STATEWIDE AGENCIES RADIO SYSTEM

Annual Status Report

A Report to the Governor, House Appropriations Committee, And Senate Finance Committee

October 2019

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Superintendent

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COMMONWEALTH OF VIRGINIA

DEPARTMENT OF STATE POLICE
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October 1, 2019

TO: The Honorable Ralph Northam, Governor of Virginia

The Honorable Thomas K. Norment, Jr.
Co-Chair of the Senate Finance Committee

The Honorable Emmet W. Hanger, Jr.
Co-Chair of the Senate Finance Committee

The Honorable S. Chris Jones
Chairman of the House Appropriations Committee

Pursuant to House Bill 5002 Item 419.C.1 of the 2019 Virginia Acts of Assembly, I am respectfully submitting herewith a report *on the Status of the Statewide Agencies Radio System (STARS) Program.*

Respectfully,

Gary T. Settle

Superintendent

TAB/LKH/tlg

Enclosure

Executive Summary

Statewide Agencies Radio System 2019 Status Report

Colonel W. Steven Flaherty, State Police Superintendent and Mr. Mark Moon, Vice President and General Manager of Motorola signed a $329 million contract between Motorola and the Commonwealth of Virginia for the design, construction, and implementation of the Statewide Agencies Radio System (STARS) on July 13, 2004. A ceremonial contract signing was held on July 16, 2004, in conjunction with a press conference.

Effective July 1, 2011, The Virginia State Police Information and Communication Technologies Division assumed the engineering, installation, maintenance, and operations of the STARS system. The STARS Network including the backbone microwave network, the land mobile radio network, the five (5) Tidewater tunnels and two (2) Western tunnels, and all vehicle-based hardware and software for all 22 State Agencies were operational.

STARS provides a multi-channel trunked digital voice and data wireless communications capability specifically designed to meet APCO Project 25 public safety requirements. The core microwave network consists of Synchronous Optical Network (SONET) ring-protected transmission paths providing the highest quality of service, security, and reliability possible through controlled system access and Advanced Encryption Standard (AES) encryption for law enforcement users when needed. This network supports the 22 participating agencies throughout the Commonwealth and facilitates interoperability with other state, local, and federal agencies.

Initial Bond Funding

Pursuant to the Code of Virginia §2.2-2264, the General Assembly authorized the Virginia Public Building Authority to issue revenue bonds not to exceed $159,300,000 for the constructing, improving, furnishing, maintaining, acquiring and renovating buildings, facilities, improvements, and land for the STARS project. Chapter 245 approved by the General Assembly session March 30, 2006, authorized additional funding via Bonds issued by the Virginia Public Building Authority in the amount not to exceed $201,900,000 to complete STARS.

The revised Contract appropriation cost for STARS is	**$361,200,000**
Less $50,000 allocated to Department of Forestry	**$361,150,000**
Phase 1 Cost	**$346,186,399**
Bond Funds remaining at completion of Phase I	**$14,963,601**
New site construction Phase 2	**$3,218,788**
New site construction Phase 3	**$1,619,871**
New site construction Phase 4	**$4,046,542**
Hampton Tower Site, GTR8000 Site Repeater Upgrade, -48VDC Power Upgrade, MDT's, and Telscan Upgrade Phase 5	**$6,000,000**
New site construction Phase 6	**$78,400**
Projected Funding Balance at Project Completion	**$ - 0 -**

STARS Program Management Structure

The STARS participants are composed of the following 22 agencies. Representatives from each agency make up the User Agencies Requirements Committee (UARC):

Chesapeake Bay Bridge and Tunnel Police
Department of Agriculture and Consumer Services
Department of Alcoholic Beverage Control
Division of Capitol Police
Department of Conservation and Recreation
Department of Corrections
Department of Emergency Management
Department of Environmental Quality
Department of Fire Programs
Department of Forestry
Department of Game and Inland Fisheries
Department of Health
Department of Juvenile Justice
Department Military Affairs
Department of Mines, Minerals, and Energy
Department of Motor Vehicles
Department of State Police
Department of Transportation
Virginia Information Technologies Agency
Virginia Marine Resources Commission
Virginia Port Authority
Buchanan County Sheriff's Department and Grundy PD

The STARS Management Group

Is a Board established by Executive Order 28 (2002) and composed of the Secretaries of Agriculture and Forestry, Commerce and Trade, Finance, Health and Human Resources, Natural Resources, Public Safety, and Transportation. The Secretary of Public Safety serves as the Chairman. The STARS Management Group provides direction and overall governance for the development, implementation, and ongoing operation of STARS. In addition, they review all procurements and contracts, coordinate radio frequency licenses granted by the federal government to agencies of the Commonwealth, and promote interagency cooperation and coordination in the use of communications resources.

