



BOARD OF COUNTY COMMISSIONERS

DATE: November 19, 2013

AGENDA ITEM NO. 22

Consent Agenda ☐

Regular Agenda ☒

Public Hearing ☐

County Administrator's Signature: 

Subject:

Change Order No.7- Radio Console System
Contract No. 990-0909-N(RG)

Department:

Public Safety Services / Purchasing

Staff Member Responsible:

Bruce Moeller / Joe Lauro

Recommended Action:

I RECOMMEND THE BOARD OF COUNTY COMMISSIONERS (BOARD) APPROVE CHANGE ORDER NO. 7 (WORK ORDER) TO THE CONTRACT FOR A RADIO CONSOLE SYSTEM WITH MOTOROLA SOLUTIONS, INC. (MOTOROLA), SCHAUMBURG, ILLINOIS.

IT IS FURTHER RECOMMENDED THAT AFTER PROPER EXECUTION OF THE CHANGE ORDER BY THE CONTRACTOR, THE CHAIRMAN BE AUTHORIZED TO SIGN THE CHANGE ORDER AND THE CLERK ATTEST.

Summary Explanation/Background:

This request for Change Order 7 to the contract for the purchase of a radio console system is for the purpose of migrating analog equipment to Project 25 (P25) protocol for the interoperability of intergovernmental 800 MHz public safety radio systems. P25 is a suite of standards for digital radio communications equipment that enables public safety responders to communicate with each other, improving response times and increasing the effectiveness of communications equipment. Currently, the County's intergovernmental 800 MHz radio system is a proprietary product of Motorola, who installed and maintains the equipment.

More specifically this change order request is to provide for the equipment, installation and warranty required for the migration to P25 technology at the County's new Public Safety Complex (PSC) utilizing the new Category 5 Communications Shelter and Tower. This change order also includes the equipment and services to upgrade the existing Pinellas County Radio System Network to Release 7.14 and to convert the existing master site, currently located at the Ridgecrest Radio Site, to a "hot standby master site", which will be the central point for all system traffic in each P25 zone.

Payments for Change Order No. 7 will be made upon completion of each of the following five (5) milestones:

- Milestone 1 : Contract Design Review (CDR) phase - 25% of the contract price
- Milestone 2: Shipment of equipment - 40% of the contract price
- Milestone 3: Installation - 20% of the contract price
- Milestone 4: Acceptance and beneficial use of the system - 10% of the contract price
- Milestone 5: Final acceptance of the system - 5% of the contract price

Previous actions pertaining to this contract in reverse chronological order are:

- Change Order No. 6 - Approved by the Board on 01/15/2013
- Name Change- Approved by the County Administrator on 05/23/2011
- Work Order No. 10-001 - Approved by the County Administrator on 08/10/2010
- Change Order No.3, No. 4, & No. 5 - Approved by the Board on 05/06/2008
- Change Order No.2 - Approved by the Board on 09/09/2003
- Change Order No. 1 - Approved by the Board on 05/03/2003
- Release of Expenditures - Approved by the Board on 12/03/2001, 11/20/2001, and 03/13/2001, respectively.
- Award of contract- Approved by the Board on 06/27/2000

Fiscal Impact/Cost/Revenue Summary:

Previous Contract Amount (Original purchase plus change orders)	\$31,568,602.90
Change Order No. 7 Increase:	<u>\$ 8,449,850.00</u>
Updated Contract Amount Not to Exceed:	\$40,018,452.90

Funds are budgeted within the Penny for Pinellas Capital Improvement Program.

Exhibits/Attachments Attached:

Contract Review

Motorola's Work Order No. 13-001

NON-PURCHASING CONTRACT REVIEW TRANSMITTAL SLIP

PROJECT: Motorola Solutions Work Order No. 13-001	
CONTRACT NO.: 990-0909-N	ESTIMATED <u>EXPENDITURE</u> / REVENUE: amount \$8,449,850 (Circle or underline appropriate choice above.)

VZ

In accordance with Contract Administration and its Review Process, the attached documents are submitted for your review and comment. Please complete this Non-Purchasing Contract Review Transmittal Slip below with your assessment, and **forward to the next Review Authority on the list, skipping any authority marked "N/A."** Indicate suggested changes by noting those in "Comments" column, or by revising, in RED, the appropriate section(s) of the document(s) to reflect the exact wording of the desired change(s).

OTHER SPECIFICS RELATING TO THE CONTRACT:

REVIEW SEQUENCE	DATE	INITIAL/ SIGNATURE	COMMENTS (IF ANY)	COMMENTS REVIEWED & ADDRESSED OR INCORPORATED
Originator: Jackie Weinreich	10/29/13	<i>[Signature]</i>		
Risk Mgmt: Virginia Holscher	10/31/13	<i>[Signature]</i>	Insurance in original agreement	
Finance:** Cassandra Williams	11/5/13	<i>[Signature]</i>		
OMB:** Eric Naughton- Bill Berger	11/7/13	<i>[Signature]</i>	Cost is \$8,449,850 + CIP Project Budget For FY 14 is \$9,000,000. <i>[Signature]</i> Project 001815A	
Legal: Don Crowell	SEE legal comments attached			
Assistant County Administrator or Executive Director: Bruce Moeller	11/8/2013	<i>[Signature]</i>		

OK
VZ

Please return to Jackie Weinreich By Click here to enter text..
All inquiries should be made to Jackie Weinreich ext.464-3879.

** See Contract Review Process

Garcia, Rosa

From: Crowell, Don S
Sent: Friday, November 08, 2013 7:23 AM
To: Hostetler, Gina M; Gonya, Paula; Garcia, Rosa; Weinreich, Jacqueline L; Belknap, Miles S; Moeller, Bruce
Subject: RE: Nov. 19 Motorola agenda item - CATS #43559
Attachments: Re: CIP Project for Motorola Radio System Upgrade; DSC AATF Chng Order 110813.PDF

Attached are my comments and the Approved as to Form Change Order. I did not have the contract review sheet to sign off on so I hope that these attachments will be sufficient. I have left the original Approved as to Form copy in the Departmental Pickup bin at the front desk in the County Attorney's Office with Jackie's name on it (with the attachments).

Call if you need something else from our office and I will coordinate it.

Don

Donald S. Crowell
Managing Assistant County Attorney
Pinellas County Attorney's Office
315 Court Street, 6th Floor
Clearwater, FL 33756
Phone: (727) 464-3354
Fax: (727) 464-4147
dcrowell@pinellascounty.org

All government correspondence is subject to the public records law.

From: Hostetler, Gina M
Sent: Thursday, November 07, 2013 2:23 PM
To: Gonya, Paula; Garcia, Rosa
Cc: Crowell, Don S
Subject: Nov. 19 Motorola agenda item - CATS #43559
Importance: High

We are walking the attached item through to be placed on the Nov. 19th BCC Agenda (must be at County Admin. by Friday morning).

It is currently at OMB. Purchasing is to provide County Admin. with the memo as soon as possible. Please contact Jackie Weinreich x43879 with any questions.

Thank you!

Gina Hostetler
Admin Support Spec
Pinellas County Safety and Emergency Services
400 S Fort Harrison Avenue, Ste 140
Clearwater, FL 33756
Phone (727) 464-3351
Fax (727) 464-3265
ghostetler@pinellascounty.org

Garcia, Rosa

From: Crowell, Don S
Sent: Thursday, November 07, 2013 8:50 PM
To: Weinreich, Jacqueline L; Moeller, Bruce
Cc: Belknap, Miles S; Mitchell, Gloria
Subject: Re: CIP Project for Motorola Radio System Upgrade

Jackie and Bruce,

I have looked the change order, the scope, the backup previously provided from the historical Motorola contracts, and the letter provided by the consultant indicating that the scope is consistent with what they negotiated. As I previously indicated given the time frames desired for completion, the technical nature of the work outline in the documents, and history to date I agree that the change order is consistent with my understanding of the business deal that staff is supporting. I have concerns with the lack of objective specificity in the measurement of the deliverables and milestones (which cuts both ways), but I understand the consultant on whom staff is relying is comfortable with the scope as written to meet needs of the business deal. The key will be during administering the agreement to be very careful before any payment is made that staff is satisfied that the objective has been met from the County's perspective. I am also concerned with the front loaded payment schedule that will be disadvantageous for any practical remedy in the event that the system ends up having actual function problems (over \$5 million (65%) will be paid before installation begins) but again, this is a business decision. The change order is legal and I will approve it as to form so you can meet your desired timeframe or will ask that Miles approve it in my absence.

Miles please call my cell at 727-512-3891 at your earliest convenience.

Thanks.

Don

Sent from my iPad

> On Nov 7, 2013, at 4:20 PM, "Weinreich, Jacqueline L" <jweinrei@co.pinellas.fl.us> wrote:
>
> Further FYI....this is what I sent to you last week. So sorry for the inconvenience!!!
>
>
>
>
>
>
> From: Weinreich, Jacqueline L
> Sent: Tuesday, October 29, 2013 1:15 PM
> To: Moeller, Bruce; Garcia, Rosa; Lauro, Joseph; Crowell, Don S;
> Mancuso, Candis L
> Cc: Beim, Donna J; Dempsey, Gary
> Subject: CIP Project for Motorola Radio System Upgrade
>
> Rosa and Candy,
>
> Just wanted to give you, Joe and Don a heads' up that we and RCC (our consultant) have completed negotiations with Motorola and that we are initiating paperwork for the November 19th BCC agenda. We are short on time to get this project completed before June 1, 2014 (hurricane season). So, you can expect to see the item on your desks in the coming weeks.

**Work Order No. 13-001**

This Work Order No. 13-001 ("Work Order") to Pinellas County Contract Reference No. 990-0909-N, Motorola Contract Reference No. 04-19786/hmm, dated May 9, 2005 (the "Agreement") between Motorola Solutions, Inc. and Pinellas County, Florida, is made and entered into as the last date signed below ("Effective Date").

1. This Work Order is an integral part of the Agreement. If there are any inconsistencies between the provisions of this Work Order and the provisions of the Agreement, the provisions of this Work Order shall prevail.
2. This Work Order includes and is limited to the Equipment, Services, and Warranty to provide and install a new 7.14 Master Site, MidZone Prime Site and a twenty (20) Channel ASR Site at the County's new Public Safety Complex utilizing the new Category 5 Communications Shelter and Tower. This Work Order also includes the Equipment and Services to upgrade the existing Pinellas County Radio System Network to Release 7.14 and to convert the existing Master Site, currently located at the Ridgecrest Radio Site, to a Hot Standby Master Site.
3. The Contract Price will be adjusted as follows:

Original Contract Price	\$5,149,000.00
Previous Change Order Amounts Change Orders Number 1 – 5 and Work Order 10-001	\$26,419,602.90
This Work Order	\$8,449,850.00
Adjusted Contract Price	\$40,018,452.90

4. The Contract Completion Date will be adjusted as follows:

Earliest Work Start Date	November 1, 2013
Schedule Completion Date	December 31, 2014

5. Exhibits A through F in Section 1 of the Agreement shall remain in full force and effect for the work to be performed pursuant to the Agreement, and shall not affect parties' duties and obligations under this Change Order. For purposes of the work to be performed pursuant to this Change Order, the following Exhibits shall apply.

Exhibit A System Pricing, System Description, Statement of Work, Warranty and Equipment, Materials and Services List

Exhibit B Payment Terms

6. Customer shall make payment to Motorola, per Exhibit B, within forty-five (45) days of receipt of Motorola's invoice.



MOTOROLA SOLUTIONS

Except as specifically stated in this Change Order, the Agreement in all other respects is ratified, confirmed and continues in full force and effect.

In Witness Whereof, the parties have executed this Change Order as of the Effective Date set forth below.

MOTOROLA SOLUTIONS, INC.

