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**DATE:** August 28, 2019  
**TO:** MERA Next Generation Project Oversight Committee  
**FROM:** Ernest Klock, Operations Officer  
**SUBJECT:** AGENDA ITEM G: Update on Motorola Change Order #8 – Multi-Protocol Label Switching (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.

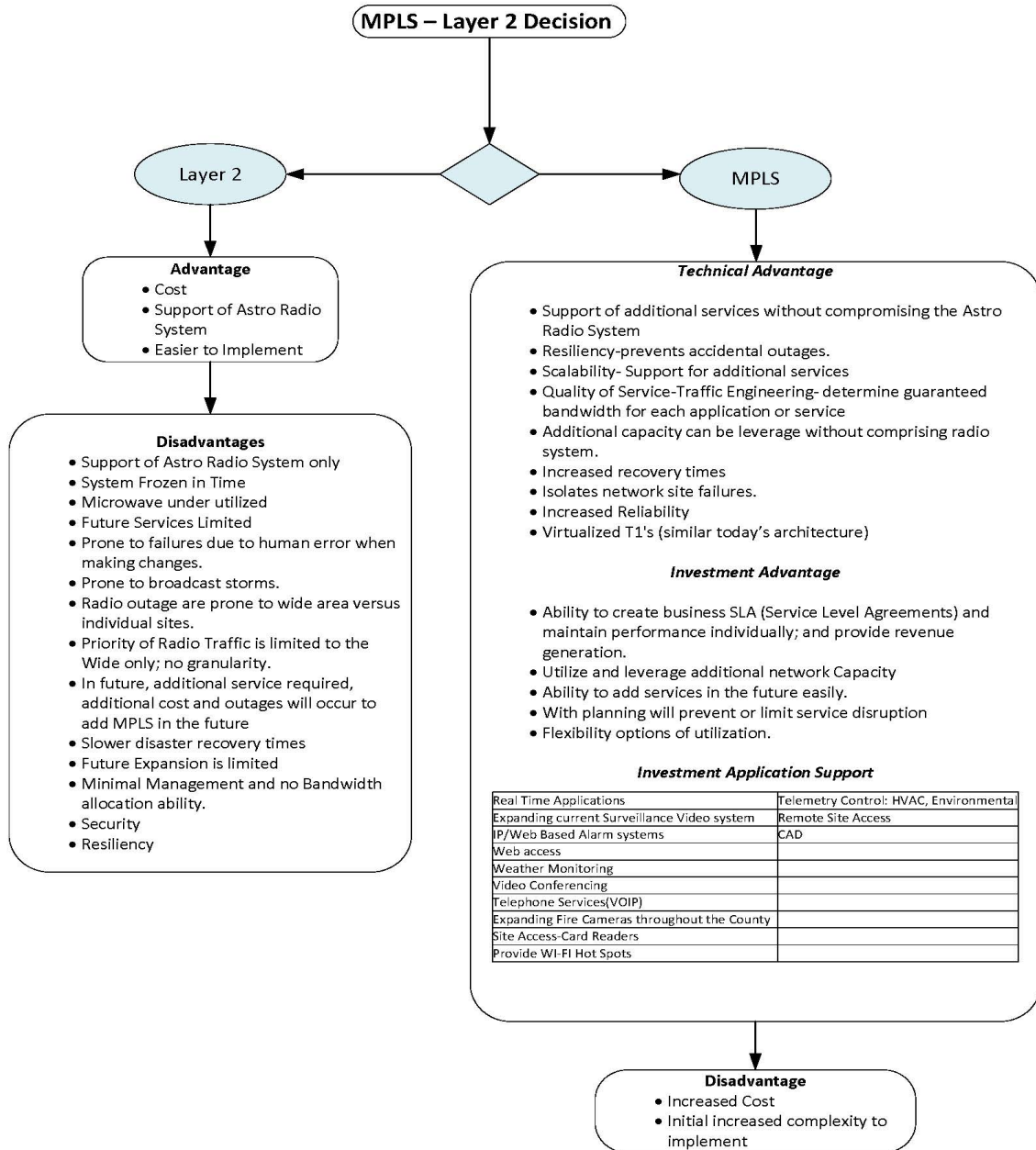
Discussion: The MPLS contract change order #8 (CCO#8) item was presented at various meetings in 2018, as well as the June 26, 2019 Next Gen Project Oversight Committee and the subsequent Governing Board meeting. Since the June 26 meeting, additional research has been performed regarding options for MERA 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**

