A STEP-BY-STEP GUIDE FOR MISSION CRITICAL RADIO SYSTEM UPGRADES OR REPLACEMENTS

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Agencies throughout the nation are encountering increasing pressure to upgrade or replace their radio system. Many users are facing a reduced availability of parts because their existing system is reaching the end of its support lifecycle. Population growth is driving the need for system expansion to address coverage and capacity. Thousands of systems still have not addressed the Federal Communications Commission (FCC) mandate to migrate all VHF/UHF wideband systems to narrowband (12.5 KHz) operation by the end of 2012. The need to improve interoperability continues to pressure older technology systems as new and more innovative technology, offering enhanced features becomes available.

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Public safety agencies and other mission critical radio system users should use these steps as a guide when they replace or upgrade their radio system:

1. Organize the right stakeholders.
2. Assess the existing system.
3. Develop a strategic roadmap and begin master planning.
4. Evaluate existing technology platforms and reach a consensus.
5. Implement the new system and develop project timelines.

This white paper is designed to assist land mobile radio users preparing for system replacement, expansion or upgrades. It is based on our experience helping agencies throughout the country and includes a logical step-by-step approach to radio system replacement.

- Organize the Right Stakeholders.
- Assess the Existing System.
- Develop a Strategic Roadmap and Begin Master Planning.
- Evaluate Technology Platforms and Reach a Consensus.
- Implement the New System and Develop Project Timelines.
Funding and Availability of Radio Spectrum

Although funding and determining the availability of radio spectrum are not official steps in the process, they are critical components of any system upgrade.

Funding

Funding is historically the most imperative consideration during the replacement or upgrade process. There are a variety of funding sources that could support radio system replacement or upgrade goals, including federal programs such as Homeland Security and Assistance to Firefighters grants or earmarks pursued through federal representatives. Other funding solutions could include bonds, leasing and purchasing agreements.

Radio Spectrum Availability

Spectrum availability should be your second consideration. Obtaining sufficient clear spectrum to upgrade a system or build a new system can be a challenge. Identifying and licensing the right frequency spectrum and number of necessary channels takes time and effort in many areas of the county, even for public safety applications. Address this responsibility early in the upgrade and replacement process.

Step 1: Organize the Necessary Stakeholders and Partners

The bulk of the fixed public safety infrastructure may remain the responsibility of the county or organization that builds the new radio system. However, there are many stakeholders who have vital interests in the procurement of a new system. It is prudent and appropriate to involve all major system users when developing a new communications system because they may have specific financial and operational interests, especially during the negotiation stage with vendors and during vendor selection.

There are a variety of ways to include the associated stakeholders in the decision-making processes. The most effective way is to select a committee representing the operational partners, and in some cases, the financial partners that will be involved with system procurement. Ideally, committee members should bring together a mix of technical and operational knowledge and should be able to represent and make commitments on behalf of the organizations they represent.

L.R. Kimball’s experience demonstrates that in order to be fully effective, the committee should be relatively small with no more than 8-10 members. We also recommend that the committee meetings and discussions be lead by an independent third party whose role is to facilitate and provide structure and guidance. Independent or third parties can help facilitate the decision making process without vested interests. The bulk of the fixed public safety infrastructure may remain the responsibility of the county or organization that builds the new radio system.
Step 2: Assessing your Existing System

To ensure an understanding of the issues and shortcomings of an agency’s current system and devise a plan for the future, L.R. Kimball recommends the agency first assess their existing system and its capabilities. Use this checklist as a guide.

