Background

In 1940, the Maine State Police put into operation their first two-way radio system – one of the first statewide systems in the USA, and has seen small upgrades over the years.

Today, however, State of Maine is now facing an unavoidable reality that its two-way mobile radio systems – ones that were based on the most modern technologies at the same time Ken Curtis was Maine's Governor and when cellular phones, home VCRs, and even the most rudimentary "personal" computer, had yet to be invented. Even though the State's team of radio technicians have demonstrated unmatched resourcefulness in keeping these systems afloat for long past their intended useful lives, these two-way radio systems are now four to five generations-obsolete, suffering from an increased number of outages, and critical spare parts are available almost exclusively through eBay™ auctions. Also compounding their obsolescence are upcoming deadlines from the FCC that require radio licensees such as the State of Maine replace their old radio systems with modern, spectrally more efficient equipment. Finally, the attacks of 9/11 also highlighted that communication interoperability and coordination between federal, State, and local public safety agencies in Maine is problematic at best…impossible at worst.

Modernizing Maine's current radio systems – especially addressing the expanding needs of public safety such that the system will remain in compliance with FCC regulations – is no easy task, however. A radio replacement project of this magnitude demands a significant long-term commitment, both in funding, logistics, and human resources drawn from all parts of State government. After years of failed attempts by previous administrations to build the consensus and financial support needed to commence with modernization, Governor Baldacci's office elected to move responsibility for its radio communications infrastructure under the most technology-oriented agency available: the Office of Information Technology (OIT). Applying the same project leadership and management processes proven successful on the largest telecommunication and IT networks, the OIT set up a formal Project Office to help organize and facilitate a new spirit of trust and cooperation among different State agencies now operating as a formalized, constructive, project steering committee, then later reengaging one of the USA's leading public safety radio communications system engineering firms, Macro Corporation, to provide technical design and expert guidance over the modernization project.

With the OIT, its project steering committee, and Macro Corporation, working together closely in a cohesive, complementary manner, the Macro team was able to turn the project into a "win-win" business case for the State's first responders and its taxpayers/bondholders. Building on a solid engineering framework completed several years ago by Macro, the project team has been able to formulate a new modernization strategy that, through OIT's leadership, now forecasts an affordable system with an estimated budget of $50 million.

OIT engaged Macro Corporation to complete a new conceptual radio system design and attendant implementation plan based on a digital, VHF statewide narrowband conventional platform. The initial "design" phase of this project is now complete, and stands ready to begin procurement activities. This paper serves to provide an executive-level summary of Macro's work.

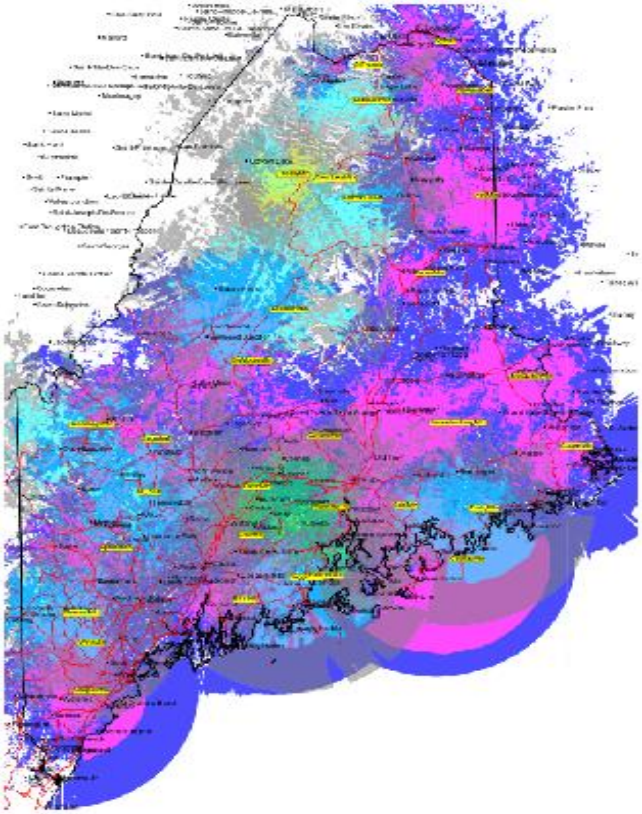
Findings

1. Rather than pooling resources, over time most State agencies instead chose to build out their own two-way radio network to their peculiar configuration and functional requirements: The following agencies use one or more largely obsolete, wide-band, analog, VHF two-way mobile voice radio networks that are owned, operated, and licensed by the State:

