

# **City of Stockton, CA**

## **Radio Equipment Inventory Report**



**March 4, 2015**

**CITY OF STOCKTON, CALIFORNIA**  
**Radio Equipment Inventory Report**

**Executive Summary:**

Trott Communications Group, Inc. (Trott) was retained by the City of Stockton, CA (Stockton) to assist with the inventory of existing two-way radio equipment. Trott worked with Stockton to develop an inventory plan. Trott performed the inventory of fixed-site equipment with the assistance of Delta Wireless, Inc. (Delta), and Stockton. Stockton individual departmental staff performed user equipment inventories.

This report documents the inventory findings and analysis. The inventory data is provided separately on a CD-ROM in Microsoft Excel format including pictures of equipment. The analysis provided in this report and inventory identifies the equipment by Stockton asset tag number.

The inventory was initiated on August 18, 2014 with the fixed-site equipment inventory completed that week and user equipment inventory completed subsequently. A portion of the equipment is already past its useful life. This equipment has been discontinued by the manufacturer and support has ended or will end within the next four years. This existing user equipment can theoretically remain in service until such time that system technology is changed or the equipment becomes inoperable and unable to be repairable. It is recommended that Stockton begin planning for the replacement of all outdated equipment.

The inventory process identified 1844 user radios. Some but not all user equipment is covered by a maintenance agreement with yearly preventive maintenance (PM) performed. A strong and consistent PM program is critical to ensure that all user radios are operating as intended. It is recommended that all user equipment that will remain in service for the next 12 months or beyond be incorporated into Stockton's PM maintenance contract.

Stockton has indicated the possibility of joining the San Joaquin County (County) P25 Trunked Radio System as the build-out of that system continues. P25 is a digital modulation standard designed specially for public safety applications. Trott recommends a comprehensive study of the coverage and features provided by the proposed County system prior to development of long-term communications plans. Only the most recent user equipment, purchased in the last 5-7 years, is capable of operation on the County system as indicated on the inventory spreadsheet. The County has stated its intention to eventually migrate to P25 Phase 2, an

enhanced version of P25 with more user capacity. Only the Motorola APX series user equipment purchased in the last 12 months is capable of upgrade to P25 Phase 2.

A large number of handheld and mobile user radio equipment (approximately 900 units) are no longer supported by the manufacturer and replacement parts are generally unavailable. Models include Motorola MTS2000, MCS2000, Max Trac, Astro Spectra, and XTS3000 and make up 48% of the mobile and portable fleet. These obsolete units should be replaced as soon as possible. The majority of the fixed-site equipment will have manufacturers' support through 2018 and could possibly be used to augment the County system until that time. End-of-life notices, for all but the recently purchased APX series units, are expected later this year, although replacement parts may continue to be available for some time.

During the inventory process, 95 pieces of user equipment identified in Stockton's databases were not found. It is possible that some of this equipment is in use, in the process of being assigned, in storage, or destroyed (surplused). This number excludes missing units that were located during a subsequent verification and audit process.

It was challenging to collect all relevant inventory data, as each department employs different processes and procedures for tracking radio assets and managing equipment maintenance. Trott recommends development of a system-wide radio asset management process with clear and consistent procedures to be followed by all departments; or a centralized process to be managed by Stockton on behalf of the user departments. The asset management process should include periodic inventory verification. The report body contains specific recommendations to address inventory and asset management deficiencies; see the "Recommendations" section.

### **Introduction:**

Trott Communications Group, Inc. (Trott) was retained through a competitive procurement by the City of Stockton, CA (Stockton) to assist with the inventory of existing two-way radio equipment. Trott worked with Stockton to develop an inventory plan. Trott performed the inventory of fixed-site equipment with the assistance of Delta Wireless, Inc. (Delta), and Stockton. Stockton individual departmental staff performed user equipment inventories.

This report documents the inventory plan, inventory methodology, and presents findings. The inventory data is provided separately in Microsoft Excel format.

### **Planning Meeting:**

A planning meeting with Trott, Stockton, and Delta was conducted on August 18, 2014. The meeting developed plans and schedules for inventory of current Stockton radio equipment.

