

MARIN EMERGENCY RADIO AUTHORITY

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DATE: June 26, 2019
TO: MERA Governing Board
FROM: Ernest Klock, Operations Officer
SUBJECT: AGENDA ITEM D-1: Multi-Protocol Label Switching (MPLS) for the Microwave Network

Recommended Action: Receive update on 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.

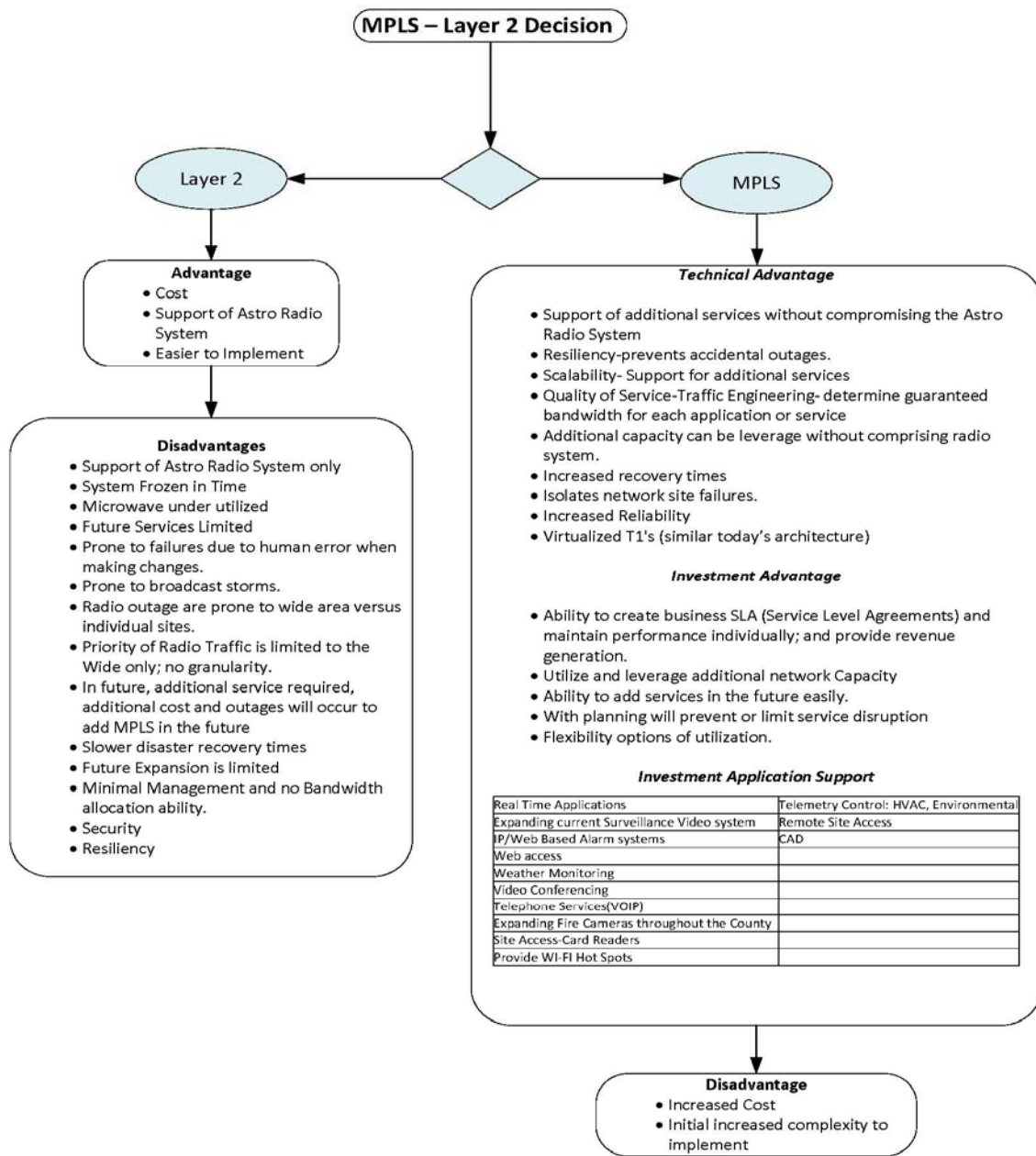
The NextGen System Request for Proposals (RFP) released in 2016 specified a digital microwave network as a replacement for the existing MERA microwave system. In addition to radio voice traffic, the existing microwave system includes other traffic such as FBI and CHP voice circuits, MERA technician troubleshooting 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 SUAII 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 SUAII 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