- Coverage
- Capacity
- Interoperability
- Radio dispatch console system
- Connectivity—microwave, fiber, leased lines, bandwidth
- Base stations/repeaters
- Frequency plans
  (as noted earlier, this can have a major impact on planning)
- System loading and capacity requirements
- Talk group requirements
- Site facilities
- User equipment
- Data infrastructure
- System management applications
- Network security systems
- Cost of ongoing software and maintenance

A successful assessment is one that focuses not only on the technical aspects of the system, but also on the user’s operational needs. Technology can be designed to serve operational needs, but only if those needs are defined and considered. L.R. Kimball has found that it is important to work with an independent or third party firm when assessing and defining the operational needs rather than system or equipment vendors and representatives. The vendor community will play an important role in system implementation. However, compatibility with their unique product can sometimes influence their proposed solution. Take the time to develop a thorough understanding of the technical and operational gaps in the current system and use this information to perform an unbiased examination of potential solutions in order to ultimately select the best upgrade path.

Using Surveys During a System Assessment

Objective and unbiased surveys of the primary system users and stakeholders play an important role when determining the operational needs of the users. The findings and interviews will:

- Provide an understanding of the current equipment inventory
- Identify any special or unique system coverage issues as well as current and future coverage requirements (locations, buildings, etc.)
- Determine coverage deficiencies experienced with the current systems
- Recognize feature and equipment requirements that must be supported
HIGHLIGHTS

A frequency inventory will help predict the amount of environmental noise, interference, coverage deficiency, unusable equipment and communications irregularities that might exist when expanding, upgrading or replacing an agency's system.

The survey should be developed with a final objective in mind and the nature and tone of questions should be considered. It is important to be sensitive to a wide range of respondent dynamics, which can include anything from local politics to the technical knowledge of the respondents. Inputs from the stakeholder community can provide initial insight into key areas and can help to communicate the need for accurate responses to the users they represent.

Another benefit of interviewing the system's users is the opportunity it presents to educate stakeholders about the reasons for upgrading the system. Based on L.R. Kimball's experience, successfully developing and securing funding for significant changes or upgrades to public safety radio communications systems requires the buy-in and full support of all stakeholders, including the user community. Seeking stakeholder input demonstrates that their needs are being heard and documented. It also provides an excellent opportunity to begin educating them on the goals, issues and occasional limitations.

Conducting a Current System Inventory

On the technical side, L.R. Kimball also recommends performing an inventory of all system assets. This information will be extremely useful when assessing the various aspects of the upgrade plan, from identifying equipment that may be impacted by the narrowbanding mandate to understanding what elements might be reused in a new system.

Frequencies are often overlooked and can sometimes be the most difficult element to inventory, evaluate and obtain. A complete frequency inventory consists of two primary elements.

- The frequencies that are being used
- The frequencies others in the operational area are using

Without considering both of these elements, a proper analysis cannot be performed and environmental noise, interference, poor coverage, unusable equipment and communications irregularities could eventually result. As discussed previously, frequency assessment and planning is important because it is often a limited, yet necessary requirement for expanding, upgrading or replacing an agency's system.

Step 3: Developing a Strategic Roadmap and Master Planning

A strategic roadmap should be developed from the data gathered and analyzed during the assessment step. Benchmarks in current technology, system lifecycles, interoperability and operational trends should be established and recommendations should be developed. Typically, recommendations provide more than one conceptual design or solution. Agencies should consider the cost estimates for acquiring and implementing as well as for ongoing maintenance and operations.

Strategic roadmaps should include a gap analysis that aids in identifying any unmet challenges, such as coverage and capacity problems, reliability and usage issues and desired feature improvements. Benchmarks are keys to
identifying gaps. In addition to specific voice and data technology wish lists identified through the gap analysis, some of the other factors you may need to consider before moving forward include:

- Industry trends to standards (P25 and similar)
- Interoperability requirements and consistency with your statewide interoperability plan
- Redundancy and reliability improvements in the infrastructure
- Potential effects on operations and requirements of dispatch center
- Integration of mobile data and voice on the system
- Potential interconnectivity to Next Generation 9-1-1
- Ongoing operational problems for users
- Changing coverage requirements
- Interest in enhanced features
- Regulatory and spectrum requirements including FCC mandated migration from wideband (25 KHz) to narrowband (12.5 KHz/6.25 KHz) in VHF (150-174 MHz) and UHF (450-512 MHz) bands
- Frequency band performance characteristics
- Frequency availability
- The need for and availability of additional tower sites

Standards-based technology and interoperability always generate a lot of debate and are worth further exploration.