The User Agencies Requirements Committee (UARC)

This committee consists of two representatives (primary and alternate) from each member agency and institution. The Chairman of the UARC is selected by the STARS Management Group. The UARC shall have two co-chairs. The VSP Communications Officer shall serve as co-chair and the second co-chair shall be recommended by the URAC membership. The UARC meets as necessary, but at least quarterly. The specific duties of UARC are to advise on the needs of member agencies for the planning, design, establishment, and operation of STARS, provide advice on proposals for other federal, state, or local agencies to join STARS and on any proposals for third party use of any STARS infrastructure or component, and assist the STARS Management Team with the development of a comprehensive management plan and procedures for the operation of STARS.

STARS Annual Operating Costs

The STARS Network is a public safety grade wireless communications system that must be maintained in an operational status 24 hours per day, seven days per week, 365 days per year. To accomplish this, a well trained staff of engineers and technicians must be available with access to repair parts, test equipment, and vehicles on a 24/7 basis. On July 1, 2011, the Department assumed the responsibility for equipping new vehicles, aircraft, and boats that belong to the 22 STARS agencies, removing equipment from decommissioned or crashed vehicles, and the refurbishment and re-installation of the reconditioned hardware into another vehicle. Per Chapter 836, 2018 Virginia Acts of Assembly, Item 422, and the FY2019 allotted funding for Telecommunications and Statewide Agencies Radio System (STARS) (30204) is $27,409,122.

Current Enhancement Projects

Maintaining technology today is a labor intensive and costly proposition. Hardware and software is typically obsolete by the time it is purchased and installed and STARS is no exception. The FY 2019 lifecycle cost to keep the core Motorola portion of the network current is $1,283,277. This does not include the hardware and software upgrades, repair parts, and labor necessary to keep the transport network at top operational efficiency.

Current enhancement projects include:

- Replacement of all -48VDC power supplies and the retirement of the uninterruptable power supplies
- Upgrading the STARS platform from Release 7.16 to 7.18

Motorola upgrade release 7.18 is almost complete and all land mobile radio fixed site repeater hardware and software have been replaced in order to be supported by the manufacturer Motorola Solutions.

Most transmission equipment is powered with -48VDC power plants. These units power the equipment using batteries with the batteries constantly recharged from either commercial power or generator backup power. Other site equipment is powered from commercial power through an uninterruptible power supply (UPS) also equipped with battery backup. The GTR8000 site repeaters can be powered with either source but are being DC powered allowing the retirement of the very expensive end-of-life UPS systems. The remaining AC powered hardware will be supplied power through redundant inverters. The projected cost of the -48VDC power plants and inverters is $2.4M. The elimination of the UPS's results in a multi-million dollar savings.

The implementation of the FirstNet public safety network required the re-banding of the frequencies used between the STARS Digital Vehicle Repeaters and portable radios that allows a law enforcement officer to communicate on a portable radio while outside his/her vehicle. The FCC allocated FirstNet the frequency band used by STARS DVRS's. FirstNet funded the effort to replace the filters in the units to allow operation in another 700MHz frequency band. This project required the coordination of frequencies with all states bordering Virginia. This project was completed as of August 1, 2018.

The core of the STARS voice and data network operates on Motorola hardware and software. The VSP Information and Communication Technologies Division has negotiated a Software Upgrade Agreement II (SUA II) lifecycle contract with Motorola that upgrades the network once every two years. The SUA II annual contractual agreement provides software, hardware, and labor required to implement one system infrastructure upgrade in a two-year period. VSP chose a schedule that keeps STARS one upgrade below the latest to allow other users to identify system bugs and have them corrected before our upgrade. The SUA II agreement does not cover all hardware and software.

