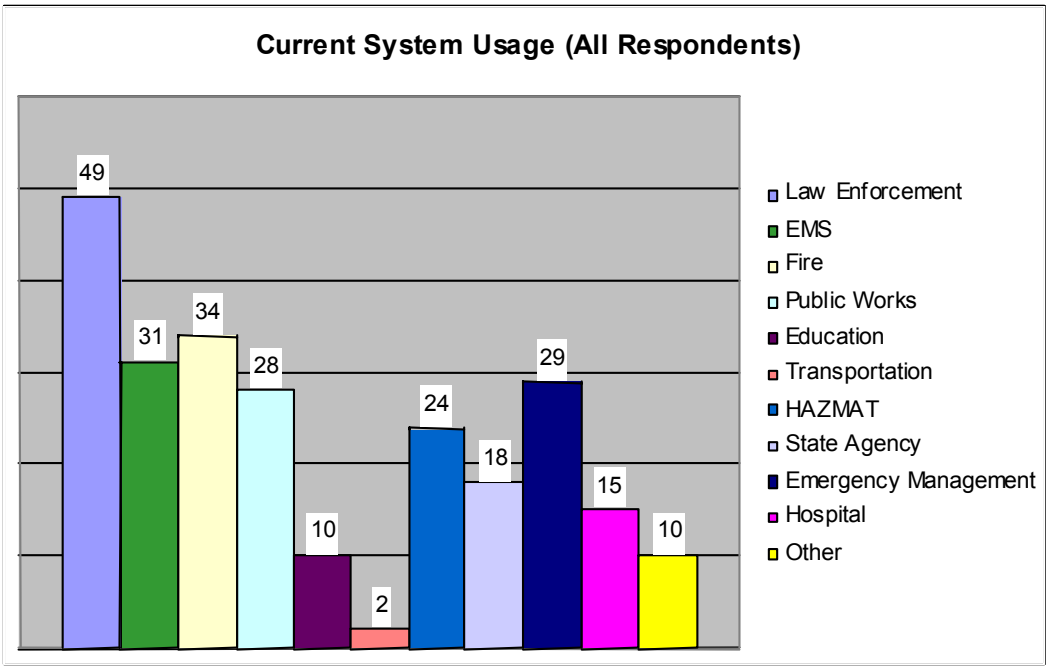


Figure 2-2. Current System Usage Distribution (All Respondents)

Section 3 of the survey allowed the IPT to determine the current level of public safety interoperability the responding agency enjoys and to characterize the technologies and methods utilized for interoperability purposes. This section included evaluations of interoperability by type of communication and targeted agency, finishing with a ranking of barriers to interoperability.

Asked directly if they have communications interoperability 23% of the respondents answered negatively. ***Therefore nearly a quarter of all respondents seek even a basic level of interoperability not possible today.*** Closer evaluations show that this shortcoming affects municipalities most frequently with approximately one in two lacking interoperability while counties and state agencies have significantly greater interoperability. ***Detailing the target of the interoperability, all geopolitical subdivisions indicated public safety and cross-jurisdictional communications as the top five needs.***

Section 3, Question 3b and 3c asks for a characterization of each respondent's interoperability with the various geopolitical tiers (i.e. state, county, local) and provides three key findings:

1. Any respondent is more likely to have interoperability with an agency within the same tier and the more removed an agency is from a particular tier the less likely interoperability exists. Thus neighboring municipalities are more likely to have

interoperability amongst themselves and much less likely to have any interoperability at the state or federal level.

2. Counties, as the central geopolitical tier, have the greatest degree of interoperability and tend to serve as primary facilitators of interoperability within their respective geographies. This is reinforced by the responses to questions 3g and 3h, which show that 88% of respondents have mutual aid agreements the majority of which involve the counties.
3. Regardless of geopolitical tier, agencies are more confident of interoperability for day-to-day communications and become less confident as the scope increases to task force and mutual aid levels reinforcing the discussions found in Section 1.2 concerning incident scale and preparedness.

2.2.1.2 Maryland Exhibits Significant Radio Spectrum Diversity. Questions 3d and 3e were designed to detail the radio spectrum usage throughout Maryland and the follow-up survey specifically targets the various mutual-aid frequencies typically available to public safety agencies. Results from these survey components reveal that survey respondents throughout Maryland are nearly evenly distributed across the various public safety bands with no dominant band evident and no common band available. When considering the counties that form the foundation of most existing interoperability solutions, the survey reveals the distribution illustrated in **Figure 2-3**.

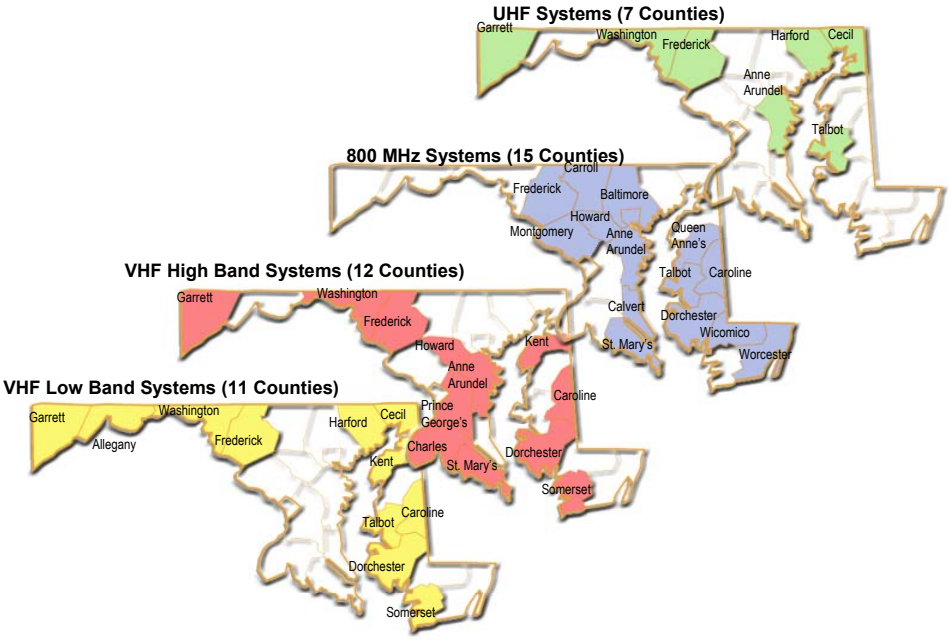


Figure 2-3. Frequency Band Distribution

(For this analysis, Baltimore City was considered as a County)

Further analysis of the follow-up survey also shows a lack of usage of the dedicated mutual aid frequencies in each of the respective public safety bands.

2.2.1.3 Radio Systems Can Take Secondary Interoperability Role. Question 3i results provide a detailed distribution of the technologies used between agencies for interoperability and are

shown in **Figure 2-4**. Somewhat surprisingly, use of landline and cellular telephones far outpaced radio mutual aid channels. This highlights a lack of mutual-aid channel usage as well as a dependency on commercial services whose availability and reliability can be affected depending upon the incident. This is confirmed in responses to Question 5a where cellular telephones are as common as mobile radios and nearly as common as handheld units.

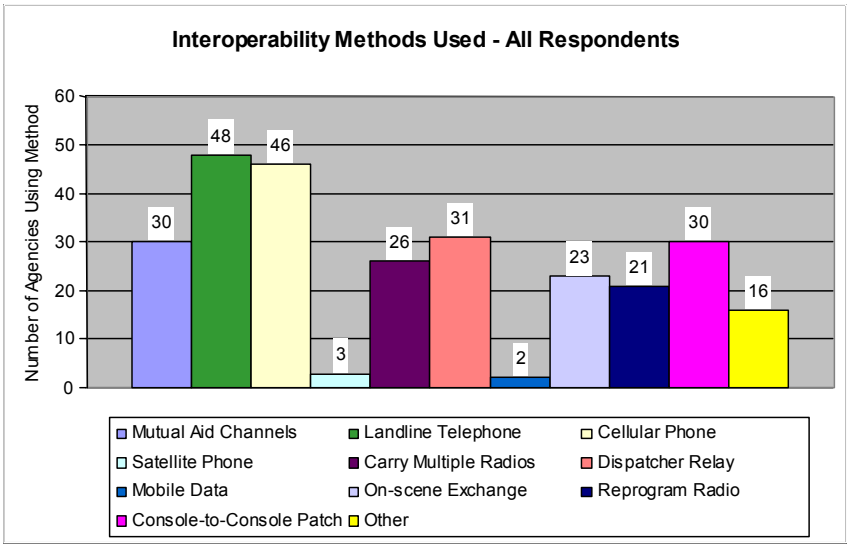


Figure 2-4. Interoperability Technologies Used (All Respondents)

During an incident, any first responder requires a communications system that is both available (a channel for communications exists) and reliable (the communications channel provides clear and comprehendible information exchange). Numerous survey responses indicate a need for additional coverage or channels for voice radio systems and the above results indicate the first responders may be overly relying on commercial systems when the radio system cannot support the required traffic. This is confirmed with the results and responses to Question 5b-9, which shows 63% of respondents perceive significant limitations within their system.

2.2.1.4 Interoperability Solutions Being Sought. Responses to question 3k indicate that 33% of all respondents are already testing interoperability solutions in some form. Short-term basic interoperability solutions have been implemented as evidenced by a 65% sharing ratio among survey respondents (Question 3j). The various forms of radio system sharing used by respondents are methods of obtaining interoperability as indicated in the SAFECOM *Interoperability Continuum* (see Section 1, Figure 1-2) and will be discussed further in Section 4. The results also indicate that the sharing usually involves a county system again reinforcing the county's interoperability facilitation role. This combined with the various efforts discussed in Section 3 show a continued drive to improve interoperability.

2.2.1.5 Existing Technical Diversity is Significant. The responses to Section 5, part b demonstrate the wide diversity of radio systems found in Maryland. Specifically questioned about their voice systems, respondents demonstrated the significant spectral diversity discussed in Section 2.2.1.2 as well as technical diversity in terms of the radio system modes (i.e. analog vs. digital, conventional vs. trunked).

2.2.1.6 Existing Radio Systems Have Technical Limitations. Section 5, Part b also shows a majority of systems under agency ownership. These owned systems are also large in terms of number of users requiring continued use of these systems until investments are recovered. The age of most systems within the state is under ten years old, but state agency systems are significantly older and have exceeded manufacturer life-cycle recommendations. Older systems are not able to offer the advanced features and increased reliability found in newer systems. Understandably, nearly one third of all respondents indicated future plans to add additional sites for increased coverage (improving availability and reliability) and one half of the respondents are looking to add additional features to their voice subsystems.

Additionally, many respondents commented on a lack of available channels or frequencies limiting the effectiveness or range of their radio system.

2.2.1.7 Barriers to Interoperability. Survey results indicate that after funding, technology differences are ranked as some of the most significant barriers to interoperability (refer to **Figure 2-5**). The survey clearly shows funding limitations as the primary barrier to interoperability. ***Combining these funding limitations with the large degree of technical diversity requires that any short-term solution utilizing the existing equipment must incorporate a cross-band or audio level patching technology.*** Building or migrating to a more homogenous statewide system is constrained to being a long-term solution due to these funding limitations and the lack of available spectrum mentioned by many respondents.

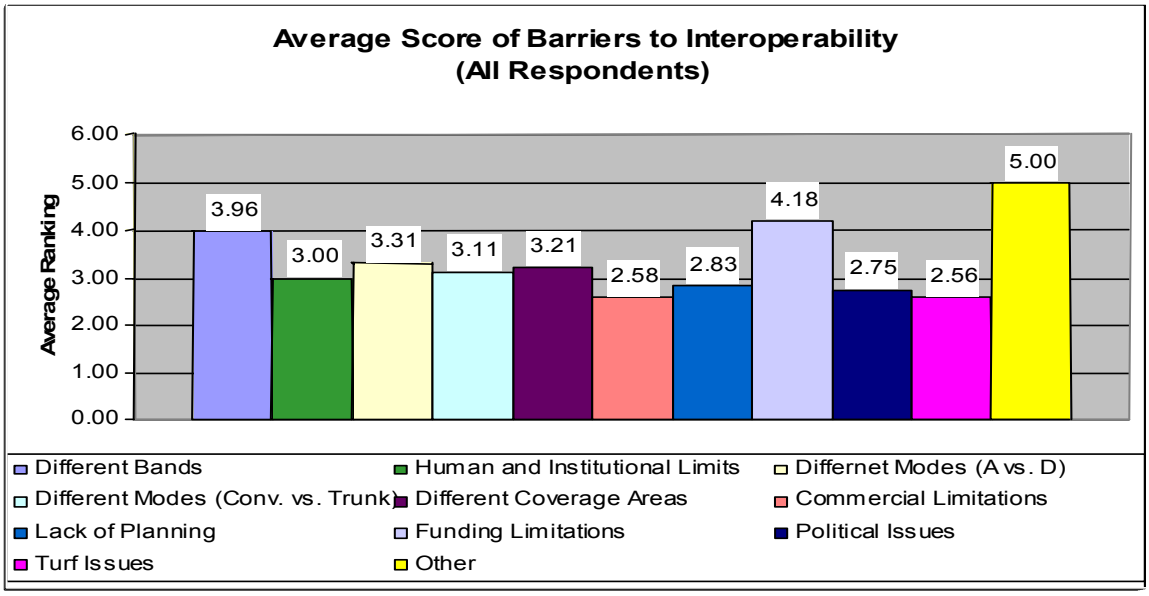


Figure 2-5. Ranking of Barriers to Interoperability (All Respondents)

2.2.2 Backbone and Infrastructure Systems

Maryland has already invested in developing a statewide infrastructure system involving microwave towers under the Statewide Wireless Infrastructure Project as well as a fiber infrastructure under the Net Work Maryland Project. These projects are described in detail in

Section 3. These systems have been used in various radio systems for backbone support or as locations for antenna sites. However, the availability of both bandwidth between and tower space at these system locations cannot be guaranteed. ***It is expected that these systems, if expanded to provide statewide public safety interoperability functionality, will require additional funding, engineering construction and maintenance.***

2.2.3 Data and Incident Management Systems

When examining the use of data systems, survey results indicate just over 25% of respondents operate a data system, and of those, half are based on a commercial system offering. Survey comments imply that these systems provide limited bandwidth; this coupled with information incompatibilities reduces the potential benefits of this technology to the first responders.

Respondents indicate that these systems are primarily agency owned and relatively young (less than five years old). Most of these systems are relatively small with only half the agencies indicating systems with greater than 50 users.

Commenting on the barriers to implementing this technology, agencies rank cost again as the most significant barrier with security and technology maturity as notable barriers as well. Overall, Maryland's use of data systems for first responders is limited. Future plans indicated by most respondents involved the addition of subscriber units to increase availability with counties just as likely to be adding sites in established systems for increased coverage, reliability and bandwidth.

2.2.4 Operational Environment

Responses to Question 3j show that approximately 65% of the respondents share a radio system; further analysis shows that the typical sharing scenario involves a municipality sharing a county system. This result would imply a certain degree of interoperability but the majority of respondents indicated they operate an independent dispatch facility. This dispatch independence isolates the sharing agency from an operational perspective and potentially limits the interoperability benefits.

Owning agencies tend to dispatch for multiple agencies or departments and therefore have additional interoperability benefits and/or capabilities. Counties tend to provide multiple dispatch positions making them a focal point for interoperability. Municipalities are involved with multiple dispatches only half the time whereas state agencies are completely independent.

When considering hours of operation, the survey shows counties are operating on full 24 X 7 support schedules with municipalities and state agencies doing so 64% and 73% of the time, respectively.

The use of Computer Aided Dispatch (CAD) is more often found in county agencies and only half as likely for municipal or state agencies. Use of CAD can provide additional features and capabilities not available in a non-equipped system and can imply additional capabilities may be present such as data systems and/or incident management systems.

Reviewing respondent's future plans for dispatching, one finds that respondents are as likely to be consolidating as expanding their dispatch facilities.

2.2.5 Concerns and Challenges (Based on Survey Results)

Overall the survey responses show the requirements for interoperability exist throughout Maryland and that in many ways agencies are attempting to address the issue. The survey analysis when distilled to its primary findings yields the following concerns or challenges.