At the meeting, it was determined that George Weimer (of Trott), George Gonzalez (of Delta), and Terrell Harper (of Stockton) would perform a complete inventory of all fixed-site radio equipment with photographs to the extent possible. Determinations were to be made relating to the condition of the equipment and the extent to which they may be reusable in a digital system upgrade.

It was also determined that current user equipment (mobile, portable and some control stations) in service were to be surveyed by Stockton's individual user departments. Due to the operational constraints and geographic separation of some user equipment, department representatives would collect inventory information from the various user-group leaders and compile that information for review by Trott. To the extent possible, user equipment was to be physically inspected and documented by Stockton's inventory team members. It is anticipated that roughly 10% of the user equipment would be physically inspected. Photographs of typical user equipment, roughly 5% of the various types, were to be collected.

### **Inventory Process:**

A recent city-wide inventory database has been acquired and was provided to Trott. The inventory date was listed as August 18, 2014. Based upon discussions held between Trott and Stockton, it was decided to utilize the August 18, 2014 inventory spreadsheet as the starting point for the master inventory database developed under this project. The database depicts the results of the inventory collection process by identifying the source of the physical inventory and referencing relevant photograph numbers for fixed-site equipment. The sites that Trott could not access were surveyed and photographed by Delta and provided to Trott on 9/17/2014. The Stockton Fire Department provided their initial inventory on 8/21/2014 and an updated inventory on 11/16/2014. The Stockton Police

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Department provided their initial inventory on 9/17/2014 and an updated inventory on 10/22/2014. The Municipal Utility Department (MUD) user equipment inventory was first provided on 10/22/2014. MUD user equipment was last updated on 01/05/2015.

Trott noted during the fixed-site inspection that several classes of equipment contained no Inventory Asset Tag. Other Asset Numbers were hand-written on the equipment. It was also noted that many items were not listed in the August 18, 2014 inventory spreadsheet.

#### **Inventory Discrepancies:**

In addition, Trott identified discrepancies between items physically inventoried and items listed on the August 18, 2014 spreadsheet. These items are identified below:

| Asset Tag                                                                      | Photo | DB | S/N        | Note                |
|--------------------------------------------------------------------------------|-------|----|------------|---------------------|
| RA107083                                                                       | 7008  | No |            | Astro Control Sta.  |
| None                                                                           | 7052  | No | 52963-A    | 60-68-07-OLC-G1     |
| RA102841                                                                       | 7150  | No | 940106-002 |                     |
| RA102841                                                                       | 7150  | No | 940106-02  | EMR Divider         |
| None                                                                           | 7154  | No | 019TFW3891 |                     |
| RA107782                                                                       | 7156  | No |            |                     |
| RA107778                                                                       | 7161  | No |            |                     |
| RA107779                                                                       | 7174  | No |            |                     |
| None                                                                           | 7180  | No | 735A4708   |                     |
| None                                                                           | 7181  | ?  | Unavail.   | Zetron Mod 6        |
| None                                                                           | 7186  | ?  | Unreadable | TSU 600e            |
| None                                                                           | 7189  | No | E42M1590   | TSU 600e            |
| None                                                                           | 7200  | No | 019TNG5287 | Moto PM400          |
| RA107776                                                                       | 7201  | No |            | TSU 100e            |
| None                                                                           | 7212  | No | 914D4377   | TSU 100e            |
| None                                                                           | 7227  | No | 740CBJ0380 | Desk Remote         |
| None                                                                           | 7234  | No | 740CUG4639 | Desk Remote         |
| RA107046                                                                       | 7239  | No |            | Voter               |
| RA106261                                                                       | 7244  | No | Unavail.   | Tx-Rx Filter Rack   |
| RA106261                                                                       | 7245  | No |            | Filter Multicoupler |
| Unreadable                                                                     | 7254  | ?  | Unreadable | Console Controller  |
| None                                                                           | 7256  | ?  | Unavail.   | Zetron Mod 26       |
| None                                                                           | 7258  | ?  | Unavail.   | Zetron Mod 26       |
| RA-63310                                                                       | 7264  | No | Unavail.   | Voter               |
| None                                                                           | 7266  | No | 474CXV0087 | MTR2000             |
| None                                                                           | 7267  | ?  | Unavail.   | Securenet Digitac   |
| None                                                                           | 7269  | ?  | Unavail.   | Securenet Digitac   |
| RA107787                                                                       | 7295  | No | 00363-076  | Zetron Encoder      |
| RA107784                                                                       | 7305  | No | 00360-076  | Zetron Encoder      |
| RA107785                                                                       | 7310  | No | 00362-076  | Zetron Encoder      |
| None                                                                           | 7316  | No | 00474-117  | Zetron Encoder      |
| <b><i>Please note that this table was last updated on October 23, 2014</i></b> |       |    |            |                     |