CUSTOMER:

By: _____
(Signature)

By: _____
(Signature)

Name: _____
(Print - Block Letters)

Name: _____
(Print - Block Letters)

Title: _____

Title: _____

Date: _____

Date: _____

PINELLAS COUNTY CONTRACT NO. 990-0909-N, MOTOROLA CONTRACT NO. 04-19786/HHM

Exhibit A



MOTOROLA

The design, technical, pricing, and other information ("Information") furnished with this submission is proprietary information of Motorola Solutions, Inc. ("Motorola") and is submitted with the restriction that it is to be used for evaluation purposes only. To the fullest extent allowed by applicable law, the Information is not to be disclosed publicly or in any manner to anyone other than those required to evaluate the Information without the express written permission of Motorola.

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September, 2013

Pinellas County, FLorida

Use or disclosure of this proposal is subject
to the restrictions on the cover page.

Pinellas County Contract No. 990-0909-N, Motorola Contract No. 04-19786/hhm



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STATEMENT OF WORK

Motorola will provide the installation and configuration of the following equipment at the specified locations.

Site Name	Major Equipment
Pinellas County Radio System Network	Upgrade the current Network from ASTRO 7.9 to ASTRO 7.13
Pinellas County PSC Category 5 Communications Shelter	Install a new ASTRO 7.14 Master Site, New ASTRO 7.14 MidZone Prime Site and New 20 channel ASTRO 25 ASR Site
Pinellas County Radio System Network	Completion of Upgrade of the Entire Pinellas County Network to ASTRO 7.14

This document delineates the general responsibilities between Motorola and Pinellas County as agreed to by this Work Order No. 13-001.

1.1 MOTOROLA RESPONSIBILITIES

Motorola's general responsibilities include the following:

- Perform the installation of all Motorola supplied equipment.
- Schedule the implementation in agreement with Pinellas County, based on an agreed to Customer Design Review.
- Coordinate the activities of all Motorola subcontractors under this Work Order.
- Administer safe work procedures for installation.
- Provide Pinellas County with full As-Built Documentation at the conclusion of the project.

1.2 PINELLAS COUNTY RESPONSIBILITIES

Pinellas County general responsibilities include the following:

- Provide access to all buildings, equipment shelters, and towers required for system installation.
- With Motorola's assistance, obtain all FCC licensing required.
- With Motorola's assistance, obtain frequencies for project as required.
- Customer agrees to use Suncoast C&E, Inc. located at 3195 Tech Drive North, St. Petersburg, Florida, as the dedicated delivery point, for receipt, inventory and storage of equipment prior to delivery to the site(s).
- Coordinate the activities of all Pinellas County contracted vendors or other contractors.



Motorola has made several assumptions in preparing this proposal, which are noted below. In order to provide a firm quote, Motorola will need to verify all assumptions or seek alternate solutions in the case of invalid assumptions.

- Approved FCC licensing provided by the customer.
- Any required system interconnections not specifically outlined here will be provided by the Customer. These may include dedicated phone circuits, or other types of connectivity.

1.3 CONTRACT AWARD (MILESTONE)

1.3.1 Contract Administration

Motorola Responsibilities

- Assign a Project Manager as the single point of contact with authority to make project decisions.
- Assign resources necessary for project implementation.
- Set up the project in the Motorola information system.
- Schedule the project kickoff meeting with the Customer.

Customer Responsibilities

- Assign a Project Manager as the single point of contact responsible for Customer signed approvals.
- Assign other resources necessary to ensure completion of project tasks for which the Customer is responsible.

Completion Criteria

- Motorola internal processes are set up for project management.
- Both Motorola and the Customer assign all required resources.
- Project kickoff meeting is scheduled.

1.4 PROJECT KICKOFF

Motorola Responsibilities

- Conduct a project kickoff meeting during the Contract Design Review (CDR) phase of the project.
- Ensure key project team participants attend the meeting.
- Introduce all project participants attending the meeting.
- Review the roles of the project participants to identify communication flows and decision-making authority between project participants.
- Review the overall project scope and objectives with the Customer.
- Review the resource and scheduling requirements with the Customer.



- Review the Project Schedule with the Customer to address upcoming milestones and/or events.
- Review the teams' interactions (Motorola and the Customer), meetings, reports, milestone acceptance, and the Customer's participation in particular phases.

Customer Responsibilities

- The Customer's key project team participants attend the meeting.
- Review Motorola and Customer responsibilities.

Completion Criteria

- Project kickoff meeting completed.
- Meeting notes identify the next action items.

1.5 CONTRACT DESIGN REVIEW

Motorola Responsibilities

- Meet with the Customer project team.
- Review the operational requirements and the impact of those requirements on various equipment configurations.
- Establish a defined baseline for the system design and identify any special product requirements and their impact on system implementation.
- Review the System Design, Statement of Work, Project Schedule, and Acceptance Test Plans, and update the contract documents accordingly.
- Discuss the proposed Cutover Plan and methods to document a detailed procedure.
- Submit design documents to the Customer for approval. These documents form the basis of the system, which Motorola will manufacture, assemble, stage, and install.
- Prepare equipment layout plans for staging.
- Provide minimum acceptable performance specifications for microwave, fiber, or copper links for any customer supplied links.
- Establish demarcation point to define the connection point between the Motorola-supplied equipment and the Customer-supplied link(s) and external interfaces for any customer supplied links.
- Perform Frequency Coordination and file PCN.

Customer Responsibilities

- The Customer's key project team participants attend the meeting.
- Make timely decisions, according to the Project Schedule.

Completion Criteria

- Complete Design Documentation, which may include updated System Description, Equipment List, system drawings, or other documents applicable to the project.
- Incorporate any deviations from the proposed system into the contract documents accordingly.



- The system design is “frozen,” in preparation for subsequent project phases such as Order Processing and Manufacturing.
- A Change Order is executed in accordance with all material changes resulting from the Design Review to the contract.

1.6 DESIGN APPROVAL (MILESTONE)

- The Customer executes a Design Approval milestone document.

1.7 MANUFACTURING

Motorola Responsibilities

- Manufacture the Fixed Network Equipment (FNE) necessary for the system based on equipment order.

Customer Responsibilities

- None.

Completion Criteria

- FNE shipped CCSI for Staging

1.8 MANUFACTURE NON-MOTOROLA EQUIPMENT

Motorola Responsibilities

- Manufacture (third party equipment suppliers) non-Motorola equipment necessary for the system based on equipment order.

Customer Responsibilities

- None.

Completion Criteria

- Ship non-Motorola manufactured equipment to either CCSI for Staging, or the county designated storage facility if it is non-staged field equipment.

1.9 DEVELOP MOSCAD TEMPLATES

Motorola Responsibilities

- Motorola assists the Customer in defining each MOSCAD template.

Customer Responsibilities

- Approve templates.

Completion Criteria

- Templates completed and approved by the Customer.



1.10 STAGE SYSTEM

Motorola Responsibilities

- Set up and rack the system equipment on a site-by-site basis, as it will be configured in the field.
- Label the cables with information to specify interconnection for field installation and future servicing needs.
- Assemble required subsystems to assure system functionality.
- Power up, program, and test all staged equipment.
- Confirm system configuration and software compatibility to the existing system.
- Load application parameters on all equipment.
- Complete programming of the Fixed Network Equipment.
- Inventory the equipment with serial numbers and installation references.
- Complete system documentation.
- Third party subsystems may be staged at the manufacturer's facilities and integrated in the field.

Customer Responsibilities

- Provide information on existing system interfaces as may be required.

Completion Criteria

- System staging completed and ready for testing.

1.11 PERFORM STAGING ACCEPTANCE TEST PROCEDURE

Motorola Responsibilities

- Test and validate system software and features.
- Functional testing of standard system features.
- Conduct site and system level testing.
- Power up site equipment and perform standardized functionality tests.

Customer Responsibilities

- Review and approve Factory Test Plan Results.

Completion Criteria

- Approve Factory Acceptance Testing.

1.12 SHIP EQUIPMENT TO FIELD

Motorola Responsibilities

- Pack system for shipment to final destination.
- Arrange for shipment to the field.

Customer Responsibilities

- None.

Completion Criteria

- Equipment ships from CCSI facility to the Pinellas County designated storage facility.

1.13 SHIP ACCEPTANCE (MILESTONE)

- All equipment shipped to the Pinellas County designated storage facility.

1.14 CIVIL WORK FOR THE CUSTOMER PROVIDED FACILITIES

Motorola Responsibilities

- Provide Antenna Mounting for sites as needed.
- Provide any new outlets as needed.

Customer Responsibilities

- Secure site access as required.
- Resolve any environmental issues including, but not limited to, asbestos, structural integrity (rooftop, water tank, tower, etc.) of the site, and any other building risks. (Resolve environmental or hazardous material issues).
- Pay for usage costs of power and generator fueling, both during the construction and installation effort, and on an ongoing basis.
- Complete all customer deliverables in accordance within the approved project schedule.

Completion Criteria

All sites are ready for equipment installations in compliance with Motorola's Standards and Guidelines for Communication Sites (R56).

1.15 SYSTEM INSTALLATION

Motorola Responsibilities

- Receive and inventory all equipment at the Pinellas County designated storage facility.
- Should Pinellas County System Experience interference, Motorola can be contracted to investigate the source and recommend solutions to mitigate the issue.



- Install system equipment as specified by the Equipment List, System Description, and system drawings.
- Bond the supplied equipment to the site ground system in accordance with Motorola's Standards and Guidelines for Communication Sites (R56).

Customer Responsibilities

- Provide access to the sites, as necessary.
- Provide removal or disposal of unused equipment.

Completion Criteria

- Fixed Network Equipment installation completed and ready for optimization.

1.16 FIXED NETWORK EQUIPMENT INSTALLATION COMPLETE

- All fixed network equipment installed and accepted by the Customer.

1.17 SYSTEM OPTIMIZATION

Motorola Responsibilities

- Verify that all equipment is operating properly and that all electrical and signal levels are set accurately.
- Motorola and its subcontractors optimize each subsystem.
- Verify communication interfaces between devices for proper operation.
- Test features and functionality are in accordance with manufacturers' specifications and that they comply with the final configuration established during the CDR/system staging.
- Connect MOSCAD RTUs.
- Verification of MOSCAD communications path between central and remote locations.
- Verification of MOSCAD remote alarm in puts and control outputs.

Customer Responsibilities

- Provide access/escort to the sites as required.

Completion Criteria

- System FNE optimization is complete.

1.18 OPTIMIZATION COMPLETE

- System optimization is completed. Motorola and the Customer agree that the equipment is ready for acceptance testing.

1.19 TRAINING

Motorola Responsibilities

- Training is included.

1.20 AUDIT AND ACCEPTANCE TESTING

Motorola Responsibilities

- Test individual components of the system to verify compliance to the equipment specifications.
- Repeat any failed test(s) once Motorola (or the Customer) has completed the corrective action(s).
- Prepare documentation of component tests to be delivered as part of the final documentation package as required.

Customer Responsibilities

- Witness tests if desired.

Completion Criteria

- Successful completion of equipment testing.

1.21 PERFORM FUNCTIONAL TESTING

Motorola Responsibilities

- Verify the operational functionality and features of the individual subsystems and the system supplied by Motorola, as contracted.
- If any major task as contractually described fails, repeat that particular task after Motorola determines that corrective action has been taken.
- Document all issues that arise during the acceptance tests.
- Document the results of the acceptance tests and present to the Customer for review.
- Resolve any minor task failures before Final System Acceptance.

Customer Responsibilities

- Witness the functional testing.

Completion Criteria

- Successful completion of the functional testing.
- Customer approval of the functional testing.

Note: Traffic activation of system prior to completion of final testing and system acceptance will constitute "Beneficial Use" and "Acceptance" of the affected portion.

1.22 SYSTEM ACCEPTANCE TEST PROCEDURES (MILESTONE)

- Customer approves the completion of all the required tests.

1.22.1 Finalize

1.22.2 Cutover

Motorola Responsibilities

- Motorola and the Customer develop a mutually agreed upon cutover plan per discussions held during the CDR.
- During cutover, follow the written plan and implement the defined contingencies, as required.

Customer Responsibilities

- Attend cutover meetings and approve the cutover plan.
- Notify the user group(s) affected by the cutover (date and time).
- Conduct a roll call of all users working during the cutover, in an organized and methodical manner.

Completion Criteria

- Successful cutover.

