



Not long ago, public safety agencies had limited choices for wireless communications systems. But now, with widespread use of digital technology, rapid feature development, regulatory changes, and the emergence of voice and data applications tailored to wireless systems, the range of technologies and alternative solutions available is staggering. The advanced features of computer-aided dispatch, in-vehicle report writing, and the instant access to building plans and up-to-date criminal records have improved emergency services.

Older communications systems used by many public safety agencies are not only limited in capability, but unable to expand or readily communicate with agencies in other jurisdictions. To address these shortfalls, many agencies are forced to consider building a new system. Choosing and implementing a new wireless system is a complicated process that requires significant resources. Prudent systems planning is critical to constructing a new land mobile radio (LMR) system successfully. Significant delays and cost overruns are unfortunately common for agencies that do not adequately understand the process of building a new system.

This foldout is designed as a road map for public safety agencies that have decided to develop or replace a private LMR system. It gives an overview of the system development process that starts with very early planning and ends with system operation and maintenance.



communications

'A Priority Investment for America's Future Safety, PSWNet Program Information Brief'

To ensure successful outcomes for new communications systems, agencies need to anticipate the whole systems development process at the outset. In a survey by the Public Safety Wireless Network (PSWNet) Program, nearly one-third of public safety agencies said lack of adequate planning was a serious obstacle to implementing interoperable communications. The seven-step process depicted below is relatively well known and understood. In addition to the broad outline, however, agencies need to foresee details and ways to work through the process. Taking time to understand and thoroughly prepare for these steps is a "stop along the road," but it is critical to effective project planning and successful interoperability improvement.

Public Safety Land Mobile Radio Systems Development Process

partnership

Key Roles and Challenges

Without these professionals and specialists, the systems development road would be "rough." The table lists common challenges as questions that individuals responsible for key roles need to answer in the systems development process. The bottom of the table itemizes factors for each role that are critical to successful systems development.

	User Representatives	Program Managers	System Managers & Technical Support Staff	Budget Specialists	Spectrum Managers	Site Managers	Security Specialists	Procurement Specialists
Common Challenges "Along the Road"	<ul style="list-style-type: none"> What can we do to help secure support for a new system that meets our mission needs? What can we do to guarantee that the system will handle our operational requirements now and in the future? What can we do to ensure acquired equipment is user friendly? What can we do to ensure that users understand how to operate the new equipment? What can we do to ensure that the installation of new equipment will not disrupt current operations? 	<ul style="list-style-type: none"> What can we do to demonstrate the necessity of replacing our legacy system? What planning is involved in systems development? What can we do to secure support for a new system that meets our users' mission needs? What can we do to obtain the support necessary to fund a new system? What can we do to minimize resources spent and maximize system performance? What can we do to develop a shared system with other state and local entities? What can we do to ensure the needed level of interoperability with required organizations? What can we do to ensure system acquisition is technically correct and cost-effective? What can we do to ensure a smooth transition to the new system free from disruptions to emergency operations? 	<ul style="list-style-type: none"> What can we do to determine which LMR alternatives (e.g., conventional, trunked, hybrid) are appropriate for our radio system? What can we do to ensure requirements are met now and in the future? What can we do to ensure interoperability is adequately incorporated into system concepts and designs? What do we need to do to reuse or dispose of legacy system equipment? What can we do to ensure that adequate system equipment is procured? What can we do to ensure the radio system is built to our specifications? What can we do to ensure a smooth transition to the new system free from disruptions to emergency operations? After installation, what do we monitor to ensure the new system is operating reliably and at required levels? What can we do to ensure adequate training to support and maintain the new system? 	