Following the June 26, 2019 NGPOC meeting, several options have been further 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:

|   | <b>OPTION 0</b>                         | <b>OPTION 1</b>                                      | <b>OPTION 4A</b>                        | <b>OPTION 4B</b>  | <b>OPTION 4C</b>  | <b>OPTION 4D</b>   |
|---|---|--|---|---|---|--|
| <b>Description</b>  | Stay with Motorola Layer 2 per contract | Motorola implements MPLS now, before design complete | Motorola implements MPLS now, no SUA II | Motorola implements MPLS now, SUA II via NASPO – closest to CCO#8 | Motorola implements MPLS now, SUA II via NASPO, no Adv. Replace   | Motorola implements MPLS now, SUA II via NASPO, no repair SUA II |
| <b>Cost - No SUA, no hardware refresh</b>                 | \$0                                     | \$640,562.86   | \$502,009                               | \$502,009   | \$502,009   | \$502,009  |
| <b>Added Cost - 15 yr. SUAII, Year 6 hardware refresh</b> | \$0                                     | \$1,140,530  | \$0                                     | \$2,520,020   | \$2,487,302 + repairs covered, but no Adv. Replacement = downtime | \$1,710,079 + repairs via Time and Materials                     |
| <b>L2 Network Refresh Credit</b>                          | N/A                                     | (\$413,000)  | (\$413,000)                             | (\$413,000)   | (\$413,000)   | (\$413,000)  |
| <b>Price after Layer 2 Network Refresh Credit</b>         | \$0                                     | \$1,367,840  | \$89,009                                | \$2,608,777   | \$2,576,058   | \$1,798,835  |

**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. APCO International ANSI standards for public safety communication sites (recently revised for 2019) include many recommendations for site and systems monitoring that could be conveyed over MPLS. APCO recommendations for public safety communication sites to include:

**APCO Ref**

**Description**

- 3.6.3.9 The site should be equipped with one or more remote cameras.
- 3.6.3.10 The site should be equipped with a remote video recording system.
- 3.6.3.11 The site should be equipped with a local site audible siren.
- 3.7.3.7 Video surveillance of on-site generator should be installed.
- 3.7.3.9 Access to on-site generator should have a capability to remotely manage access authentication.
- 3.7.3.10 Access to site’s battery plant should have a capability to remotely manage access authentication.
- 3.8.2.8 Video monitoring system (Interior/Exterior) shall be implemented with digital-video- recording systems.

- 3.8.2.9 All alarms and monitoring tools shall be connected and monitored by a NOC or SOC.
- 3.8.2.14 The site should be equipped with one or more remote cameras.
- 3.8.2.15 The remote camera(s) video feed should be monitored (or monitor capable) from the NOC/SOC and/or local law enforcement if applicable.
- 3.8.2.16 The site should be equipped with a remote video recording system.

**Option 1 - MPLS for the Microwave Network - \$1,781,092.86 less Layer 2 Credit = \$1,367,840**

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 SUA II services including one MPLS network refresh in year 6 after cutover to the Next Gen System. This update represents utilization of \$413,000 in L2 credit applied to CCO#8 pricing to result in a \$1,367,840 final CCO#8 price. The services provided under this CCO#8 are commensurate with the services as outlined in Attachment 2 – Warranty and Post-Warranty Costs currently provided for MERA’s Layer 2 Microwave. This CCO#8 price is contingent upon implementation concurrently with the overall NextGen system design/implementation as well as confirmation from Motorola that the Layer 2 credit can be applied. Decision on this item should be made ahead of the completion of the Customer Design Review (CDR) package to defer additional costs. CDR will be presented for MERA approval following completion of CEQA – anticipated end of 2019.