Motorola Responsibilities

- Work with the Customer to resolve punch list items, documented during the Acceptance Testing phase, in order to meet all the criteria for final system acceptance.

Customer Responsibilities

- Assist Motorola with resolution of identified punch list items by providing support, such as access to the sites, equipment and system, and approval of the resolved punch list item(s).

Completion Criteria

- All punch list items resolved and approved by the Customer.

1.23 TRANSITION TO SERVICE/PROJECT TRANSITION CERTIFICATE

Motorola Responsibilities

- Review the items necessary for transitioning the project to warranty support and service.
- Provide a Customer Support Plan detailing the warranty and post warranty support, if applicable, associated with the Contract equipment.



Customer Responsibilities

- Participate in the Transition Service/Project Transition Certificate (PTC) process.

Completion Criteria

- All service information has been delivered and approved by the Customer.

1.24 FINALIZE DOCUMENTATION

Motorola Responsibilities

- Provide the following documentation:
 - Rack Profiles.
 - Acceptance Test Plan test sheets and results.
 - ATP Test Checklists.
 - Block Diagrams.

Customer Responsibilities

- Receive and approve all documentation provided by Motorola.

Completion Criteria

- All required documentation is provided and approved by the Customer.

1.25 FINAL ACCEPTANCE (MILESTONE)

- All deliverables completed, as contractually required.
- Final System Acceptance received from the Customer.

1.25.1 Project Administration

1.26 PROJECT STATUS MEETINGS

Motorola Responsibilities

- Motorola Project Manager, or designee, will attend all scheduled project status meetings with the Customer, as determined during the CDR.
- Record the meeting minutes and supply the report.
- The agenda will include the following:
 - Overall project status compared to the Project Schedule.
 - Product or service related issues that may affect the Project Schedule.
 - Status of the action items and the responsibilities associated with them, in accordance with the Project Schedule.
 - Any miscellaneous concerns of either the Customer or Motorola.



Customer Responsibilities

- Attend meetings.
- Respond to issues in a timely manner.

Completion Criteria

- Completion of the meetings and submission of meeting minutes.

1.27 PROGRESS MILESTONE SUBMITTAL

Motorola Responsibilities

- Submit progress (non-payment) milestone completion certificate/documentation.

Customer Responsibilities

- Approve milestone, which will signify confirmation of completion of the work associated with the scheduled task.

Completion Criteria

- The Customer approval of the Milestone Completion document(s).

1.28 CHANGE ORDER PROCESS

Either Party may request changes within the general scope of this Agreement. If a requested change causes an increase or decrease in the cost or time required to perform this Agreement, the Parties will agree to an equitable adjustment of the Contract Price, Performance Schedule, or both, and will reflect the adjustment in a change order. Neither Party is obligated to perform requested changes unless both Parties execute a written change order.



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ASTRO 25 is optimized for the rigorous demands of public safety, providing reliable communications. When an emergency involves multiple agencies, first responders can share voice and data communication among their teams. In addition, centralized command and control can deploy resources efficiently, maintain communication security, and track personnel effectively. See Figure 2-1 below.

**RELIABLE
VOICE & DATA
INTEGRATED
AS ONE**

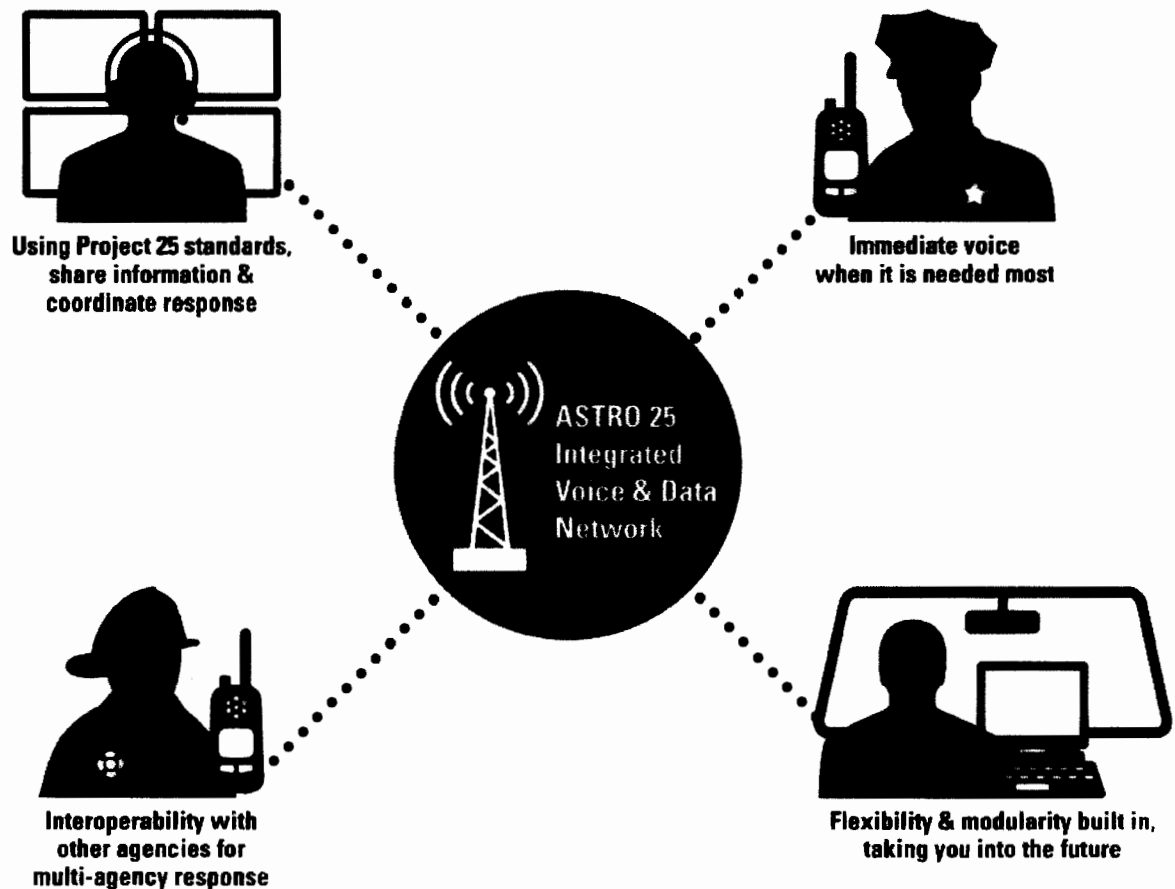


Figure 2-1:ASTRO 25 Integrated Voice and Data Network

SYSTEM DESCRIPTION

2.1 PURPOSE AND SCOPE

This document is intended to provide a general overview of the ASTRO®25 simulcast trunked system proposed for the Pinellas County. This includes:

- The 7.9 to 7.13 and 7.13 to 7.14 Upgrades will be performed on the current Pinellas County 7.9 infrastructure.
- The Dynamic System Resilience (DSR) for the Pinellas County system will be installed at the Ridgecrest Master site and the new Pinellas County Public Safety Complex (PSC).
- The Geographically Redundant Prime for the Pinellas County MZ Simulcast Sub system will be installed at the Ridgecrest Master site and the new Pinellas County Public Safety Complex (PSC).
- The 20 channel ASR site will be installed at the Pinellas County Public Safety Complex (PSC).

2.1.1 Overview

ASTRO 25 is the most widely used Project 25, Mission-Critical, Integrated Voice and Data (IV&D) communication network for public safety agencies. Installed worldwide, ASTRO 25 solutions meet and exceed IV&D requirements for day-to-day operations, as well as emergency response in the most demanding situations. ASTRO 25 is a wireless platform that combines uncompromising, real-world performance and the legendary reliability of Motorola Solutions, Inc. (Motorola).

**A PLATFORM WITH
UNPARALLELED
FLEXIBILITY**

From single-site to nationwide deployments, ASTRO 25 is a flexible, modular network with advanced call processing capabilities designed to meet the needs of public safety. ASTRO 25 can adapt to accommodate additional users, increased geographic coverage, enhanced data applications, and connectivity to other networks—all to ensure an efficient and cost-effective solution for decades to come.



2.2 THE BENEFITS OF ASTRO 25 IP TECHNOLOGY

Motorola's proposed solution for Pinellas is our ASTRO 25 platform with IV&D, the foundation of the Mission-Critical portfolio. ASTRO offers a Project 25, standards-based Internet Protocol (IP) modular solution, providing your first responders with:

- **Cost savings** – ASTRO 25 reduces costs by integrating your voice and data needs into a single solution.
- **Interoperability** – ASTRO 25 is compliant with APCO Project 25 standards, offering seamless interoperability with other compliant systems and radios, putting the highest level of interoperability in the end-users' hands, without the need of gateways or console patches.
- **Reliability** – Pre-release software and upgrade testing, third-party hardware and software certification process, fault-tolerant architecture with multiple fallback modes, multiple levels of redundancy, and real-time network and security monitoring provide Mission-Critical reliability.
- **Increased security** – Information Assurance (IA) enhances the confidentiality, integrity, and availability of the Radio Network Infrastructure (RNI). Multiple encryption algorithms keep end-to-end voice and data transmissions confidential.
- **Enhanced productivity** – Easy and intuitive interfaces to critical, real-time information is delivered to users when and where they need it.
- **Flexibility** – Scalable, flexible design allows ASTRO 25 to dynamically adapt to the operational demands of any size organization. The IP-based design supports a unique mix of voice, data, and geographical requirements, permitting easy system enhancements as the users' needs evolve.

ASTRO 25
WHEN MISSION
CRITICAL
COMMUNICATIONS
DEMAND PROJECT 25
INTEROPERABILITY
& IP FLEXIBILITY

A description of the features, benefits, system architecture, and hardware components are provided in this document.

2.3 ASTRO 25 IP SYSTEM FEATURES

An ASTRO 25 system is a feature-rich, modular platform that consists of a Core site, which may include ASTRO 25 RF sites and simulcast cells. This section discusses the various key features and equipment components that comprise the proposed system.

2.3.1 Master Site

The master site is the central point for all system traffic in each ASTRO 25 zone. Call processing and system management occur at the master site. The Voice and Data call processing for each zone is performed by the Zone Controller. The Zone Controller(s) maintain constant communication between the RF Sites, Simulcast Sites and Network Management (NM) sub-systems via the Network Transport Subsystem.

2.3.2 Dynamic System Resilience (New Feature to Pinellas County System)

A master site can be redundant, consisting of a primary master site, and a back-up master site. This is known as the Dynamic System Resilience (DSR).

The Dynamic System Resilience (DSR) feature automatically maintains critical radio system communications in the event of a catastrophic master site failure. DSR ensures your system will remain active, with no loss of features at your most critical time of need—thus maintaining strategic communications and preserving the safety of your organization. During such a failure, DSR maintains full system functionality, including network management features and core component redundancy. The switch between master sites is automatic and seamless, with minimal interruption to radio system users.

The Zone Controllers are the heart of the voice subsystem. For each zone in a DSR system, two dedicated Zone Controller applications exist in each master site. The four Zone Controllers securely communicate to select one active Zone Controller; the selection algorithm is weighted to give preference to the primary core.

Remote sites and remote zones' active Zone Controllers establish control links with whichever of the four is active. Critical (or all) remote sites have an additional site link to the backup core to support wide-area trunking if the master site with the primary core fails completely. Recovery from failures to the voice subsystem is automatic, i.e., not requiring end-user action.

DSR introduces redundant data subsystem components that switch independently of the voice components. Data component failures and switchover do not impact voice system operation. Per zone, per enabled data service (IV&D and/or High Performance Data [HPD]), a backup Packet Data Gateway (PDG) is added to the backup core. Also, a second Gateway GPRS Support Node (GGSN) is required in the system for backup. Each core within a zone has access to a separate GGSN.

In Multi-Zone systems, the master site's GGSN is shared between a zone's primary core and another zone's backup core. Note that more than two GGSNs in a DSR system can be configured. Each redundant pair of PDGs is associated with a redundant pair of GGSNs. Note that multiple pairs of PDGs can share a single pair of GGSNs. Additionally; redundant Customer Network Interface (CNI) paths are provided to each Customer Enterprise Network (CEN) in the system. As with remote sites, the PDGs are aware of the four Zone Controllers and establish connections for mobility information with the active one.

