

MARIN EMERGENCY RADIO AUTHORITY

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DATE: June 26, 2019
TO: MERA Next Generation Project Oversight Committee
FROM: Ernest Klock, Operations Officer
SUBJECT: AGENDA ITEM H: Contract Change Order #8 - MPLS

Recommended Action: Provide recommendation to be forwarded to the MERA Governing Board regarding the inclusion of Multi-Protocol Label Switching (MPLS) in-lieu of Layer 2 as part of the microwave system for the MERA Next Gen System project.

Discussion: The MPLS contract change order #8 (CCO#8) item has been presented at various meetings including: the September 5, 2018 Operations Working group; the September 12, 2018 joint meeting of the Next Gen Project Oversight Committee and Finance Committee and a verbal report given to the subsequent Executive Board meeting. These items were further discussed at the September 26, 2018 Governing Board meeting. Since that time, additional research has been performed regarding options for MERA to implement this technology in the Next Gen System.

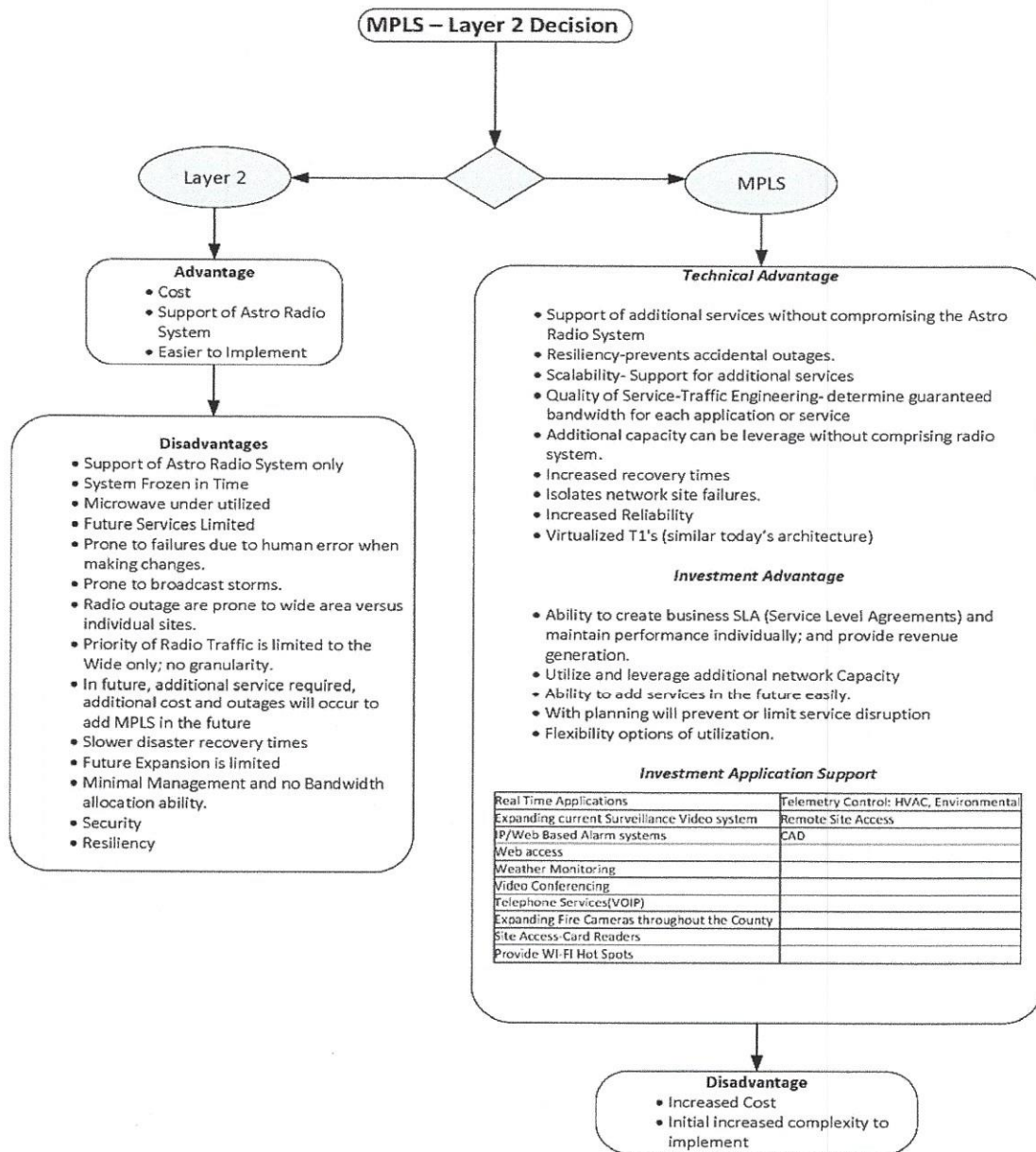
The NextGen System Request for Proposals (RFP) released in 2016 specified a digital microwave network as a replacement for the existing MERA microwave system. In addition to radio voice traffic, the existing microwave system includes other traffic such as FBI and CHP voice circuits, MERA technician troubleshooting tools, and security cameras for several MERA sites. The existing system can accommodate this traffic because of the method that the system uses to route data (called TDM). This technique (created in the 1960's) allows a small number of services to share a common link without interfering with each other. Using TDM, the existing MERA P25 voice radio traffic is transmitted in its own time slot on the microwave network and is therefore isolated from these other services.