- **Funding Limitations Exist for Most Public Safety Agencies –** The ability to provide communications interoperability is limited to the fiscal resources that can be brought to bear on the solution. This limitation is well documented nationally and not limited to Maryland.
- **Maryland Must Deal with the Existing Older Technologies –** Respondents are near or in the case of most state agencies have reached the end of the effective life cycles for their communications systems. Once these technology investments have been recovered newer systems will be required to ensure first responder effectiveness in the future. In some cases this need is immediate.
- **Public Safety Agencies Have Insufficient Radio Channels and System Coverage Limitations –** Available spectrum limits the number of channels possible in most systems and the coverage possible in some systems despite efficient frequency reuse strategies.
- **FCC Authorized Mutual Aid Channels are Under Utilized in Maryland –** Many agencies are not taking advantage of the mutual aid frequencies provided for public safety use. Funding and lack of statewide coordination of mutual aid efforts has limited their implementation.
- **Maryland Lacks a Common Statewide Public Safety Frequency Band –** Presently, Maryland public safety agencies are not and cannot be placed in a common band to ease interoperability issues.
- **Maryland Requires a Robust Statewide Infrastructure –** A statewide infrastructure is critical to supporting any interoperability effort. Although programs are in place to construct systems, which provide this capability, these programs must be evaluated and adjusted to permit the additional functionality required by the interoperability efforts.
- **Maryland Public Safety Agencies are Limited Users of Wireless Data Systems –** The use of data by first responders is limited due to system availability, security and a lack of data compatibility within the public safety community.

3.0 Active Public Safety Communications Efforts

There are many active federal, state, and local projects that address various aspects of voice and data interoperability. These projects are varied in their approach, ownership, scope, and scale and are in various stages of maturity. This Section provides an overview of some of the most relevant projects that the IPT has identified as candidates to support the 'Vision' for interoperable public safety communications. This is not an exhaustive list, but represents key projects and programs that were reviewed by the IPT during this study. Detailed descriptions and contact information for the various programs and projects discussed in this section can be found in **Appendix B**.

3.1 NATIONAL AND REGIONAL EFFORTS

Disaster preparedness, ability to effectively and efficiently respond to, and manage disaster through information sharing and collaboration are important focus areas for the Federal government. Interoperability facilitates relationships between agencies with responsibilities for detection, prevention, and response. While the technology to facilitate this communication, sharing of information and access to data is critical it is also important to identify and refine the processes and relationships required to make the exchange of information and smooth functioning of public safety processes. The NIMS (referenced in Section 2), Disaster Management Interoperability Service (DMIS) and Capital Wireless Integrated Network (CapWIN) are two programs of particular interest to Maryland to facilitate data sharing and collaboration.

3.1.1 Disaster Management Interoperability Services (DMIS)

Incident Management System (IMS) is a term used to represent the ideal system that integrates multiple technologies (e.g., cell phones, personal digital assistants, radios, etc.) combined with policies and procedures to support the most efficient response to a given incident. This gained efficiency allows responders to:

- Gain Early Awareness
- Better Coordinate Response Among Organizations
- Save More Lives
- Minimize Property Damage.

The development of an integrated IMS is among the top priorities articulated by the State and local incident response community. The fundamental objective is optimizing emergency management operations by the use of technology tools that augment and enhance the deployment of emergency response assets.[3]

[3] *The Maryland Mapping Resource Guide (MMRG) Web site, Frequently Asked Questions,* (http://www.marylandgis.net/faq.jsp)

The Disaster Management Interoperability Services (DMIS), developed by FEMA, is designed to act as a communications service providing standard information exchange of IMS related information.

DMIS is an open architecture, object-oriented, and distributed computing technology to achieve interoperability among resources for comprehensive emergency management throughout the United States. DMIS is designed as a service, not a system aimed at bringing interoperability to all levels of the emergency management community – local (municipal), county, regional, State, and Federal – along with volunteer organizations active in disasters (VOAD). Stakeholders will have the means to comprehensively share information and access resources.

DMIS provides its services via the DMIS Interoperability Backbone. The DMIS Interoperability Backbone is a web service that provides responders with communication tools that allow them to share information with other responder organizations. Responder groups receive and transmit information over the web, enabling them to rapidly develop and exchange incident information with other responder organizations. This capability of sharing incident information gives all responders greater knowledge of a particular disaster event by leveraging technology to gain efficiency.

Interoperability Benefits

DMI-Services provide for the following:

- Improved disaster response by enabling responders to share information seamlessly between organizations.
- New software tools at no cost to responder organizations for increased disaster response effectiveness.
- Provides information standards and interfaces for the development of additional capabilities.

Table 3-1 illustrates how DMI-Services -- or DMIS -- meets the public safety communications and interoperability challenges faced by the State.

Table 3-1. How DMIS Meets Maryland's Public Safety Interoperability Challenges

Challenges	DMIS Meeting the Challenge
1- Funding Limitations	Provides for the research & development of standards and tools at no cost to the State.
2- Existing older technologies	No direct impact.
3- Insufficient Radio Channels & System Coverage Limitations	No direct impact.
4- FCC Authorized Mutual Aid Channels are Under Utilized	No direct impact.
5- Lack of a Common Statewide Public Safety Frequency Band	No direct impact.
6- Need for a Robust Statewide Infrastructure	No direct impact.
7- Limited Use of Wireless Data Systems	Provides the foundation for the exchange of data among first responders and serves as a foundation for many of the IMS components discussed later in this report. Indirectly addresses this challenge by making incident management information more readily available at reduced costs to the State.

For more information on DMIS, see http://www.cmi-services.org/

3.1.2 Capital Wireless Integrated Network (CapWIN)

CapWIN is a state-of-the-art wireless integrated mobile data communications network being implemented to support Federal, State, and local law enforcement, transportation and public safety agencies in the Washington, D.C. Metropolitan area. It integrates transportation and public safety data communication systems in the two states and the District. CapWIN began initial operations in June 2004, and is the first multi-state transportation and public safety integrated wireless network in the United States. Designed as a model for the nation, it has already reached significant milestones toward linking first responders across jurisdictions and disciplines. CapWIN creates an IMS framework and therefore provides a "communication bridge" allowing mobile access to multiple criminal justice, transportation, and hazardous material data sources.

To address the interoperability communication problem, the NCR, Federal, State, and local officials from Maryland, the District of Columbia, and Virginia came together, with help from the Federal government, and initiated the Capital Wireless Integrated Network (CapWIN) in late 1999. The goal of CapWIN is to integrate transportation and public safety data and voice systems in these jurisdictions – creating the first multi-state, inter-jurisdictional integrated wireless network in the United States.

Figure 3-1 provides an overview of the CapWIN Architecture.

CapWIN Characteristics

- Open, scalable, and reliable Web-based architecture
- Provides minimal impact to existing systems
- Makes efficient use of limited bandwidth
- Makes extensive use of technology standards
- Makes extensive use of Commercial-Off-The-Shelf (COTS) products

- Provides low total cost of ownership (TCO)
- Provides enhanced data security
- Provides better uses of limited resources.

Interoperability Benefits

Initially, CapWIN will provide three critical services:

- A mobile data communications platform for agencies that do not currently have one
- Mobile access for authorized users to securely obtain criminal justice, transportation, and hazardous materials information
- Interoperability between existing incompatible mobile data communication systems.

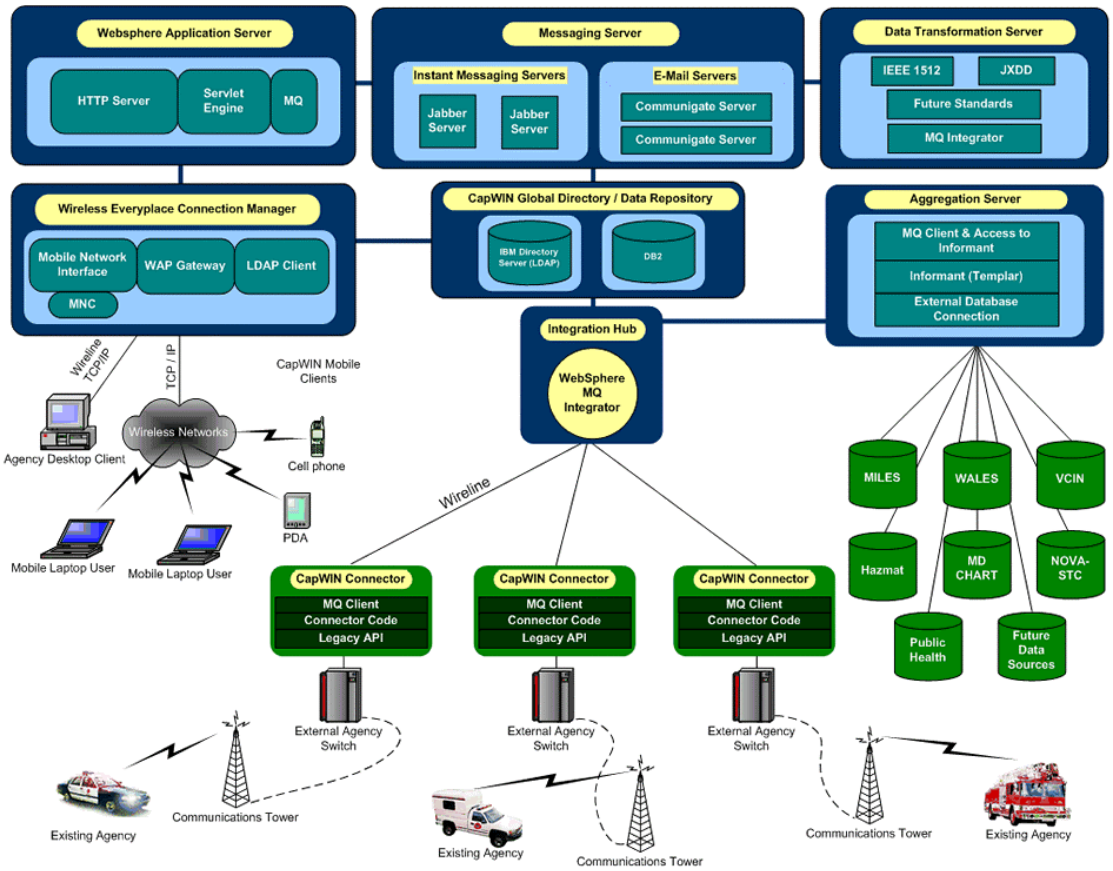


Figure 3-1. CapWIN Architecture

The Future of CapWIN:

Future phases may include the addition of priority functionality, expansion of interfaces, and system operations and maintenance. Potential functionality and interfaces to be added during these Phases include, but are not limited to: Automatic Vehicle Location (AVL) including "two-way" AVL and Instant Messaging; Application of voice recognition capability for mobile client

software; Identification and integration of an evolving technology for voice communications interoperability; Interfaces to medical databases; Video to and from field units; Interfaces to local, state and federal CAD systems; Detailed mapping; and Interfaces to E911 call centers.

Table 3-2 illustrates how CapWIN meets the public safety communications and interoperability challenges faced by the State.

Table 3-2. How CapWIN Meets Maryland's Public Safety Interoperability Challenges

Challenges	CapWIN Meeting the Challenge
1- Funding Limitations	Provides for the research and development of standards and tools at no cost to the State. Strives to develop interfaces to existing information through existing systems leveraging existing resources.
2- Existing older technologies	No direct impact.
3- Insufficient Radio Channels & System Coverage Limitations	Provides for potential commercial wireless system interfaces to IMS related data, which would offset the spectrum requirements of a private wireless data infrastructure.
4- FCC Authorized Mutual Aid Channels are Under Utilized	No direct impact.
5- Lack of a Common Statewide Public Safety Frequency Band	No direct impact.
6- Need for a Robust Statewide Infrastructure	No direct impact.
7- Limited Use of Wireless Data Systems	Provides the environment for the exchange of data among first responders and can serve as a portal for the IMS components discussed later in this report. Makes incident management information more readily available at reduced costs to the State.

3.2 MARYLAND EFFORTS

There are many operational and communication stovepipes in Maryland that do not contribute to the easy sharing of information among functionally disparate agencies or between the political tiers of government. Agencies with public safety responsibilities at the state, regional, county, and municipal level recognize the need to collaborate and share information more effectively and more efficiently. They recognize that commitments, or mutual aid agreements, to share information require tools to facilitate that communication and sharing. At all levels of government in the State, there are active efforts to identify, create, and implement systems and tools to facilitate better public safety communications and interoperability. This is true for both voice and data. Following are descriptions of some of the most prominent and promising efforts.

3.2.1 Voice Communication and Interoperability Efforts

Ubiquitous, immediate, clear, and reliable voice communications are the lifeline of public safety personnel. In response operations or mutual aid situations responding agencies must be able to communicate with one another, commanders must be able to communicate with their people in the field, and field personnel must be able to communicate with one another.

As evidenced in the Interoperability Survey results, most counties have built, or are in the process of building, countywide radio networks, which facilitate interoperability at the county level. As often noted in interoperability studies interoperability needs to be extended to cross borders at all levels. There are three prominent multi-county/regional projects underway in the state to facilitate interoperability: MIMICS; MESIN; and CMARC. A new program (TAC-Stack) is under review for implementation to support short term to interim interoperability. The IPT has identified these four projects as a promising starting point on which to build.

3.2.1.1 TAC-Stack

The TAC-Stack concept is a result of work Richard A. Bohn (DBM), Alan T. Kealey (DNR) and others have been involved with since approximately 2001. TAC-Stack is a concept and methodology to provide basic radio interoperability to all first responders that may normally operate in the 800 MHz, UHF, VHF or other designated frequencies assigned for public safety activities. Using nationally dedicated interoperability channels in each of the primary frequency bands provides additional radio channel capacity during mutual aid operations. Utilizing these Nationwide Interoperability Channels, the original repeater stack concept has evolved into a device referred to as the "TAC-Stack" or "Band Bridge." This device would be capable of linking together multiple frequency bands independent of the subscriber equipment manufactures protocol. As 700 MHz systems and hardware begin deployment, the 7TAC interoperability channels could also be incorporated into any existing TAC-Stacks that are in service.

TAC-Stacks would be deployed throughout the State in such a manner as to provide good local radio coverage with consistent performance between each frequency band, while maximizing the frequency reuse of these frequencies. A design allowing for frequency reuse in mind provides the benefit that multiple unrelated incidents are able to operate simultaneously utilizing these mutual aid devices while minimizing self-interference. With similar radio coverage footprints for each mutual aid frequency band, all responders working together in a given area should be able to communicate consistently on scene with their normally assigned radio. Operationally, it is expected a first responder would establish contact on a "call channel" and then is directed to the TAC channel assigned to the incident. At no time does the responder have be aware of their frequency band, since all responders are directed to the same TAC channel designation and the TAC-Stack makes the cross connection (band bridge) between the frequency bands. The responders do not have to be concerned with the frequency band they or their allied agency members are utilizing.

This concept works with existing Maryland interoperability projects such and MESIN, MIMICS (ACU 1000) and CMARC that are implementing the 800 MHz National Channels providing additional radio channel capacity in that band. Adding the UTAC and VTAC channels – or any other identified mutual aid channels – would enhance sites now being developed with the 800 MHz National Channels as part of these existing projects. When completed, first responders from multiple agencies would be able to intercommunicate independent of their radio's operating frequency band.

As illustrated in **Figure 3-2**, any single TAC channel can be considered a group of base stations interconnected with multiple bi-directional ports. An input to any port translates into an

appropriate output at each of the other assigned ports. Each port could be another on-site base station or connection into a larger transport network as represented by the cloud in Figure 3-2. The larger wide area network could be 4-wire DS0 (voice), VoIP or a combination of all methods.