1 – Some of the Quintron Automatic Protection Switches have asset tags (Photo 7041, 7085, 7092), while some do not (Photo 7113, 7250).

2 – Most of the Zetron Fire Station Decoders have an Asset number that is hand-written but those numbers do not appear in the inventory database. In addition, the radio control stations associated with the Fire Station Decoders do not have asset tags although they are identified in the database through their serial number. The Table below lists the hand-written Asset Numbers that do not appear in the inventory:

| Location | Asset No.           | S/N       | Photo     |
|----------|---------------------|-----------|-----------|
| FS-1     | RA106200            | 00796-076 | 7155      |
| FS-2     | RA106204            | 00797-076 | 7360      |
| FS-3     | RA106202            | 00798-076 | 7163      |
| FS-4     | RA106182            | 00799-076 | 7205      |
| FS-5     | RA106187            | 00802-076 | 7158      |
| FS-6     | Station Unavailable |           |           |
| FS-7     | RA106192            | 00795-076 | 7198      |
| FS-8     | Station Unavailable |           |           |
| FS-9     | RA106196            | 00800-076 | 7176      |
| FS-10    | RA106183            | 00794-076 | 7209      |
| FS-11    | RA106189            | 00801-076 | 7169      |
| FS-12    | RA106186            | 00805-076 | 7063      |
| FS-13    | None                | None      | 7181&7182 |
| FS-14    | RA106195            | 00804-076 | 7192      |

3 – Some of the C&D Power supplies have asset tags (Photo 7093), while some do not (Photo 7103).

4 – Several items, although in the database, are misidentified; for example:

- a. Alerting base at FS-1 is listed by S/N in the database as a missing handheld radio.
- b. Radio Console (Photo 7300) Tag RA106489 is listed as an HP Vectra. The HP Vectra associated with that Operator Position has an Asset Tag C31099.
- c. None of the other Radio Consoles have an Asset Tag.
- d. Local Government VHF Voter has Asset Tag RA-63310; however, serial number 273CDS0085 on the device is in the database as RA-63318.
- e. Local Government Quantar Repeater (RA107454) is listed in the database as a UHF Power Amplifier R3.

5 – Several items, identified in the fixed-site inventory are not in the database, for example:

Alerting base at FS-7 (Photo 7200) is identified by Serial Number and not in the database.

6 – There are 1844 total user radios listed in the inventory database. The initial inventory of user equipment was unable to locate 100 portable radios city-wide. During subsequent investigations, it was found that one radio was surplus, one was on loan outside Stockton, and three were found in service while auditing a sample of the portable inventory. It is likely that additional missing units are in service and will be located over time. The follow table is a listing of Asset Tags for the 95 radio units that remain unaccounted for.

|          |          |          |          |          |
|----------|----------|----------|----------|----------|
| RA106875 | RA106995 | RA107274 | RA109274 | RA107503 |
| RA106901 | RA107017 | RA107284 | RA109275 | RA107568 |
| RA106907 | RA107023 | RA107619 | RA109276 | RA107572 |
| RA106908 | RA107024 | RA107624 | RA109279 | RA107582 |
| RA106917 | RA107036 | RA107682 | RA109281 | RA107720 |
| RA106923 | RA107037 | RA107688 | RA109422 | RA107723 |
| RA106929 | RA107110 | RA107692 | RA107223 | RA107733 |
| RA106932 | RA107126 | RA107709 | RA107252 | RA107813 |
| RA106933 | RA107127 | RA107737 | RA107309 | RA107818 |
| RA106942 | RA107131 | RA107747 | RA107457 | RA108265 |
| RA106945 | RA107133 | RA108715 | RA107468 | RA108403 |
| RA106953 | RA107134 | RA109249 | RA107471 | RA108548 |
| RA106955 | RA107137 | RA109250 | RA107476 | RA108549 |
| RA106956 | RA107138 | RA109254 | RA107477 | RA108551 |
| RA106966 | RA107147 | RA109255 | RA107490 | RA108555 |
| RA106970 | RA107156 | RA109259 | RA107493 | RA108841 |
| RA106975 | RA107159 | RA109263 | RA107496 | RA108844 |
| RA106983 | RA107161 | RA109269 | RA107497 | RA108845 |
| RA106994 | RA107176 | RA109271 | RA107502 | RA108846 |