Change Order No. 08

Date: 03/04/19

Project Name: MERA Next Generation Radio System

Customer Name: Marin County

Customer Project Mgr: Ernest Klock

The purpose of this Change Order is to:

Capture the following changes:

1. Addition of MPLS hardware, design and implementation services - including the provisioning of non-LMR traffic, and 15 year life cycle services

Contract # 31701399

Contract Date: 03/07/17

In accordance with the terms and conditions of the contract identified above between Marin County and Motorola Solutions, Inc., the following changes are approved:

Contract Price Adjustments

Original Contract Value:	\$ 34,337,451.06
Previous Change Order amounts for Change Order numbers <input type="text" value="0-7"/> through <input type="text" value="9-10"/>	\$ 7,653,457.77
This Change Order:	\$ 1,781,092.86
Existing Contract Credit:	\$ 0.00
Net Contract Impact of this Change Order:	\$ 1,781,092.86
New Contract Value:	\$ 43,772,001.69

Completion Date Adjustments

Original Completion Date:	3/27/2019
Current Completion Date prior to this Change Order:	12/27/2022
New Completion Date:	12/27/2022

Changes in Equipment: *(additions, deletions or modifications)* **Include attachments if needed**

Please refer to the attached equipment list

Changes in Services: *(additions, deletions or modifications)* **Include attachments if needed**

Please refer to the attached Scope of Work (SOW) document

Schedule Changes: *(describe change or N/A)*

The project schedule will be finalized upon CDR approvals and is contingent upon CEQA and site construction timelines

Pricing Changes: *(describe change or N/A)*

Please refer to the attached pricing summary sheet
Please note that taxes are estimated at 9% but the final number will be determined based on where the equipment will be shipped

Customer Responsibilities: *(describe change or N/A)*

Please refer to the attached Scope of Work (SOW) document

Payment Schedule for this Change Order:
(describe new payment terms applicable to this change order)

The Payment milestone plan for this Change Order is the following:

1. 20% of the Change Order Price upon signing this Change Order
2. 45% of the Change Order Price upon shipment of equipment
3. 25% of the Change Order Price upon completion of installation (site by site)
4. 10% of the Change Order Price upon final system acceptance

If Subscribers are purchased, 100% of the Subscriber Contract Price will be invoiced upon shipment (as shipped).

Motorola may make partial shipments of Equipment and will request payment upon shipment of such Equipment. In addition, Motorola will invoice for installations completed on a site-by-site basis or when professional services are completed, when applicable. The value of the Equipment shipped/services performed will be determined by the value of the shipped/services performed as a percentage of the total milestone value. Unless otherwise specified, contract discounts are based upon all items proposed and overall System package. For invoicing purposes only, discounts will be applied proportionately to the FNE and Subscriber Equipment values to total Contract Price. Overdue invoices will bear simple interest at the maximum allowable rate.

For Lifecycle Support Plan and Subscription Based Services:

Motorola will invoice Customer annually in advance of each year of the plan. The annual warranty and post-warranty services costs quoted in this Change Order (Appendix D of the attachment) is in addition to the original contract's annual costs of tech support and infrastructure replacement, SUA II, and Nokia's Maintenance and Upgrade Program for the MPR 9500 system.

Unless amended above, all other terms and conditions of the Contract shall remain in full force. If there are any inconsistencies between the provisions of this Change Order and the provisions of the Contract, the provisions of this Change Order will prevail.

IN WITNESS WHEREOF the parties have executed this Change Order as of the last date signed below.