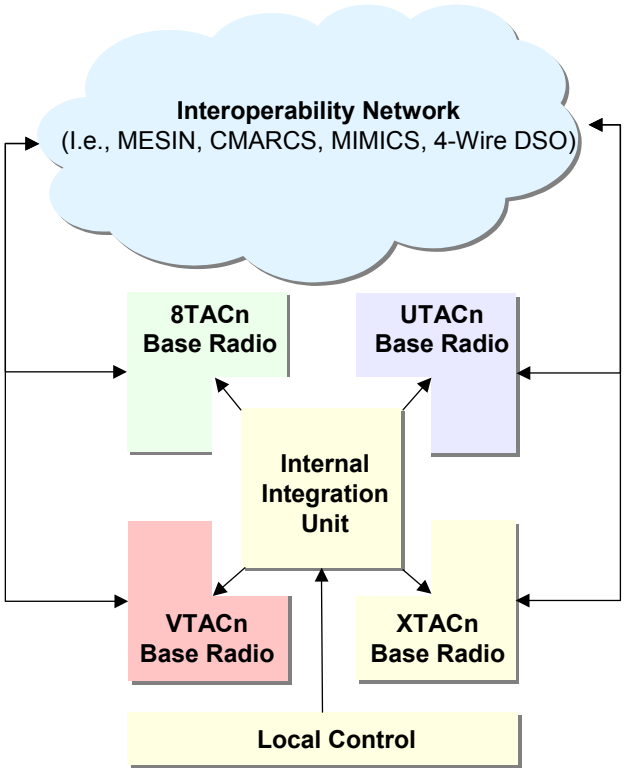


Figure 3-2. TAC Stack Single Channel Relationship (RF and power connections not shown)

Other than the remote control activating or deactivating any tactical channel via the *Internal Integration Unit* (IIU), each TAC-Stack could operate independently of any gateway or other network patching devices. Local receive and transmit audio (VF) would be interconnected between the various radios via a local signal distribution buss and control mechanism contained within the IIU. This additional control provides benefits such as fast switching times between channels and the ability to function as a "band bridge" if the network is not available. Any TAC-Stack could also be controlled via radio commands, thus functioning without any network interface. The Internal Integration Unit is not a standard commodity, but rather a combination of off-the-shelf components configured for this specific application. See **Appendix D** for more details on TAC-Stack

3.2.1.2 Maryland Incident Management Interoperable Communications System (MIMICS). MIMICS is a Maryland State Police program being designed to supply connectivity between public safety communications systems throughout the State. This connectivity will be supported through the

use of computer controlled audio interconnect[4] switches at 21 fixed locations statewide. The MIMICS currently has in-place a significant Interconnect system of ACU-1000's enhanced by the wide area interoperability systems (WAIS). There are also mobile interconnect switches that can be transported to an incident scene.

Additional funding is being sought for radio equipment to implement a TAC-Stack concept at each MIMICS location. The TAC-Stack will provide localized radio coverage to enable the 'fish out of water' responder to access and communicate over the mutual aid channels. **Figure 3-3** illustrates the basic concept of the ACU-audio interconnect solution. The interconnect solution provide a bridge between systems using different technologies or different frequencies. But, only users operating within the coverage area of their systems (able to reach back to the tower that provides them a signal) can be interconnected in this way. The ACU provides connection to disparate technologies *in a specific coverage area* but does not increase system coverage or capacity. Therefore, if responders from another county, region, or state are involved in an incident they have no means of communicating with their local peers because they do not have any signal in that area.

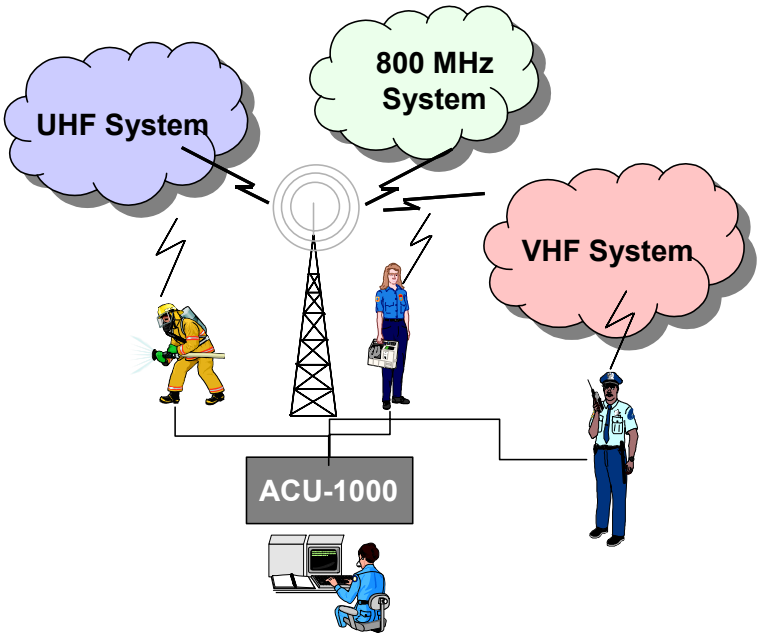


Figure 3-3. Basic Interconnect Solution Concept links disparate systems in a common coverage area

Figure 3-4 illustrates how responders from area B are unable to coordinate with their peers at a site because they are outside of their coverage area (B) and do not have radio signal.

[4] An interconnect takes the audio signal from a radio transmission and retransmits it on a different radio channel or system.

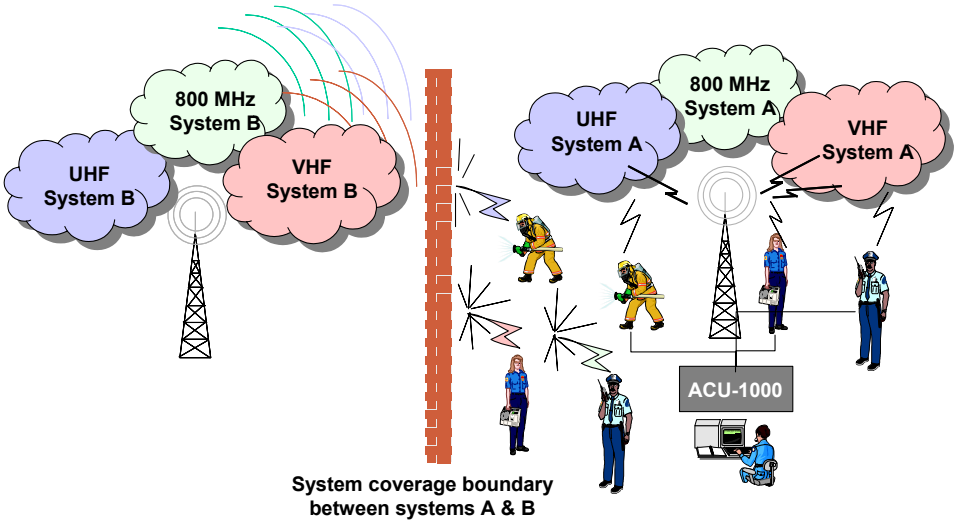


Figure 3-4. ACU does not provide signal coverage to non-local responders

The TAC-Stack would provide real synergy to this solution by providing for a localized 'coverage cloud' whereby responders from outside the coverage area could connect via their mutual aid channels AND the ACU-1000 interconnect to communicate on-scene with their local counterparts.

Funding is also being sought to provide MSP officers with XTS 5000 800 MHz portables and in-vehicle 700 MHz crossband repeaters to support statewide 800 operations on all county systems.

Table 3-3 illustrates how MIMICS addresses the public safety communications and interoperability challenges identified in the survey. As indicated, MIMICS has been funded by federal grants; facilitates interoperability between existing legacy systems, leverages mutual aid channels to provide additional capacity and expands the coverage area for beyond previous boundaries.

Table 3-3. How MIMICS addresses the public safety communications and interoperability challenges

Challenges	MIMICS Meeting the Challenge
1- Funding Limitations	Provides for the enhancement of public safety interoperability through federal grant funding.
2- Existing older technologies	Allows for the existing legacy systems throughout the state to interoperate with newer systems by enabling cross-band inter-system communications. Additional funding will also provide for the replacement of some aging equipment.
3- Insufficient Radio Channels & System Coverage Limitations	Indirectly creates additional spectrum availability when providing mutual aid channels for communications interoperability (assumes TAC Stack implementation).
4- FCC Authorized Mutual Aid Channels are Under Utilized	Potentially provides for the implementation of mutual aid frequencies with TAC Stack implementation.
5- Lack of a Common Statewide Public Safety Frequency Band	No direct impact.
6- Need for a Robust Statewide Infrastructure	Intends to use statewide infrastructure provided by other programs.
7- Limited Use of Wireless Data Systems	No direct impact.

3.2.1.3 Maryland Eastern Shore Interoperability Network (MESIN). MESIN will provide public safety communications connectivity to twelve designated mutual aid sites throughout the Eastern Shore, nine (9) County Dispatch Centers, Ocean City Dispatch, MEMA, and three State-Owned ACU-1000 sites. The project will utilize National Public Safety Planning Advisory Committee (NPSPAC) mutual aid frequencies combined with an IP based network consisting of gateways, routers, and a fully redundant switch. Mutual aid network users will automatically be connected to legacy system users whenever the dispatch center activates the designated talk groups and provides capabilities for cross-band inter-system operation. This approach will lead to enhanced interoperability and improved effectiveness for Maryland eastern shore public safety organizations.

The Maryland Eastern Shore Interoperability Network will provide public safety communications connectivity to 227 entities within the service area shown in **Figure 3-5**.

- 9 counties
- 57 municipalities
- 80 fire companies
- 61 ambulance companies
- 8 state agencies
- 7 federal agencies
- 3 utilities.

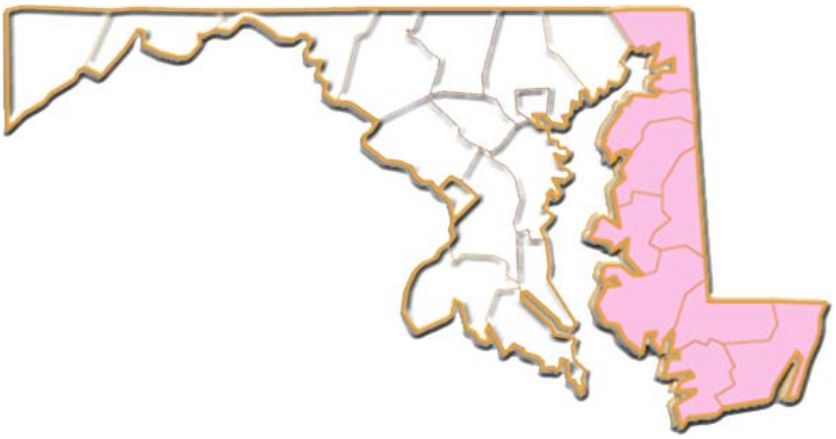


Figure 3-5. MESIN System Coverage

Table 3-4 illustrates how MESIN addresses the public safety communications and interoperability challenges identified in the survey. As indicated, MESIN has been funded by federal grants; facilitates interoperability between existing legacy systems, leverages mutual aid channels to provide additional capacity and expands the coverage area for beyond previous boundaries.

Table 3-4. How MESIN addresses the public safety communications and interoperability challenges

Challenges	MESIN Meeting the Challenge
1- Funding Limitations	Provides for the enhancement of public safety interoperability through Federal grant funding.
2- Existing older technologies	Allows for the existing legacy systems in the service area to interoperate with newer systems by enabling cross-band inter-system communications.
3- Insufficient Radio Channels & System Coverage Limitations	Indirectly creates additional spectrum availability by providing mutual aid channels for communications interoperability within the service area.
4- FCC Authorized Mutual Aid Channels are Under Utilized	Provides for the implementation of the NPSPAC mutual aid frequencies in the service area.
5- Lack of a Common Statewide Public Safety Frequency Band	No direct impact.
6- Need for a Robust Statewide Infrastructure	Intends to use statewide infrastructure provided by other programs.
7- Limited Use of Wireless Data Systems	No direct impact.

3.2.1.4 Central Maryland Area Regional Communications (CMARC) System. The Central Maryland Area Regional Communications System will deploy infrastructure in the central Maryland area for region-wide use of the national calling and tactical 800 MHz channels (8TAC). These channels will provide another "layer" of communications interoperability for central Maryland emergency services providers.

All CMARC dispatch centers and field providers will have the ability to receive and transmit on the National Calling Channel (NCC) and all National Tactical Channels (NTACs). Communications on the NCC and any NTAC will be governed by protocols adopted by the CMARC Oversight Committee. MEMA will serve as the control point for the National mutual aid channels and will monitor the NCC at all times.

Project Team Members include representatives from all jurisdictions in the Baltimore Metro Statistical Area, as well as representatives from various county, state and federal agencies. The CMARC project service area is shown in **Figure 3-6**.

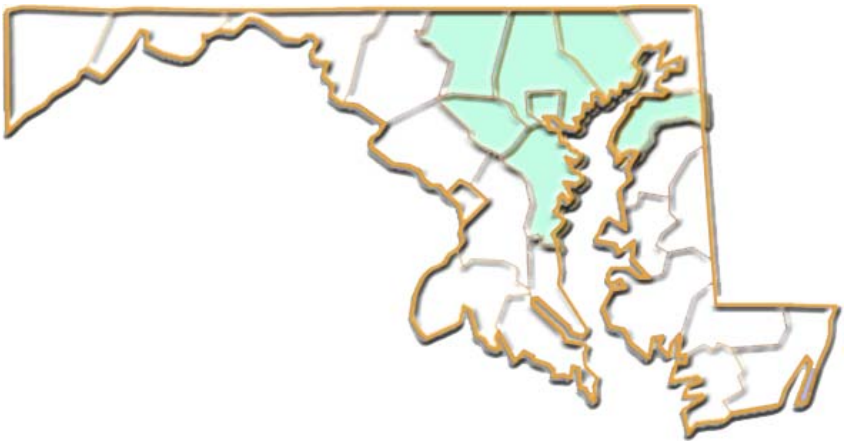


Figure 3-6. CMARC System Coverage

Table 3-5 illustrates how CMARC addresses the public safety communications and interoperability challenges identified in the survey. Like MESIN, CMARC has been funded by federal grants; facilitates interoperability between existing legacy systems, leverages mutual aid channels to provide additional capacity and expands the coverage area for beyond previous boundaries.

Table 3-5. How MESIN addresses the public safety communications and interoperability challenges

Challenges	CMARC Meeting the Challenge
1- Funding Limitations	Provides for the enhancement of public safety interoperability through Federal grant funding.
2- Existing older technologies	Allows for the existing legacy systems in the service area to interoperate with newer systems by enabling cross-band inter-system communications.
3- Insufficient Radio Channels & System Coverage Limitations	Indirectly creates additional spectrum availability by providing mutual aid channels for communications interoperability within the service area.
4- FCC Authorized Mutual Aid Channels are Under Utilized	Provides for the implementation of the NPSPAC mutual aid frequencies in the service area.
5- Lack of a Common Statewide Public Safety Frequency Band	No direct impact.
6- Need for a Robust Statewide Infrastructure	Intends to use statewide infrastructure provided by other programs.
7- Limited Use of Wireless Data Systems	No direct impact.

3.2.2 Data Communications Related Projects

As illustrated by the Interoperability Survey results, there is currently very little use of mobile data by the public safety community at this time. One reason for this is lack of funding. Private wireless data systems are expensive and use of commercial wireless survives for mobile data may not provide public safety users the coverage they require. Mobile data is also an area of public safety communications that is rapidly developing and new options are emerging all the time. Overall, public safety users are just starting to see the utility and financial benefits/cost savings potential of mobile data.

As with public safety voice communications, interoperability and adherence to standards is critical to allow data access, management, and sharing. CapWIN is a significant mobile data option for Maryland to consider. However, before considering the options for moving data to support public safety and emergency response efforts it is important to establish the data.

3.2.2.1 Emergency Management Mapping Application (EMMA). EMMA is a web-based mapping application that enables properly equipped emergency management personnel to display relevant geospatial information before, during, and after an incident occurs. EMMA has an open architecture and includes features that enable emergency responders to identify incident locations, generate location-specific reports, visualize incident locations via a map, perform site-specific analysis, and coordinate response efforts. EMMA provides basic and advanced tools for map visualization, location analysis, and report generation.

Interoperability Benefits
EMMA provides the following interoperability benefits:

- Identification of Incident
- Creation of Location Report
- Visualization of Incident Location
- Spatial Analysis of Affected Area
- Coordination of Response
- Connection to Other Systems, and Tools for Data Exchange.

Table 3-6 illustrates how EMMA addresses the public safety communications and interoperability challenges identified in the survey. EMMA has been funded by federal grants and will enhance collaboration and emergency response operations through availability of geographical data and access to incident management information.

Table 3-6. How EMMA addresses the public safety communications and interoperability challenges

Challenges	EMMA Meeting the Challenges
1- Funding Limitations	No direct impact.
2- Existing older technologies	No direct impact.
3- Insufficient Radio Channels & System Coverage Limitations	No direct impact.
4- FCC Authorized Mutual Aid Channels are Under Utilized	No direct impact.
5- Lack of a Common Statewide Public Safety Frequency Band	No direct impact.
6- Need for a Robust Statewide Infrastructure	No direct impact.
7- Limited Use of Wireless Data Systems	Provides the mechanism for the exchange of geospatial data among first responders and can serve as a mapping component of any IMS system. Makes incident management information more readily available at reduced costs to the State.

3.2.2.2 Maryland Emergency Geographic Information Network (MEGIN). MEGIN is a central portal for geographic data, directing users to a distributed network of data and application assets. The *enhanced network capacity* and *interoperability* achieved will provide the ability to more readily share available information. Progress in this area includes the significant award of an Information Technology Evaluation Program (ITEP) DHS Grant (for $1M) in September 2004 for further development of distributed data sharing through a secure network. The implementation of MEGIN will establish a statewide GIS data clearinghouse modeled after similar operational implementations of metadata services linked to distributed map serving technology. MEGIN will expand upon existing funded efforts and will be built from the Maryland Mapping Resource Guide (MMRG) and EMMA.