7 – Stockton Fire Department and Stockton Police Department report new radio purchases that were not assigned at the time of the inventory. The following table lists 28 newly purchased Motorola APX7000/7500 units for SFD and 17 new APX6000 units for SPD.

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| Asset Tag | Make     | Asset Tag | Make     | Asset Tag | Make    |
|-----------|----------|-----------|----------|-----------|---------|
| RA109588  | APX7500  | RA109810  | APX7000r | RA109777  | APX6000 |
| RA109589  | APX7500  | RA109811  | APX7000r | RA109779  | APX6000 |
| RA109626  | APX7500  | RA109812  | APX7000r | RA109782  | APX6000 |
| RA109627  | APX7500  | RA109813  | APX7000r | RA109785  | APX6000 |
| RA109641  | APX7500  | RA109814  | APX7000r | RA109786  | APX6000 |
| RA109771  | APX7500  | RA109815  | APX7000r | RA109787  | APX6000 |
| RA109772  | APX7500  | RA109816  | APX7000r | RA109788  | APX6000 |
| RA109773  | APX7500  | RA109817  | APX7000r | RA109790  | APX6000 |
| RA109774  | APX7500  | RA109818  | APX7000r | RA109791  | APX6000 |
| RA109803  | APX7000r | RA109819  | APX7000r | RA109792  | APX6000 |
| RA109804  | APX7000r | RA109820  | APX7000r | RA109793  | APX6000 |
| RA109805  | APX7000r | RA109821  | APX7000r | RA109794  | APX6000 |
| RA109806  | APX7000r | RA109822  | APX7000r | RA109795  | APX6000 |
| RA109808  | APX7000r | RA109775  | APX 6000 | RA109796  | APX6000 |
| RA109809  | APX7000r | RA109776  | APX 6000 | RA109797  | APX6000 |

### **Inventory Results:**

During the inventory process, updates and changes were submitted by the user groups for their handheld portable radio units. As a general rule, mobile radios mounted in vehicles were not inventoried since the Asset Tags are normally attached to the top, bottom or rear of the radio itself. This placement requires that the radio be removed to identify the Asset Number. The removal would require extensive time and effort on behalf of the maintenance contractor and substantial cost to Stockton beyond the normal maintenance contract. The master inventory database (separate inventory spreadsheet dated February 13, 2015) contains the results of all inventory activities to date. The inventory database must continue to be updated as discrepancies are resolved and additional inventory activities are performed.

Below is a sample of the data contained in the inventory database. Note that some fields were removed from the sample table to accommodate the page-size of this report. Please see the inventory spreadsheet for the complete dataset and all 2300+ inventory records.