The original STARS contract provided mobile data terminals (MDT) for all law enforcement vehicles via laptops installed in the vehicles and the Integrated Voice and Data (IV&D) feature in the network. This capability provided for Virginia Criminal Information Network (VCIN) checks and Division of Motor Vehicle (DMV) license checks through the radio network. The variety and complexity of information technology has changed dramatically as has the data transmission bandwidth requirements since the inception of STARS. The IV&D feature in the STARS network was designed to accommodate short message traffic and cannot accommodate enhancements such as DMV photographs. To

accommodate these new bandwidth requirements commercial wireless data cards were added to the laptops.

In addition to the increased bandwidth demands, the FBI and Department of Homeland Security have added new security requirements that require portable computer hard drives to be encrypted to protect sensitive data if stolen, encryption for all transmitted data that traverse unsecured networks such as the Internet, and multi-factor authentication to ensure that the person logging into the network is who they purport to be.

All of these latter requirements add a strain on an already tight budget. Hard drive encryption requires new software. The encryption of transmitted data requires virtual private network (VPN) hardware and software. Depending on the implemented solution for multi-factor authentication, hardware and/or software will be required. All of these capabilities require new administrative procedures.

The original STARS Motorola laptops were out of warranty and have been replaced with the latest Panasonic Tough book laptops. The projected cost to replace the Motorola laptops was projected to be at least $16M at a rate of $3.2M per year. The final installment of laptop replacements was funded through STARS bond funds and General Funds. The replacement of the laptops was completed in July of 2017. It is recommended that 100 MDTs be purchased annually for re-fresh.

Interoperability Between STARS and Outside Agencies

Local, state, and federal radio systems operate in a number of specific frequency bands (VHF low-band, VHF high-band, UHF, 700 and 800 MHz). Radios operating in different frequency bands cannot communicate directly. The Commonwealth Link to Interoperable Communications (COMLINC) allows dispatchers at the state, federal, county, and city communications centers to establish communications patches between themselves and other agencies regardless of frequency band. For example, a Sheriff's Department can patch to the Fire Department regardless of the frequencies used by each agency. Patches can also be made to phone networks and used to establish dispatcher conferences. By using COMLINC, each dispatcher initiates the patch themselves at their console in coordination with the participating agency. COMLINC also provides instant recall of recorded audio.

COMLINC was initially implemented in 16 localities in VSP Division one, and at State Police Divisions one and five along with STARS Network Operations Center (NOC). Through grants the network has grown to 135 fixed sites and 20 mobile command posts or tactical units providing interoperability between all State Police Divisions, most localities, colleges and universities, and other state and federal agencies.

As the network has grown, the Virginia State Police Information and Communication Technologies Division accepted responsibility for engineering, installation, maintenance, and technical support for the entire statewide

COMLINC network. An additional four Communication Technician positions have been funded and are in the hiring process. As with the STARS Network, this network has become outdated with most servers and workstations still operating on the Microsoft Windows XP operating system. The cost of upgrading all existing COMLINC sites to the latest release of software and the Windows 7 or Windows 10 computer operating system is estimated at well over $3 million. This upgrade will extend interoperability to smart phones allowing radio communications and streaming audio and video.

In 1977, the Statewide Interdepartmental Radio System (SIRS) Advisory Board was created to improve coordination between state and local law enforcement agencies. At that time, no direct radio link existed between these agencies. The Advisory Board accepts applications for the use of the selected low-band VHF radio frequency of 39.54 MHz for statewide access for SIRS participating agencies. The FCC had set aside a Very High Frequency (VHF) of 155.475 MHz (wideband) and 155.4825 MHz (narrowband) as VHF interoperability channels to be used by law enforcement statewide. The SIRS advisory board manages the low band and VHF interoperability frequencies.

Currently all STARS law enforcement vehicles are equipped with an independent low band (39.54 MHz) SIRS radio. This radio being independent of the STARS radio is always available to send and receive radio transmissions. STARS mobile radios are programmed to transmit and receive on VHF high-band frequencies.

SIRS radios have been installed in 18 STARS sites throughout the Commonwealth and will appear on all VSP dispatch consoles to improve interoperability with localities and the VSP.