<ul style="list-style-type: none"> What can we do to demonstrate that the new system is more cost effective than the legacy system? What can we do to determine system funding options? What can we do to ensure that buying a new radio system is a cost-effective solution? What can we do to accurately quantify system cost? What can we do to sell the need for this system? What can we do to ensure that cost estimates are accurate? What can we do to ensure that adequate consideration of the project's financial risks? What can we do to hold down new system costs? What can we do to ensure the system development stays within budget? 	<ul style="list-style-type: none"> What can we do to help develop strategies for acquiring spectrum resources? What can we do to ensure sufficient spectrum assets to meet our needs? What process and paperwork do we need to complete to obtain needed spectrum assets? What coordination assistance is available to help with acquiring the needed spectrum? What mutual-aid frequencies are available to aid interoperability? What can we do to maximize the coverage of the system? What can we do to ensure vendor system designs use spectrum efficiently? What can we do to protect our frequency assignments from adjacent channel interference? 	<ul style="list-style-type: none"> What can we do to help develop site consolidation strategies? What can we do to evaluate whether existing legacy system sites are appropriate for the new system? What can we do to ensure our existing site infrastructure is appropriate for the installation of new equipment? What can we do to ensure our tower sites meet federal, state, and local regulations? What can we do to ensure vendor site designs meet our requirements? What can we do to ensure sites are built to our specifications? What can we do to ensure installed sites are adequately maintained? 	<ul style="list-style-type: none"> What can we do to ensure the system design meets security requirements for secure communications? What can we do to ensure administrative security of the new system? What can we do to minimize threats to our new system? What can we do to ensure the system design meets security requirements? What can we do to minimize system downtime in the event of a disaster? What can we do to ensure vendor security designs meet our requirements? What can we do to ensure that users understand security policies? What can we do to ensure that our security policies and procedures are effectively implemented? 	<ul style="list-style-type: none"> What can we do to assess which type of procurement is best (e.g., lease, buy, lease to buy)? What can we do to help develop equipment consolidation strategies? What can we do to understand available options for contracting with a vendor? What can we do to limit the possibility of a vendor contesting the award? What can we do to ensure that proposals received meet our specific public safety needs? What can we do to ensure that our contract terms meet our time and budget requirements? What mechanisms can we use to comprehensively evaluate each vendor? What can we do to ensure that our ongoing system maintenance requirements are being adequately met?
Critical Success Factors	<ul style="list-style-type: none"> User requirements are met Users are adequately trained Operations are not disrupted 	<ul style="list-style-type: none"> User requirements are met Project receives adequate funding, staffing, and support Project is completed within budget and on time Vendor meets contractual terms Operations are not disrupted 	<ul style="list-style-type: none"> System design meets requirements System design complies with federal, state, and local regulations Transition from legacy to new system does not disrupt operations Vendor's system installation meets design and performance specifications Technical support staff are adequately trained in system operation 	<ul style="list-style-type: none"> Project receives adequate funding and support Project costs are minimized Project estimates are accurate Costs are accurately monitored during the project 	<ul style="list-style-type: none"> Spectrum assets are obtained in time to meet schedule deadlines RF interference is minimized Frequency assignments are adequately maintained 	<ul style="list-style-type: none"> Tower sites comply with federal, state, and local regulations Tower siting disputes are limited Vendor's site installation meets design specifications Radio towers and other site structures are adequately maintained and secured 	<ul style="list-style-type: none"> Users requirements for secure communications are met System designs meet system security requirements Personnel understand and comply with security policies and procedures Security measures, requirements, and plans protect the system against possible risks and malicious actions 	<ul style="list-style-type: none"> RFP complies with federal, state, and local procurement regulations Equipment costs are minimized Vendors do not contest the award Vendors meet all contractual obligations