Motorola Solutions, Inc.	Customer
By: _____	By: _____
Printed Name: KENT MARTIN	Printed Name: _____
Title: Regional Services Manager	Title: _____
Date: March 4, 2019	Date: _____
Reviewed by: Kourosh Mostashari	Date: March 4, 2019
_____ Motorola Solutions Project Manager	_____

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CHANGE ORDER #8 ATTACHMENT

MARCH 4, 2019



CHANGE ORDER #8 ATTACHMENT

The following changes have been captured in Change Order #8:

1. Addition of MPLS hardware, design and implementation services - including the provisioning of non-LMR traffic, and 15 year life cycle services

Summary of services included for this item is the following:

- Establish the system architecture and logically identify which networks/sites need to communicate within the system
- Define and build the bandwidth requirements document (TNCT report) for each site
- Define the QoS values for ASTRO and other applications
- Determine demarcation points at each site for non-ASTRO traffic
- Review and validate all the requirements identified in Appendix A
- Define and build the WAN Transport IP Plan for ASTRO application based on the logical design
- Gather, validate and input TNCT parameter for config generation, validation and configuration file generation
- Build and deploy MPLS Configuration files. This includes the Network Management Subsystem
- Ensure all MPLS equipment is installed and connected as specified in the rack drawings
- Ensure physical connectivity has been tested and validated before validating service/logical connectivity
- Each service logical path will be tested using the Y.1564 testing method to validate the design specifications
- Provide As-Built Documentation for provided equipment; this will include a network drawing and final IP plan
- Provide all router configuration files and audit of each device

All MPLS equipment come with a one-year standard repair warranty.

Summary of the 15-year post-warranty services are the following:

- **RTS Gold** – Remote Technical Support, Gold. The NOKIA Technical Support (TS) Service provides the customer remote access to NOKIA engineers in support of product-related questions, troubleshooting assistance, diagnostic procedures, Patch Releases and Maintenance Releases, as may be made available, to restore service and/or functionality and resolve problems for Maintained Products. Customer access is provided via phone or email to the Welcome Center or, if available, via web-based Online Customer Support 24 hours a day, 365 days a year, to open a ticket or ‘Assistance Request’ (“AR”).
- **RES-AES-NBD** – Repair & Exchange Services, Advanced Exchange Service, Next Business Day The NOKIA Repair & Exchange Services (RES) provides repair or exchange of defective, customer-owned hardware (Parts). Upon receipt and acceptance

of a 'Part Request' from the Customer, NOKIA will provide a functioning part from the list of RES Entitled Parts (based on existing customer configuration). The functioning part is delivered within the next business day (NBD) in advance of the Defective Return from the Customer except for RES Entitled Parts that require customer configuration before dispatch, require SW installation before dispatch or exceed 60 lbs. (27 kg). Upon receiving the replacement Part, Customer will ship or return the reported defective Part to Seller within five (5) Calendar Days.

- **SSP** – Software Subscription Plan for nodal equipment. **SRS** – Software Release Service for NFM-P network management systems. The NOKIA SSP or SRS makes available all Feature Releases of software for network/node elements and management systems for specific network elements or families of network elements, and other network-related applications available for download from a NOKIA web site. Professional Services to provide Installation or application of such software upgrades, is not included in SSP or SRS.

Please note that the warranty and post-warranty pricing for this item in the Change Order captures one MPLS network refresh only. The MPLS network refresh as quoted replaces the original 7705-SAR hardware with the same functionality, but with the exception of the T1 cards. It is assumed that the T1 functionality will be replaced with ethernet in the future by the time of refresh. Also, the 7705 OS is not included in the refresh price since OS upgrades would already have been covered by the Software Subscription Service (SSP) for the 7705's.

In collaboration with MERA, Motorola has identified the non-LMR traffic (such as IP cameras) that will be provisioned on the MPLS network as per Appendix A.

The detailed MPLS equipment list has been provided in Appendix B.