**Standards-Based Technology**

For public safety systems in North America, the current standards-based technology platform is the Association of Public Safety Communications Officials (APCO) Project 25, also referred to as the P25 or TIA-102 digital standards. The P25 standards can apply to conventional systems as well as trunked systems and have been endorsed by virtually all major public safety organizations. The federal government has adopted P25 as the standard for all federal agencies. Most federal funding streams are qualified by the candidate’s participation in P25 technology.

There are some additional reasons to specify the P25 standard, such as:

- Standards-based shared systems provide the highest level of interoperability.
- The competitive pricing of subscriber equipment from multiple manufacturers should reduce the cost of the initial purchasing of field equipment and replacing field equipment over the system's lifecycle.
- P25 system offerings are available from multiple system vendors. This increases competition and the number of choices in architecture and design approaches that meet different needs and budgets.
- P25 standards continue to grow and evolve as standards supporting areas allows connection between different vendor systems and define the migration to the P25 Phase 2 TDMA next generation of digital radio.
Interoperability

One of the largest goals of any emergency communications system upgrade is to provide interoperability for emergency response personnel. In general, interoperability refers to the ability of emergency responders to communicate with other responders and their systems or equipment. The most ideal scenario is one where the ability to interoperate is seamless and occurs without any special effort. When communications systems are interoperable, police and firefighters responding to a routine incident can talk directly to each other, or equally important, can communicate with a common incident command post or dispatcher who is in charge of coordinating efforts.

Clearly, communications interoperability makes it possible for agencies responding to catastrophic accidents or disasters to work together. Effective interoperability plans enable emergency response personnel to maximize their resources for predictable events and for disaster relief. Understanding and considering the system users’ operational challenges is a key element to understanding their interoperability needs. Once these needs and current gaps are understood they can be translated into the operational and performance requirements of the new or upgraded system as well as to the appropriate requirements of the subscriber units that will be used on the new system.

Step 4: Technology or Platform Choices and Consensus

At this point in the technology upgrade or replacement roadmap one or more approaches have typically emerged. These approaches could involve changes in technology such as moving to digital or to trunking or system architectures such as simulcast. Often, the upgrade may also require adding additional sites to improve coverage.

In some cases, there may be factors such as limited-frequency-availability that make the choice of the system upgrade platform clear while in other cases there might be more than one viable approach to addressing the user’s needs. Of course, budget considerations will always play a role in the decision. L.R. Kimball encourages agencies to engage the stakeholder committee in this discussion and decision for a number of reasons.

- This committee represents the ultimate users of the system and they should have a voice in evaluating the choices that best meet the needs of those they represent.
- Upgrade or replacement to a modern highly reliable radio communications system can be a significant expense. In seeking funding for the new system, it will be important that there be solid consensus behind both the need for the upgrade as well as the choice of the technology platform.

Step 5: Performance Requirements and Procurement Documents

Once a consensus strategic plan or technology choice has been developed, funding approval is the next step for system procurement. For most government entities the procurement vehicle is likely to be a bid, or request for proposal (RFP) process although there are occasions where existing contract vehicles
may be used. These decisions are generally locally-driven based on applicable regulations and should be discussed with your purchasing or legal departments.

**Determining the Procurement Approach**

Two different alternatives are often compared in the procurement phase—seeking proposals on a turnkey basis or releasing several RFPs for major elements of the project.

**Approach One: Turnkey**

In a turnkey approach, proposals for all the elements required for building and implementing the system are addressed in a single procurement document. Responses are sought from vendors who will act as the prime contractor, often providing a mix of elements they might manufacture themselves and elements from third parties that they package to create a total system.