System Development Road Map

In the final analysis, the systems development road map identifies the many actions undertaken and completed by key staff members at appropriate times during the seven-step process. The road map highlights the need for input, cooperation, and coordination by members of each discipline at all phases of development. It also depicts common outputs that mark the end of each phase. Most significantly, the road map delineates specific actions that help guide systems development from the initial vision to actual operation of a LMR system—a critical resource enabling firefighters, emergency medical services personnel, and police officers to save lives and protect property.



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	1 Phase Strategy & Evaluation	2 Phase System Concept Development	3 Phase Requirements & Technology Analysis	4 Phase Design & Engineering	5 Phase Acquisition	6 Phase Implementation	7 Phase Operations & Maintenance
User Representatives	<ul style="list-style-type: none"> Analyze operational needs and expected changes Provide operational analysis results to program and system managers 	<ul style="list-style-type: none"> Ensure high-level concept supports current and projected operational needs Identify organizations with which users need to interoperate Promote high-level concept to users to facilitate buy-in 	<ul style="list-style-type: none"> Provide current and projected (5-year) requirements data to system planners Validate requirements analysis and projection results Define operationally suitable criteria for user equipment 	<ul style="list-style-type: none"> Review and help system managers refine interim system designs to ensure operational needs are met Identify training needs to ensure users understand how to use and take advantage of new technologies Help system managers develop operational scenarios for performance and acceptance testing 	<ul style="list-style-type: none"> Ensure functional specifications support operational needs Assist acquisition specialists in acquisition planning and execution 	<ul style="list-style-type: none"> Support acceptance testing Help program managers develop and implement systems training plan for users 	<ul style="list-style-type: none"> Ensure systems effectively support operational needs Continue to inform program and system managers of changes to operational and user requirements Continue to inform program and system managers of system performance
Program Managers	<ul style="list-style-type: none"> Assess how current system meets/does not meet mission needs Identify opportunities for and benefits of developing shared systems with surrounding or related jurisdictions Guide system managers in developing and scoping a preliminary system concept Analyze system affordability Develop an integrated set of management, organizational, funding, acquisition, technical, and operational strategies that support the system concept Identify the different audiences that need to buy-in politically and financially Develop a simple, easy-to-understand message to describe and justify new system development 	<ul style="list-style-type: none"> Develop high-level concept, consistent with strategic plans and expected funding Make interoperability a key driver in concept development Promote concept benefits to users, senior management, and high-level external organizations (e.g., city council) Establish program and performance metrics to set objectives and measure results If shared systems are possible, establish partnership agreements (e.g., memorandums of understanding) with other organizations to develop and manage the shared system Develop high-level risk management plan 	<ul style="list-style-type: none"> Ensure user representative(s) and system managers and technical support staff work together and share data Ensure technology analysis focuses on alternatives that are feasible and consistent with expected funding Communicate requirements and how they relate to the new system development, to senior management, and to high-level external organizations (e.g., city council) 	<ul style="list-style-type: none"> Provide overall direction and oversight to system planners Develop risk mitigation strategy Review risks and set priorities 	<ul style="list-style-type: none"> Obtain political and financial support to initiate acquisition Establish technical and cost evaluation panels Ensure acquisition planning complies with all prevailing rules, policies, and procedures Continue risk management 	<ul style="list-style-type: none"> Ensure implementation meets program milestones and can be supported with staff resources Develop and implement systems training plan for users Continue risk management 	<ul style="list-style-type: none"> Monitor how the system supports operations Conduct annual reviews to determine design refinement needs and consider technology refreshment If shared system, continue to review the interrelationship and coordination among member organizations Identify additional system equipment needs Monitor regulatory environment for new regulations affecting tower sites
System Managers & Technical Support Staff	<ul style="list-style-type: none"> Evaluate legacy systems at or near replacement age Develop high-level assessment criteria Evaluate system performance based on established procedures 	<ul style="list-style-type: none"> Analyze system alternatives Develop and implement systems engineering management plan (e.g., interface integration, configuration management, quality assurance) Develop and implement procedures to assess and mitigate technical risks Perform baseline assessment of legacy system Develop network management plan Acquire site support tools (e.g., software, test equipment) as needed Include interoperability as a part of system concept development 	<ul style="list-style-type: none"> Develop high-level system design Assess complementary systems (e.g., data) and current and emerging technologies' ability to satisfy program requirements Determine the extent of resource sharing and interoperability required Develop system supportability, reliability, maintainability, availability requirements and performance metrics Develop technical and functional specifications Determine reusability of legacy assets based on user requirements Analyze traffic patterns and forecast expected growth Determine user operational requirements and forecast expected growth 	<ul style="list-style-type: none"> Establish overall technical approach Develop technical and operational architecture based on system specifications Develop cost-effective system design that satisfies requirements Include the needed level of interoperability in system designs Develop detailed test procedures Develop system transition plan Determine how to incorporate legacy assets into system design Validate user requirements Validate system requirements Develop system acceptance test plan 	<ul style="list-style-type: none"> Schedule new equipment procurement and installation Help acquisition specialists evaluate proposals to ensure system requirements are adequately met 	<ul style="list-style-type: none"> Establish procedures to ensure technical requirements are satisfied Develop and implement site activation plan Monitor installation and construction activities to ensure work quality Update as-built documentation Phase out legacy system consistent with transition plan Schedule disposition of legacy equipment Verify system acceptance plans Perform system acceptance tests Optimize system after testing is complete Develop operations, systems, and maintenance manuals Coordinate mission operations with transition activities Develop systems administration training procedures for technical support staff 	<ul style="list-style-type: none"> Monitor network management Develop and maintain a repair/service center Perform preventive equipment maintenance Procure miscellaneous equipment Establish procedures to continually track performance status Identify additional system equipment needs Monitor regulatory environment for new regulations affecting tower sites