APPENDIX A – NON-LMR TRAFFIC

MPLS NETWORK/Non LMR CONNECTIONS																			
Services	PORT #	EOF	CIVIC CENTER 2ND DECK	BIG ROCK	DOLLAR	MILL VALLEY	MT TAM	OTA	SAN PEDRO	TIBURON	WOLFBACK	BARNABE	COYOTE	MUIR WT	REYES	STEWART	TOMALES	SONOMA	SKYVIEW
GATEWAY 1		VLAN BHS 1	VLAN BHS 1	VLAN BHS 1	VLAN BHS 1	VLAN BHS 1	VLAN BHS 1	VLAN BHS 1	VLAN BHS 1	VLAN BHS 1	VLAN BHS 1	VLAN BHS 1	VLAN BHS 1	VLAN BHS 1	VLAN BHS 1	VLAN BHS 1	VLAN BHS 1	VLAN BHS 1	VLAN BHS 1
CCGW 1		VLAN BHS 1	VLAN BHS 1	VLAN BHS 1	VLAN BHS 1	VLAN BHS 1	VLAN BHS 1	VLAN BHS 1	VLAN BHS 1	VLAN BHS 1	VLAN BHS 1	VLAN BHS 1	VLAN BHS 1	VLAN BHS 1	VLAN BHS 1	VLAN BHS 1	VLAN BHS 1	VLAN BHS 1	VLAN BHS 1
GATEWAY 2		VLAN BHS 2	VLAN BHS 2	VLAN BHS 2	VLAN BHS 2	VLAN BHS 2	VLAN BHS 2	VLAN BHS 2	VLAN BHS 2	VLAN BHS 2	VLAN BHS 2	VLAN BHS 2	VLAN BHS 2	VLAN BHS 2	VLAN BHS 2	VLAN BHS 2	VLAN BHS 2	VLAN BHS 2	VLAN BHS 2
CCGW 2		VLAN BHS 2	VLAN BHS 2																
RECTIFIERS(Mngmt)		CEN 1	CEN 1	CEN 1	CEN 1	CEN 1	CEN 1	CEN 1	CEN 1	CEN 1	CEN 1	CEN 1	CEN 1	CEN 1	CEN 1	CEN 1	CEN 1	CEN 1	CEN 1
INVERTERS(Mngmt)				CEN 1	CEN 1		CEN 1		CEN 1	CEN 1		CEN 1			CEN 1	CEN 1		CEN 1	
COUNTY USE(FD Camera)		VLAN MC 1	VLAN MC 1	VLAN MC 1	VLAN MC 1	VLAN MC 1	VLAN MC 1	VLAN MC 1	VLAN MC 1	VLAN MC 1	VLAN MC 1	VLAN MC 1(WoodAcre)	VLAN MC 1	VLAN MC 1	VLAN MC 1	VLAN MC 1	VLAN MC 1	VLAN MC 1	VLAN MC 1
COUNTY USE(Security Camera)		VLAN MC 2	VLAN MC 2	VLAN MC 2	VLAN MC 2	VLAN MC 2	VLAN MC 2	VLAN MC 2	VLAN MC 2	VLAN MC 2	VLAN MC 2	VLAN MC 2	VLAN MC 2	VLAN MC 2	VLAN MC 2	VLAN MC 2	VLAN MC 2	VLAN MC 2	VLAN MC 2
CEN- Uwave -UEM-Mngmt		VLAN MC 3	VLAN MC 3	VLAN MC 3	VLAN MC 3	VLAN MC 3	VLAN MC 3	VLAN MC 3	VLAN MC 3	VLAN MC 3	VLAN MC 3	VLAN MC 3	VLAN MC 3	VLAN MC 3	VLAN MC 3	VLAN MC 3	VLAN MC 3	VLAN MC 3	VLAN MC 3
Web-Wifi-		VLAN MC 4	VLAN MC 4	VLAN MC 4	VLAN MC 4	VLAN MC 4	VLAN MC 4	VLAN MC 4	VLAN MC 4	VLAN MC 4	VLAN MC 4	VLAN MC 4	VLAN MC 4	VLAN MC 4	VLAN MC 4	VLAN MC 4	VLAN MC 4	VLAN MC 4	VLAN MC 4
VOIP-IP Phone		VLAN MC 5	VLAN MC 5	VLAN MC 5	VLAN MC 5	VLAN MC 5	VLAN MC 5	VLAN MC 5	VLAN MC 5	VLAN MC 5	VLAN MC 5	VLAN MC 5	VLAN MC 5	VLAN MC 5	VLAN MC 5	VLAN MC 5	VLAN MC 5	VLAN MC 5	VLAN MC 5
Future		VLAN MC 6	VLAN MC 6	VLAN MC 6	VLAN MC 6	VLAN MC 6	VLAN MC 6	VLAN MC 6	VLAN MC 6	VLAN MC 6	VLAN MC 6	VLAN MC 6	VLAN MC 6	VLAN MC 6	VLAN MC 6	VLAN MC 6	VLAN MC 6	VLAN MC 6	VLAN MC 6
SMARTX		T1-1	T1-1																
SMARTX		T1-2	T1-2																
SMARTX		T1-3	T1-3																
SMARTX		T1-4	T1-4																
SMARTX		T1-5	T1-5																
Woodacre telephone/CAD		T1-6	T1-6 ?									T1-6(to Woodacre)							
FBI ckt(v.24)			RS232(12 port)	RS232(12 port)															
CHP Ckt							4W(6 port)					4W(6 port)							
			RNI NETWORK IP BACKHAUL	Primary Use															
			CNI IP BACKHAUL	Secondary Use															
			COUNTY USE IP BACKHAUL	Secondary Use															
			SMARTX T1 BACKHAUL	Primary Use															
			NON IP BACKHAUL	Primary Use															