At the time of the development of the Next Gen RFP, the presence of the non-Land Mobile Radio (LMR) traffic on the existing MERA microwave system was not clear, so accommodations for it were not required in proposer bids. Since the inclusion of these additional services was not required, Motorola proposed a microwave system that will use simple Layer 2 network protocols to route traffic on the network. After the non-LMR traffic listed above and other features were considered, MPLS was suggested as an alternative to accommodate these services, and CCO#8 was proposed.

The Layer 2 (Ethernet) equipment proposed by Motorola is a series (one per site) of network switches that creates one data "lane" and does not have the capability to "intelligently" manage the non-LMR traffic. A Layer 2 design can carry normal LMR traffic (made up of small bursts of data), but it cannot carry larger data packets such as video traffic, or CHP or FBI circuits without increased system vulnerability (due to feedback loops). In addition, the Layer 2 option is not as scalable when creating larger networks, or "broadcast domains", and the performance degrades if it is configured as such.

Motorola cannot guarantee system performance if Layer 2 is configured to carry the non-LMR traffic, so MPLS should be used if accommodation of these services is to continue.

Unlike the Layer 2 switches, the MPLS equipment is a series (one per site) of network routers that create several data “lanes” and can be configured to route each of the non-LMR services independently. Therefore, the LMR voice traffic can be isolated from the other non-LMR services to guarantee mission-critical voice is always available. A design using MPLS will increase the redundancy, reliability, and future flexibility for the NextGen System. The following diagram compares the two technologies.



Discussion of Options

Several options have been investigated for inclusion of the MPLS design in the Next Gen Project. A description of each option, the pros/cons, and costs associated with each are included in a comparison matrix (Attachment 1). Below is a summary table followed by a discussion on each item:

	OPTION 0	OPTION 1	OPTION 2	OPTION 3	OPTION 4
Description	Stay with Motorola Layer 2 per existing contract	Motorola implements MPLS now, before design complete	Motorola implements MPLS after Next Gen System Cutover	IPKeys implements MPLS after Next Gen System Cutover	Motorola implements MPLS now via Layer 2 SUAll credit
Cost - No SUA, no hardware refresh	\$0	\$640,562.86	\$1,076,162.86	\$326,132	~\$89,000
Additional Cost - 5 yr. SUA, Year 6 hardware refresh	\$0	N/A	N/A	\$623,559	N/A
Additional Cost - 15 yr. SUA, Year 6 hardware refresh	\$0	\$1,140,530	\$1,204,930	N/A	N/A

Option 0 – Keep the Current Layer 2 Motorola Design

This option involves no immediate actions, nor cost impacts to MERA, however, the non-LMR services will need to be terminated at cutover to the Next Gen System as Motorola will not support them on Layer 2. The FBI and CHP voice circuits would be disabled impacting those agency resources in the areas served, MERA technician troubleshooting tools would be disabled potentially increasing service time, and security cameras for several MERA sites would be disabled.

Option 1 - MPLS for the Microwave Network - \$1,781,092.86

CCO#8 includes the replacement of the currently proposed Layer 2 network architecture with MPLS network architecture for the NextGen System microwave network. The cost includes approximately \$640k in MPLS equipment and \$1.14m in SUAll services including one MPLS network refresh in year 6 after cutover to the Next Gen System. A complete list of non-LMR connections carried by the existing microwave network is provided in Appendix A within CCO#8 (Attachment 2). This list has been created in conjunction with County Radio Communications staff, MERA staff, and Motorola. This CCO#8 price is contingent upon implementation concurrently with the overall NextGen system design/implementation.