Throughout Maryland, local, regional, and state agency data and application assets abound. Participants in the MEGIN system will use EMMA and a variety of desktop clients and methods to access these distributed datasets using thin clients such as common Web browsers, free data viewers, or robust desktop GIS and analysis applications. MEGIN will ensure that emergency

responders are aware of available data resources when needed. Recognizing that every emergency incident is unique, MEGIN will provide a mechanism for turning data into information and place that data in relationship to the landscape, providing a "Common Operating Picture". This common picture turns data into information, information into knowledge, and knowledge into coordinated action.

Table 3-7 illustrates how MEGIN addresses the public safety communications and interoperability challenges identified in the survey. As with EMMA, MEGIN has been funded by federal grants and will enhance collaboration and emergency response operations through availability of geographical data and access to incident management information.

Table 3-7. How MEGIN addresses the public safety communications and interoperability challenges

Maryland's Challenges	MEGIN Meeting the Challenges
1- Funding Limitations	No direct impact.
2- Existing older technologies	No direct impact.
3- Insufficient Radio Channels & System Coverage Limitations	No direct impact.
4- FCC Authorized Mutual Aid Channels are Under Utilized	No direct impact.
5- Lack of a Common Statewide Public Safety Frequency Band	No direct impact.
6- Need for a Robust Statewide Infrastructure	No direct impact.
7- Limited Use of Wireless Data Systems	Provides the mechanism for the exchange of geospatial data among first responders and can serve as a mapping component of any IMS system. Makes incident management information more readily available at reduced costs to the State.

3.2.3 Backbone And Infrastructure Related Projects

Neither voice nor data applications/communications would be available to public safety organizations, and personnel without a communications backbone and infrastructure. Whether a local Municipal Police Department, a shared County radio system, or a statewide agency system, all communications flow over a backbone or infrastructure. At this time, there is no single statewide infrastructure that can support a converged statewide radio network. Creating that statewide infrastructure is a high priority for the IPT to achieve its public safety communications and interoperability goals. The IPT has identified two significant infrastructure projects underway that can be leveraged: Net.Work.Maryland and the Statewide Wireless Infrastructure Project.

3.2.3.1 Net.Work.Maryland.

NetworkMaryland is the vision of a statewide high-speed network for public sector use. The network was created from an initiative to utilize resource shared fiber optic cable assets throughout the state to provide affordable, high-speed bandwidth to all areas of the State and to provide a cost savings to the citizens of the State of Maryland.

NetworkMaryland will provide Wide Area Network (WAN) connectivity for all public entities in the State to improve the economy of scale by coordinating joint network build-outs, consolidation of services and by providing the necessary information for proper network growth. The Network currently offers Internet Services, Statewide Government Intranet (SwGI), and InterLATA[5] Transport Services.

The current network includes the core PoPs in Baltimore, Easton, College Park and Hagerstown. The network comprises a core made up of both State fiber and leased circuits that can provide a tremendous amount of bandwidth between all four Local Access Transport Areas (LATAs) in Maryland. NetworkMaryland interconnects a Metropolitan Area Network (MAN) in Baltimore, known as BMAN and a MAN in Annapolis, known as AMAN. These MANs provide services to many of the State Agency offices located in these areas.

The networkMaryland team is currently working on completing the tasks in Phase 2 of the network build out. The installation of hardware and fiber resources has been completed for the Western MD segment and activated. The project team also completed the installation of an OC-48 SONET ring between the core PoPs of College Park and Baltimore that will ultimately serve the Annapolis Campus. The fiber ring is designed with both hardware redundancy and fiber diversity to increase the overall reliability of the network. Engineering for the fiber spur into the city is also under way. NetworkMaryland is also in the process of expanding into the Eastern Shore by utilizing High-Speed microwave to serve each county.

The network today serves customers in each of the four LATAs across the State. Over half the state Executive branch agencies are utilizing networkMaryland services to meet their need with equal or better service for a lower cost. The goal is to have all state Agencies participating in FY2005 per the JCR 49 requirement. The networkMaryland project is funded by approximately $7 million in capital funds, which are allocated to the remaining portions of the network build out plan. Primary benefits to the state are: A single managed communication infrastructure and services for all state agencies and public sector entities; and reduced cost to State agencies for Internet and cross LATA connectivity. Currently, Maryland State agencies pay over $5.5M per year on leased circuits.
http://www.dbm.maryland.gov/dbm_publishing/public_content/dbm_taxonomy/technology/about_networkmaryland/networkmdfaq.html

Table 3-8 illustrates how Net.Work.Maryland addresses the public safety communications and interoperability challenges identified in the survey. Net.Work.Maryland's primary contribution is providing a fiber optic statewide backbone that can provide redundancy to the wireless infrastructure and will support data transit to first responders.

Table 3-8. How Net.Work.Maryland addresses the public safety communications and interoperability challenges

Maryland's Challenges	Net.Work Maryland Meeting the Challenge

[5] A Local Access Transport Areas (LATA) is a geographic service area. LATAs are represented by a 3-character code, and there are 164 of them across the country.Long distance service within a LATA is provided by the Local Exchange Carrier (LEC). Service between LATAs (InterLATA) is provided by an Interexchange Carrier (IEC).

1- Funding Limitations	No direct impact.
2- Existing older technologies	No direct impact.
3- Insufficient Radio Channels & System Coverage Limitations	No direct impact.
4- FCC Authorized Mutual Aid Channels are Under Utilized	No direct impact.
5- Lack of a Common Statewide Public Safety Frequency Band	No direct impact.
6- Need for a Robust Statewide Infrastructure	Provides a fiber optic based statewide backbone network providing redundancy and robustness when combined with the Statewide Wireless Infrastructure Project.
7- Limited Use of Wireless Data Systems	Provides the mechanism for the efficient terrestrial transport of data for delivery to first responders. Makes incident management information more readily available at reduced costs to the State.

3.2.3.2 Statewide Wireless Infrastructure Project. The State has been actively engaged in addressing the need for a statewide infrastructure to support the envisioned statewide wireless public safety communications system. In anticipation of the release of frequencies in the 700 MHz spectrum which will enable the achievement of an interoperable statewide radio system using Voice over Internet protocol/Radio over Internet protocol (VoIP/RoIP), the State has funded and constructed several towers with microwave links. The infrastructure is estimated to be 40% completed as of the writing of this report.

In the 1999 legislative session, a summer study project was ordered to examine the use of NPSPAC channels. A Joint Subcommittee report, *"Beyond 800 MHz -The Next Generation Public Safety Communications System"* was prepared as a result of the study. Based on the report findings the following recommendations were made:

- Fund a ten year program to construct all of the necessary towers, shelters, emergency generators, and digital microwave needed to implement a statewide communications system in the new 700 band
- Form partnerships with Maryland counties to reduce the number of towers and overall cost
- Make use of the new towers and microwave to improve the existing communications systems until a new system is available.

An Infrastructure Committee was formed to oversee the project. The committee is comprised of the Communications Directors of the major state public safety agencies: SHA, MIEMSS, MSP, DNR, MEMA, DHMH, DBM, DPSCS, and MPT to name the major partners. All of the 24 jurisdictions are invited to participate as equal partners.

Table 3-9 illustrates how the Statewide Wireless Infrastructure project addresses the public safety communications and interoperability challenges identified in the survey. A statewide infrastructure and system would help produce significant savings to the State through economies of scale it would enable. It is expected to facilitate system coverage limitations by

enabling a converged statewide radio system. Its primary contribution is in providing a statewide backbone for transport of voice and data communications.

Table 3-9. How the Statewide Wireless Infrastructure Project addresses the public safety communications and interoperability challenges

Challenges	Statewide Infrastructure Project Meeting the Challenge
1- Funding Limitations	Indirectly address this challenge by providing for economies of scale with the cooperative nature of the project.
2- Existing older technologies	No direct impact.
3- Insufficient Radio Channels & System Coverage Limitations	Indirectly addresses this challenge by providing potential future transmission sites for new radio systems as they are developed.
4- FCC Authorized Mutual Aid Channels are Under Utilized	No direct impact.
5- Lack of a Common Statewide Public Safety Frequency Band	Does provide infrastructure to support a system when a band is made available.
6- Need for a Robust Statewide Infrastructure	Provides a microwave based statewide backbone network providing redundancy and robustness when combined with Net.Work.Maryland.
7- Limited Use of Wireless Data Systems	Provides the mechanism for the efficient terrestrial transport of voice and data for delivery to first responders.

3.3 CONCLUSION

There are many projects and programs underway within the State of Maryland that address various aspects of interoperable communications for public safety as discussed in the preceding Sections. **Table 3-10** illustrates these projects in conjunction with the Challenges Maryland faces. The challenges are:

1. Funding limitations exist for most public safety agencies.
2. Maryland must deal with the existing older technologies.
3. Public safety agencies have insufficient radio channels and system coverage limitations.
4. FCC-authorized mutual aid channels are under utilized.
5. Maryland lacks a common statewide public safety frequency band.
6. Maryland requires a robust statewide infrastructure.
7. Maryland public safety agencies are limited users of wireless data systems.

Programs reviewed are listed in the left hand column. Challenges are listed across the rows. Bullets indicate where ongoing programs address the specific challenges. Where a program does not significantly address a Challenge, that cell is marked with a red X.

Table 3-10. Ongoing Projects Address Maryland's Public Safety Communications & Interoperability Challenges

Programs	Maryland's Challenges						
	Funding	Old technology	Radio Channels & System Coverage	Mutual Aid Channel Utilization	Common Statewide Frequency Band	Statewide Infrastructure	Wireless Data
DMIS	●	X	X	X	X	X	●
CapWIN	●	X	●	X	X	X	●
MESIN	●	●	●	●	X	●	X
CMARC	●	●	●	●	X	●	X
MIMICS	●	●	●	●	X	●	X
EMMA	X	X	X	X	X	X	●
MEGIN	●	X	X	X	X	X	●
Net.Work Maryland	X	X	X	X	X	●	●
Statewide Infrastructure	●	●	●	X	●	●	●

● Indicates that this program addresses the challenge
X Indicates that this program does not impact or address the challenge

As is illustrated in above, the ongoing projects address some of the challenges, but there remain holes to be addressed:

- **Lack of Funding:** Most of the programs underway are already funded; this alleviates the need to acquire more funds for those projects. Some of these projects however, require additional funding to provide for complete build-out or additional capabilities. Funding will dictate the pace and scope of the enterprise architecture construction. Creation of the strategic plan to outline a common approach and direction to interoperability must be followed by local, county, and state agencies to ensure that funds spent contribute to real interoperability solutions. This will also help ensure that federal grant funds contribute as much as possible to addressing requirements.
- **Dealing with Older Technology:** Several key programs being implemented address the limitations of mixed technology and specifically older technologies through the use of audio level interconnect. It can be anticipated that there will always be some issue associated with incompatible or diverse aged equipment.
- **Channels & Coverage:** About half the programs currently underway are or can be used to address the challenges associated with channels and lack of coverage. Through the implementation of mutual aid frequencies or providing of physical infrastructure to support additional sites and coverage most programs provide the momentum to address this challenge.
- **Under utilization of mutual aid channels:** The MESIN and CMARC programs make direct use of mutual aid channels to provide interoperability among public safety providers. A full analysis of which mutual aid channels are required in each specific locality for local interoperability and which are needed to ensure remote interoperability must be completed to determine the most effective implementation path.

- **Common Statewide Frequency Band:** There is a real need to address the problems created by lack of public safety spectrum. Efforts to obtain 700 MHz frequencies for the enterprise architecture must be pursued with the utmost diligence. Continued lobbying for the use of these frequencies and pursuit of additional spectrum in the 800 MHz band due to rebanding will provide additional transitional resources for Maryland. Maryland needs to optimize the use of funds provided for these changes and migrate as many agencies to the higher spectrum bands as possible. The result of this migration will provide more features and capabilities for the users while allowing for a simplification of the audio level interconnect network.
- **Robust Statewide Infrastructure:** Several of the projects underway contribute toward the statewide infrastructure development either directly or depend on its availability. In order to ensure a strong foundation is available for the enterprise architecture it will be necessary to conduct focused planning to ensure proper consideration has been made to support the architecture. Ultimately, Maryland must build an infrastructure providing the "four R's" (Reliability, Robustness, Resiliency, and Redundancy) necessary to support public safety communications. Additionally, establishing a fair governance structure to ensure that municipal, county, and state agency requirements are equally met is necessary to establish true statewide interoperability.
- **Use of Wireless Data:** Several of the projects underway contribute infrastructure to support or environments for the use of wireless data. Data can be utilized to alleviate the pressure on crowded voice systems, acquire critical information necessary to support the missions of first responders, and improve efficiency of incident mitigation. Wireless data frees first responders from hours of administrative tasks returning them to public safety support functions.

4.0 Vision for Public Safety Communications

The Vision establishes the "To Be" Framework. The IPT's Vision for statewide voice and data public safety communications and interoperability include:

- Open architecture
- Converged voice and data communications
- Leverage available funding from all sources (State, Local, Federal, and Private)
- Leverage and enhance statewide cooperation
- Leverage public and private resources and data
- Maximized use of existing systems and technology
- Multiple layers of voice and data communication channels to enhance the ability to communicate during significant emergency response situations
- Access to voice and data networks to comply with defined security requirements
- Recommend and adopt procedure and protocol guidelines

Recognizing the convergence of voice and data communications, the envisioned long-term solution for public safety communications focuses on implementation of standards-based, open systems. These systems will be secure and accessible by users from Municipal, County, and State agencies. Success will be enhanced by the continued cooperation and sharing of technological expertise by all stakeholders within an ongoing and open governance structure.

The IPT Vision and conceptual models for public safety communications are based on the five key concepts:

- Interoperability
- Partnering
- Capacity
- Information Sharing
- Positioning for the Future.

Addressing the challenges (identified in Section 3), the IPT created and adopted conceptual models for voice communications (see **Figure 4-1**, **Figure 4-4**), data (see **Figure 4-5**), governance (see **Figure 4-3**), and operations (see **Figure 4-2**) that will guide Maryland to build public safety communications capabilities that address these concerns and challenges. The models help define short and long-term objectives and actions to achieve them, while striving to maximize the leverage obtained from ongoing projects and activities.

The Vision for each of these concepts is detailed in the following Sections.

4.1 VISION FOR INTEROPERABILITY

The IPT Vision is achievement of a statewide system that will support communications interoperability, and will facilitate real-time communications across boundaries of agencies, jurisdictions, levels of government, and ultimately, across State boundaries with Maryland's

neighbors. Interoperable communications will ensure that Maryland's public safety providers can coordinate with one another, share information, and provide a consolidated response.

The IPT's long-term vision for facilitating public safety communications interoperability is to establish a statewide public safety communications system that will be standards-based, open architecture addressing the needs of all stakeholders from the enterprise level. The system will leverage internet protocol. It will operate in a single frequency band (700 MHz). It will allow the rollout of additional services such as short messaging, paging, mapping, and data. **Figure 4-1** illustrates the envisioned interoperability concept of a single statewide system.

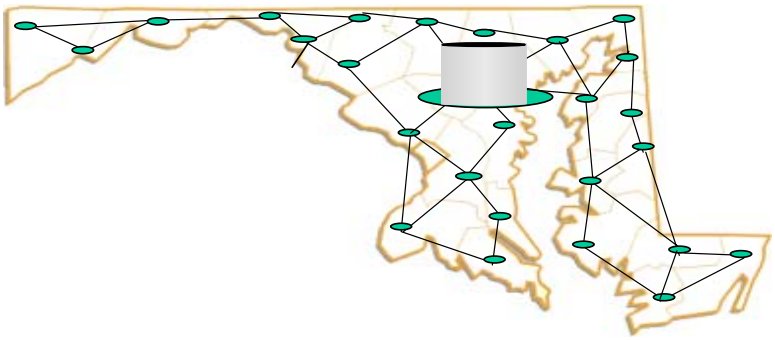


Figure 4-1. Conceptual Vision of Statewide Wireless System

Figure 4-2 illustrates this in operational terms. The IPT developed a general model to define the role of the various functional groups and physical systems involved. It emphasizes center-to-center; field-to-field; and center-to-field communications. Public safety communications centers serve as focal points for incident resolution and communication. Operations centers will communicate with each other as well as with field personnel to gather information about a given incident. After analysis, EOCs will provide guidance or support to the field personnel for coordinated incident response. EOCs will concurrently serve as a focal point for providing critical information and guidance to the public.