2.3.3 Geographically Redundant Prime Site (New Feature to Pinellas County System)

This feature enables continued normal wide-area simulcast subsystem operations as a part of the complete ASTRO 25 system, even after a catastrophic prime site failure.

This will be installed on the Pinellas County MZ simulcast subsystems that cover a large number of users in high density areas.

Geographically separated Redundant Simulcast Prime Sites maintain wide-area simulcast trunking operation with wire-line dispatch even if one prime site is destroyed – natural disaster, terrorism, etc.

2.3.4 Network Management System

The Network Management (NM) system can be viewed as a set of software applications or tools used to manage the ASTRO 25 wide-area trunked radio system and its constituent components.

The NMS supports the following services:



- **Network Monitoring** – Applications are included for monitoring the status of the transport network and the individual infrastructure components; displaying status information; forwarding alert information; and performing diagnostic procedures.
- **Configuration Management** – Facilities are provided for entering and maintaining the operational parameters of the infrastructure components and user devices (i.e., the mobile and portable radios).
- **Accounting Management** – NMS supports the tracking of radio usage of the system by providing an optional interface to third-party accounting and/or billing applications.
- **Performance Management** – Standard and optional applications are available for monitoring, reporting, controlling, and optimizing the use of system resources.
- **Security Management** – NMS includes features for setting user privileges and controlling their access to view and/or modify information contained in the configuration databases.

The Network Management subsystem will include the following servers at the zone and system levels of the ASTRO 25 system.

- **NMS Zone-level Servers (one each per zone)** – Air Traffic Router, Zone Database Server, Unified Event Manager (UEM), and Zone Statistics Server.
- **NMS System-level Servers** – User Configuration Server (UCS) and System Statistics Server.

2.3.4.1 Unified Event Manager

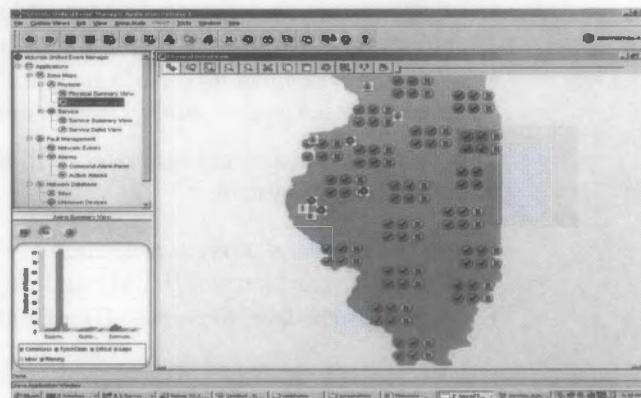
The Unified Event Manager (UEM) application allows system management personnel to manage LMR system devices from a single screen. Historical and real-time traffic screens give users access to radio events, radio status, and any device alarms. Other features include:

- Graphical views/maps
- Active alarms and summary views
- External notification flexibility
- Remote site control
- Fault reporting capabilities
- Device inventory
- External notification
- Customized views
- Role-based access

The UEM provides a customized discovery process for optimization and deep discovery of subcomponents

reported on by a device. The application also allows for automatic registration of the devices without pre-configuration. Interpreting and displaying events in an easy-to-understand and meaningful format—along with a topology of the network and devices tailored for the ASTRO 25 network—will ease navigation and present the network in a manner that is intuitive to a system operator.

Health of services is provided in addition to device-based alarms, including rules for determining the overall status of services in a separate service view (e.g., redundant controller is down – service is still up; we represent both views). Rules have been developed for calculating alarms based on interpreting incoming events. Security procedures are in place to roll SNMPv3 keys and maintain the ability to receive SNMP inform requests through the key role of an entire network. Device commands are presented in a manner specific to each device type. During discovery, a complete device inventory with specific rules to identify service and proxied components is accomplished for all individual devices. Table 2-1 outlines features and benefits of the UEM.



Sample UEM Screen



Table 2-1: Unified Event Manager (UEM) Features and Benefits

Feature	Benefit
Optimized Discovery Based on System Design	UEM supports subnet discovery of the IP addresses which are designated for radio system devices. This translates to an efficient device discovery process.
Discovery of Fault Managed Devices	Based on the device type the UEM has pre-determined rules for discovery of the custom entities supported on the device. Additional rules are used for event translation and alarm generation.
Fault Manager Registration	Procedures in place to register the manager's IP address as a trap/inform destination.
Centralized View of the Communications Network	System Managers can view the ASTRO 25 system status and quickly isolate problems to the board level.
Intuitive Graphical User Interface (GUI)	System Managers are quickly notified of failures on the system and can diagnose device problems. Summary and Detail maps provide a graphical display of site status in their geographical location within the system.
Active Alarms View and Alarm Summary	Persistent single view of all failure conditions ("What's Inoperable") in the network and a quick reference summary of alarms by severity, allowing users to quickly pinpoint the highest priority failures.
Secure Device Access	SNMPv3 protocol with SHA and AES 128-bit encryption to prevent security breach attempts.
Role-Based Access Control	Assignment of user privileges for access to views and operational capabilities.
Email Notifications	User-specified event notifications are sent via secure email or forwarded to a portable mobile device, which allows System Managers to work away from the System Management Terminal but remain aware of system events.
Fault Reporting Capabilities	Event history data is auto-archived and exported for further analysis and reporting.
Remote Command Operation	Remote state change capability helps to service remote devices and avoid unnecessary trips to the sites for troubleshooting.
Network Inventory	Tabular view of the devices and their associated status.
Audit Trail and Job Status	Traceability and status for commands and actions executed.

The UEM is optimized to quickly discover the devices in our network—making installation and setup quick and error-free. The UEM has a built-in capability to identify the type of device it is discovering; it will activate the pre-determined rules for discovery of the devices, which results in faster event translation and alarm generation in the manager. Each device, via its various entities (i.e., fan, power supply, etc.), will quickly inform the manager what it needs to monitor. Procedures built into the UEM will configure the IP address in the device to give the correct path for sending its information during operation.

Quick and accurate interpretation of the system activity is crucial in effective management of the devices. The UEM translates the events into intuitive information, which will inform the user of either the severity of the failure or implication of the event.

UEM translates the events into active alarms, which make the user aware which events require immediate attention versus more minor events/alarms. The alarm view dynamically updates based on the condition of the reported device (i.e., the alarm will be cleared from the alarm view when a device sends a clear event to the UEM).

The Reliable Communication design in the UEM provides Supervision and Synchronization services:

- **Supervision** – Provides periodic SNMP Polling to ensure communication is established with each device on the network. The UEM generates communication failure alarms/events when communication between the agent and the manager fails.
- **Synchronization** – Used to ensure the accuracy of the state that the device is reporting. If the connection between the UEM and the device is lost, the device will queue up the missed fault events and re-send when the connection is re-established. These Motorola-defined procedures were put in place to enhance the reliability of basic SNMPv3 trap messaging. These procedures manage the re-synchronization of missed failures. The UEM utilizes SNMPv3 informs to enable the device to detect whether the connection has been interrupted.
- **Northbound Interface (NBI)** – A real-time event stream using a standard industry protocol that can escalate events to a higher-level management application for added flexibility. NBI is provided for customers who prefer to manage their network with existing tools. The UEM handles the custom/proprietary interfaces to the network elements. The NBI provides a published fault event API to the customer's manager, which allows them to manage both Motorola and non-Motorola devices. The NBI agent supports SNMPv3 and uses a SNMPv3 User-based Security Model (USM) for secure communications with the UEM. The Fault Management Services provided with NBI are: Quick Synchronization – MOM requests more recent activity to update on health; File-Based Synchronization – Request to generate a file for missed information; and UEM-NMS Communication Link Supervision to notify of any interruption.

2.3.4.2 MOSCAD NFM System

The MOSCAD Network Fault Management (NFM) system is an end-to-end solution which collects alarms from devices and equipment at Motorola communication sites; then it sends the information to the Graphic Master Computer (GMC) server and UEM, where the information is stored so that it can be displayed and analyzed by system technologists and managers. Features and benefits of the MOSCAD NFM system are outlined in Table 2-2 below.



Table 2-2: MOSCAD NFM System Features and Benefits

Feature	Benefit
Collection of Environmental Alarms	A single SDM3000 supports data interfaces and digital alarm inputs to site equipment such as doors, tower lights, UPS, security, and third-party devices.
Data Interfaces to Site Equipment	The SDM3000 collects alarms and values from a wide range of Motorola stations, Microwave Radios, Channel Banks, Frequency Standards, and more via RS232, SNMP V1 & V3, and IP.
Collection of Analog Information	The SDM3000 interfaces to site equipment with analog outputs such as temperature sensors, fuel sensors, RF Power sensors, etc.
Initiation of Site Controls	The SDM3000 interfaces to site equipment which can be controlled, such as doors, generators, security, equipment switching, etc.
Local Web Server	The SDM3000 incorporates a built-in Web Server so that Service Technologists can view alarms of equipment and devices while on site or over the ASTRO network infrastructure.
Reliable Communications	The SDM3000 provides reliable communications to the GMC and UEM via encrypted SNMP V3.
Intuitive Drill Down Display of Alarms	The GMC incorporates an intuitive "Drill Down" display of alarms: Multi-Zone level, Zone level Map Screen, Site level, Device level, and Alarm level.
Intuitive Representation of Equipment	Chassis view graphics of the equipment are displayed on the GMC and GWS GUI, giving System Technologists an immediate understanding of the equipment and subcomponent which is in alarm.
Analog Display Screen	Graphical meters display the analog information of the site (i.e., Generator Fuel Level).
Equipment Control Screen	Equipment and devices can be controlled (turned On/Off, Open/Closed) from the control screen.
Immediate Update of Alarm Status	A combination of polling from the GMC and event reporting from the SDM3000 ensure alarm information is displayed on the GMC/GWS as quickly as possible.
Auto Archive of Alarms	Alarm information is automatically archived on the GMC server for future access by the Historical Alarm Report tool.
User-Defined Historical Alarm Reports	Historical Alarm data in the SQL database on the GMC can be easily accessed to produce reports with the Report Generator function.



Feature	Benefit
Multiple User Levels	Up to 8 user levels, ranging from Administrator to Guest, allow definition of operational capabilities from system configuration through system control to viewing and acknowledgment of alarms.
Alarm Summary Window	The Alarm Summary Window lists all time stamped alarms and can be sorted by Zone, Site, and Equipment, and by acknowledged/un-acknowledged alarms. This allows users to quickly identify any issues with their system.
Station Values Displayed	Station and Microwave values such as RSSI, BER, RF Power, and VSWR are displayed on the GMC/GWS, providing System Technologists with analytical information on the site they are troubleshooting.
Remote Configuration	A terminal window on the GMC/GWS allows remote configuration of analog QUANTARs and TeNSr Channel Banks.
Alphanumeric Paging of Alarms	The GMC/GWS can send specified descriptive alarm messages to alphanumeric-capable pagers over paging networks such as SkyPager or Skytel.
Client View of Multi-Zone System	Each GWS client can view alarms from each zone level GMC server, which minimizes the total number of clients needed in the system.

GMC Server and GWS Client

The MOSCAD NFM GMC server and GWS client is an NFM solution specific to Motorola communications systems. The NFM application graphic screens depict current system status; the user can easily navigate from a macroscopic system view down to the individual site details. RF site alarms are time stamped, stored in the alarm history database, and accessed by the Report Generator utility, which helps the user to filter alarms and events, then displaying, printing, and exporting them.

One GMC is required per Zone, and all the GWS clients (up to 16) view the real-time system alarms, status, and controls from all GMC servers.

GMC Server and GWS Client Graphics

The GMC/GWS NFM application has been developed to provide several layers of screens. The first layer is the System Overview Screen: a map showing the site locations with each site location icon selectable. The second screen layer is the individual site screen (Figure 2-2), graphically showing the exact equipment at each site with selectable equipment graphic icons. A third layer of screens is the individual site component hardware, such as GTR, Microwave, Rubidium standard, and other site support equipment, including environmental alarms. Alarm icons on the site equipment graphic show which module (i.e., Power Supply) is in alarm; selecting that icon provides a list of the alarms for that module. All alarms are also shown on the alarm summary screen.