Network Operations Center/Virginia Criminal Information Helpdesk

The Virginia State Police employs sixteen Network Operation Center Operators and one Network Operations Center Supervisor that: monitor the STARS Land Mobile Radio and point-to-point microwave radio systems statewide, emergency power, environmental systems, make routine infrastructure inputs and changes that allow only authorized users access to the LMR network. They have added the additional responsibilities and duties of the Virginia Criminal Information Network Help (VCIN) Desk support staff. This adds the duties of changing passwords, providing client access support on a 24 hour per day, 7 days per week, 365 days per year basis. Six VCIN Helpdesk positions were transferred to the NOC to aid in the additional workload demands.

New STARS Site Construction

After the STARS Network was turned over to the Information and Communication Technologies Division, users in a number of areas within the Commonwealth began to report radio problems that were identified as areas of very weak or poor coverage. Radio transmissions were garbled or robotic sounding in digital terms or radios were not able to send and receive. STARS Network Operations Center personnel began to gather the locations and opened informational trouble tickets

that enabled the engineers to perform coverage testing to determine the best location for new sites.

During the initial network construction, the VSP Information and Communication Technologies Division took over engineering and installation of several subsystems of the STARS network resulting in a cost savings to the Commonwealth. Subsequently, the Information and Communication Technologies Division requested permission from the STARS Management Group to use these funds to install additional land mobile radio sites to fill in coverage gaps in the original network. To date 15 sites have been completed with three more in various stages of construction.

The additional new sites and their degree of completion are as follows:

- Waverly — Complete
- Dumfries Scales — Complete
- Rawley Springs — Complete
- Potts Mountain — Complete
- Bath County Hydro — Complete
- Elliott Knob — Complete
- Massanutten — Complete
- Virginia Beach — Complete
- Gordonsville — Complete
- Big Walker Mountain — Complete
- Lambsburg — Complete
- Buck Knob — Pending completion of environmental review
- 1st Division Dispatch — Complete
- VSP Driver Training Facility — Complete
- Amelia VDOT — Blue Mountain pending funding approval to collocate with locality
- West Point — Complete
- Columbia Pike — Addition of 50 feet to tower pending construction

Work continues on identifying additional coverage gaps.

STATEWIDE AGENCIES RADIO SYSTEM (STARS)

Annual Report of Anticipated Expenditures for Equipment Replacement

A Report to:

House Appropriations Committee
Senate Finance Committee
Secretary of Public Safety and Homeland Security
Secretary of Finance
Secretary of Technology
Director of the Department of Planning and Budget
STARS Management Group

October 2019

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Co-Chair of the Senate Finance Committee

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The Honorable S. Chris Jones
Chairman of the House Appropriations Committee

Pursuant to House Bill 1700, Chapter 854 Item 419.C.1 of the 2019 Virginia Acts of Assembly, I am respectfully submitting herewith a report *on the Status of the Statewide Agencies Radio System (STARS) Program.*

Respectfully,

Superintendent

TAB/LKH/tlg

Background:

Colonel W. Steven Flaherty, State Police Superintendent and Mr. Mark Moon, Vice President and General Manager of Motorola signed a $329 million contract between Motorola and the Commonwealth of Virginia for the design, construction, and implementation of the Statewide Agencies Radio System (STARS) on July 13, 2004. Effective July 1, 2011, The Virginia State Police Information and Communications Technology Division (ICTD) - Communications Section assumed responsibility for the engineering, installation, maintenance, and operation of the STARS Network. The STARS Network includes the backbone microwave network, the land mobile radio network, the five (5) Tidewater tunnels and two (2) Western tunnels, and all vehicle-based hardware and software for all participating State Agencies. Subsequent to this milestone one locality has joined the network.

The STARS Network provides a multi-channel trunked digital voice and data wireless communications capability specifically designed to meet APCO Project 25 public safety requirements. The core microwave network consists of Synchronous Optical Network (SONET) ring-protected transmission paths providing the highest quality of service and reliability possible with security through controlled system access.

Maintaining technology today is a labor intensive and costly proposition. Hardware and software is typically obsolete by the time it is purchased and installed and the STARS Network is no exception. The annual lifecycle cost to keep the core Motorola portion of the network current is over $1M annually. This does not include the hardware and software upgrades necessary to keep the transport network at top operating efficiency. In addition, much of the support hardware including microwave radios, power subsystems, and multiplexing equipment is at or beyond end-of-life. While all new sites under construction are being equipped with the latest hardware and software there is much work to be accomplished.