- Notes:**
1. Custom Tones: Review Gold Elite Admin
 2. Test Radio on Mt. TAM will be Connected to CCGW
 3. Intercom System Connected to CCGW
 4. Refer Conventional Interface Drawing

APPENDIX B – EQUIPMENT LIST

MPLS Equipment List

Item	Part Number	Description	BIG ROCK	CIVIC CENTER	COYOTE PEAK	DOLLAR HILL	EOF	MILL VALLEY MT 2	MT BARNABE	MT FAHAB PAS	MT THURON	Muir Beach	OTA BROADCASTING	PT REYES	SAN PEDRO	SKYVIEW VT	SONOMA VT	STEWART PT	TOMALES	WOLFBACK RIDGE
3.00		7205-SAR-8																		
3.01	3HE06791AA	SAR-8 SHELF V2	1	1	1	1	2	1	1	2	1	1	1	1	1	1	1	1	1	1
3.02	3HE06792AA	Fan Module (SAR-8 Shelf V2) Ext Temp -48VDC	1	1	1	1	2	1	1	2	1	1	1	1	1	1	1	1	1	1
3.03	3HE02774AB	CONTROL SWITCH MODULE V2 (CSMV2)	2	2	2	2	4	2	2	4	2	2	2	2	2	2	2	2	2	2
3.04	3HE02784KA	SAR RELEASE 8.0 BASIC OS LICENSE	1	1	1	1	2	1	1	2	1	1	1	1	1	1	1	1	1	1
3.05	3HE02782AA	Packet Microwave Card (48/+24 VDC)	2	2	2	2	2	2	2	6	2	2	2	2	2	2	2	2	2	2
3.06	3HE02776AB	8 PORT GE/FE ETHERNET CARD V2		1																
3.06	3HE02775AB	16 PORT T1/E1 ASAP CARD V2 (-48/+24 VDC)		1			1		1											
3.09	3HE03391AB	12P SERIAL DATA CARD V2 -48/+24VDC	1	1					1											
3.10	3HE03126AA	8 port E&M Interface Card							1	1										
3.07	3HE03394AA	32 PORT T1/E1 RAS PANEL		1			1		1											
3.08	3HE03397AA	T1/E1 CABLE FOR DISTRIBUTION PANEL 1M		1			1		1											
3.10	3HE04507AB	RS232 Cable - 2M	2	2																
3.11	3HE04511AA	6 PORT RS232 DISTRIBUTION PANEL	2	2																
3.09	3HE03401AA	SYNCHRONIZATION Y- CABLE	1	1	1	1	2	1	1	2	1	1	1	1	1	1	1	1	1	1
3.10	3HE00062CB	SFP - GIGE BASE-T RJ45 R6/6 DDM -40/85C	8	10	8	8	8	8	8	24	8	8	8	8	8	8	8	8	8	8
3.11	3HE00027CA	SFP - GIGE SX - LC ROHS 6/6 DDM -40/85C	4	4	4	4	4	4	4	12	4	4	4	4	4	4	4	4	4	4
3.50		7205 Spares																		
3.51	3HE06791AA	SAR-8 SHELF V2																		
3.52	3HE06792AA	Fan Module (SAR-8 Shelf V2) Ext Temp -48VDC																		
3.53	3HE02774AB	CONTROL SWITCH MODULE V2 (CSMV2)																		
3.54	3HE02782AA	Packet Microwave Card (48/+24 VDC)																		