Communication between EOCs and field personnel typically involves both voice and data, and communications can occur over one or more subsystems depending on the configuration of the infrastructure and distance between the incident and the operations center. At the operations center, all the communications will be processed through the incident management system, which logs all information, records communications, and supports analysis of the data gathered from the incident.

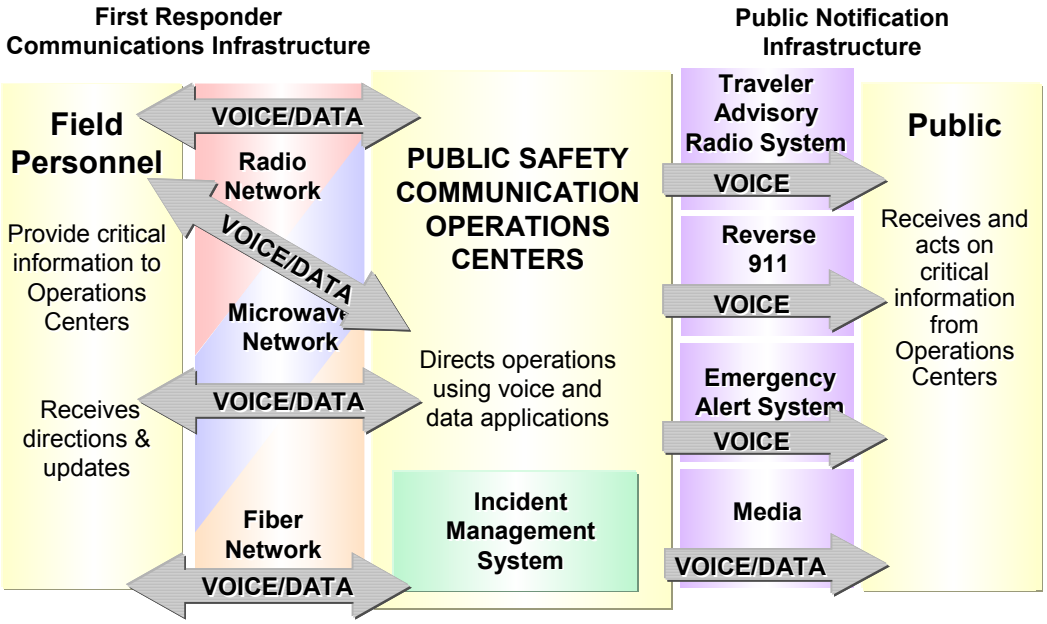


Figure 4-2 Operational Model

4.2 VISION FOR PARTNERING

In the long-term, the governance body will support the implementation of public safety communications plans statewide. The governance body will facilitate communications, mediate disputes, ensure oversight and explore technical options as well as track finances for public safety communications.

Figure 4-3 illustrates the envisioned Governance (or Partnering) structure.

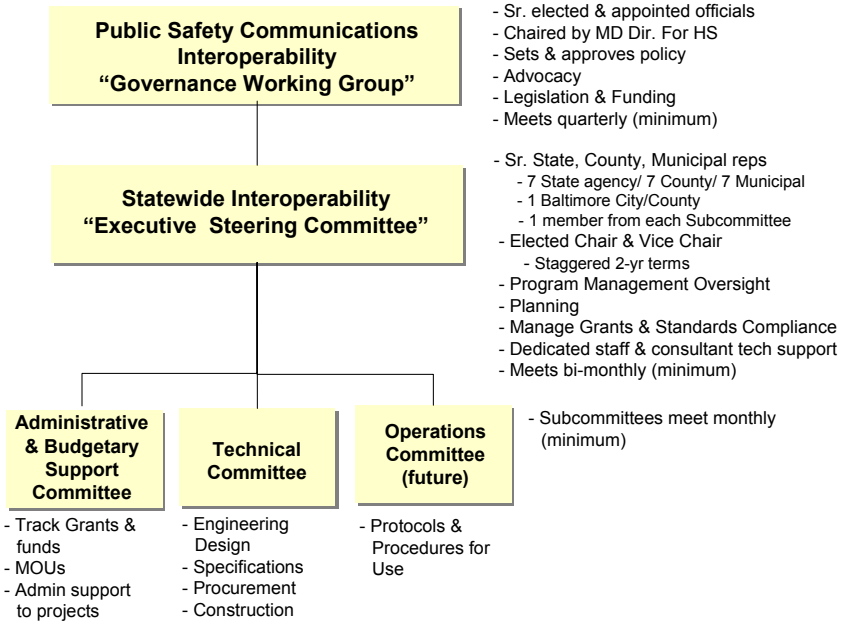


Figure 4-3. The envisioned Governance (or Partnering) structure.

The IPT has proposed a partnering structure to continue the State, County, and Municipal partnerships that have produced this study and several of the interoperability initiatives currently being deployed. The proposed partnering structure for public safety communications and interoperability in Maryland should be implemented by June 2005. At each level in the Governance structure, the primary goal is to coordinate efforts and reach consensus on efforts to achieve Maryland's vision for Interoperable Public Safety Communications systems across all levels of government.

The proposed partnering structure will support the implementation of public safety communications plans statewide, facilitate communications, mediate disputes, ensure oversight, explore technical options, and track finances for public safety communications. This partnering structure should provide administrative, technical, and operational efficiencies in designing, procuring, implementing, and maintaining a statewide public safety communications infrastructure and network. It will:

- Provide economies of scale in procurements
- Sustain the commitment, vision, and direction of the effort over the long term
- Assist in bridging organizational boundaries
- Help in obtaining a greater share of Federal grant funds for public safety communications and interoperability voice and data projects.

The IPT's proposed partnering structure provides a forum to address cross-regional (both internal to Maryland as well as external between Maryland and other Regional organizations, States, Counties, or Municipalities) issues by bringing together technical and political leadership and by converging potentially fragmented efforts. Projects with statewide scope – like the multi-band mutual aid project – need a partnership forum such as this to facilitate program and project management.

Proposed Membership & Responsibilities

The IPT proposes that membership in each level of the partnering structure will consist of representatives from Municipalities, Counties, and State agencies.

The Public Safety Communications Interoperability Governance Working Group (i.e., GWG) will be comprised of senior elected and appointed officials from Municipal, County, and State government. Municipal and County representatives will be selected in coordination with the MML and MACo respectively. The Governor will appoint state agency representatives. The Maryland Director of Homeland Security in the Governor's Office will chair the "GWG". The IPT proposes that the "GWG" meet at least four times per year. Additional meetings may be required to resolve critical issues that may arise.
The "GWG" will be responsible for:

- Overall policy making and approval regarding public safety voice and data communications interoperability
- Advocacy for adopted public safety communications interoperability voice and data projects
- Provide leadership in obtaining necessary legislation and funding for these projects.

The Statewide Interoperability Executive Steering Committee (i.e., "Steering Committee") will report to the "GWG". The Steering Committee will be comprised of senior appointed officials from State, County, and Municipal agencies; again in coordination with MACo and MML respectively. The Steering Committee will be lead by an elected Chair and a Vice Chair that will serve staggered two-year terms. The IPT anticipates that the Steering Committee will require a small, dedicated staff to be developed in conjunction with the Governor's Office of Homeland Security and ongoing consultant technical support funded through Federal grant funds. The IPT proposes that the Steering Committee meet at least bi-monthly. Additional meetings may be required to resolve critical issues that may arise. The Steering Committee will be responsible for:

- Overall program management oversight
- Continuing the planning process to ensure the 'Vision' for public safety communications interoperability and conceptual frameworks outlined in this document are carried out
- Managing grant funds
- Managing standards compliance.

Subcommittees: Reporting to the Steering Committee will be at least three Subcommittees. Membership in the Subcommittees will be broadly inclusive. Each subcommittee will have an appointed Chair and a Vice Chair who will serve staggered two-year terms. The subcommittees will provide support to the Steering Committee in their areas of expertise to facilitate implementation of adopted public safety communications and interoperability projects. The subcommittees will be responsible for coordination and facilitation. Project management and implementation activities will be the responsibility of the sponsoring agencies represented on the subcommittee. The IPT proposes that the Subcommittees meet at least monthly.

Administrative & Budgetary Support (ABS) Subcommittee: The ABS Subcommittee will be responsible for:

- Tracking applicable grants and other funds
- Drafting, analyzing, ensuring legal sufficiency and facilitating the execution of applicable MOU's
- Administrative actions required to facilitate the various projects adopted

Technical Subcommittee: The Technical Subcommittee will be responsible for:

- Engineering design
- Specifications
- Procurement
- Construction matters
- Maintenance

Operations Subcommittee: The Operations Subcommittee (to be formed at a later date) will be responsible for:

- Establishing protocols & procedures for using these systems
- Definition of how organizations coordinate (to align with the National Incident Management Structure)

Proposed Processes

The IPT proposes that all applicable and appropriate Emergency Public Safety Voice and Data Communications and Interoperability projects be presented to the partnering structure for vetting to identify synergies, opportunities for partnering, economies, and funding possibilities. The IPT proposes that applicable and appropriate projects would include programs or projects related to homeland security/emergency public safety communications or interoperability of voice and data that would impact or affect the operations of emergency response, emergency management, public safety organizations beyond the confines of a municipality. Additionally, public safety communications and interoperability voice and data projects that seek funding from the State or Federal grants would be included in this category. Projects should contribute to achieving the 'Vision' for public safety communications and interoperability, or at a minimum be compliant with the established criteria and standards. Projects should be registered with the Steering Committee for vetting. Ideally, all applicable projects should be at least registered with the Steering Committee to maintain the Maryland Public Safety Communications and Interoperability Assets and Capabilities Database. The Steering Committee will provide recommendations to the GWG for final approval and funding.

The IPT proposes that approval of a project or initiative be proportional to the amount of funding to be provided through the partnering structure. If this Public Safety Communications Interoperability Group is authorized to manage and allocate state and federal grant funds to projects that further interoperability, the Group can require established minimum criteria and standards be followed as a condition for funding. If a project is outside the scope of the applicable and appropriate projects (to be defined) and does not require approval for funding through the Group, then review and comments will be advisory only.

The IPT's Vision for partnering and governance anticipates that the GWG, Executive Steering Committee, and the Subcommittees will strive to work toward consensus both in their internal interactions as well as interactions between the Committees. This does not mean that unanimity will prevail, but that these Committees and their members will work cooperatively and collaboratively allowing for open discussion and ample consideration of differing views. The IPT proposes that all decisions be reached at the lowest applicable level in this partnering structure to first achieve the greatest common good for the citizens of Maryland and secondly, to respect the inherent autonomy of each agency and jurisdiction. In cases where a Committee is unable to achieve consensus on an issue - that issue will be raised to the next applicable level for adjudication or guidance as appropriate.

Beyond the technology challenges of creating and benefiting from a standards-based, Interoperable, statewide public safety communications system are the human challenges that must be overcome. The hurdles of the human challenge require that the public safety stakeholders from Municipalities, Counties, and the State partner to successfully achieve the

Vision. Partnering will ensure alignment among stakeholders to realize and leverage the benefits of the emerging capabilities and system. Partnering will enable coordination, sharing, and realization of synergies by directing scare resources in a coordinated manner. Partnering will require compromise from all sides. Partnering will necessitate a fair and equitable governance structure, clear well-defined goals, and utilization of constraints and incentives to ensure achievement of the common good.

4.3 VISION FOR CAPACITY

The long-term success and achievement of both the public safety voice and data systems are directly linked to the availability of a statewide backbone and infrastructure subsystem. The efficiency or optimization of any infrastructure or backbone network can be measured using Reliability, Robustness, Resiliency, and Redundancy.

In the long-term the IPT envisions achieving increased capacity through completion of the statewide infrastructure begun in 1999. The infrastructure will be internet-protocol based. The governance body will oversee implementation of the statewide 700 MHz public safety communications system. Budget should include revenue for Operations and Maintenance as well as establish a fund for technology refreshment and replacement. Findings in other states indicate that collaborative planning for, and implementation of, a large-scale public safety system takes approximately 10 years. The viable life cycle of a public safety communications system is approximately 15-20 years.

Figure 4-4 illustrates the Vision for the Statewide Public Safety Communications System. It is an extension of the radio subsystem conceptual model with the addition of an interface to wired services such as the public telephony network (POTS - Plain Old Telephone Service) and the connection of the backbone network to the internet via the required security firewall. Figure 4-4 simultaneously illustrates the transition from the "As Is" to the "To Be" public safety communications environment:

- The "As Is" public safety communications environment (bottom block) where personnel communicate using incompatible disparate radio systems, satellite and cellular phones, specialized mobile radios (such as Nextel), and the Plain Old Telephone (landline System (POTS). In the "As Is" communications environment Mutual Aid/Tactical channels are available in most radio bands that allow users operating in those bands to talk between systems operating in those bands. This does not facilitate communication between systems operating in differing bands (for instance VHF to UHF communications).
- In the next block up, the short term vision for achieving interoperability is illustrated using the Audio Interconnect (ACU-1000) to bridge communications between systems operating in different bands or using unlike technologies. Additionally, this illustrates the implementation of the TAC-Stack which will provide 'islands' of coverage that enable responders outside the boundaries of their system's service (or coverage) area to communicate using their Tactical channels.

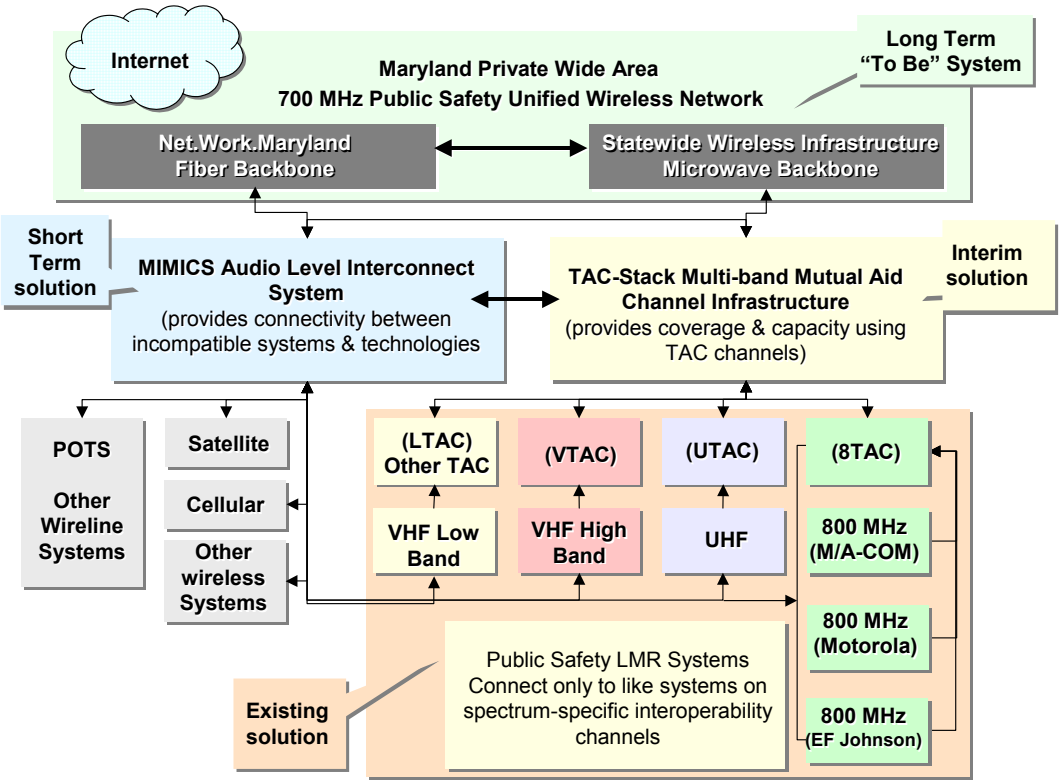


Figure 4-4. Vision for the Statewide Public Safety Communications System

- The IPT's "To Be" Interoperability Vision is indicated in the topmost block (and the Red block to the left) wherein the State will implement a single statewide system using VoIP/RoIP and operating in the 700 MHz spectrum to enable voice and data communications and interoperability statewide.

4.4 VISION FOR INFORMATION SHARING

The Vision of the IPT for public safety communications entails bringing mobile data access to public safety agencies and personnel statewide. Mobile data capability in the hands of first responders will increase their responsiveness and reduce the amount of voice traffic required to respond to most incidents. Maryland's first responders have yet to benefit from large-scale deployment of wireless data and incident management (IM) systems. The IPT's vision is to enable public safety responders with data access and mobile data. The conceptual model for public safety data is based on how the data should flow to the first responder.