   - Dept of Public Safety (State Police)
   - Dept of Conservation
   - Dept of Inland Fisheries and Wildlife (Warden Services)
   - Dept of Defense, Veterans and Emergency Management (MEMA)
   - Dept of Marine Resources
   - Judicial Branch – Office of Court Security
   - Dept of Corrections
   - Bureau of General Services
   - Dept of Transportation

2. Collectively, the State owns and uses more than 4,200 two-way mobile and portable radios used on one or more of these different systems.
3. Radio communications, and particularly sensitive law enforcement issues, are subject to public eavesdropping using inexpensive frequency scanners available from many retail electronics merchants.
4. Although the agency with most radios is the DOT (approx. 1,800 units), because of their public safety responsibilities, the State Police (over 1,000 units) still places the most significant demand on their system over all other Maine state agencies in terms of *usage*. The overarching principle is to meeting the State of Maine's public safety needs.
5. Much of this equipment is obsolete, no longer supported by the manufacturer, and spare parts are scarce, very expensive, or increasingly no longer available at all. The average age of the State of Maine's radio communication system infrastructure is 26 years old.

6. The State's radio systems eventually will not comply with the FCC prevailing rules and regulations governing their licensing and operation.
7. Coverage available from these different systems is not uniform or complementary, resulting in significant overlap in some regions of the State at the expense of no coverage in other, large but more austere, regions.
8. The different system's radio towers and dispatch centers are interconnected by a variety of aging analog microwave and spread-spectrum wireless radio, and leased T1 wireline, links. These links are susceptible to occasional outages due to equipment failure, prevailing geography, uncertain quality of service-performance, or poor atmospheric conditions.
9. With few exceptions, communications interoperability between different agencies is both cumbersome and time-consuming to affect, if possible at all – particular during significant emergencies requiring response by several different State and local agencies at one time.
10. Several State-owned tower sites are in varying degrees of disrepair, including not providing the intrusion and weather protection measures appropriate for housing today's remote, mission-critical, high-value, two-way radio equipment.



Design Approach (Highlights)

New VHF Radio System

- Consolidates all State agencies onto one, fully modernized, digital, narrow-band (12.5 KHz), VHF conventional (non-trunked) two-way land mobile radio system, while allowing each agency to communicate independently and privately.
- New mobile and portable radios (note: recent upgrades to dispatch radio consoles are planned to be preserved in the new system)
- Improved radio coverage, voice quality/clarity, and channel capacity
- Complies with upcoming FCC rules, regulations, and deadlines
- More securely and seamlessly interoperable across all levels of government
- Superior reliability and fault tolerance

- Improved standardization of equipment

Upgraded Interconnection Network

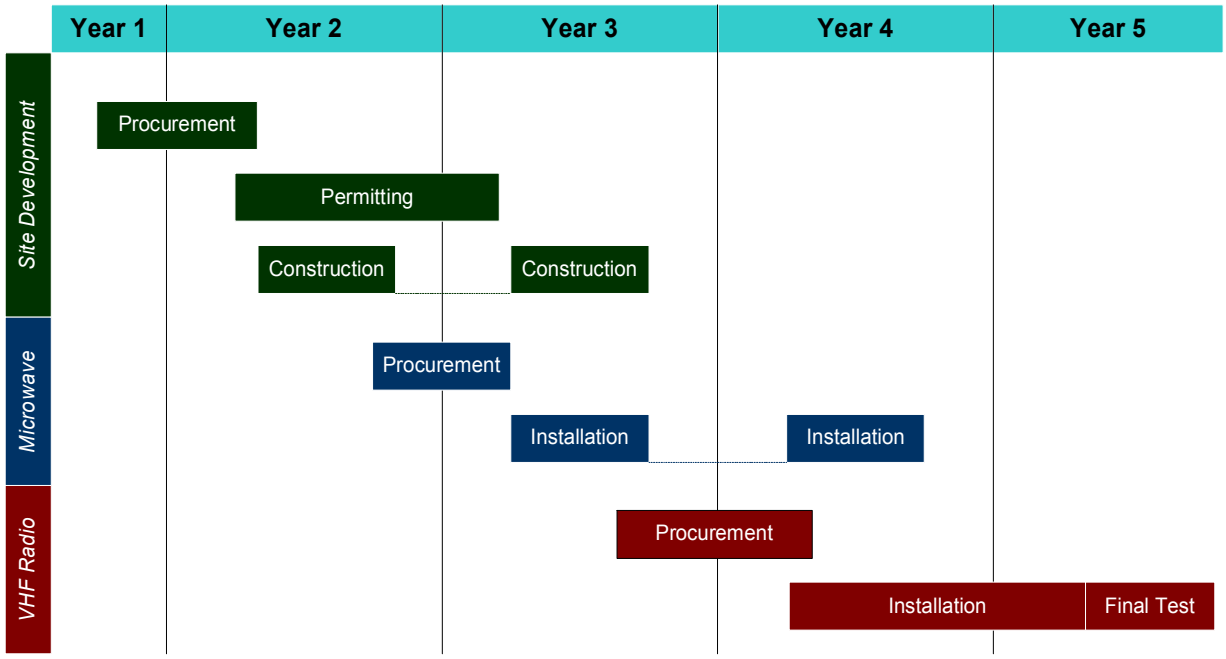
- Heterogeneous radio tower and dispatch site interconnection network architecture, featuring:
  - Digital 6 GHz and 11 GHz microwave long-haul links
  - Spread-spectrum 960 MHz and 450 MHz short-haul links
  - Bandwidth: OC-3 (155 Mb/sec).
  - Loop and monitored hot standby-protected configuration for maximum reliability performance
  - Improved, more flexible and cost-effective bandwidth
  - Centralized manageability
- Offers significant spare capacity available for use by other State and local government agencies
- Highly expandable and scalable in order to connect other sites, State buildings, and even local governments, in the future