3.55	3HE02776AB	8 PORT GE/FE ETHERNET CARD V2																		
3.55	3HE02775AB	16 PORT T1/E1 ASAP CARD V2 (-48/+24 VDC)																		
3.56	3HE03391AB	12P SERIAL DATA CARD V2 -48/+24VDC																		
3.57	3HE03126AA	8 port E&M Interface Card																		
3.56	3HE00062CB	SFP - GIGE BASE-T RJ45 R6/6 DDM -40/85C																		
3.57	3HE00027CA	SFP - GIGE SX - LC ROHS 6/6 DDM -40/85C																		
4.00		NFM-P																		
4.01	3HE11799DA	NSP 18: NFM-P STANDARD BASE																		
4.02	3HE11801DA	NSP 18: NFM-P STANDARD LP	23	33	18	18	31	18	28	51	18	18	18	18	18	18	18	18	18	18
4.03	3HE11803DA	NSP 18: NFM-P HIGH AVAILABILITY LP	23	33	18	18	31	18	28	51	18	18	18	18	18	18	18	18	18	18
4.50		Software / OS Upgrades																		
4.51	3HE02785XX	7205 SAR RELEASE X.D BASIC OS UPGRADE (2 OS level upgrades)	2	2	2	2	4	2	2	4	2	2	2	2	2	2	2	2	2	2
4.52	3HE10161AA	NFM SRS 2 years (2 NFM sw upgrades)																		

APPENDIX C – PRICING SUMMARY

	Price
MPLS Equipment, Implementation Services, and Training after discount	\$640,562.86
MPLS 15 Year Life Cycle Services (including one network refresh in year 6) after discount	\$1,104,930
Total	\$1,745,492.86
Estimated Equipment Taxes at 9%	\$ 35,600.00
Final Price	\$1,781,092.86

15 Year Life Cycle Services Annual Cost Breakdown															
Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Total
\$ 33,669.75	\$ 42,835.45	\$ 42,835.45	\$ 42,835.45	\$ 42,835.45	\$ 412,562.62	\$ 50,923.64	\$ 50,923.64	\$ 50,923.64	\$ 50,923.64	\$ 56,732.26	\$ 56,732.26	\$ 56,732.26	\$ 56,732.26	\$ 56,732.26	\$ 1,104,930.00

Milestone Plan for MPLS Equipment, Implementation Services, and Training Total (including taxes)	\$ 676,162.86
Payment Milestone	Payment Amount
20% of the Change Order Price upon signing of the Change Order	\$ 135,232.57
45% of the Change Order Price upon shipment of equipment	\$ 304,273.29
25% of the Change Order Price upon completion of installation (site by site)	\$ 169,040.72
10% of the Change Order Price upon final system acceptance	\$ 67,616.29
Total	\$ 676,162.86