The value of data is directly related to the ability of users to find and process it in a timely manner. The IPT's data and Information Management conceptual model defines the functional components necessary to make data valuable to the first responder. ***The data subsystem must provide access to an array of data repositories at all levels of government.*** Data must be presented so as to offer actionable information to a variety of responders relative to a given incident. The collaboration of these various individuals and agencies provides for the optimum resolution to any incident.

The IPT's envisioned Long-term solution for data involve implementation of the statewide enterprise system for public safety communications. The IPT's long-term vision for data provides for a converged voice and data network allowing the presentation and manipulation of data by first responders through the same radio subsystem using standards-based incident management systems. In the long-term, the governance body will support continued rollout of mobile data through the statewide infrastructure. **Figure 4-5** illustrates the Vision for Information Sharing. This illustrates how an Incident Commander might effect collaboration and effective action. Specific data resides in multiple databases or other repositories established by functional agencies, Municipalities, Counties, the State, or Federal entities (pictured along the bottom). EMMA, MEGIN, and Incident Management tools can be used to reach out and bring together the data elements to create useable, actionable information. This information can then be shared using the suite of tools such as DMIS to ensure a common understanding of the environment and collaborate.

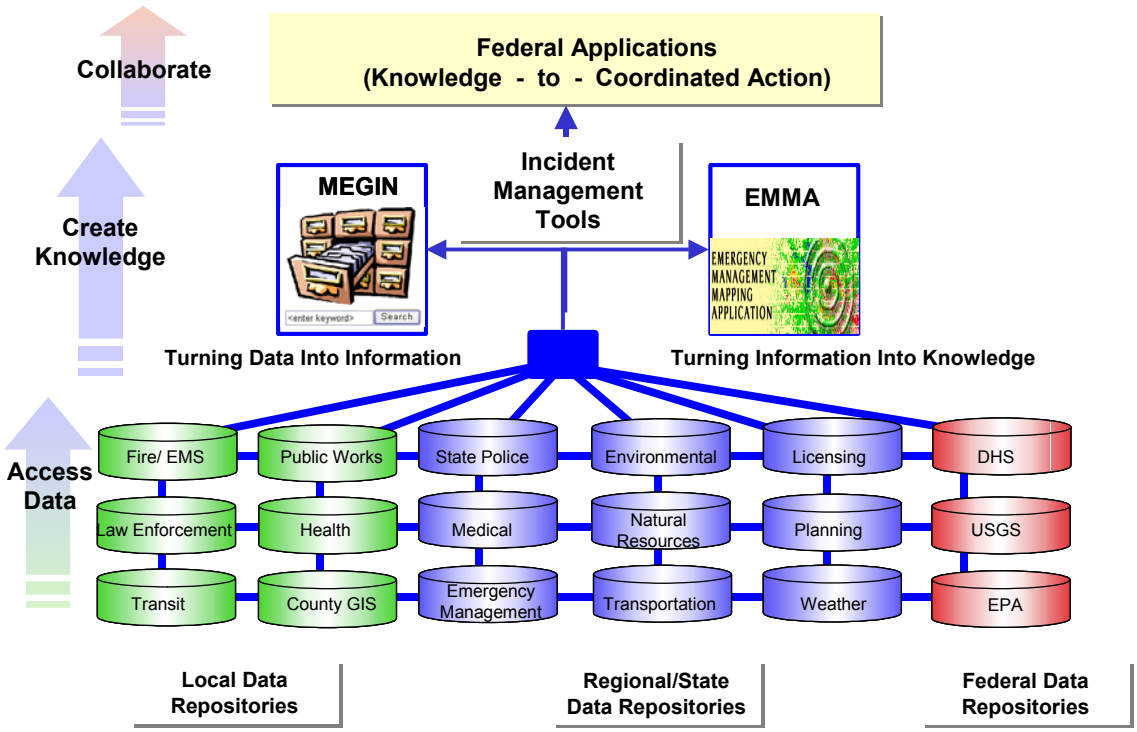


Figure 4-5. Vision for Information Sharing

4.5 POSITION FOR THE FUTURE

The IPT's combined Vision for achieving an effective public safety and homeland security infrastructure relies on taking coordinated action in all four of these areas concurrently. Current interoperability projects lay the foundation for state-of-the-art standards based voice and data systems that will have the necessary capacity to meet operational needs. The IPT anticipates that the FCC will release the 700 MHz spectrum for public safety use before 2013 although statements vary from 2008 through 2015 and optimism that the FCC will be able to meet this

timeframe varies considerably. Regardless, the Vision established by the IPT and laid out in this document provides a basic framework or roadmap for achieving statewide interoperable voice and data in Maryland.

5.0 Engineering Master Plan for Public Safety Communications

The Engineering Master Plan is focused on providing the roadmap or guidance for action to achieve the Vision. It outlines goals and objectives, and a series of steps to be carried out or to achieve those goals and objectives. The Master Plan identifies what needs to be done and a timeframe for doing it (Short term, Interim, and Long Term). It helps determine priorities in implementing change. The Master Plan provides a framework to support decisions on how to allocate resources, address challenges, and take advantage of opportunities that arise along the way. It establishes direction, supports setting priorities and identifying obstacles and opportunities that may limit or enable accomplishment of the mission.

This Section addresses the recommended actions (Short term, Interim, and Long Term) to achieve the Objectives established in the Vision for Public Safety Communications organized in the following areas:

- Interoperability
- Partnering
- Information Sharing
- Capacity
- Positioning for the Future.

These five areas are closely interlinked, and progress must be made in each area to assure that the Vision is achieved.

5.1 SHORT TERM ACTION PLAN

The Short term is defined here as 0-1 year (by the end of 2005). The Short-term focus is taking steps and making necessary preparations that will position the State for the Future.

5.1.1 Interoperability – Short Term

The State needs to support, encourage, and facilitate projects already underway to achieve interoperability. It is also important at this time to make plans for projects to support interoperable public safety communications between different jurisdictions, Municipalities, Counties, and State agencies that will assure viable coordination, command, and control for multi-jurisdictional Task Force efforts, special events, or emergency response efforts. Short-term action must support communications across agency or jurisdictional boundaries, across language or code barriers, incompatible transmission technologies, and multiple frequency bands.

Beyond enhancing the availability and utility of mutual aid channels, short-term action cannot realistically address the coverage barrier that prevents responders from using their own native equipment in jurisdictions outside the coverage footprint of their own radio systems. Within the next year (2005) the State's objective is to increase or maximize interoperable communications using already available systems, equipment, and funding though:

5.1.1.1 Standards & Criteria for Acquisition of New User Equipment. The State, Counties, Municipalities, and agencies currently utilize a wide variety of communications systems and equipment of various vintages from different manufacturers. Much of the public safety communications equipment is proprietary and does not readily support interoperable communications. The Federal Government and the SAFECOM Statement of Requirements advocate migration to non-proprietary standards-based communications systems and equipment. Currently the only standard (advocated by SAFECOM and DHS) is the APCO Project 25 standard.

In the next year, the State must promote cooperative efforts between and among state agencies, Counties, and Municipalities to agree on standards and an approach to facilitate acceptance and adherence to those standards. It will be necessary to obtain stakeholder agreement that for procurements, other than replacement of any grandfathered equipment, any new wireless systems or equipment purchased will be non-proprietary standards-based in accordance with the agreed upon set of standards. Establishing incentives for compliance and disincentives for non-compliance are helpful but success will rely on obtaining buy-in from all stakeholders.

The State will work closely with all stakeholders to identify criteria for public safety communications equipment to ensure greater utility through features that allow users to select a different frequency or operate on multiple bands so that they can effectively 'join' a network outside the coverage of their own system. The State will establish a program of reviews and incentives to support compliance with the established standards and criteria. The criteria will be forward leaning to ensure reusability of user equipment in the long-term public safety communications system. The State decision makers, sate agencies, counties, municipalities, and any other key stakeholders must:

- **Identify requirements-based standards for all public safety communications equipment:** The State must identify those standards that meet the requirements and promote achievement of the 'Vision' for technical architecture for public safety communications and interoperability. Agreed upon standards for equipment and systems should:
  - Be compliant with technical requirements such as Project 25
  - Be identified for all architecture components
    - User equipment – i.e. mobile, and portable radios, mobile data devices
    - Systems equipment, infrastructure, hardware, software, etc.
  - Include standard interface definitions and target dates for their implementation
  - Address requirements from the NIMS program.

- **Identify incentives for standards compliance:** The Steering Committee must draft a proposition (in the Steering Committee) regarding the accepted standards and need for compliance:
  - Encourage compliance through conditional funding, system inclusion standards, and legislative mandate
  - Ensure all state supported funding efforts relating to public safety are conditionally dependent on adherence to the developed standards

- Identify and provide assistance in obtaining grants and funding sources for meeting the requirements
- Encourage legislative support of standards
- Develop sufficient formal legislative support of the envisioned technical architecture for public safety communications interoperability to ensure long-term system success.

- **Identify system and equipment purchases that will and will not fall within these guidelines.**

- **Provide monitoring through leadership (Steering Committee).**

5.1.1.2 Public Safety Database. To move toward achieving its objectives of statewide public safety communications and interoperability it is necessary that the State, agencies, Counties, and Municipalities to firmly establish the "As Is" -- know what the existing assets are, their location, status, age, ownership, etc. The State needs to support the ability to identify and forecast public safety communications requirements including the real projected needs for communications and coordination under a variety of scenarios, and develop a realistic assessment of any shortfalls in meeting these needs in order to ensure that these are addressed. Public Safety communications services are provided by many agencies that have various assets (personnel and equipment) throughout the State. Ensuring that these assets are accounted for in the planning process for public safety communications and interoperability and have the ability to communicate with one another and work together smoothly means knowing what is available.

Establishing a web based database for public safety agencies will enable and enhance the ability of the State to achieve it goals through leveraging existing assets and ensure that all the citizens of Maryland benefit from enhanced public safety and homeland security capabilities. This requires that the State take action over the next year to create a dynamic, secure repository of public safety and homeland security related resources. The database must:

- **Identify, or define, the public safety population**: It will be necessary to develop a clear picture of all public safety providers including the non-traditional entities such as utilities. Data fields should include: Organization, size, location, etc.
- **Inventory assets:**
  - Infrastructure
  - Systems
  - User equipment
  - Dispatch
  - Communications centers
- **Be accessible to responding agencies preferably through the incident management systems used on a daily basis.**
  - The web based public safety asset tracking tool needs to allow each participating agency to dynamically update their capability, assets and needs as necessary.
- **Be secure:** The database and its data should comply with established physical and information security standards as applicable to public safety and the specific types of data resident within the database, and in transit to and from the database.

- **Be fully accessible by appropriate agencies via a universal and commonly accessible method such as a secure intranet or internet portal:** The database should be a common repository to facilitate coordination, sharing of data, and planning but should provide virtual privacy to each participating agency requiring permissions from data owners for sharing and access.
- **Database requirements available to user community via web:** It will be necessary for the Steering Committee to establish standards and requirements to guide development of the database and communicate those guidelines and system requirements to the user community.

5.1.1.3 Gateways to Facilitate Inter-System Communications. In the current environment, public safety providers use proprietary communications equipment and systems of various vintages, from various manufacturers. Facilitating communications between these systems is not a simple matter. There are several efforts currently underway to facilitate inter-systems communications using Gateway technology (i.e., the ACU-1000). In the short term, this is the fastest and surest method to support communications between agencies and entities using incompatible communications equipment.

The Maryland State Police have been installing a statewide network of ACU-1000s in their MIMICS program. This program addresses the basic short term vision identified for interoperability by providing bridges between incompatible systems to facilitate interoperability and collaboration on an as needed basis for task force or special events. MIMICS goes beyond this basic requirement by providing network of these bridges and management. Further, the MSP has plans of incorporating the TAC-Stack program (which would provide for additional coverage and capacity) into the MIMICS program. The State needs to work with the State Police to bring additional support and resources to fully realize this program throughout the State.

The MIMICS project has already established gateways across the entire state and will contribute many of the functional elements necessary to achieve the envisioned public safety communications and interoperability technical architecture. MIMICS provides the following elements that support achievement of the objective for a statewide interoperable public safety communications system:

- An IP Based Proprietary Audio Level Interconnect System (JPS)
  - 800 MHz Radio Interfaces
  - UHF Radio Interfaces
  - VHF High Band Radio Interfaces
  - VHF Low Band Radio Interfaces
- Connectivity to the Statewide Microwave Infrastructure
- Connectivity to the MESIN Project
- TAC-Stack implementation (if funded)
- 800 MHz radios for MSP (if funded).

As **Figure 5-1** illustrates, MIMICS provides many of the core components necessary to achievement of the envisioned public safety communications voice architecture. Therefore continued support of this program is recommended through the following actions:

- **Review the Engineering Plan for the MIMICS system and determine the potential for scope changes that increase support for the envisioned technical architecture.**
  - Complete an engineering review of the existing design to determine if additional coverage or channels may be required to support potential future users and develop a program to provide future expansion.
- **Review the engineering plans for the regional radio systems to determine solutions for interconnection with the MIMICS system.**
  - Review the regional system architecture for each participating agency to determine optimum technical interconnect and operational coordination method for inclusion in the MIMICS system.
  - Develop technical and operational standards for MIMICS system inclusion.
- **Complete a study of MIMICS service areas to determine TAC-Stack component demand and feasibility. (In preparation for achieving Interim Vision elements)**
  - Local coverage analyses: Complete a coverage analysis of the existing design to determine TAC channel requirements for each local geography.
  - Spectrum surveys for each of the local geographies to determine TAC-Stack implementation priorities.
- **Develop phased program for TAC-Stack development in each local geography**
  - Prioritize the technical component installations to meet the immediate needs first (day to day interoperability)
  - Develop plans for complete Stack build-out to meet long-term requirements (fish out of water situations).

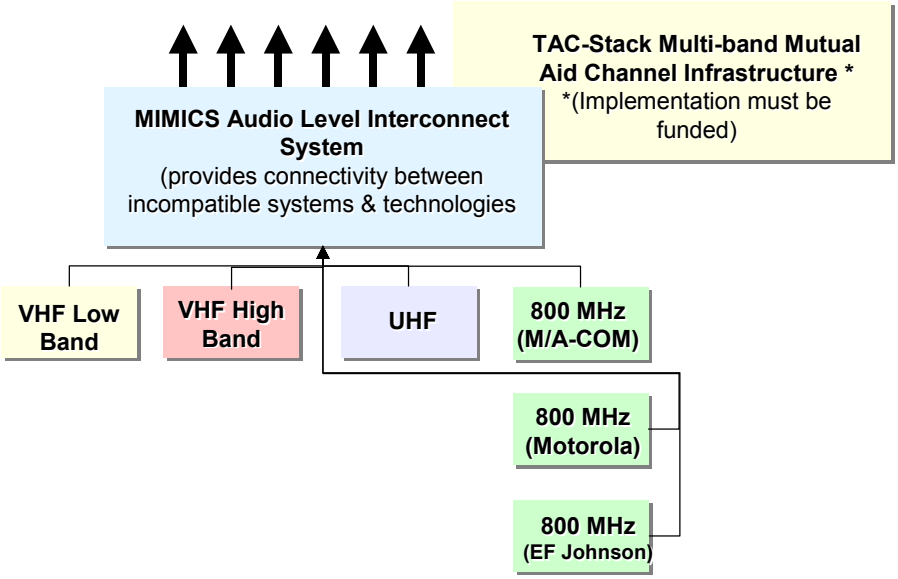


Figure 5-1. MIMICS Project Functional Elements

5.1.1.4 Expand Coverage & Capabilities of Regional Systems. The State needs to work with Regional consortia, counties, municipalities, and State agencies that have already implemented, or are in the process of implementing systems to facilitate interoperable communications. The most likely projects at this time are the MESIN and CMARC projects. Although CMARC and MESIN are using different technologies to support interoperability – both rely on utilization of Internet protocol that will be the basis of the State's long-term envisioned solution for public safety communications interoperability.

In the next year the State can study the feasibility of expanding these systems to include additional counties. The State should also study the feasibility of linking these two systems to quickly provide interoperable communications to the majority of the State.

As illustrated in **Figure 5-2**, the capabilities introduced through implementation of MESIN will create a number of the functional elements found in the technical architecture for the project service area. It will provide:

- 8TAC Mutual Aid Deployment
- IP Based (MA/COM) Proprietary Audio Level Interconnect System
- 800 MHz Radio Interfaces
- VHF High Band Radio Interfaces
- VHF Low Band Radio Interfaces
- Connectivity to the Statewide Microwave Infrastructure
- Connectivity to the MIMICS Statewide Audio Level Interconnect System.