Facilities/Leasehold Upgrades

- 42 upgraded / updated radio and/or microwave tower sites
- Improved site security, weather resistance, grounding, etc.
- Ecologically friendly to wildlife
- Efficient and reliable primary and back-up power systems

Implementation Plan

The system is planned to be procured and implemented across several years in order to better spread out and minimize the financial burden on State budgets, while also ensuring that such a "phased" deployment approach does not isolate State expenditures in prior phases nor demand an additional investment in a forthcoming fiscal budget. In other words, no one implementation stage is intended to become an "island", largely unusable to the State, should future funding dry up:



As the preceding presentation of the "Design Approach" suggests, the implementation plan presented above breaks up the system into three (3) logical subsystems: VHF radio, microwave backhaul, and site improvements. Other plans are still being considered that might possibly yield more favorable cost and risk outcomes. The OIT, therefore, will continue to assess and maintain a consensus-driven decision-making over these other implementation strategies.

Because of the short construction season common for the State of Maine, this plan suggests that the State initiate work first on the assorted tower sites to include securing access, followed shortly by the procurement and installation of the microwave backhaul network. It is presently planned that a system integrator and construction manager will be utilized for all site work. Installation and commissioning of the new, state-of-the-art, statewide digital VHF conventional radio equipment will be performed as the new microwave system is being deployed.

Cost Estimate

The following cost estimate for the VHF radio, Microwave, and Site Development subprojects is based upon a database of vendor prices and implementation cost history that Macro Corporation has built over the course of nearly 100 other state, county, and local public safety radio system engagements completed over the last decade. The estimates for each of these subprojects have been summarized into the following categories:

	Estimated Cost
VHF Radio Subsystem	$24,861,026
Microwave Subsystem	$10,142,873
Site Development	$8,776,460
Radio Project Office	$4,069,547
Technical Support	$1,174,890
TOTAL	***$49,024,796***

- VHF Radio Subsystem – Digital, conventional mobile radios, portable radios, and base station repeaters, antenna systems, power supplies, installation, and acceptance testing
- Microwave system – Digital 2 GHz and 960 MHz spread-spectrum microwave radios, waveguide & antenna systems, power supplies, installation, and acceptance testing
- Site Development – tower superstructures, secure equipment shelters, site access security, primary and secondary power systems, HVAC, grounding, etc.
- "Radio Project Office" - State personnel to staff RPO to oversee procurement, installation, acceptance, and commissioning of MSCommNet
- "Technical Support" - Outside technical/project implementation consultant to support RPO to oversee procurement, installation, acceptance, and commissioning of MSCommNet

Recommendations

- Immediately commence site improvement-phase of statewide VHF narrowband digital radio system plan by preparing scope of work statements, development proposals, and development strategy, for groundbreaking in 2007. Microwave and VHF radio subprojects to follow.
- Formalize and staff a Radio Project Office (RPO) under OIT, including project manager, staff engineers, and administrative staff.
- Organize and launch a constituency outreach program for building political and financial support at local government-levels.
- Constitute a system governance structure under a set of fair and equitable bylaws.