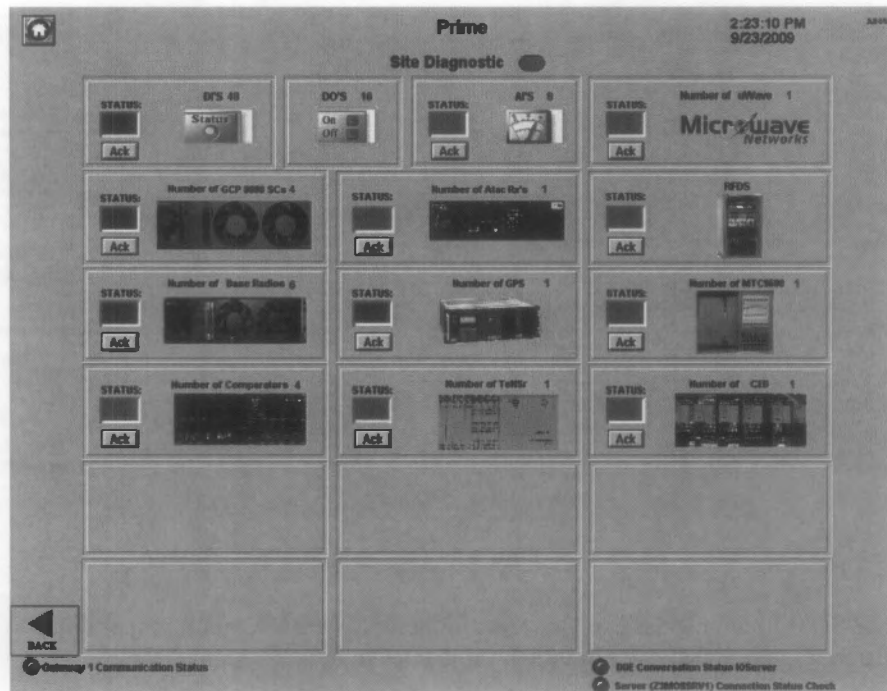


Figure 2-2: Sample Individual Site Screen

SDM3000 Site RTU

The heart of the MOSCAD NFM solution is the SDM3000 site Remote Terminal Unit (RTU), where RF components and environmental equipment are alarmed and controlled. The SDM3000 interfaces to IP devices via SNMP and FSP, to monitor alarms and capture values such as RSSI, RF Power, and BER. The SDM3000 serially interfaces (RS232) to remote site devices by emulating the specific device protocol, allowing the SDM unit to control, collect alarms, configure, and change parameters of the device (Figure 2-3). The SDM3000 collects alarms and initiates controls through the various inputs, outputs, and analog signals via the onboard Input and Output (I/O).

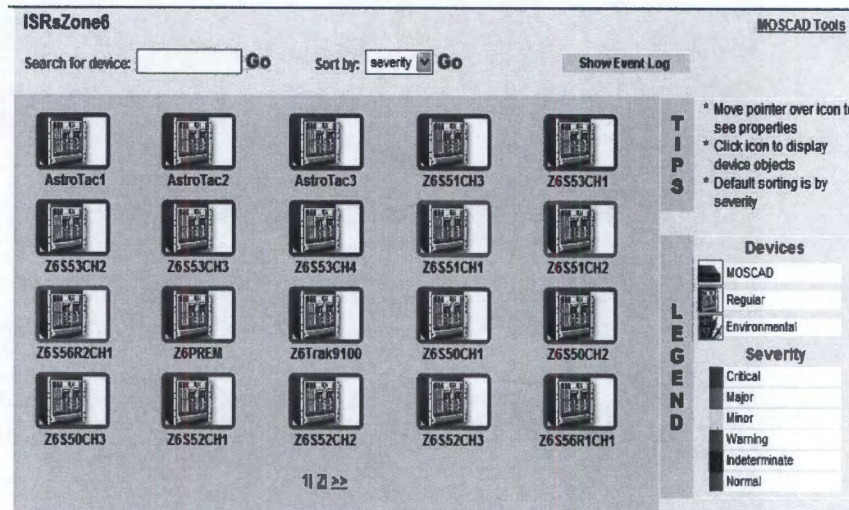


Figure 2-3: Sample SDM3000 Screen

The SDM3000 units take advantage of inherent communications capabilities to securely communicate via encrypted SNMP v3 from the remote sites to the UEM and GMC.

A built-in Web Server on the SDM3000 allows Service Technologists to use a browser to view alarms from all equipment and devices, while they are on site or remote over the ASTRO network infrastructure.

2.3.5 Configuration Management Applications

This section provides information about the applications that provide configuration management capability in ASTRO 25 systems. These devices are the Unified Network Configurator (UNC) and the Provisioning Manager (PM) See Figure 2-4.

2.3.5.1 Unified Network Configurator

The Unified Network Configurator (UNC) is a network change and configuration management tool that enables users to efficiently manage the configurations of networks and devices in an ASTRO 25 system.

The UNC is built on VoyenceControl, which is an automated compliance, change, and configuration management system. The UNC provides a single application for the configuration of all radio system and transport devices. Some of the key features that the UNC provides include:

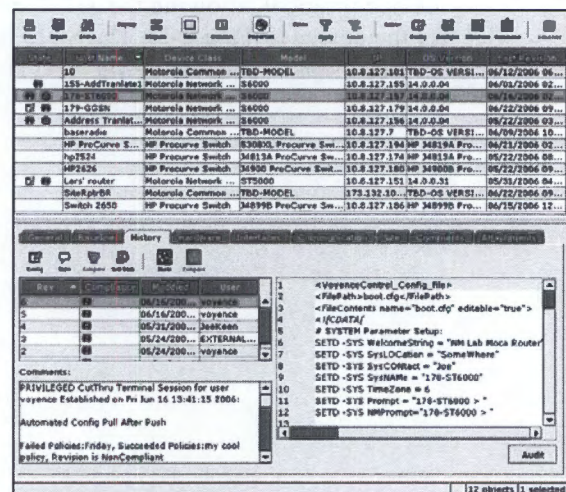


Figure 2-4: Sample UNC Screen

- Efficient, role-based user setup.
- Auto discovery of devices/configurations, reducing configuration errors and initial configuration time by providing minimal data entry.

Historical configuration information is easily accessible, along with forensic information and the ability to roll back to previous versions. A valuable tool that the application provides is the ability to create a configuration and not implement it immediately. The UNC allows another user to approve and implement changes, which can help distribute those changes during off hours when system loading is minimal.

The UNC application allows system management personnel to see planned and current configurations simultaneously for quick comparison. This application offers easy editing screens and configuration “wizards” to reduce data entry.

Benefits of the UNC are outlined in Table 2-3.

Table 2-3: UNC Benefits

Feature	Benefit
Built-in Network Tool kit to enable features	Tools provide a methodical process to enable features in the system with minimal labor and chance of error. Examples of these are: turning on authentication on a set of protocols within the Gateways; locking Ethernet switch ports; setting delay; and jitter alarm thresholds.
Auto Discovery of Devices	Components are automatically discovered, and their configurations are added to the database without the need for any manual entry of data.
Scheduled Distribution	Users can determine the time of day when they would like configurations to be sent to the devices, or delay the distribution of a configuration change until approved.
Distribution Monitoring	Allows users to view the status of configuration changes, such as whether the change is in progress, has successfully completed, or has failed.
Change Logging/Audit Trail	Maintains a log of various user interactions with the configuration system that can be used to help diagnose issues.
Configuration Versioning	Constantly tracks and logs versions that have changed and provides the ability to view or compare versions.
Management of Credentials	SSH and SNMP passwords can be managed. Automated mechanism allows seamless password and passphrase rolling, which can be performed automatically if desired.
Wizards for Common Operations	Radio system administrators can perform common operations using a simple web-based interface specifically developed for ASTRO 25 users. Provides an intuitive guide to assist in easy-to-follow setup procedures.
Rollback to Previous Version	Immediately reverts the device configuration to a previously created version.

2.3.5.2 Provisioning Manager

The Provisioning Manager (PM) is a centralized interface for all user and system configuration.

The PM provides the following:

- Configure system-level parameters for call capability.
- Configure system-level parameters for the master site, such as the parameters for home zone mapping and sub-band restricted ID mapping.
- Configure Console Users, Radios, Talkgroups, Multi-Groups, Agency Groups, and Broadcast Data Agencies.
- Configure access control for users in the PM.
- Configure ZoneWatch windows.
- Configure and manage the attributes relating to a zone such as MGEG Application Platform, Aux I/O Configuration, and Consoles.
- Ability to export some configuration data from the PM.
- Ability to import some configuration data to the PM.
- Optional API available to interface to the PM.

Features and benefits for the PM are outlined in Table 2-4.

Table 2-4: Provisioning Manager Features and Benefits

Feature	Benefit
Central Point for All User Configuration Information	Minimizes configuration conflicts created by multiple entry points. Enables simplified control and consistency for subscriber provisioning.
Radio User Capabilities	Efficient configuration capabilities across multiple agencies and system.
Reuse Configuration information Using Profiles	Minimize configuration data re-entry through the creation of profiles that are shared across several radio users and talkgroups.
Intuitive Navigation	Provides a tree-based navigation with objects arranged logically, allowing users to navigate to their required tasks.
Fleet Management	Allows the user to easily create talkgroup and agency group mapping.
Agency Partitioning	Offers the ability to create security groups to partition system management resources among various agencies and users.
Concurrent User Access	Enables distributed configuration management from multiple users.
MCC7500 Console Information Synchronization	MCC 7500 consoles are automatically synchronized with radio user configuration information from the system, minimizing data entry and allowing for a cohesive view of configuration information.
Manage Configuration Data Distribution	Provides users with control over the distribution of configuration information to the various network devices in the system.

2.3.6 Performance Management Applications

The Motorola performance suite enables a customer to monitor, manage, and report on system performance in near real-time. The applications empower system managers to proactively plan for expansion. The performance suite is composed of both Motorola and third-party solutions that are all certified, sold, and supported by Motorola. Each application has a unique set of features and benefits to facilitate efficient and effective system management. Together, these applications complete the big picture: how the system is performing, operating, and being used, by providing insight into the activity of each zone, site, subscriber, or talkgroup.

Motorola offers performance management as a standard feature of ASTRO 25 systems. Other standard features include ZoneWatch, Historical Reports, and Dynamic Reports. These features enable customers to manage their communications system business more efficiently. ZoneWatch displays real-time communications activity, while Dynamic and Historical reports collect traffic statistics over predetermined intervals for report generation. These applications are used to monitor, collect, log, and evaluate network performance and resource utilization; they collect statistics about radio resource usage for radio units, talkgroups, channels, sites, zones, and system-wide activity report generation. Dynamic and Historical Reports have archival and export features for saving reports for offline data analysis. Statistics are aggregated into detailed and summarized reports on both an individual zone and system-wide basis.

Additionally, Motorola offers enhanced Performance Management features for ASTRO 25 systems, which are described below. Enhanced Performance Management features are available to provide further insight into system performance. Applications perform a variety of tasks, such as polling system resources, detailed reporting, long-term archiving and logging, and data stream collection.

Affiliation Display

Affiliation Display provides a dynamic view of the sites to which all operating units are currently affiliated; it suggests the area in which a unit may currently be operating based on its last affiliation and the site's radio coverage (Figure 2-5). The application enables system managers to monitor how radio users travel between different sites in a zone, and to monitor how they communicate with assigned talkgroup members and those outside of their talkgroup. Affiliation Display is used to trace a state/location of a single subscriber, and also to monitor location and affiliation information organized by site, console site, radio, channel, or talkgroup.