Option 2 - MPLS by Motorola After Next Gen System Cutover - \$2,281,092.86

This option includes moving to MPLS with a Motorola proposal after the Next Gen System is operational and pricing and scope of services are similar to CCO#8. Pricing cannot be guaranteed with this option as the hardware and services associated with this option would not be implemented for several years. Motorola has indicated that additional costs of \$400-500K over CCO#8 would be incurred if MERA elected to implement after the NextGen system goes live, depending on whether the System Upgrade Agreement (SUA) services are included. This item cannot be directly compared with IPKeys proposal as the SUAll services are for different terms – see below.

Option 3 – MPLS by Third-Party Vendor (IPKeys) - \$949,691

Because the MPLS portion of the system is an open standard and not part of the Motorola P25 system, nor is it directly dependent on the microwave equipment that has been installed, it can be competitively bid and replaced independently at a later date as needed. In order to evaluate the cost-competitiveness of Motorola's CCO#8, DPW solicited a proposal from IPKeys Technologies LLC to provide and implement MPLS protocols on the microwave network in addition to the Layer 2 design currently in the Motorola contract. The IPKeys design would require software changes and additional hardware. IPKeys was identified as a vendor with experience converting Motorola Layer 2 based networks to MPLS. The IPKeys proposal cost is \$566,132 for Cisco equipment, installation, implementation, and 5-year Cisco technical support services. A one-time technology refresh (hardware/software) is also proposed for Year 6 at an additional cost of \$383,559, yielding a total proposed cost of \$949,691. IPKeys would perform the upgrade work after the NextGen system goes live. Motorola has contracted with IPKeys for MPLS on other projects.

The Motorola/Nokia MPLS system included in CCO#8 includes equipment, installation, implementation (at a cost of \$640,562.86) plus 15 years technical support and a one-time Year 6 network refresh, including equipment (at cost of \$1,140,530). Yearly SUA technical support cost averages about \$50,000 per year. IPKeys was unwilling to submit a proposal for a 15-year technical support that was similar to Motorola's as IPKeys expects technology advances would likely render the system obsolete before the end of the 15-year term. This poses a risk if MERA intends to maintain the IPKeys/Cisco system beyond 5 years versus upgrade to newer technology. The \$326k cost to implement IPKeys/Cisco MPLS system (equipment only) is half that of Motorola/Nokia. Annual support services and hardware refresh costs appear to be roughly the same as Motorola/Nokia. It is critical to note that if MPLS is not integrated into the design effort currently underway and is postponed until after NextGen system goes live, and Motorola is selected to perform the work, MERA would face an additional \$400-500K in Motorola change order costs to implement the Motorola/Nokia MPLS at a later date. Further, there will be some cost from Motorola for facilitating the connection of third-party equipment to the Next Gen System – potentially \$50,000 not included in the prices herein. Finally, there could be some risk associated with Motorola warranties should an issue arise with third-party equipment.

Option 4 – MPLS now by Motorola via Layer 2 SUAII Network Refresh Credit - \$89,000

Motorola has offered an additional option that includes reducing the number of Layer 2 network refreshes from two to one during the fifteen-year lifecycle of the SUAII services in the existing contract. By eliminating the service agreement for one of the two included network refreshes and receiving SUA and layer 2 credits, the cost would be lowered to approximately \$89,000 for implementing MPLS hardware now. This approach provides the advantages of upgrading the microwave network at a lower cost while delivering the benefits of MPLS mentioned above.

The risk introduced by eliminating one refresh is an increase in long-term support as the system gets older, since there is a greater chance of running the equipment past its manufacturer-support life cycle. It should be noted that MERA has not refreshed its existing microwave system since the original installation, partly because of how TDM was able to support additional services. The flexibility of MPLS reduces the need to refresh the network as often because MPLS is able to support more configurations, similar to the existing TDM system. A Layer 2 solution is more likely to encounter limitations within its lifecycle, especially considering modern network design migrating away from larger layer 2 networks, thereby requiring more maintenance. This is likely why two network refreshes were included in the existing SUAII services.

With these considerations in mind, this approach can be a good compromise of lower cost while maintaining higher performance and system flexibility with reduced long-term risk. Costs for third-party SUAll type services for long-term maintenance can be developed further if this is an area of interest for MERA.

Summary

The attached matrix summarizes five options for consideration. Option 0 is a ‘do nothing’ option that continues the current design path pursuant to the Motorola contract utilizing a Layer 2 architecture. The other four options provide an upgrade to MPLS, either by Motorola or a third-party vendor.

Given that some existing diagnostic and security services will not be available in the Layer 2 microwave design that is currently planned, there will be increased maintenance costs and higher risk of system busy or temporary outages as technicians would have to drive to remote sites to diagnose certain system performance that currently is monitored remotely via the microwave network.