Some advantages offered by a turnkey approach:

- There is one single point of responsibility for the entire system
- There is one single vendor who acts as the general contractor that provides and installs all of the system's components

The convenience of this approach comes with a higher price in comparison to procuring the major elements independently. The vendor acting as the general contractor will normally mark up the third party equipment to account for their expenses. A cost for having overall system responsibility will be charged, especially in the case of a performance-based contract. Typically the overall total cost of a turnkey procurement will be higher than the cost of separate procurements of the individual elements. An honest assessment of the organization's ability to take on the coordination role or act as the general contractor if they elect to separate the procurements will impact their decision. This may not be an option for many organizations.

**Approach Two: Separate Procurements or RFPs**

Alternatively, an agency may elect to procure varying major elements of the overall system through separate procurements or RFPs. For example, an RFP for the radio system itself along with elements such as dispatch consoles, subscriber units, etc. could be developed and separate RFP’s for microwave or other connectivity tower/shelter/civil work could be procured via a separate RFP.

**Soliciting an Outside Project Manager**

One alternative to a turnkey approach to consider is a third party such as a project manager or consultant that would be engaged to coordinate separate procurements and different contractors. This approach provides the necessary resources and time to coordinate multiple vendors and allows overall savings.
Developing Detailed Performance Specifications

Regardless of the procurement process selected, it is essential that detailed performance specifications be developed for the new system as a means to convey to the vendor community exactly what requirements and expectations exist. Typically these requirements will be conveyed in the form of a Request for Proposal (RFP) to solicit solutions from multiple vendors. They should address specific coverage and capacity requirements, detailed specifications for system performance and define the corresponding method by which the system will be evaluated and tested.

The user requirements identified and defined during the needs assessment will help dictate coverage requirements specified in the RFP and ultimately be reflected in the system design. In addition to capturing and defining the functional and operational features and requirements of the system one of the most critical challenges is to accurately define coverage requirements.

User input can be utilized to prepare grid maps of the required coverage area boundaries where differing levels of coverage may be required. They may also be used to identify any other critical areas where specific gaps or unique coverage requirements might exist.

Required coverage area that may extend beyond jurisdictional borders should also be considered. Although a radio system may not be able to provide coverage to every possible location where mutual aid could be requested, areas of frequent mutual aid responses should be included. Other technological solutions may also be required to provide interoperability for mutual aid beyond user’s primary service area.

Evaluating Vendors on a Level Playing Field

Once vendor responses or proposals are submitted, the procurement process moves to the evaluation and award phase. In order to insure a competitive and level playing field and a fair evaluation process, L.R. Kimball recommends defining evaluation and scoring criteria before proposals are submitted. In fact, we suggest that the RFP provide vendors with at least an overview of the evaluation process and areas of scoring priority so they can fully understand how they will be evaluated and the eventual basis of the contract award.

Defining the evaluation criteria and assigning point values and weighting factors before proposals are submitted helps assure that an open and straightforward evaluation is designed to award the best overall proposal. Each jurisdiction must determine for themselves the specific areas of priority and point weighting that will apply. Once you establish these areas and criteria, we recommend developing and using specific questions, itemized lists and scoring sheets. These scoring sheets can be provided to the evaluation committee members so that everyone is working from the same sheet of paper.

During the evaluation process and contract negotiations it is common to conduct oral presentations that allow the vendors an opportunity to present an offering overview and address questions. Some jurisdictions also allow for a “Best and Final Offer” (BAFO) stage as part of the procurement process. Regardless of the specific steps or process of evaluation, we recommend that all of the parties
HIGHLIGHTS

Assign a full-time project manager who has the time and authority to oversee and manage a large-scale technology project.

involved and that evaluation committee and vendors be provided with written information describing the “rules of engagement”, contact points and process overview.

Step 6: Implementation

Ideally the new system would be installed without disrupting any day-to-day communications or the existing system’s elements. Unfortunately, this ideal is rarely a reality. The new system often has to be implemented using some or all of the current sites or facilities and in some cases may even need to use existing system frequencies.