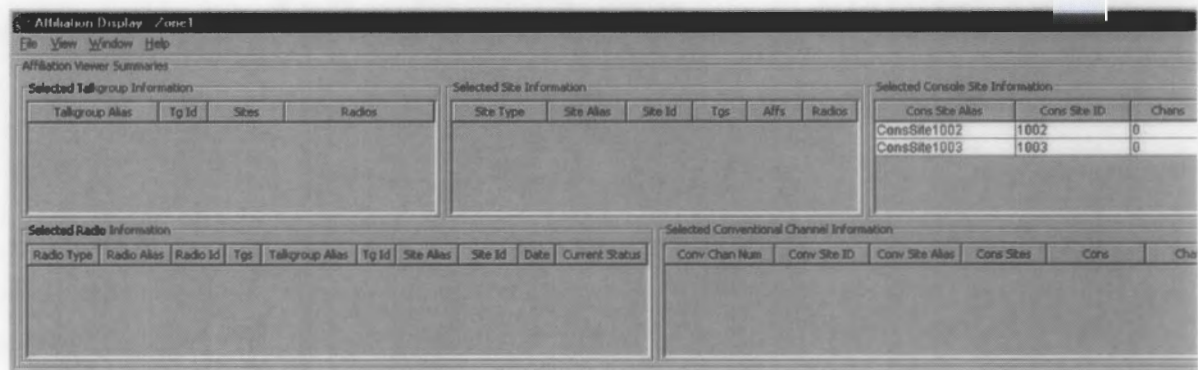


Figure 2-5: Sample Affiliation Display Screen

Table 2-5 outlines benefits of Affiliation Display.

Table 2-5: Affiliation Display Features and Benefits

Feature	Benefit
Real-Time Display	Monitor selected radios, sites, talkgroups, consoles, and conventional channels to track how radios are roaming between sites, and how traffic moves within sites in a zone. Display sites and console sites where each talkgroup is currently operating.
Graphing	Display graphs of the site, console site, and talkgroup data to see how radio usage is distributed across sites and talkgroups, to help determine if system resources are deployed to maximize system performance.

Air Traffic Information Access

The Flexible Air Traffic Information Access (ATIA) interface provides an access point for air traffic call information on the system. Whenever significant events occur in call processing, call information will be provided through ATIA. For non-call activity, the Flexible ATIA interface will provide call information in unique data packet formats. Benefits of ATIA are outlined in Table 2-6.

Table 2-6: Air Traffic Information Access Features and Benefits

Feature	Benefit
Integration Flexibility	ATIA stream data can be integrated with third-party applications to produce detailed reports custom built to a system manager's needs.
All Call Control Information	Information can be used to understand what is happening on the system, e.g., who called, where they called from, and type of call, to monitor the system's operation.



Computer Aided Dispatch Interface (CADI)

Computer Aided Dispatch Interface (CADI) is an Application Programming Interface (API) for use by third-party CAD applications, permitting customers to work with third-party vendors to create software that specifically meets their dispatch needs on Motorola ASTRO 25 systems. The API gives CADI direct access to the commands and events used by the radio system and its network management applications.

THIRD PARTY COMPANIES THAT HAVE INTERFACED WITH MOTOROLA'S CADI API

- ACIC client/server with Geocomm AVL server
- Archonix message switch
- Ather Biokey
- Cisco
- Customer-Created CAD:
 - Pinellas County, FL
 - Hanover County, VA
 - Prince Georges County, MD
- Fatpot CAD
- The Genesis Group
- Geo911
- INIT (Transit CAD Application)
- Interact
- Interact Field Based Reporting with CrimeAgent Client
- Intergraph
- New World
- Northrup-Grumman
- Orbital (Transit CAD Application)
- Ortivus AVL and CAD
- OSSI
- Premier MDC
- Tiburon Mobile and Forecom
- Trapeze
- Tri-Tech

Dynamic Reports

Dynamic Reports monitor and report usage trends in order to improve radio and talkgroup system management. System managers can closely examine what happens during a shift or set period of time: for example, checking the busy count to see if calls are being missed. Dynamic Report recommendations can be made on system expansion and design to improve communication. See Figure 2-6.

Table 2-7 outlines features and benefits of Dynamic Reports.

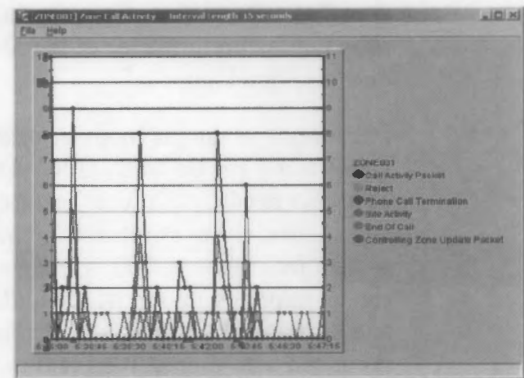


Figure 2-6: Sample Dynamic Reports Screen

Table 2-7: Dynamic Reports Features and Benefits

Feature	Benefit
Real-Time Display	This display provides zone-level, real-time line charts that illustrate channel utilization for all call types—group, private, interconnect, control channel, and dynamically blocked calls.
Graphing	Graphs can be run at the zone, site, and console site level to understand how often and why busy conditions occur on the system; this increases system efficiency and provides insight into how the system is being utilized.

Feature	Benefit
Data Intervals	Dynamic statistical data objects are presented in time-based intervals. At the end of each interval, a new set of statistical values is added to the display. The timed intervals are defined as follows: 15 seconds (default), 1 minute, or 15 minutes for 1–100 intervals.
Accessing Data/Exporting Data	Reports can be output to the client PC workstation display, printer, or file for convenient access.
Data Storage	Statistics are aggregated into detailed and summarized reports on both an individual zone and system-wide basis. They are available on an hourly basis for 10 days, daily for 62 days, and monthly for 1 year.

GenWatch3

GenWatch3 monitors the Air Traffic Interface Application (ATIA) or 9600 baud Control Channel. It decodes it, stores it, reports on it, watches it, alarms on it, and more. GenWatch3 displays detailed information about subscriber, talkgroup, site, zone, and system activity in a way that makes sense—it is the dashboard showing the performance of the Motorola radio network. See Figure 2-7.

Because of its unique modular design, GenWatch3 can be easily tailored to meet customer needs. Additional features can be added later: either as Genesis creates them, or as system requirements and/or budgets allow. Data can be imported into most accounting software and is archived for up to 12 months. Reports are produced in a Microsoft Excel Format.

Benefits of GenWatch3 are outlined in Table 2-8.

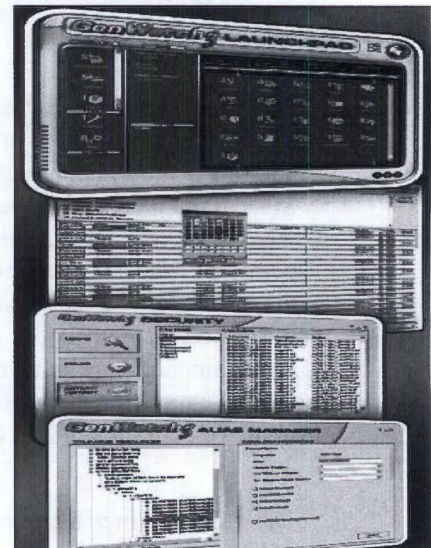


Figure 2-7: GenWatch 3

Table 2-8: GenWatch3 Features and Benefits

Feature	Benefit
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Feature	Benefit
Real-Time Display	The many live windows allow for real-time system information to easily identify abnormalities and emergencies. Displays are sorted by All System Activity, Channel, and Talkgroup views. GenWatch3 monitors system performance at the System, Zone, Site, Channel, Subscriber, and talkgroup level.
Detailed Reporting and Graphing	Reports allow for 365 x 24 x 7 access to system information in a user-friendly format for monitoring and forensic purposes. Reports can be manipulated and organized by System, Zone, Site, Channel, Subscriber, Talkgroup, and Agency level for various types of activity (PTTs, RCMs, etc.).
Data Intervals	Reports can be sorted by year, month, day, hour, or minute.
Accessing Data/Exporting Data	Reports are produced in a Microsoft Excel format for easy customization and manipulation; they can also be exported to various other programs and formats.
Data Storage	Control Channel data can be stored for up to 1 year; ATIA data can be stored for as long as the hard drive allows.

Historical Reports

Historical Reports generate reports on system-wide activity as well as individual zone activity (Figure 2-8). The reports contain statistical data gathered at specific, predefined time intervals. They monitor and analyze information about zones, sites, channels, talkgroups, and users to assist a system manager in understanding how the system is performing; and they are utilized to more efficiently manage resources. Individual reports cannot exceed 16,000 objects (radio users, talkgroups, etc.). Reports can be exported to CSV, HTML, PDF, and XML formats. Table 2-9 outlines the features and benefits of Historical Reports.

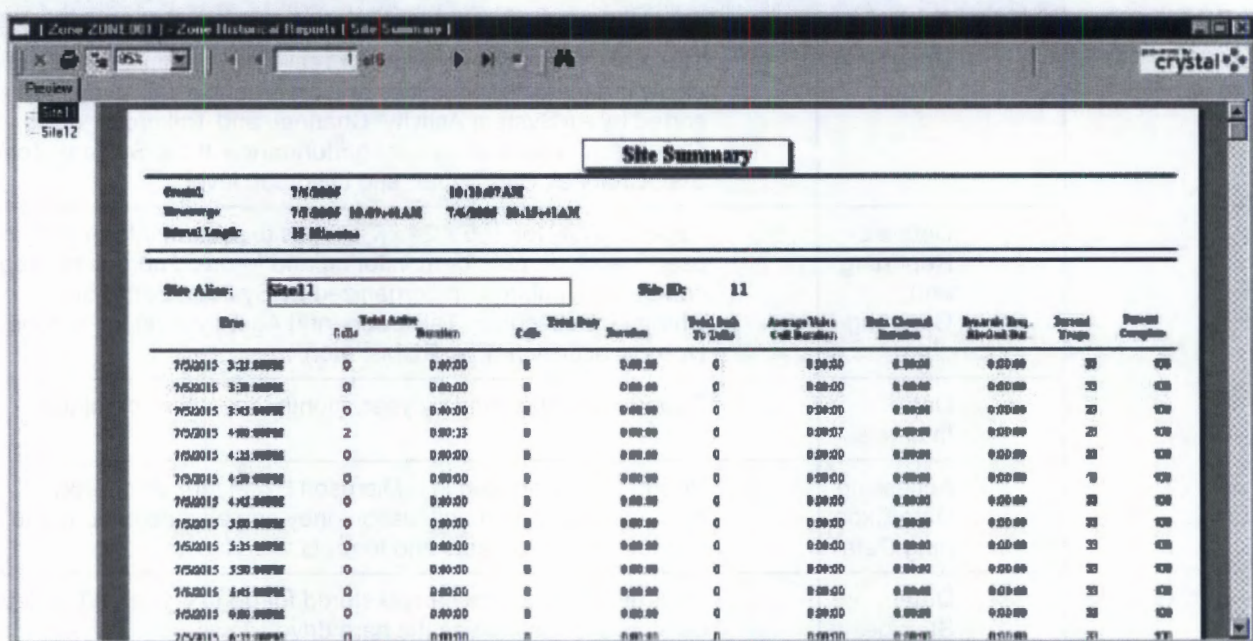


Figure 2-8: Sample Historical Reports Screen

Table 2-9: Historical Reports Features and Benefits

Feature	Benefit
Real-Time Display	Monitor and analyze information about zones, sites, channels, talkgroups, and users to understand how the system is performing and utilized to more efficiently manage resources.
Reports	Create various types of reports at the zone or system level, organized by system resources to analyze activity and performance.
Data Intervals	<p>Historical data is stored in time-based intervals. For each interval type, the oldest interval in storage is removed as a new interval is added to storage. The timed intervals are defined as follows:</p> <ul style="list-style-type: none"> • Every 15 minutes for 100 intervals (approximately one day; zone level only). • Hourly for 241 intervals (approximately 10 days; system and zone level). • Daily for 62 intervals (approximately 2 months; system and zone level.) • Monthly for 36 months (3 years; system and zone level).