Likewise, as illustrated in **Figure 5-3**, the CMARC project will also create a number of the functional elements found in the technical architecture for its project service area (refer to Figure 3-2). The project will provide the following elements:

- 8TAC Mutual Aid Deployment
- An IP Based Proprietary Audio Level Interconnect System (Motorola)
- 800 MHz Radio Interfaces
- Connectivity to the Statewide Microwave Infrastructure.

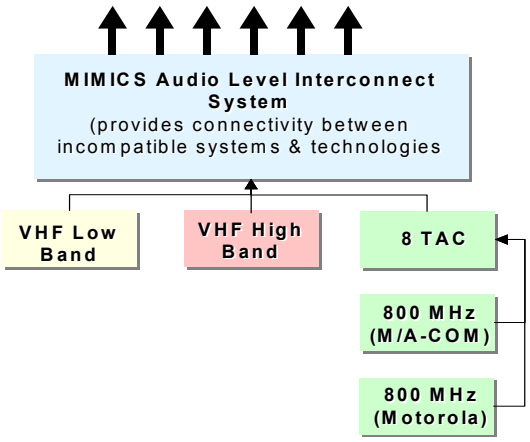


Figure 5-2. MESIN Project Functional Elements

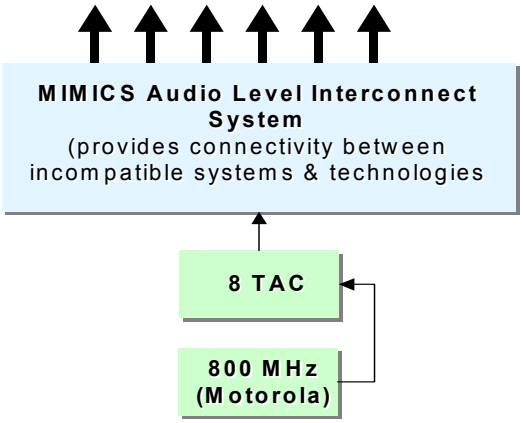


Figure 5-3. CMARC Project Functional Elements

Leveraging and expanding upon the opportunities offered by the CMARC and MESIN programs will necessitate the following short-term actions:

- **Review the Engineering Plan for each system and determine the potential for scope changes that increase support for the technical architecture.**
  - Complete an engineering review of the existing design to determine if additional coverage or channels may be required to support potential future users and develop a program to provide future expansion.
- **Review the engineering plans for the regional radio systems to determine solutions for interconnection with the other systems.**
  - Review the regional system architecture for each participating agency to determine optimum technical interconnect and operational coordination method for inclusion in the appropriate system
  - Develop technical and operational standards for system inclusion.

5.1.2 Partnering-Short term

Ensuring the participation and support of all stakeholders in the planning, oversight, and implementation process will help to ensure success as well as foster collaboration and interoperability between organizations. The State is in the process of facilitating the creation of a governance structure that continues the State, County, and Municipal partnerships developed in the GWG and IPT. This partnering will increase efficiency, provide economies of scale and help in obtaining additional federal grant funds. Such partnering will also ensure a workable governance structure to oversee and manage change.

Beyond the technology challenges of creating and benefiting from a statewide public safety communications system are the human challenges that must be overcome. The hurdles of the human challenge require that the public safety stakeholders from municipalities, Counties, and the State partner to successfully achieve the Vision. Partnering will ensure alignment among stakeholders and to realize and leverage the benefits of the emerging capabilities and system. Partnering will enable coordination, sharing, and realization of synergies from wisely directing scare resources in a coordinated manner. Partnering will require compromise from all sides.

Partnering will necessitate a fair and equitable governance structure, clear well-defined goals, and utilization of constraints and incentives to achievement of the common good.

The focus for the short term is to develop and foster partnerships and relationships between Municipal, County, and State entities begun in the IPT, GWG, and Wireless Infrastructure Committees. Short-term priorities for partnering include:

- **Governance Structure**: Formalize and refine membership and role of a Public Safety Communications Interoperability Committee to guide.
- **Complete an operational systems model for the technical architecture developing appropriate standards.**
  - Conduct a detailed assessment of roles, responsibilities, and requirements taking into consideration the role played by non-traditional public safety entities such as utilities.
- **Develop a standard operations procedure (SOP) day-to-day, tactical, and mutual-aid communications.**
  - Develop a Concept of Operations (CONOPS) to govern how entities will operate, with whom they will communicate, and how that can be achieved most effectively based on the assessment and the various standards guidelines such as NIMS. The Concept of Operations will aid in partnering and collaboration. A detailed operational model is dependent on the technology employed in building the system and the operational methods and requirements of the various agencies utilizing the system. To facilitate the development of this model it will be necessary to conduct a detailed study of these methods and requirements. The IPT developed a general model to define the role of the various functional groups and physical systems involved. This general model is shown in **Figure 5-4**.
- **Develop a program for optimizing system control and operation.**
  - Identify any functional gaps in coordination
  - Identify areas where there is excessive redundancy.
- **Develop a Memorandum of Understanding that could be utilized as a baseline with all stakeholders.**

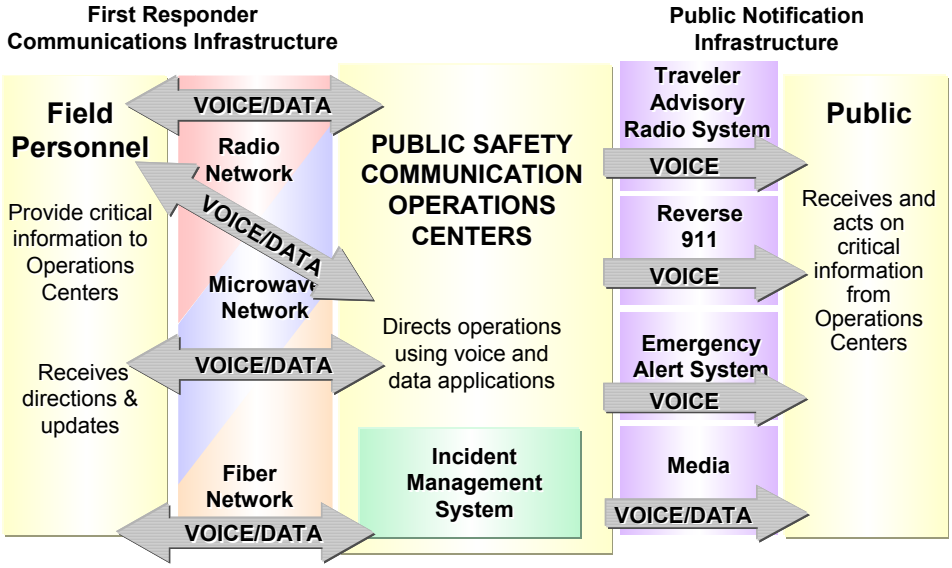


Figure 5-4. Conceptual Operational Model

In this Operational model, the public safety communications centers serve as focal points for incident resolution and communication. The IPT survey results indicate that the typical operation center is a county Emergency Operation Center (EOC). Operations centers will communicate with field personnel to gather information about a given incident. After analysis, the EOC will provide guidance or support to the field personnel for coordinated incident response. The EOC will concurrently serve as a focal point for providing critical information and guidance to the public.

5.1.3 Information Sharing-Short Term

Mobile data capability in the hands of first responders will increase their responsiveness and reduce the amount of voice traffic required to respond to most incidents. Current data projects focus on fixed operations centers and data availability. Maryland's first responders have yet to benefit from large-scale deployment of wireless data and incident management (IM) systems. The value of data is directly related to the ability of users to find and process it in a timely manner. The IPT's data and Information Management conceptual model defines the functional components necessary to make data valuable to the first responder. The data subsystem must provide access to an array of data repositories at all levels of government. Data must be presented so as to offer actionable information to a variety of responders relative to a given incident. The collaboration of these various individuals and agencies provides for the optimum resolution to any incident.

Short Term goals and objectives for information sharing are designed to provide immediate increases in first responder use of data systems. Short-term plans include:

- **Complete study to determine cost effectiveness of increasing system coverage areas to support data usage and growing data subscriber populations.**
  - Forecast system data requirements based on needs analyses
  - Implement a program for meeting the forecasted needs.
- **Develop standards for data storage/access (data dictionaries), interfaces (protocols and software platforms) and delivery methods (last mile technologies).**
  - Develop hardware and software standards for data subsystem components.
- **Deploy messaging capabilities, Incident Management applications facilitating collaboration at EOCs using applications such as WebEOC and EMMA.**
  - Continue IMS component development based on forecasted user needs and periodic requirements determinations.

5.1.4 Capacity-Short Term

The long-term success and achievement of both the public safety voice and data systems are directly linked to the availability of a statewide backbone and infrastructure subsystem. The existence of a high capacity terrestrial infrastructure is a critical core element of a statewide interoperable system. The IPT's plan is to adapt existing systems that have been installed to date to allow for the increased requirements of the technical architecture for public safety communications and interoperability. To meet the objectives for statewide public safety communications and interoperability it will be necessary to identify and commit the resources to complete the statewide infrastructure backbone of towers and microwave network. This infrastructure will ensure system availability and should be designed to support plans for the 700 MHz system so that it can quickly be implemented once the frequencies are released.

Since 1999, the State Wireless Infrastructure Committee has been planning, overseeing, implementing, and administering the basis of a statewide infrastructure by constructing towers throughout the State. In the short-term, the State will support, fund, and encourage continuation of this effort under the governance of the new Maryland Public Safety Communications Organization. The Statewide Wireless Infrastructure Program will provide the core foundation component of the envisioned public safety communications and interoperability technical architecture. The Statewide Wireless Infrastructure will allow for the immediate interconnection of public safety communications architecture components over significant distances at very high speeds via microwave. The existing structure locations serve as communications consolidation points. Each structure may serve as an integration point in the overall public safety communications architecture. A short-term benefit of the statewide wireless infrastructure is the potential availability of support structures for the short-term architecture objectives.

It will be necessary to conduct a detailed analysis of the statewide wireless infrastructure project to ensure that the network is sized and configured to support the envisioned public safety communications and interoperability architecture. This analysis will also be necessary to identify and requirements network additions or modifications to support the envisioned 700 MHz system. Backbone architectures typically experience longer life cycles than the systems they support so design considerations must also be made to ensure the long term availability of this resource while adjusting to the technological changes which have occurred since its inception in 1999.

The governance body will collaborate to establish program and project management for the continued build out of the infrastructure.

Combined with the capabilities provided through Net.Work.Maryland, this will provide the backbone and infrastructure subsystem for a statewide public safety communications system as envisioned. The continued deployment of Net.Work.Maryland can be leveraged to provide an enterprise backbone for many State public safety communications projects. The Net.Work.Maryland infrastructure can be utilized to support the immediate interconnection of the envisioned public safety communications architecture components over significant distances at very high speeds via fiber. This network also can provide access to many of the data resources necessary to support first responders. Combined with the Statewide Wireless Infrastructure Project Net.Work.Maryland can add communications path redundancy to the envisioned public safety communications technical architecture while creating technical and physical path diversity.

It will be necessary to conduct a detailed analysis of the Net.Work.Maryland project to ensure that the network is sized and configured to support the envisioned public safety communications and interoperability architecture. The results of this analysis should be used to make recommendations for required network additions or modifications that may be required. Backbone architectures typically experience longer life cycles than the systems they support, so design considerations must also be made to ensure the long-term availability of this resource.

Short Term capacity objectives will ensure that the foundation exists to support the information transportation requirements of the envisioned public safety communications technical architecture. To ensure this, the State plans to:

- **Conduct detailed analyses of the two backbone projects to move forward in leveraging them in support of the IPT's vision for statewide public safety communications.**
  - Determine optimum interconnect methods between the two transport networks to increase redundancy and robustness of both networks. This will have a positive impact on all systems utilizing either backbone architecture.
  - Develop phased interconnection program to enhance both network's reliabilities
- **Verify the ability of the infrastructure and Net.Work.Maryland to support the bandwidth and coverage requirements of any proposed statewide, converged voice and data system.**
  - As a detailed design of the technical architecture progresses, the State needs to determine the backbone transport requirements
  - Ensure the backbone architectures (Net.Work.Maryland and Statewide Wireless Infrastructure) can support the bandwidth requirements of the envisioned public safety communications technical architecture as well as other future or current systems.
  - Forecast bandwidth backhaul requirements for the technical architecture and ensure sufficient capacity remains available based on the preliminary design

- Conduct periodic reviews of the bandwidth requirements and capacity to allow for required system capacity increases in a timely fashion.

- **Support and encourage continuation of infrastructure development under the governance of the new Maryland Public Safety Communications Organization.**
  - Continue to develop partnering agreements to increase the system coverage and capacity throughout Maryland and beyond its borders where appropriate.
  - Based on previously developed standards, create a program for new agencies and systems to be integrated into the technical architecture.
- **The governance body will collaborate to establish program and project management for the continued build out of the infrastructure.**

5.1.5 Position For The Future

Maryland needs to ensure that it is positioned for the future. Current interoperability projects lay the foundation for state-of-the-art standards based voice and data systems that will have the necessary capacity to meet operational needs. Short-term action needs to ensure that governance structures, funding, legislation, and plans are in place to ensure that over the next few years activity to achieve interoperability is more coordinated and moving toward the achievement of a common goal.

5.1.5.1 Complete Planning for 700 MHz Statewide System

The FCC must be actively encouraged to release the 700 MHz spectrum needed for the statewide system. Planning must begin in detail for a statewide architecture using the new frequencies that are scheduled to become available. The existence of this plan will provide additional urgency to release these frequencies and allow for adjustments to the core subsystems in a timely and cost effective manner.

Accelerated preparation must occur to make use of the new 700 MHz public safety frequencies when they are made available. The 700 MHz frequencies necessary may be available as early as Jan.1, 2008. On Sept. 28, 2004 a U.S. Senate amendment was approved as part of S. 2845--the National Intelligence Reform Act--requiring broadcasters to clear 24 MHz of spectrum currently used for analog TV channels 63, 64, 68 and 69. The State's goals and objectives as laid out for: Interoperability; Partnering; Information Sharing; and Capacity lay the foundation for supporting the envisioned public safety communications and interoperability architecture.

Short-term actions that will aid the State in positioning for the future are:

- **Begin detailed Planning and Engineering for a statewide public safety communications and interoperability architecture using the new 700 MHz frequencies.**
  - Verify and update inventory of dispatch centers, towers, shelters, generators, and fencing around tower/shelter/generator facility that may be used for this new system
    - Dispatch centers geographical location, age, condition, HVAC size, electrical service size, and space available for new consoles
    - Tower age, type, geographical location, height above ground, antennas by location on each tower leg, and condition

  - Shelters age, type, condition, HVAC size, electrical service size, and space available in shelter for new equipment
  - Generators age, size, and type
  - Fencing age, type, and condition
- Verify that the State has the State License for all the State channels in the 700 MHz Band
- Review the conditions for the use of the 700 MHz channels
- Develop a plan for using the interoperability channels in the 700 MHz band
- Develop a frequency plan for the State 700 MHz channels taking into account traffic loading and usage of these same channels by States adjacent to Maryland
- Undertake efforts to build support from key stakeholders: agency executives and staff, the Governor's office, Legislature and the Budget Office
- Identify the most appropriate sources of capitol funding for this project
- Prepare a RFP with detailed requirements, system performance standards, and criteria for evaluation of responses.

5.2 INTERIM ACTION PLAN

Interim action takes place between one and five years (2005-2010). In the Interim period, it will be necessary to further consolidate activities to achieve interoperability and improve public safety communications. In the short term, the State will have identified the best of breed models for interoperability, established a firm picture of the "As Is" and taken steps to facilitate coordinated movement toward achievement of the envisioned "To Be".

5.2.1 Interoperability -Interim

In the interim action plan, the State envisions expanding upon and leveraging existing capabilities while increasing coverage, or system accessibility for public safety and emergency response personnel to eliminate the 'fish out of water' situation where the only way for support personnel to communicate in emergencies is for the host jurisdiction to provide radios from a cache. This expansion will widen the opportunities for interoperability from planned events and emergency collaboration toward the goal of day-to-day interoperability.