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| Dept | RentAcct     | AssetTag | Make           | Description               | Support | Future | Cost     | P.O. Number | Serial#    |
|------|--------------|----------|----------------|---------------------------|---------|--------|----------|-------------|------------|
| FD   | 010-2660-530 | RA106855 | AstroTac 3000  | AstroTac Receiver         | 3       | 3      | 5645.13  | 111909      | 743CAK0017 |
| FD   | 010-2660-530 | RA106856 | AstroTac 3000  | AstroTac Receiver         | 3       | 3      | 5645.13  | 111909      | 743CAK0018 |
| FD   | 010-2660-530 | RA106857 | Quantar        | Astro Quantar Repeater    | 3       | 3      | 13643.32 | 111914      | 509CAK0093 |
| FD   | 010-2660-530 | RA106858 | Quantar        | Astro Quantar Repeater    | 3       | 3      | 13643.32 | 111914      | 509CAK0094 |
| FD   | 010-2620-530 | RA107225 | XTS 3000       | XTS 3000 Ruggedized       | 2       | 2      | 2688.77  | 118548      | 620ABJ1490 |
| FD   | 010-2620-530 | RA107226 | XTS 3000       | XTS 3000 Ruggedized       | 2       | 2      | 2688.77  | 118548      | 620ABJ1491 |
| FD   | 010-2660-530 | RA107313 | Astro DIU 3000 | Astro DIU 3000            | 3       | 3      | 12669.16 | 120136      | 524SBQ0012 |
| FD   | 010-2660-530 | RA107314 | Astro DIU 3000 | Astro DIU 3000            | 3       | 3      | 12669.16 | 120136      | 524SBQ0013 |
| FD   | 010-2620-530 | RA107793 | MCS2000        | MCS 2000 - VHF            | 1       | 1      | 2633.41  | 140278      | 623CEL0749 |
| FD   | 010-2620-530 | RA107794 | MCS2000        | MCS 2000 - VHF            | 1       | 1      | 2633.41  | 140278      | 623CEL0750 |
| MUD  | 431-4331-575 | RA108874 | XTL 1500       | XTL 1500 Astro            | 4       | 3      | 1533.84  | 154122      | 726THE0226 |
| MUD  | 431-4331-575 | RA108875 | XTL 1500       | XTL 1500 Astro            | 4       | 3      | 1533.84  | 154122      | 726THE0227 |
| MUD  | 421-4231-571 | RA108904 | XTS 1500 UHF   | XTS1500 UHF Astro         | 4       | 3      | 991.02   | 154216      | 687TGW9295 |
| MUD  | 421-4231-571 | RA108905 | XTS 1500 UHF   | XTS1500 UHF Astro         | 4       | 3      | 991.02   | 154216      | 687TGW9296 |
| MUD  | 431-4331-575 | RA109617 | Astro XTS 2500 | XTS2500 UHF               | 4       | 3      | 1663.31  | 180458      | 407CPV0128 |
| MUD  | 431-4331-575 | RA109618 | Astro XTS 2500 | XTS2500 UHF               | 4       | 3      | 1663.31  | 180458      | 407CPV0129 |
| PD   | 010-2470-530 | RA108921 | Astro XTS 5000 | XTS 5000 Astro UHF        | 3       | 3      | 2516.98  | 155152      | 320CHVA458 |
| PD   | 010-2470-530 | RA108922 | Astro XTS 5000 | XTS 5000 Astro UHF        | 3       | 3      | 2516.98  | 155152      | 320CHVA459 |
| PD   | 010-2470-530 | RA108931 | XTL 5000 Astro | XTL 5000 Astro UHF        | 3       | 3      | 3240.42  | 155558      | 585CHZ1596 |
| PD   | 010-2470-530 | RA108932 | XTL 5000 Astro | XTL 5000 Astro UHF        | 3       | 3      | 3240.42  | 155558      | 585CHZ1597 |
| PD   | 010-2470-530 | RA109592 | APX7000r       | Dual Band, VHF UHF        | 5       | 4      | 4820.16  | 179725      | 655cpm0088 |
| PD   | 010-2470-530 | RA109593 | APX7000r       | Dual Band, VHF UHF        | 5       | 4      | 4820.16  | 179725      | 655cpm0089 |
| PD   | 010-2470-530 | RA109783 | APX 6000       | UHF R1 MODEL 1.5 PORTABLE | 5       | 4      | 1398.97  | 185667      | 481CQR6920 |
| PD   | 010-2470-530 | RA109784 | APX 6000       | UHF R1 MODEL 1.5 PORTABLE | 5       | 4      | 1398.97  | 185667      | 481CQR6921 |

It is Trott's opinion that Stockton's staff is maintaining the equipment inventory to the best of their ability absent a centralized radio equipment asset management process. Each department is responsible for maintaining their own inventory records and each employs different processes and procedures for doing so. Trott recommends development of a system-wide radio asset management process with clear and consistent procedures to be followed by all departments; or a centralized process managed by Stockton on behalf of the user departments. See "Recommendations" for more information.