**Options 2 and 3 from NGPOC June 26, 2019 MPLS Staff Report Removed**

After feedback at the last NGPOC, Option 2 (Motorola Implement MPLS after Next Gen Live) and Option 3 (Outside Vendor Implement MPLS after Next Gen Live) have been removed from consideration. Option 2 was significantly more expensive (\$2.3M) and Option 3 did not provide commensurate SUA II services while introducing risk associated with pricing that would not hold for the next three to four years.

**Option 4A, 4B, 4C, 4D - MPLS by Motorola Now via Layer 2 SUAII Network Refresh Credit – Range of SUA II Services**

As presented at the June 26, 2019 NGPOC, Option 4 included implementing MPLS now with Motorola (equipment, configuration, and training only – NO SUAII Services) – this is now Option 4A and remains unchanged. 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 this item. Attachment 2 highlights where this credit would come from and preserves one network refresh for MERA under the existing SUA II services. It is important to note that MERA may not necessarily need to use either Layer 2 network refreshes during the 15-year SUA II period (determined by Motorola product releases and need to upgrade) and the contract structure does not allow for credits after the fact.

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.

The Layer 2 credit approach provides the advantages of upgrading the microwave network at a lower cost while delivering the benefits of MPLS mentioned above with the risk of no SUA II services. In response, three additional options (4B, 4C, and 4D) have been developed with varying degrees of SUA II services provided through contracts negotiated by National Association of State Procurement Officials (NASPO). NASPO SUA II-type services are used by communications partners in the region to maintain their microwave networks. Nokia (Motorola's subcontractor and MERA's microwave network provider for Next Gen) has pricing under NASPO and details are provided in Attachment 1.

*Option 4B – MPLS by Motorola Now via Layer 2 Credit – SUA II by NASPO - \$2,608,777*

This is the most comparable service scenario to Motorola's CCO#8 at a significantly higher cost. It includes NASPO pricing for services commensurate with MERA's Layer 2 SUA II including – 24-hour telephone support, software subscription, part repair with advance replacement for 12 years (starts in year 4), and one hardware refresh. Pricing is 2019 and will likely change in 2023 and beyond.

*Option 4C – MPLS by Motorola Now via Layer 2 Credit – Reduced SUA II by NASPO - \$2,162,805*

This is the same option as 4B service scenario with a reduction to remove the advance replacement cost. Advance replacement allows for faster service restoration on faulty equipment and costs approximately \$450,000 over 12 years. Option 4C NASPO pricing for services includes – 24-hour telephone support, software subscription, part repair (no advance replacement) for 12 years (starts in year 4), and one hardware refresh. Pricing is 2019 and will likely change in 2023 and beyond.

*Option 4D – MPLS by Motorola Now via Layer 2 Credit – Reduced SUA II by NASPO - \$1,798,835*

This is the same option as 4C service scenario with a reduction to remove all part repair and replacement costs with the intent of utilizing time and materials to address failures as they arise. Option 4D NASPO pricing for services includes – 24-hour telephone support, software subscription, and one hardware refresh. Pricing is 2019 and will likely change in 2023 and beyond.

**Summary**

Research on SUA II pricing has yielded varying results depending on the level of service MERA wishes to fund. At a minimum, 24-hour telephone support and software subscription will ensure that the microwave network can be diagnosed by technicians and is updated with the latest software releases - \$1,350,000 for 12 years. Combined with Option 4A, this results in an MPLS solution costing approximately \$1,440,000 – which is slightly higher than CCO#8 with a severe reduction in SUA II services. 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 (as recommended via APCO) and transmission of third-party traffic that could generate revenues for MERA.

Attachment 1 – Options Comparison Matrix

Attachment 2 – Warranty and Post-Warranty Costs