Budget Specialists	<ul style="list-style-type: none"> Assess financial position Help program manager develop a funding strategy 	<ul style="list-style-type: none"> Evaluate cost effectiveness of system architecture alternatives Estimate system life-cycle cost Establish project cost baseline Develop and document financial business case Formulate and defend budget Establish budget-tracking mechanism 	<ul style="list-style-type: none"> Develop cost model and analyze system affordability Develop detailed cost estimates Establish mechanisms to minimize cost risk 	<ul style="list-style-type: none"> Help program managers pursue strategies to save money and avoid costs 	<ul style="list-style-type: none"> Track and compare the budgeted and actual costs to ensure acquisition is within budget Establish cost variance reporting and analysis criteria Help procurement specialists in implementing price-reducing acquisition strategies Help procurement specialists evaluate vendor cost proposals 	<ul style="list-style-type: none"> Continue to monitor cost performance by evaluating budgeted versus actual costs 	<ul style="list-style-type: none"> Oversee operational expenditures Develop and implement cost-sharing and internal billing mechanisms Ensure operations, maintenance, and eventual system replacement as a part of planned budgets
Spectrum Managers	<ul style="list-style-type: none"> Define high-level spectrum needs Coordinate spectrum plans (e.g., sharing, exchange) with all potential users 	<ul style="list-style-type: none"> Inventory spectrum assets Determine availability of spectrum resources Select frequency band based on operational needs and other constraints Based on system and user requirements, complete and submit application for license through the appropriate frequency coordinator to the FCC 	<ul style="list-style-type: none"> Determine bandwidth requirements Evaluate propagation characteristics of each available spectrum band 	<ul style="list-style-type: none"> Analyze coverage Develop coverage test plan Evaluate potential RF interference with adjacent channels 	<ul style="list-style-type: none"> Assist procurement specialists evaluate the channel plans in vendor proposals 	<ul style="list-style-type: none"> Perform coverage tests to evaluate system coverage Address legal issues associated with adjacent channel interference 	<ul style="list-style-type: none"> Renew licenses and inform the FCC of any changes to existing licenses or assignments as required Monitor regulatory environment for new or changed regulations affecting spectrum
Site Managers	<ul style="list-style-type: none"> Help program manager identify potential consolidation opportunities to be included in the strategic plan 	<ul style="list-style-type: none"> Develop site survey criteria Identify site support tools required (e.g., software, test equipment) 	<ul style="list-style-type: none"> Determine the required level of antenna and site equipment Determine quantity, type, and accessibility of sites Determine all radio tower site requirement including FCC, FAA, building, and zoning Conduct radio tower structural analysis 	<ul style="list-style-type: none"> Determine radio site configuration as part of the overall design Track site survey information Develop site acceptance designs Develop site acceptance test plan 	<ul style="list-style-type: none"> Prepare construction procurement documents Help procurement specialists develop RFP site specifications 	<ul style="list-style-type: none"> Supervise vendor construction and installation of towers and site equipment Verify site acceptance designs Perform site acceptance tests Help system designers decommission radio tower sites 	<ul style="list-style-type: none"> Manage maintenance of towers and other buildings or structures Monitor regulatory environment for new regulations affecting tower sites
Security Specialists	<ul style="list-style-type: none"> Ensure inclusion of security as a driver or need in planning/justification documents 	<ul style="list-style-type: none"> Assess system-level design needs for security Develop security policy 	<ul style="list-style-type: none"> Define security requirements Help system managers and technical support staff determine user security requirements Develop disaster recovery plan Develop security plan 	<ul style="list-style-type: none"> Develop and perform design-phase threat assessment Develop system security designs based on requirements 	<ul style="list-style-type: none"> Help procurement specialists develop RFP system security specifications 	<ul style="list-style-type: none"> Develop and perform security tests and evaluation 	<ul style="list-style-type: none"> Assess operational security threats Develop configuration management plan Provide periodic security training Update security plan annually
Procurement Specialists	<ul style="list-style-type: none"> Help program manager identify potential consolidation opportunities and other contract cost-saving measures for the strategic plan 	<ul style="list-style-type: none"> Evaluate available contract mechanisms Develop acquisition strategies (e.g., sole source or RFP) 	<ul style="list-style-type: none"> Develop acquisition plan Develop functional specifications Determine system phasing 	<ul style="list-style-type: none"> Develop evaluation criteria Identify qualified vendors 	<ul style="list-style-type: none"> Develop and distribute RFP Hold bidders conference Hold vendor oral presentations Evaluate proposals and vendors based on evaluation criteria Negotiate contract and schedule 	<ul style="list-style-type: none"> Ensure performance of contractual obligations 	<ul style="list-style-type: none"> Coordinate with vendor for additional system equipment needs in accordance with contract Coordinate with vendor for system maintenance in accordance with maintenance contract
Outputs	<ul style="list-style-type: none"> Strategic Plan 	<ul style="list-style-type: none"> Concept of Operations 	<ul style="list-style-type: none"> Needs Assessment Implementation Plan 	<ul style="list-style-type: none"> System Design 	<ul style="list-style-type: none"> Request for Proposal Buy Decision 	<ul style="list-style-type: none"> New LMR System 	<ul style="list-style-type: none"> Network Management Plan Quality of Service Metrics

land mobile radio