Feature	Benefit
Accessing Data/Data Exporting	<p>Users can utilize the Report Scheduler window to schedule zone-wide and system-wide reports to occur at specified times, with an output to a printer or data file. Reports can be exported to one of the following formats:</p> <ul style="list-style-type: none"> • Comma Separated Values (CSV) • HTML • Adobe Portable Document Format (PDF) • Extensible Markup Language (XML)
Data Storage	<p>Statistics are aggregated into detailed and summarized reports on both an individual zone and system-wide basis; they are available on an hourly basis for 10 days, daily for 62 days, and monthly for 1 year.</p>

Radio Control Manager

The Radio Control Manager (RCM) is used primarily by dispatchers to monitor and manage radio events, issue and monitor commands, and make informational queries of the system database. The RCM runs on a local PC client and, depending upon the configuration in the User Configuration Manager (UCM), can access multiple zones. See Figure 2-10.

Table 2-10: Radio Control Manager Features and Benefits

Feature	Benefit
Radio Commands	<ul style="list-style-type: none"> • Regroup • Cancel Regroup • Selector Lock • Cancel Lock • Regroup and Lock • Cancel Regroup and Lock • Selective Inhibit • Cancel Inhibit • Storm Plan
Status Commands	<ul style="list-style-type: none"> • Radio check • Snapshot • Zone Status

Feature	Benefit
Events	<ul style="list-style-type: none"> • Emergency Alarms • ChangeMe Requests • Status Events
Reports	<p>The RCM Reports tool is used to create, view, print, schedule, and export standard reports from RCM. These reports use a common format so the data can be used in spreadsheets.</p> <p>The report information reflects the actual RCM server database information, except the Emergency Alarms. RCM Reports enables you to present and analyze data showing RCM activity on the system.</p>

ZoneWatch

ZoneWatch is a performance management tool that has customizable displays and grids to monitor real-time communications activity in a single zone (Figure 2-9). The information displayed can help system managers become proactive in making better resource planning decisions, such as when additional channels need to be added.

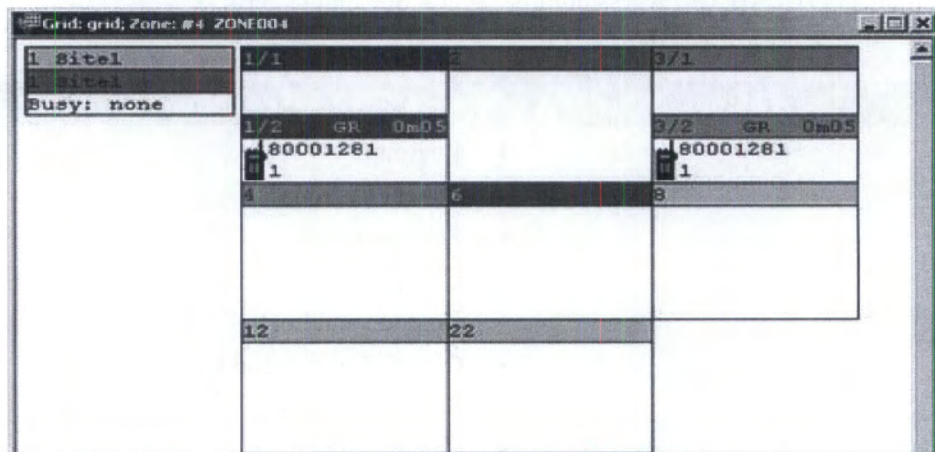


Figure 2-9: Sample ZoneWatch Screen

ZoneWatch also receives fault information relating to repeater sites, console sites, and the zone controller from the UEM. ZoneWatch is used to monitor call traffic and allows the system manager to organize displayed information using various criteria. Benefits of the ZoneWatch real-time display are provided in Table 2-11.

Table 2-11: ZoneWatch Features and Benefits

Feature	Benefit
Real-Time Display	Single Site View, Channel View, and Multisite view display all important radio call information. This provides the manager with insight about radio call activity, channel usage activity, and busy activity, to more efficiently manage the radio system.

2.3.7 Integrated Voice and Data

The Project 25-compliant Integrated Voice and Data (IV&D) operation allows data traffic to seamlessly utilize your existing ASTRO 25 stations, improving in-field efficiency. Voice is prioritized, allowing Mission-Critical traffic to always take precedence over data transmissions. The IV&D service creates a data transport layer capable of supporting both industry-standard IP and customer-developed applications, including:

- Advanced Messaging.
- Outdoor Location.
- Over the Air Programming (POP25).

Users can achieve a number of important benefits, including:

- Conservation of valuable airtime.
- Increased communications accuracy.
- Allows users in the field to perform queries without dispatch.
- Better return on investment—same assets for multiple functions.
- Utilizes common radio units for both voice and data applications.
- Advanced Messaging Service—Similar to text messaging on a cell phone, the Advanced Messaging Service provides a convenient means of communication between all network users. A user can send a text message of up to 200 characters to another radio or dispatcher. Dispatchers and radio users may be a part of a named text-messaging group, allowing point-multipoint service. Advanced Messaging Service makes use of the IV&D transport layer, and provides a store and forward function, ensuring message delivery.

Packet Data Gateway

The Packet Data Gateway (PDG) is a modular platform designed to link the wireline IP Data Network to Motorola's ASTRO 25 network.

The PDG software platform manages IP message traffic to and from the wireless network, supporting wide-area roaming. With wide-area roaming, data radios can roam seamlessly throughout the coverage area of the ASTRO 25 system without the need to select a different channel or have any specific knowledge of the RF network.

The PDG supports SNMP-based network management by providing detailed statistics and alarm information to monitor system activity and performance. These statistics and alarms allow you to monitor system operation and loading to support audit, diagnostic, and optimization activities using the SNMP-based standard. The information can be viewed directly via the PDG local console or through the Network Management System.

Motorola General Packet Radio Service Gateway Service Node Router

Motorola's General Packet Radio Service (GPRS) Gateway Service Node (GGSN) router provides for the internetworking between the customer's network and the ASTRO 25 data system, allowing for independent management of IP addresses across networks.



The GGSN router handles the IP routing services in support of end-to-end IP data messaging. These services include Static and Dynamic IP addressing, IP fragmentation, and ICMP error reporting messaging for diagnostics and troubleshooting.

Outdoor Location Solution (New Feature to Pinellas County System)

Motorola's ASTRO 25 Outdoor Location Solution is offered on the ASTRO 25 IV&D system using the 700 MHz, and/or 800 MHz. It uses Global Positioning System (GPS) satellites to provide the location of personnel and vehicles; these locations can be fed to a map-based location application, providing dispatch operators with an invaluable tool for managing and tracking personnel and resources. The ability to locate users in a Mission-Critical situation dramatically increases user safety, while improving resource allocation and responsiveness.

Figure 2-10 shows an example of the main components for the Outdoor Location Solution.

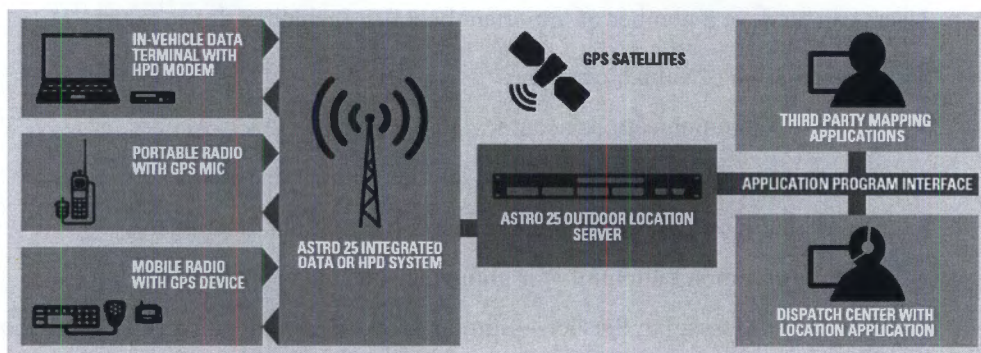


Figure 2-10: ASTRO 15 Outdoor Location Solution

Advanced Messaging Service (New Feature to Pinellas County System)

Motorola's ASTRO 25 Advanced Messaging Service is an application that makes use of ASTRO 25 IV&D data services. Advanced Messaging Service provides the ability for users within the customer network to send and receive data messages of up to 200 displayable characters. These messages may be sent:

- From one text-messaging-capable subscriber to another text-messaging-capable subscriber.
- From a text-messaging-capable subscriber to a dispatcher equipped with a Fixed Text Messaging Client.
- From a dispatcher equipped with a Fixed Text Messaging Client to a text-messaging-capable subscriber.
- From a dispatcher equipped with a Fixed Text Messaging Client to other dispatchers equipped with a Fixed Text Messaging Client.
- From a text-messaging-capable subscriber to a third-party application having an e-mail address, where the third-party could be a messaging application such as CAD, Mass Notification System, database, etc.
- From a third-party application having an e-mail address to a text-messaging-capable subscriber.

All messages are routed through a central server in the Customer Enterprise Network (CEN). This server provides a store and forward service for the system, enabling storage of messages sent to an out-of-service user for subsequent delivery when the receiver becomes available.



Over-the-Air Programming

Motorola can provide a powerful Over-the-Air Programming (OTAP) tool called Programming over P25 (POP25), which allows simple, wireless updates of LMR radios. This is an alternative to the standard method of programming, which is to connect a PC with a cable to the radio in order to read/write the programming changes. POP25 allows end-users and radio users to stay in the field during the reconfiguration process, thus saving valuable time and resources.

POP25 can reduce the total amount of time spent per radio unit update by up to 85%, allowing users and equipment to remain operational in the field. Assuming one reprogramming event every other year over the average lifetime of a radio (10 years), the total coordination and programming time can be reduced from 3.5 hours to only 30 minutes.

One of the key features of POP25 is being able to make and receive calls during the process:

- Retain full use of the radio during the configuration data transfer without interrupting communication.
- Voice always takes priority over POP25 data transfers.
- When a voice call ends, POP25 starts where it paused programming; there's no need to restart.
- Users do not have to switch to a non-busy channel.
- Users do not have to stay in an area with high signal strength during the download.
- All radio functions and capabilities are accessible and enabled.

POP25 allows for scheduled batch programming and can make specific programming changes instead of requiring a full code plug rewrite. The system will automatically generate a report, showing which radios were successfully programmed. An overview of the OTAP process is shown in Figure 2-11.

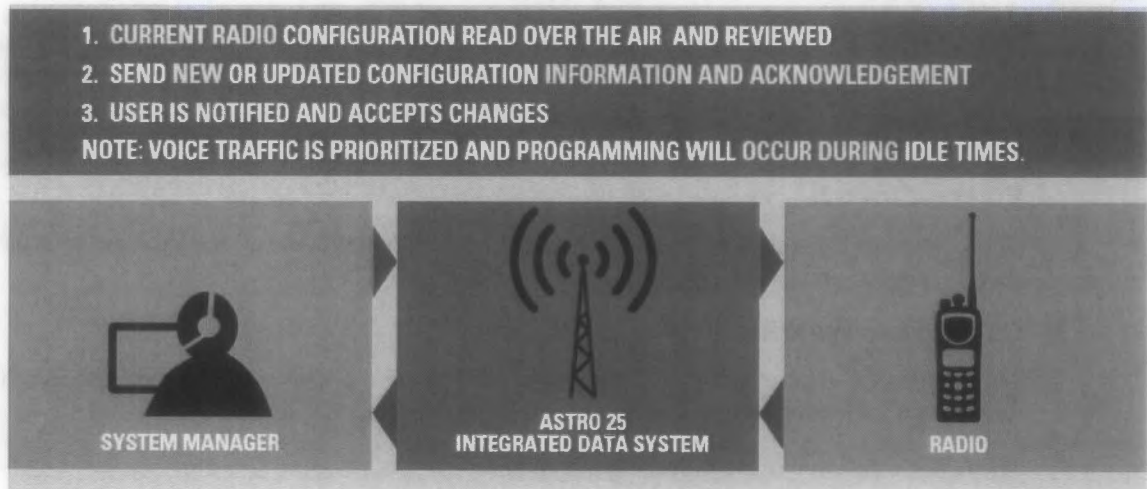


Figure 2-11: Over-the-Air Programming Steps

2.3.8 **ASTRO 25 High Availability Trunked Integrated Data and HPD (New Feature to Pinellas County System)**

The HA Data feature is intended to introduce redundancy within the Trunked IV&D and HPD data infrastructures. Packet Data service is restored within 90 seconds in the event of such a failure. Moreover, no Packet Data contexts that were active prior to such a failure will be lost. During the High Availability switchover, packet data (context activation requests, inbound/outbound data) will be dropped, but after service is restored, pre-existing contexts will regain data service.