**Condition Of Equipment:**

All fixed-site equipment is fully operational and is reported to be well maintained by Stockton. The equipment is under a maintenance contract and receives yearly preventive maintenance. Therefore, no performance testing was performed associated with this inventory effort. Such testing would have resulted in system downtime and is outside of the scope of the maintenance agreement. Some fixed-site equipment is well past its useful life, making availability of parts questionable in the long term.

All user equipment was reported by the user departments to be fully operational and in good working condition. Repairs are handled promptly by the maintenance contractor when issues arise. Therefore, all units reported as in-service are also deemed to be in acceptable condition. In theory, preventive maintenance (PM) is performed for all newer user units on a yearly basis. The PM process confirms all performance specifications and identifies physical damage that could impact performance. It is Stockton's responsibility to make units available for PM service. Some units have not been tested in the past 12 months and their performance condition is unknown. Older user equipment (XTS/XTL 3000 and prior) was deleted from the maintenance contract since many cannot be repaired due to lack of replacement parts.

The inventory process did not specifically include PM services for a majority of units. However it was reported that PM was performed for MUD radios since PM was found to be out of date for most units. Many portable radios for other departments also indicated no record of recent preventive maintenance. Trott is not able to confirm which units are covered under a maintenance contract and which units have been removed from the contract.

Although Stockton has implemented a PM program as described above, that program is failing to ensure that all units receive yearly PM checks. Further, older radios should not be eliminated from the PM cycle. These units are more likely to be in need of repair and/or retuning than newer equipment. Stockton should work with the maintenance contractor to ensure that all active and spare units have received a PM within the past 12 months. Stockton should further review and refine its PM program to define procedures and responsibilities going forward. The plan should include a PM tracking process and PM for portable radio batteries.

Trott's January 2015 inspections and audit did uncover several operational radios with damaged antennas and/or damaged remote microphones. Users should receive training for proper care of antennas and accessories. Antenna issues can have a dramatic impact on radio performance and should be addressed promptly.

Trott also recommends development of guidelines for user equipment lifecycle and planned replacements. Such guidelines will help with budget planning and reduce the need for emergency allocation of funds to replace obsolete and malfunctioning radio units. User equipment lifecycle is largely determined by daily usage patterns, mission-critical assignments, and ruggedness of the equipment. Historical repair and replacement data may also provide useful information and guidance.

For mission-critical communications users such as police and fire, equipment downtime must be minimized. Therefore, it is common for agencies to replace mission-critical radios based upon a schedule rather than equipment malfunction. Equipment that remains functional after replacement can be rotated to functions that are less reliant upon radio communications for life safety. The lifecycle for mission critical units is typically 7-10 years. Other radios that endure harsh operating conditions can be replaced more often than others. It may be acceptable for radios to remain in service until failure for users that do not rely on radio communications for life safety or daily responsibilities. It is important to note that technology obsolescence and/or availability of parts are often overriding factors for equipment replacement decisions.

### **Future Use Of Current Equipment:**

Stockton's radio systems and user equipment are aging. Manufacturer support has ended or will be ending in the near-term for all infrastructure equipment and approximately 55% of the user equipment. The existing radio system may not meet all of the current needs and requirements of the users. A plan for upgrades and enhancements will be developed. That plan will consider the potential to reuse existing equipment to the extent possible. It should be noted that equipment can only be reused with a future system if it is compatible with the following:

- Frequency band
- Protocol
- Channel technology

A majority of the Stockton equipment operates in the UHF band. As such, the equipment can only be used with UHF-band systems. Migration to a different frequency band will require the replacement of all base stations and all user equipment (excluding a small quantity of APX7000 dual-band radios). A subset of the equipment operates in the VHF band.

The existing radio system utilizes either analog (FM) modulation or Motorola's propriety Astro digital format. Conventional (non-trunked) channel control technology is used for all channels. This equipment will continue to operate in conventional mode with its current modulation type until the end of its useful life.