Even when the new platform can be implemented with minimal disruption or reuse, users must be cut-over to the new system in the least disruptive fashion. All-in-all the planning and coordination required for a modern upgrade will be a complex undertaking involving everything from manufacture and delivery of hardware and software to construction of facilities. In most areas, permitting, zoning and other local regulations must also be addressed as well as proper FCC licensing of the frequencies and spectrum used in the system itself.

In general, an agency should identify a full time project or implementation manager who has the time and authority to oversee all the various tasks and coordination required to successfully implement a large-scale technology project. Even if an agency has chosen a turnkey procurement approach, there are still substantial responsibilities and decisions that will need to be made by the system’s owner.

Some of these responsibilities and areas to monitor during implementation include:

• Technical design reviews and monitoring
• Transmission site acquisition and coordination
• FCC licensing and permits
• FAA permits
• Schedule and task coordination and integration oversight between multiple vendors
• Develop and document demarcation points between vendors and system elements
• Radio equipment inspection and punch lists
• Facility inspection and punch lists
• Final punch list development and resolution
• Authorize and witness final testing
• Cut-over plan development
• Monitor cut-over and non-fixed installation
• Review and coordinate training plan
• Review as-built documentation
HIGHLIGHTS

Create realistic expectations among end-users and stakeholders to help drive greater success and buy-in for any radio system upgrade or replacement project.

- Final inspection
- Approve acceptance
- Identify appropriate disposal method for old equipment and oversee its disposition

One key aspect of the overall implementation process is regular status meetings and associated written status reports from the responsible players. These status meetings and written reports are invaluable when tracking and addressing all of the numerous issues and changes that can occur during a long-term large project. Maintain a written record of issues and assignments to ensure that all involved parties are working together and that roadblocks are being addressed.

Developing Project Timelines

One of the most underestimated elements of this entire process is the time it can take to fully-accomplish the project. A common mistake is that the agency bypasses the assessment phase or spends an insufficient amount of time to completely gather the operational and technical inputs necessary. This can result in a system that has not been built to provide for the current or future operational user needs. Because most systems are implemented in the midst of funding constraints, operational shortfalls and diverse opinions, the outcome could be a rushed and under-built system that may not support public safety and first responder needs during a time of crisis.

Understanding the realistic timeframes needed to properly develop and implement a modern communications network and communicating these realistic timelines to the stakeholders is an important part of establishing expectations from the beginning of the project. Some realistic typical timeframes for each of the major steps described in this paper are:

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<tr>
<th>Step</th>
<th>Timeframe</th>
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<tbody>
<tr>
<td>System assessment</td>
<td>90 to 120 days</td>
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<tr>
<td>System procurement (if frequencies are licensed)</td>
<td>6 to 9 months</td>
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<tr>
<td>System implementation</td>
<td>12 to 36 months</td>
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<tr>
<td>New frequencies (if required)</td>
<td>12-18 months</td>
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Conclusion

The key elements of a successful upgrade or replacement of a land mobile radio system include:

1.) Assessment
   - Involvement and ownership of stakeholder committee
   - Meaningful understanding of needs
   - Managed expectations by a third party
   - Address operational and technical needs
   - Benchmarked analysis led by independent third party

2.) Procurement
   - A committee led by a third party
   - Decision on turnkey or major element procurement
   - Reflective performance based definition of operational and technical needs in RFP
   - Request for Proposal (RFP)—let the vendor explain their best method
   - Define evaluation criteria and process before proposals are submitted

3.) Implementation
   - Budget the proper and realistic amount of time.
   - Plan for project manager assignment
   - Status meetings and documented reports/assignments
   - Avoid phased approaches. Phased systems never receive the proper funding to be completed.
   - Develop methods to test and compare with written performance requirements.
   - Enlist the assistance of a third party to avoid the chaos of disparate opinions.

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