5.1.1.1 Statewide Mutual Aid Infrastructure. The State plans to create a statewide multi-band mutual aid channel infrastructure by integrating the CMARC, MESIN, and MIMICS programs into a network of networks. This would offer the following benefits:

- A statewide audio level interconnect capability (leveraging the network of MIMICS gateways)
- Statewide support of TAC-Stack functionality
- 8TAC/NPSPAC system deployment in the CMARC, and MESIN service areas
- Proprietary IP-based audio level interconnect capabilities in each of the respective service areas (this provides a diversity for including other jurisdictions until standards are available which provide interoperability amongst the different manufactures).

The resulting architecture would provide mid term interoperability to a majority of the State's geographic area and a significant majority of the population. When combined with the statewide wireless infrastructure fiber and microwave infrastructure projects, this integrated network would enable realization of a significant portion of the envisioned technical architecture for public safety communications & interoperability. The integrated network as illustrated in **Figure 5-5**, would also serve as the foundation for the long-term technical architecture expansion through out the remainder of the State.

- Continue development of interconnections within the Engineering Plan for each system to increase support for the technical architecture
- Complete plans for robust, redundant system interconnections between all the major regional communications systems (CMARC, MESIN)
- Develop a technical advisory body to evaluate and recommend system interconnection solutions.

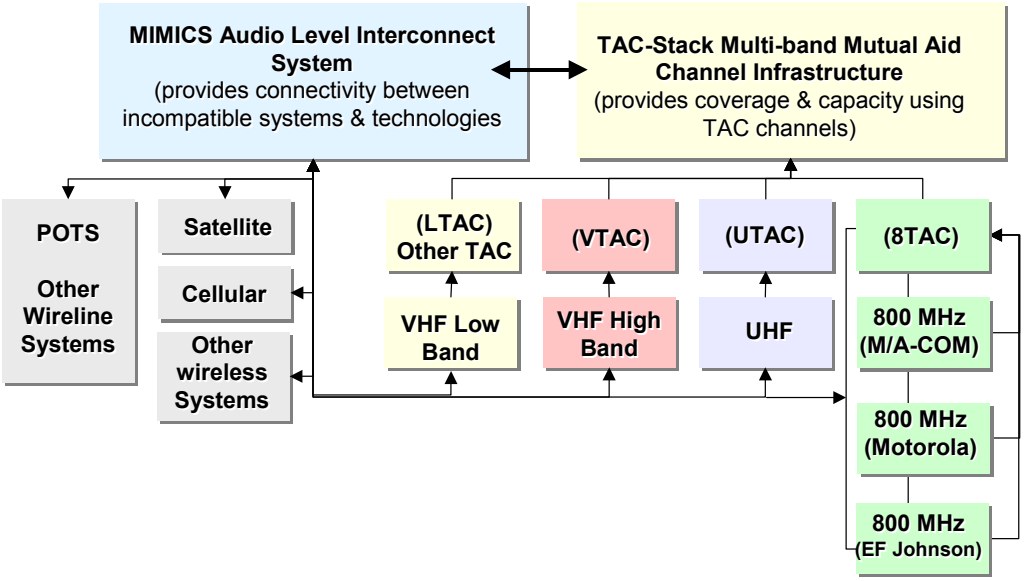


Figure 5-5. Integrated Network Functional Elements

5.2.1.2 TAC-Stack Implementation. Realizing the significant investment in communications assets and the typical usage cycles for this equipment, the State plans to continue implementing 'stacks' of mutual aid channels throughout the State where appropriate by tying together the different mutual aid channels: VTAC, UTAC, and 8TAC/NPSPAC. These TAC-Stack systems would be strategically located throughout the State where justified by need. The State also plans to create one or more mobile TAC-Stack units that could be deployed to support incident response demands.

- **Continue planning, development, implementation, and deployment of TAC-Stack providing increased coverage and channel/band capacity where needed.**
  - Based on the regional demands and availability of funding, optimize TAC-Stack deployment by maximizing area coverage, mutual aid channel re-use, and availability for day-to-day interoperability.

- **Develop a mobile TAC-Stack capability for incident response.**
  - Until a complete statewide architecture is available, create mobile TAC-Stack support platforms to provide incident coverage or additional coverage in under built areas.

5.2.2 Partnering-Interim

In the interim action plan, the State will formalize a governance structure that continues and expands upon the State, County, and Municipal partnerships already underway. This partnering will increase efficiency, provide economies of scale and help in obtaining additional federal grant funds.

- **Create a formal group charged with the management of the technical architecture to increase efficiency and provide economies of scale.**
  - Continue development of formal oversight bodies.
- **Obtain additional funds through partnering and grant activity.**

5.2.3 Information Sharing-Interim

The interim action plan for Information sharing is the rollout of mobile data access to public safety personnel. It will be necessary to facilitate data transport – possibly using the Net.Work.Maryland intranet infrastructure. This will enable a greater degree of security since data will be traveling on a private State-owned system and will not be relying on the public Internet. It will also be necessary to address data standards, data dictionaries, meta-data, and facilitate horizontal fusion of data using XML or some other tagging and sorting system to make the right data available quickly to responders and decision makers in a form that they can utilize and that will enable and facilitate greater coordination or activity, early awareness of potential man-made threats, and enhance sharing of communications and situational awareness in emergency response activities.

Interim goals and objectives for information sharing are designed to provide increases in coverage for wireless data and user populations:

- Large-scale rollout of mobile data access to public safety personnel.
- Continue resource development to facilitate data transport – possibly using the Net.Work.Maryland intranet infrastructure.
- Complete data standards, data dictionaries, meta-data and data interfaces for widespread compatibility.
  - Facilitate horizontal fusion of data.

5.2.4 Capacity-Interim

In the interim action plan, through the oversight and management of the governance body, and in collaboration with County and Municipal government, the State will continue to fund the build out of the statewide wireless infrastructure, the microwave and fiber networks. This funding will include budget for operations and maintenance: routine inspections, painting, mowing of grass, replacement of parts, and stockpiling of critical spares. In the interim period, the governance body may conduct a detailed coverage study and assessment to assure the optimum placement of towers to ensure statewide coverage and quality of service. This will

also assist in ensuring that the network is robust and the design includes redundancy so that there is no single point of failure.

Interim capacity plans are designed to ensure that the infrastructure development progresses to support and enhance the envisioned public safety communications technical architecture.

- **Obtain funding to include budget for operations and maintenance: routine inspections, painting, replacement of parts, and stockpiling of critical spares.**
  - The State needs to take action to establish guidelines and standards that will ensure consistent and appropriate maintenance of the public safety communications technical architecture to ensure maximum life cycle productivity from the system and each of it's components
  - Develop preliminary maintenance budget requirements and begin development of funding solutions.
- **Conduct a detailed coverage study and assessment to assure the optimum placement of towers to ensure statewide coverage and quality of service for the planned implementation of the 700 MHz system.**
  - As part of the detailed 700 MHz design, determine optimum locations for towers to be included in the public safety communications technical architecture
  - Provide contingencies and cost/ benefit analysis for existing locations to optimize funding dollars
  - Based on the preliminary system design, determine optimum support structure locations
  - Develop incentives for use of optimum locations and existing assets in close proximity.

5.2.5 Positioning for the Future

Interim actions should position the State to immediately capitalize on release of the 700 MHz frequencies to quickly deploy a statewide IP-based voice and data network using IP. The deployment of TAC-Stack capabilities will increase system capacity and coverage to ensure that there are no 'fish out of water' in emergency response situations. The IP and bridging technology will ensure that all existing systems and networks can be integrated into the network. The Governance structure will assure operational as well as technical standards and plans are in place to move to the long-term vision.

5.3 LONG TERM ACTION PLAN

In the long term (2010-2020), the State anticipates implementing a statewide 700 MHz digital voice and data network run by the cooperative efforts of a Governance Board composed of State, County, and Municipal officials as well as by functional experts.

5.3.1 Interoperability-Long Term

Current interoperability projects lay the foundation for a state-of the-art standards based voice and data system that will have the necessary capacity to meet operational needs. Planning must begin in detail for a long-term statewide architecture using the new frequencies that are

scheduled to become available in the 700 MHz band. The existence of this plan will provide additional urgency to release these frequencies and allow for adjustments to the core subsystems in a timely and cost effective manner.

- **Start detailed design for a standards-based; open architecture statewide 700 MHz public safety communications system.**
  - Support completion of a detailed system design of the final technical architecture
  - Develop preliminary 700 MHz statewide system design based on forecasted requirements.
  - Optimize preliminary design to utilize existing Maryland assets.
  - Begin all spectrum related planning and licensing when appropriate.
  - Determine technical & financial requirements for system implementation
  - Identify foundation components and begin the political (legislative mandates), and administrative processes (licensing and permitting) required for the successful and timely completion of the project.
  - Develop operational concept.

5.3.2 Partnering-Long Term

In the long-term, the governance body will support the implementation of public safety communications plans statewide. The governance body will facilitate communications, mediate disputes, ensure oversight and explore technical options as well as track finances for public safety communications. Long term goals and objectives for partnering are focused on ensuring political support for continued implementation of public safety communications plans statewide.

- **The governance body will facilitate communications, mediate disputes, ensure oversight and explore technical options as well as track finances for public safety communications.**

5.3.3 Information Sharing-Long Term

Long-term solutions for data involve implementation of the statewide enterprise system for public safety communications. The IPT's long-term vision for data provides for a converged voice and data network allowing the presentation and manipulation of data by first responders through the same radio subsystem using standards-based incident management systems. In the long-term, the governance body will support continued rollout of mobile data through the statewide infrastructure. It will be necessary to continue the interim efforts toward data standardization, cataloging, and utility through development and implementation of applications. Reliance on the Enterprise Architecture and Concept of Operations should facilitate this effort.

Long Term information sharing recommendations are designed to provide ubiquitous data availability and management through the technical architecture. Long-term recommendations include:

- Implementation of the converged statewide enterprise system for public safety communications allowing the presentation and manipulation of data by first responders through the same radio subsystem.
- Development and implementation of standards-based incident management systems.
- Complete rollout of mobile data through the statewide infrastructure.
- Continue the mid term efforts toward data standardization, cataloging, and utility through development and implementation of applications.

5.3.4 Capacity-Long Term

In the long-term the IPT envisions achieving increased capacity through completion of the statewide infrastructure begun in 1999. The infrastructure will be internet-protocol based. The governance body will oversee implementation of the statewide 700 MHz public safety communications system. Budget should include revenue for Operations and Maintenance as well as establish a fund for technology refreshment and replacement. Findings in other States indicate that collaborative planning for and implementation of a large-scale public safety system takes approximately 10 years. The viable life cycle of a public safety communications system is approximately 15-20 years.

To ensure successful realization and long-term viability of this network, it will be necessary to maintain sufficient network capacity. The State will need to embrace open standards and establish maintenance programs.

- **Budget should include revenue for Operations and Maintenance.**
- **Establish a fund for technology refreshment and replacement.**
  - As part of the detailed 700 MHz design, determine optimum locations for towers included in the technical architecture
  - Provide contingencies and cost/ benefit analysis for existing locations to optimize funding dollars.

ACRONYM LIST

8TAC	800 Megahertz (MHz) Tactical Aid Channel
ABS	Administrative & Budgetary Support
AES	Advanced Encryption Standard
AGILE	Advanced Generation of Interoperability for Law Enforcement
AMAN	Annapolis Metropolitan Area Network
APCO	Association of Public-Safety Communications Officials
ATM	Asynchronous Transfer Mode
AVL	Automatic Vehicle Location
BDA	Bi-Directional Amplifier
BMAN	Baltimore Metropolitan Area Network
CAD	Computer Assisted Dispatch
CapWIN	Capital Wireless Integrated Network
ComCARE	Communications for Coordinated Assistance and Response to Emergencies
CIP	Critical Infrastructure Protection
CMARC	Central Maryland Area Radio Communication
CommTech	Communications Technology Program
CONOPS	Concept of Operations
COPS	Community Oriented Policing Services
COTS	Commercial-Off-The-Shelf
DBM	Department of Budget and Management
DHMH	Department of Health and Mental Hygiene
DHS	Department of Homeland Security
DMIS	Disaster Management Interoperability Service
DNR	Department of Natural Resources
DoD	Department of Defense
DOIM	Department of Information Management
DOJ	Department of Justice
DPSCS	Department of Public Safety and Correctional Services
E911	Enhanced 911
EMMA	Emergency Management Mapping Application
EMS	Emergency Medical Service
EOC	Emergency Operations Center
EPA	Environmental Protection Agency
FCC	Federal Communications Commission
FEMA	Federal Emergency Management Agency
FICC	Federal Interagency Coordination Council
GAO	Government Accounting Office
GHz	Gigahertz
GIS	Geographical Information System
GWG	Governance Work Group

HAZMAT	Hazardous Materials
HS	Homeland Security HS
HSIN	Homeland Security Information Network
HSOC	DHS Homeland Security Operations Center
HVAC	Heating, Ventilation and Air Conditioning
IEEE	Institute of Electrical and Electronics Engineers
IETP	International Educators Training Program
IIU	Internal Integration Unit
IM	Incident management
IMS	Incident Management System
IP	Internet Protocol
IPT	Interoperability Project Team
IR	Intellirepeater
IT	Information Technology
IWN	Integrated Wireless Network
JRIES	Joint Regional Information Exchange System
LATA	Local Access Transport Area
LMR	Land Mobile Radio
LTAC	Low Band Tactical Aid Channel
MACo	Maryland Association of Counties
MAN	Metropolitan Area Network
MD	Maryland
MEGIN	Maryland Emergency Geographic Information Network
MEMA	Maryland Emergency Management Agency's
MESIN	Maryland Eastern Shore Interoperability Network
MHz	Megahertz
MIEMSS	Maryland Institute for Emergency Medical Services Systems
MIMICS	Maryland Incident Management Interoperable Communications System
MML	Maryland Municipal League
MMRG	Maryland Mapping Resource Guide
MOU	Memorandum of Understanding
MPT	Maryland Public Television
MSP	Maryland State Police
NCC	National Calling Channel
NCR	National Capital Region
NGA	National Governors Association
NIJ	National Institute of Justice
NIMS	National Incident Management System
NIST	National Institute of Standards and Technology
NPSPAC	National Public Safety Planning Advisory Committee
NTACs	National Tactical Channels
NTFI	National Task Force on Interoperability
NRP	National Response Plan

OC-48	Optical Carrier-48[6]
OCTO	District of Columbia (DC) Office of the Chief Technology Officer
ODP	Office for Domestic Preparedness
OIC	Office for Interoperability and Compatibility
OLES	Office of Law Enforcement Standards
OMB	Office of Management and Budget
OTAR	Over-The-Air Rekeying
P25	Project 25 (P25)
PoP	Point of Presence
POTS	Plain Old Telephone System
PSWN	Public Safety Wireless Network
PVCs	Permanent Virtual Circuits
RDT&E	Research, Development, Testing, and Evaluation
RF	Radio Frequency
RFP	Request for Proposal
RISS	Regional Information Sharing System
RoIP	Radio over Internet protocol
S&T	Directorate of Science and Technology
SAFECOM	Wireless Public SAFEty Interoperable COMmunications Program
SHA	State Highway Administration
SIEC	Statewide Interoperability Executive Steering Committee
SONET	Synchronous Optical Network [7]
SOP	Standard Operating Procedures
SOR	Statement of Requirements
STARS	Virginia Statewide Agencies Radio System
SwGI	Statewide Government Intranet
TAC	Tactical Aid Channel
TCO	Total Cost of Ownership
TIA	Telecommunications Industry Association
UASI	Urban Area Security Initiative
UHF	Ultra High Frequency
USGS	United States Geological Survey
UTAC	Ultra High Frequency (UHF) Tactical Aid Channel

[6] Optical Carriers are only used in very large networks such as Internet Backbones, Metropolitan Area Networks (MANs) ,and large Universities. As I mentioned above, the OC specification is determined by the STS level. The STS level is the rate at which SONET can multiplex multiple sources of data to a single fiber optic line. OC specifications are measured in multiples of 3, with a base of 1.

[7] SONET (Synchronous Optical Network) is a standard for multiplexing data. It is used primary for backbones composed of fiber optics. SONET performs a complicated timing and multiplexing scheme. It uses certain signaling levels called "Synchronous Transport Signals" or STS. Each STS level corresponds to a specification of "Optical Carriers." Due to it's complexity, the equipment needed to operate a SONET networks is extremely expensive. SONET networks powers some of the worlds most important networks (telephone and Internet). For that reason, SONET is designed to run at 99.999% uptime. This is also known as "the 5 nines" of availability.

VHF	Very High Frequency
VOAD	Volunteer Organizations Active in Disasters
VTAC	Very High Frequency (VHF) Tactical Aid Channel
WAIS	Wide Area Interoperability Systems
WAN	Wide Area Network
XML	Extensible Markup Language