The local government radio systems and equipment currently operate in UHF analog mode. It has been reported that, as a result of the mandated narrowband UHF conversion, the local government systems have experienced a reduction in range and in-building coverage. This is a normal result of analog narrowbanding. A conversion to digital (Astro or P25 Phase 1) may be helpful in mitigating this issue due to lower signal-to-noise requirements. P25 is a digital protocol that was designed specifically for public safety applications and promotes compatibility of user equipment regardless of manufacturer.

The migration from analog or Astro digital to other protocols (such as P25 digital) and/or to trunking technology will require equipment upgrades. It is technically possible to upgrade Motorola XTS and XTL series equipment to support P25 conventional and/or P25 trunking technologies. However, only

equipment with existing manufacturer support can be upgraded. The only Motorola user equipment that is capable of P25 is the XTS, XTL, and APX series units. All older models such as Spectra and MTS series radios are not capable of P25 modulation. Only APX series units are capable of P25 Phase 2 modulation. P25 Phase 2 is an enhanced version of P25 that supports two simultaneous conversations (talk paths) on each radio channel through time division multiple access (TDMA) technology.

Below is general information regarding manufacturer support and upgrade potential for relevant Motorola equipment.

1. All Motorola models that pre-date the XTS/XTL series (18% of the fleet) are no longer supported and cannot be upgraded. Parts are generally unavailable.
2. The XTS3000 portable (30% of the fleet) is no longer supported as of 2012.
3. An end-of-life notice for the XTS5000 and XTL5000 was issued effective January 2014. Support for the products ends on December 31, 2018. The Stockton fleet includes 125 of these units (7% of the total).
4. Support for all Quantar series infrastructure equipment ends on December 31, 2018. The Quantar series include Quantar base stations, AstroTAC receivers, AstroTac3000 voters, DIU, and Gold Elite consoles. Quantar base stations are capable of P25 Phase I; after hardware and software upgrade.
5. Support for Motorola MTR2000 base stations ends in August 2015. MTR2000 stations cannot be upgraded to support P25.
6. XTS/XTL 1500 and 2500 units remain in production and with support available. These units (26% of the user radio fleet) can be upgraded to support P25 conventional and P25 trunking within their frequency band of operation. End-of-life announcements are rumored to occur within the next 12 months since focus has shifted to the APX series. Support typically ends 5 - 7 years after end-of-life.
7. APX series radios are current production units and are capable of P25 Phase 1 and Phase 2 operations. These units make up 18% of the current radio fleet.

The information listed above provides compatibility considerations for upgrade planning. The inventory data includes two metrics to help identify the ability to provide support for existing equipment and evaluate the upgrade potential for future use. Each entry includes a column for "Support" and "Future".

The **Support** metric provides a score of 1 - 5 as follows:

1. End-of-support; repair parts unavailable
2. End-of-support; future availability of parts questionable

3. Discontinued; support & parts available thru 2018
4. Current production unit but previous generation series. Parts available for foreseeable future
5. Current production and current generation unit

The **Future Use** metric provides a score of 1 - 4 as follows:

1. Analog-only; not upgradable
2. Astro/P25 compatible but P25 upgrade no longer supported
3. Astro/P25 compatible; P25 upgrade available
4. Astro/P25/P25 Phase 2 compatible; upgrades available

Once an upgrade plan is determined, it will be necessary to analyze the existing equipment inventory for compatibility with the selected frequency band, protocol, and technology.

### **San Joaquin County Considerations**

Discussions with representatives from San Joaquin County (County) indicated that the county-wide system plans include an 11-site, 12-channel digital (P25 Phase 1) trunked simulcast system operating in the UHF band. The first phase of their project is a 3-site, 12-channel simulcast system for the southern county areas. There is no current timetable for the complete expansion to the 11-site system. Stockton indicated a desire to participate in this county-wide system. County personnel indicated their intention to upgrade the system to P25 Phase 2 at some future time but the timeframe is not in their current plan. This upgrade will not occur until the original P25 simulcast system is complete and all users are migrated to the system.