This document provides a detailed report of anticipated expenditures for equipment replacement from FY2018 through FY2024. The timing of all upgrades and/or equipment replacements is dependent on availability of funding. This document should provide guidance to the Governor's Office, Secretary of Public Safety and Homeland Security, the Secretary of Finance, the Secretary of Information Technology, the Director of the Department of Planning and Budget, the STARS Management Group, and the Chairmen of the House Appropriations and Senate Finance Committees sufficient detail to enable the joint effort necessary to maintain the highest quality of service, security, and reliability possible for the STARS Network.

The following narrative discusses the major subsystems of the STARS network and identifies the lifecycle cost of individual components. This narrative is followed by a detailed schedule by fiscal year of the annual and one-time expenditures planned.

Transport Backbone:

The backbone of the STARS Network consists of microwave radio and fiber optic cable links configured in unidirectional path-switched SONET rings (UPSR). Should a fiber cable or microwave hop fail, the ring protection maintains the transport services that today consist of T1 circuits. There are spurs to the backbone of varying bandwidths that are not ring protected but are designed for the highest reliability possible.

The microwave radio component of the backbone network consists of radios, waveguide, and antennas. The microwave radios used in STARS are provided by Microwave Networks Incorporated located in Stafford, Texas. The original hardware installed consists of CM6 Synchronous Optical Networking / Synchronous Digital Hierarchy (SONET/SDH) Digital Microwave radios that provide a transport bandwidth of 155.52Mbps or Optical Carrier Level 3 (OC3) and 45Mbps or DS3. Manufacture of these radios ended in June of 2006. The last date to purchase parts was December 2006 with the last date for repair support June 2022. Starting in calendar year 2017, all new microwave paths will use the Proteus MX series radio (introduced in 2011) or later model. The remaining CM6 radios in stock will be used for spare parts

Within the next four to eight years the STARS backbone will undergo a major upgrade. This will be driven by Motorola as they migrate from circuit-switched transport to packet-switched Ethernet transport from the land mobile radio RF sites to the Zone Master Sites. Based on our current understanding of this migration, all ring-based microwave radios will require replacement with higher bandwidth radios with Ethernet interfaces. This transition will require the addition of new routers capable of routing Multi-Protocol Lablel Switching (MPLS) traffic. Motorola has recommended using the Nokia 7705 MPLS router because it best interfaces with the existing infrastructure and they have extensive experience in the configuration.

Once the backbone network is upgraded the RF sites will transition until all T1 transport is eliminated and all of the bandwidth of the backbone will be dedicated to Ethernet/MPLS. The timing of this migration has been determined to begin in 2020 and expected to take 24 to 36 months to complete.

There are a variety of microwave antennas and waveguide components used in STARS. Most microwave antennas are high performance with the cost for an 8 foot dish $14K. The waveguide for a 200 foot tower with four runs of waveguide at 6GHz would cost approximately $13K @ $21 per foot and depends on the required height of the antennas. All microwave radio dishes are encased with canvas covers to keep out wildlife and weather. These covers deteriorate over time and become susceptible to weather and damage from birds seeking places to build nests. We have budgeted to replace 16 antenna covers per year ($26K).

Protection switching for transport services is currently provided by Fujitsu Network Communications, Inc. multiplexers. Motorola has indicated that their RF site equipment will move from T1 to Ethernet interfaces utilizing Multiprotocol Label Switching (MPLS) packet-switching transport technology by calendar year 2022. As stated above Motorola has recommended using the Nokia 7705 MPLS router because it best interfaces with the existing infrastructure and they have extensive experience in the configuration. This MPLS router will be configured to provide the transport protection currently provided by the Fujitsu multiplexers.

RF Site Support Hardware

The equipment shelters at STARS Radio Frequency (RF) sites are manufactured by VFP Industries. Sites with ease of access have aggregate buildings of varying sizes. These come from VFP pre-constructed and can be delivered intact. Some remote sites with mountainous access roads have shelters that consist of pre-fabricated panels that must be constructed on-site. These shelters are experiencing leaky roofs and collapsing floors and will require repairs at a projected cost of $80K each.

The towers used by STARS are predominantly free-standing and vary in height from 60 feet to 400 feet. The structural standard that applies to towers continues to become more stringent. The loading on STARS towers is maintained at approximately 85% of the current standard. As additional

microwave and Land Mobile Radio (LMR) antennas are added, the tower loading must be examined and the tower strengthened to maintain compliance with the latest standard. In rare cases such as with the Hampton site the tower must be replaced.