Another significant benefit of MPLS is that the vast amount of unused bandwidth on the new microwave network could be utilized for MERA to support applications (additional remote monitoring features, security cameras, etc.) and transmission of third-party traffic that could generate revenues for MERA.

Attachment 1 – Options Comparison Matrix

Attachment 2 – Motorola Contract Change Order #8

Attachment 1 - MPLS Comparison Matrix

OPTION 0	OPTION 1	OPTION 2	OPTION 3	OPTION 4
Take no action. Configuration in the original contract. Maintains Layer 2 architecture. Non-LMR services are not permitted on network.	Motorola implements MPLS now as part of current design of Next Gen System.	Motorola implements MPLS at a future date after the Next Gen system is accepted and in operation.	Third party vendor (IPKeys) implements MPLS at a future date after the Next Gen system is accepted and in operation.	Motorola implements MPLS now as part of current design of Next Gen System, paid for by reduction in Layer 2 SUAll services.
Layer 2 - used predominantly in single-use networks.	MPLS - commonly used in high performance networks.	MPLS - commonly used in high performance networks.	MPLS - commonly used in high performance networks.	MPLS - commonly used in high performance networks.
Conventional voice channels, interoperability voice channels, 700 MHz trunked voice channels, and basic system management data.	Conventional voice channels, interoperability voice channels, 700 MHz trunked voice channels, and system management data, plus data traffic from other applications (cameras, site security, radio system diagnostics, etc.)	Conventional voice channels, interoperability voice channels, 700 MHz trunked voice channels, and system management data, plus data traffic from other applications (cameras, site security, radio system diagnostics, etc.)	Conventional voice channels, interoperability voice channels, 700 MHz trunked voice channels, and system management data, plus data traffic from other applications (cameras, site security, radio system diagnostics, etc.)	Conventional voice channels, interoperability voice channels, 700 MHz trunked voice channels, and system management data, plus data traffic from other applications (cameras, site security, radio system diagnostics, etc.)
- According to Motorola, it can robustly and reliably support single-use traffic at no additional cost to current project.	- MPLS is specifically designed to carry many kinds of traffic simultaneously. - More reliable network. - More flexible and more future oriented. - Motorola alone is responsible for correcting all implementation issues. - Various diagnostic and security tools for the P25 radio system can be added.	- MPLS is specifically designed to carry many kinds of traffic simultaneously. - More reliable network. - More flexible and more future oriented. - Motorola alone is responsible for correcting all implementation issues. - Various diagnostic and security tools for the P25 radio system can be added.	- MPLS is specifically designed to carry many kinds of traffic simultaneously. - More reliable network. - More flexible and more future oriented. - IPKeys has experience in designing and configuring these systems. (Motorola has contracted with them for this type of work in other locations.) - Various diagnostic and security tools for the radio system can be added.	- MPLS is specifically designed to carry many kinds of traffic simultaneously. - More reliable network. - More flexible and more future oriented. - Motorola alone is responsible for correcting all implementation issues. - Various diagnostic and security tools for the P25 radio system can be added.
- Low-level protocols may not have the logic built in that would be required to compensate for a broadcast storm or other sudden network event. - May not support future upgrades to the P25 radio system. - Uses only a fraction of the available bandwidth of the Next Gen microwave network. - Existing troubleshooting services will be removed. - Current non-MERA users (CHP, FBI) will be required to find another path. - Provides less functionality than today's microwave system. - Not industry best practice.	- Significant additional cost to project. - Requires additional hardware. - Adds some complexity to the network. - Hardware refresh is only for hardware that is not compatible with updated Motorola software. - Reduces contingency funds in current project.	- Significant additional cost to project. - Requires additional hardware. - Adds some complexity to the network. - \$400-500K more expensive than Option 1 because Motorola will have to remobilize resources. - Risk of outages when modifying the system after going live. - Additional installation and commissioning labor required when modifying a live system. - Hardware refresh is only for hardware that is not compatible with updated Motorola software.	- Significant additional cost to project. - Requires additional hardware. - Adds some complexity to the network. - Introduces an additional vendor to the project, possibly leading to scope and blame issues. - Risk of outages when modifying the system after going live. - Additional installation and commissioning labor required when modifying a live system.	- Additional cost to project. - Requires additional hardware. - Adds some complexity to the network. - Hardware refresh is only for hardware that is not compatible with updated Motorola software. - Reduces contingency funds in current project. - Reduces Layer 2 network hardware refresh from two instances to one. - SUA II services reduced from existing contract.
\$0	\$640,562.86	\$1,076,162.86	\$326,132	-\$89,000
\$0	N/A	N/A	\$623,559	N/A
\$0	\$1,140,530	\$1,204,930	N/A	N/A