The County has circulated a user equipment recommended-purchase list for mobile and portable radios consistent with their system plans. Stockton should continue to follow these County recommendations if Stockton intends to participate in this county-wide system. As discussed at the County meeting, P25 provides equipment compatibility from multiple manufacturers. There are several less expensive models available for purchase that could be used for non-public safety user groups. These alternate manufacturers include Kenwood, Tait, Relm, BK, etc. in addition to alternate Motorola models. However, it will be important to work with the County to determine specific radio features and specifications that are required for operation on their system.

Note that the County purchase list recommendations do not include the TDMA option, which is required for Phase 2 operations. Also, the recommendation does include OTAR, which provides a mechanism for over-the-air rekeying of encryption keys. This is a relatively expensive option. Unless Stockton plans to utilize encryption and change encryption keys regularly, this option may not be necessary as a general rule, or may only be valuable for specific groups and operations.

Discussions with representatives from the County indicated their system plan includes three sites to cover Stockton. Stockton is currently operating from three transmit sites and eight receive-only sites. The increase in receive sites is necessary to compensate for the transmit power difference between handheld portables (3-5 watts) and base transmitters (100 watts). As a result, Stockton may experience lack of coverage in some areas, especially inside buildings from the County's 3-transmit/3-receive site system. A detailed coverage study, including measurements, is recommended prior to Stockton contemplating a complete transition to the County system. If Stockton decides to join the County system, it will be necessary to work with Stockton departments and the County to develop a detailed system migration plan.

### **Recommendations**

- 1 - Trott recommends that the fixed-site equipment inventory be corrected by affixing Asset Tags to all equipment and ensuring that the equipment is correctly registered in the inventory database.
- 2 – Trott recommends that all user radio equipment classified in this report with "Support" classification of #1 or #2 (894 total units) be scheduled for replacement as soon as possible. These radios are obsolete and generally not repairable. Continued operation of this equipment absent a replacement plan will increase the risk of failures in the field and prolonged resource outages while waiting to secure unplanned replacement units.
- 3 - Trott recommends that all user radio equipment classified in the Support metric 3 (125 units) be budgeted for replacement prior to the 2019 end-of-support date. Replacement should be accelerated as needed to accommodate upgrade plans and schedules.
- 4 - Trott recommends that only equipment with Support metric 4-5 and Future Use metric 3-4 be retained long-term (825 units / 45% of the fleet). All future replacement equipment purchases should be capable of upgrade to P25 Phase 2 to maximize equipment longevity and help protect against premature obsolescence.
- 5 – Trott recommends that all equipment that will remain in service for the next 12 months or beyond be incorporated into Stockton's PM maintenance contract.
- 6 – Trott recommends review and refinement of its PM program. The PM plan should define procedures and responsibilities for performing PM and should institute a PM tracking process to ensure that all user equipment is adequately maintained and meets all original manufacturers' specifications. This program should also include PM and replacement cycles for portable radio batteries.
- 7 – Trott recommends periodic inventory verification. User equipment inventory should be verified every 12 or 24 months to identify discrepancies relating to missing equipment, reassigned equipment, surplus equipment, and new equipment added since the previous inventory. This process could also verify PM status and overall maintenance condition.

8 – Trott recommends development of a system-wide asset management process to address noted inventory deficiencies and to implement the above recommendations. The asset management tasks can be centralized (performed by Stockton) or decentralized (performed by the departments). However, absent an overall plan with accountability, radio equipment asset management will continue to be inconsistent. However, a reliable and comprehensive asset management process will provide a valuable tool not only for tracking these assets but for forecasting equipment replacement cycles and additional equipment requirements.

9 – Trott recommends development of guidelines for user equipment lifecycle and planned replacements. Common timeframes for mission-critical radio units and users that rely on radio communications for life safety are 7-10 years.

10 – Trott recommends that users receive training for proper care of radios, antennas, batteries, and accessories. These accessories should be replaced as damage occurs to achieve optimum performance.

11 – As noted above, there is consideration for Stockton to join the San Joaquin trunked radio system. Trott recommends a comprehensive study of the coverage and features provided by the proposed system prior to development of long-term communications plans.

12 – If Stockton moves toward usage of the County system, funding should be secured as early in the process as possible. In light of the information provided in this report, a detailed transition, funding and operational plan, consistent with the County's plan and schedule, should be developed with the cooperation of all City agencies and departments.