Each STARS shelter is equipped with two BARD HVAC units. These units have been in operation since 2005 and are failing at an increasing rate. The most common failures are the contactor that converts the low voltage thermostat signals to high voltage required to start and run the compressor and fan motors. VSP technicians have been trained to replace these common electrical failures. To change a compressor requires someone with a certification in handling the Freon. The Freon must be vacuumed out of the failed unit and captured. After the new unit is installed it is pressure tested with an inert gas, the unit is recharged with Freon. There are 84 STARS Shelters with two units each. VSP has budgeted to replace twelve (4) units per year. As the system ages this number may need to be increased.

Each STARS RF site is equipped with a propane fueled generator and associated transfer switch. These devices are manufactured by Cummins. The generators and transfer switches are maintained by VSP personnel. Generators and transfer switches are rated by their output under load and cost on average $12K annually to maintain.

STARS LMR sites were initially equipped with uninterruptible power supplies (UPS) manufactured by Emerson to provide backup power for AC powered equipment until the backup generator starts. These Uninterruptible Power Supply (UPS) units are well beyond end-of-life and will not be replaced. Most transmission equipment such as the microwave radios and Fujitsu multiplexers are powered by -48VDC power. The new GTR8000 site repeaters can be DC powered making it possible to eliminate the UPS. The existing -48VDC power supplies will be resized to power all of the site equipment. Remaining AC powered devices will be powered through inverters. The -48VDC power supplies and GTR8000 repeaters are included in FY2018 funding. The cost for a new -48VDC power plant is $26K and includes inverters and backup batteries.

The incoming commercial power line for each STARS site is equipped with a surge arrestor to protect site equipment from surges from power company equipment failures and lightning strikes. There is an additional surge arrestor installed between the generator and site equipment for the same purpose. VSP has budgeted to replace twelve (12) units per year at a cost of $1.2K each.

Land Mobile Radio Infrastructure Equipment

The land mobile radio (LMR) equipment used in STARS consists of Local Area Network/Wide-Area Network (LAN/WAN) hardware, site controllers, site repeaters, combiner/multi-couplers that allow multiple frequencies or channels to use the same transmission lines, and antennas. A typical STARS RF site is equipped with a minimum of one receive antenna and one or more transmit antennas. Antennas are susceptible to ice, wind and water damage. We anticipate replacing 5 LMR antennas a year at an average cost of $3.5K each. Transmission line for LMR is $11 per ft. For a 200 foot tower the cost would be approximately $6K.

The Quantar site repeaters have been replaced by GTR8000 repeaters for the 7.16 to 7.18 system upgrade which is almost complete.

To add capacity to an LMR site requires a pair of frequencies for each channel added. The VHF frequency spectrum that STARS operates in is all but occupied. To overcome congestion in the various wireless frequency bands, new digital technologies have been introduced that allow more information to be carried in smaller bandwidths. Time Division Multiple Access (TDMA) technology

splits the current 12.5 KHz channel bandwidth into two 6.25 KHz channels doubling the per channel capacity. To implement TDMA requires new hardware and software: MCC7500 consoles, new mobile and portable radios, a second receive antenna in some instances, and new RF site and master site software. The recently installed GTR8000 repeaters are capable of the TDMA technology.

TDMA implementation guidelines specify that at some sites a second receive antenna is required. An additional antenna at the top of the tower requires transmission line, additions to the combiner/multi-coupler network, and possibly a new tower structural analysis. Manpower to implement TDMA will also be impacted. This modification to an RF site is expensive ($12.7K):

- Average cost of LMR antenna - $3.5 K
- $3-5K for additions to the combiner/multi-couple networks
- Transmission line @ $11 per foot with towers ranging from 60-400 feet ($2.2K for a 200 foot tower)
- New structural analysis for the tower - $1.5-3K each.

The contract to modify the LMR licenses for TDMA has been awarded and is proceeding. For some of the sites located in the National Quiet Zone this involves approval from the National Radio Astronomical Observatory (NRAO) which maintains strict radiation guidelines within the Quiet Zone. This can sometimes be a lengthy process.

The Motorola 2500 site routers were no longer supported after Release 7.16 and have been replaced by the GGM8000 routers to facilitate the system upgrade to 7.18.

Repair parts for site repeaters, antennas, transmission lines, and combiner/multi-coupler components are required from time-to-time due to damage by wind, water, or lightning.

Network Management Platform

The STARS Network is managed, monitored, and programmed by the Network Operations Center (NOC) through a number of redundant network management platforms. The RF site environment is monitored by the Motorola Supervisory Control and Date Acquisition (MOSCAD) System. This system was upgraded prior to the Motorola Release 7.14 upgrade in 2015. This system also monitors the microwave radios, the Zone multiplexers, and the site repeaters for faults. The Motorola Unified Event Manager (UEM) also monitors the system and is partially redundant with the MOSCAD. These systems have been integrated into a single client computer with the Release 7.18.

The Zone Watch application monitors all radio call activity by pulling trunking information from the Air Traffic Router (ATR). Zone Watch also receives fault information relating to repeater sites and the zone controller from the Unified Event Manager (UEM). Through the Zone Watch display NOC personnel can view the health of each LMR site and all channels operating at a site with a quick glance.

STARS LMR configuration management is provided by the Provisioning Manager and the Unified Network Configurator. The Provisioning Manager enables centralized provisioning of ASTRO® 25 systems with various system-level, user-level, and device-level configuration required for proper system operation: specifically the ability to configure subscriber radios, consoles, system infrastructure, and radio traffic applications. The Unified Network Configurator application is used to discover network devices, manage configurations, and manage credentials.

The microwave radio network is primarily monitored by the Telscan application. The company that provided this system is out of business and this system was scheduled to be replaced in FY2018. The Fujitsu multiplexers are monitored and programmed through the Fujitsu NETSMART application. Both of these systems are now scheduled to be replaced in FY2019 through an RFP with funding provided by existing STARS bond funds. A replacement monitoring system for both systems from Megasys Inc. has been purchased and is in the initial stages of being implemented.

Subscriber Equipment

Each STARS vehicle is equipped with over $30K in electronic hardware consisting of mobile and portable radios, laptops, cameras, sirens, light bars, digital vehicular repeaters, and speed enforcement devices. Most subscriber equipment has been in service for twelve years and is nearing or beyond end-of-life. The mobile radio, portable radio, and digital vehicular repeaters work as a combined system and have to be replaced at the same time. Not all replacement hardware is compatible.

As of this writing VSP plans to replace the primary subscriber hardware: SIRS radios, mobile radios, DVRSs, and portable radios in fiscal years 2020-2022. Base station radios will be replaced during the same timeframe.

The cost for a single subscriber equipment unit is:

- Mobile radio - $6.4K each
- Portable radio - $7.0K each
- Digital vehicle repeater - $7.8K each
- SIRS mobile radio - $1.2K each

In addition to in-vehicle equipment STARS uses three models of base station radios that allow stationary office users to communicate with mobile users. The XTL5000 consolettes are used in dispatch centers to backup dispatch consoles. The cost of the replacement radios is $9.5K each.

XTL5000 and XTL2500 control station radios allow office personnel to communicate with mobile users. The cost to replace both of these units with a single unit is $6.8K each.

Another desired feature to be implemented is radio authentication. This feature blocks any cloned radio from connecting to the STARS network. This feature requires new mobile, portable, and DVRS radios and will be implemented after the radio replacement effort described above. If all new radios are ordered with the feature included the infrastructure cost will be between $130 and $150K.

Software and Tools

To engineer, operate and maintain a complex network like STARS requires engineers and technicians and a host of software applications, tools, and test equipment. LMR and microware radio design today is performed using a number of software applications. Specialty tools abound from automotive analyzers to speedometer calibration devices. Test equipment is required to tune radios, calibrate other test sets, and identify sources of radio frequency interference. The cost of a single spectrum analyzer is over $30K each.

STARS Master Site Disaster Recovery

As projects proceed and if funding becomes available, a preliminary estimate for this is $3,357,000.00.

Additional Information

In addition to the specific items identified above, there are annual hardware and software maintenance requirements. The current projected annual cost of hardware and software maintenance is $901K. The detailed list of procurements below includes all of the major items requiring replacement.

The 2019 Legislature has approved $132M and forwarded to the Governor's office for approval funding for the projects listed above. The Governor has approved all funds and procurement has been initiated at this time.