2.3.9 **ASTRO 25 Enhanced Data (New Feature to Pinellas County System)**

ASTRO 25 voice systems have been building to portable grade coverage specifications for several years. The ASTRO 25 system provides all of the components and the wide-area system coverage necessary to perform a mobile and portable GPS reporting function. Motorola understands the customer's needs to poll for location data more frequently. Constant tracking of the locations of all field personnel has been a need for the Public Safety sector for a long time. Next generation of ASTRO 25 Integrated data benefits will provide the following benefits

- Provide outdoor location data for all of the users with a faster polling rate.
- Increased AVL and telemetry capacity as compared to Classic P25 Integrated Data.
- Ability to have dedicated, data only, Enhanced Data channels.
- Ability to prioritize data over non Emergency voice calls on Enhanced Data channels.

2.3.10 **Network Transport Subsystem**

The ASTRO 25 transport core is engineered to meet the performance requirements of a real-time system transporting voice, call control, network management, and ancillary network services. The Transport Network is a closed network. Only Motorola-supplied equipment, applications, and services can be used on the network.

Ethernet Switch

The Enterprise Ethernet Switch (LAN Switch) is used to aggregate all the Ethernet interfaces for all servers, clients, and gateways.

Cooperative WAN Routing

The Motorola Cooperative WAN Routing (CWR) solution allows core and exit routers to interface directly with RF sites, network management sites, console sites, and inter-zone links.

The CWR solution has the following advantages:

- Provides redundant router failover capabilities.
- Allows for easy configuration, testing, and maintenance.
- Minimizes downtime during upgrades.



The CWR consists of:

- **Core Gateways**—perform the routing control of audio and data in and out of the zone, while achieving the fast access levels required by real-time voice systems.
- **Gateway Routers**—used for devices that are multicasting beyond their local LAN, such as to IV&D and High Performance Data (HPD) packet data gateways.

Redundancy

To ensure system availability, the Transport Network provides:

- Redundant Ethernet switches.
- Redundant routers.

2.3.11 Information Assurance Elements

The integration of Information Assurance (IA) is another step towards continuing enhancement, ensuring these mission-critical networks remain operational so users can do their jobs better and more efficiently.

The next several paragraphs explain some of the processes, hardware, and software that can be implemented with an ASTRO 25 system. We will work closely with your security team to ensure this system experiences minimal disruption due to outside sources. The following sections list several of the key services that are provided in our IA package.

Router Access Control List

The Router Access Control List feature provides basic packet filtering capabilities provided by routers. A router's primary function is to route traffic. Routers are not designed to provide the fine grained packet inspection that firewalls typically provide.

TCP/IP traffic filtering is employed at core, exit, gateway, and site routers to enhance the security of the network. The security enhancement is realized by only allowing traffic for a combination of predefined subnets, hosts, and protocols. All other traffic not defined in the Router Access Control List is dropped by the router. Some examples of traffic that would be dropped by the router may include traffic to/from illegitimate IP address, some known insecure protocols, and specific port numbers that support known Denial of Service attacks. The Access Control Lists employed on the routers are configured with a "deny-by-default" policy. This policy forces the router to drop packets that have not been explicitly defined as allowed.

Centralized Authentication

Centralized Authentication provides one control point for identification, authentication, and authorization services. Authentication is proving who you are. Authorization is what you are allowed to do once you are determined to be authentic. Authorization can define what functions and operations user can perform, and on what devices. Accounting is the paper trail. Accounting is included in this feature and a limited authorization implementation is also part of the feature. It also addresses identity management within the ASTRO 25 network through a centralized user credentials (account and password) database. Identity management includes the management of user accounts, contact details of user accounts, and system user accounts. A Centralized Authentication subsystem consists of a group of computers, which uses or offers services to organizational units for the purpose of administrative and policy management.



Ethernet Switch Port Security

The Ethernet Switch Port Security feature of the proposed ASTRO 25 system for Pinellas utilizes two methods: MAC Port Lockdown and 802.1x capability for Service Ports.

The MAC Port Lockdown feature provides a layer of security at the physical location of the equipment. MAC Port Lockdown prevents unauthorized access to the system via ports on a network switch by locking each port to one or more MAC addresses. Access to the system via a locked port is denied to any devices with MAC addresses not matching the address(es) locked to that port. Information sent to the locked address cannot be hijacked and directed out to the port of an intruder. MAC Port Lockdown also controls address learning on the switch, which prevents station movement at remote sites.

The 802.1X feature is added to the GCP 8000 Ethernet service port and may also be added to HP switches when a service port is desired. The IEEE 802.1X standard defines port-based, network access control that is used to provide authenticated network access for Ethernet networks. Port-based network access control uses the physical characteristics of a switched LAN infrastructure to authenticate devices that are attached to a switch port. The ability to send and receive frames using an Ethernet switch port is denied if the authentication process fails.

Centralized Event Logging

The Centralized Event Logging Services feature allows central collection of system events from logging-enabled devices in the ASTRO 25 network. Because of the industry need for increased security, all devices sold by Motorola will have built in logging functionality. As a result, there may be potentially hundreds of logging-enabled devices in a large ASTRO 25 system. Thanks to a centralized mechanism for collecting event logs, network and security administrators are able to manage and review log file information without having to access every network element individually. It provides customers with an accepted IT industry standard solution for collecting and managing system information at a central repository.

The recording of system information is needed to establish accountability for system events and for the actions of system entities that cause them. Logging of system events creates an audit trail by providing evidence of access control, change management, and accountability, which can support the detection, and subsequent investigation of security breaches.

Zone Core Protection

Zone Core Protection (ZCP) is a feature that provides the hardware and software necessary to protect the Radio Network Infrastructure (RNI) from potential attacks that originate from Remote Sites or the communication links that Remote Sites utilize.

The ZCP feature provides TCP/IP traffic filtering in the ASTRO 25 Radio Network Infrastructure to enhance the security of the network. The traffic filtering is implemented by Stateful Packet Inspection firewalls. This security enhancement is realized by only allowing traffic for a combination of predefined subnets, hosts, and protocols. All other traffic not defined as valid for the ASTRO 25 network is dropped by the firewall. Some examples of traffic that would be dropped by the firewall may include traffic to/from illegitimate IP address, some known insecure protocols, and specific port numbers that support known Denial of Service attacks.

The firewalls implemented by the ZCP feature are configured with a “deny-by-default” policy. This policy forces the firewall to drop packets that have not been explicitly defined as allowed. ZCP provides traffic filtering specifically between the Master Site and Remote Sites, and between different zones. A pair of firewalls is introduced by the ZCP feature to provide this traffic filtering. Pair of Ethernet LAN switches are also introduced to provide connectivity between the firewalls and the



associated core and exit routers. These LAN switches, referred to as Mediation LAN switches, also provide connectivity for an optional Centralized Logging Server and traffic monitoring points. These firewalls and switches are deployed in redundant pairs to allow the feature to operate with a single component failure.

Service Access Architecture

The Service Access Architecture feature provides secured communications access between the Radio Network Infrastructure (RNI) and service users. The feature can be viewed as four primary access scenarios as follows:

1. Access to the RNI from Motorola System Support Center via dedicated WAN connection.
2. Access to the RNI via dial-up connection provided by modem located in the DMZ (the service user for this scenario may be Motorola service users or customer based service users).
3. Access to the RNI via dial-up connection provided by modem located at Simulcast Prime Site (the service user for this scenario may be Motorola service users or customer based service users).
4. Access to the RNI via LAN switch located at a remote site (the service user for this scenario may be Motorola service users or customer based service users)

These scenarios provide access to services for the service user such as remote control of devices, diagnostics, file transfer, security monitoring, and fault management. Secure remote access to these services allows a reduction in cost for maintenance of the radio network and reduced response time for issue resolution.

Securing Protocols with SSH

The ASTRO 25 system consists of many components that communicate with each other using a variety of standard protocols. Many of these protocols are not secure. This creates a serious risk to the network. There are various levels of risk associated with different protocols. The highest risk is administrative type of protocols that pass authentication parameters (i.e., passwords) in the clear. Capturing this information by sniffing the network can lead to unauthorized access to a device, which constitutes the most severe compromise of data and network security.

Secure Shell (SSH) addresses this threat by providing secure alternatives for clear file transfer and r-command protocols. Specifically, the following clear protocols (non-secure protocols) are replaced: telnet, FTP, TFTP, rlogin, rsync, rcp, and rsh. The use of the targeted clear protocols, currently used in our systems, is prohibited in certain portions of the public-safety radio market. The reduction of clear protocol usage is necessary to sustain Authority to Operate (ATO) certification for U.S. federal systems and is increasingly identified as a mandatory system requirement for non-federal systems.

SSH provides a secure point-to-point connection between two different machines where the connection is encrypted and both ends have been authenticated. Many elements in the ASTRO 25 system will utilize this capability for secure communications.

Radio Authentication (New Feature to Pinellas County System)

ASTRO 25 Radio Authentication provides a mechanism that allows a radio to prove that it is genuine and therefore can utilize the trunking system. It is based on the P25 TIA 102.AACE Link Layer Authentication standard; it can be incorporated on existing ASTRO 25 systems and most ASTRO 25 radios, and it allows P25 radios from other vendors to use the feature. Systems without the optional Radio Authentication feature are susceptible to cloned and otherwise unwanted radios on the system. Radio Authentication prevents these unwanted P25 radios from successfully unit registering, thus preventing them from using the services of the system. Unregistered radios cannot listen to calls, place calls or otherwise disrupt Pinellas' operations.

2.3.12 Encryption Capabilities

When it is absolutely critical that communications not be monitored by unauthorized parties, radio systems can be configured with encryption. Encryption ensures only authorized units in the system can listen to transmissions being made. Encrypted calls are protected end-to-end throughout the network.

Project 25 Encryption Algorithms

ASTRO systems can be equipped with current Project 25 algorithms and are fully compliant with all Federal Information Processing Standards (FIPS). The following encryption is available: DES-OFB, DVI-XL, DVP-XL, DES-XL, AES, and ADP.

Software-Based Encryption Algorithms

Advanced Digital Privacy (ADP) is an entry-level encryption algorithm, offered exclusively by Motorola. ADP allows users to protect any and all communications from eavesdroppers and scanners for less cost than the hardware-based encryption algorithms. With Health Insurance Portability and Accountability Act (HIPAA) compliance being more closely scrutinized, many users are implementing this cost-effective security option for all of their users.

KVL 4000 Key Variable Loader

The KVL 4000 is Motorola's encryption Key Variable Loader for secure enabled Motorola products. Equipped with the Motorola MC55 handheld, the key loader is outfitted with state-of-the-art features and user interface for increased efficiency and programming flexibility. A large LCD color display, paired with an easy-to-use alphanumeric keypad, enables simple viewing and data entry. Built with legendary Motorola quality and security, the KVL 4000 is built to withstand everyday use in federal and public safety environments.

KVL4000 Features and Benefits

The KVL4000 utilizes the Motorola MC55 handheld computer with large 3.5 inch color display, touch screen interface, and QWERTY keyboard. The device is built to withstand everyday use in federal and public safety environments. See Figure 2-12.

Features of the KVL 4000 are outlined in Table 2-12 below.

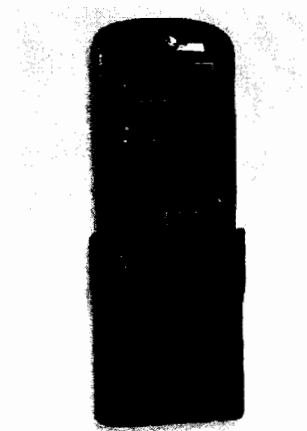


Figure 2-12: KVL 4000

Table 2-12: KVL 4000 Features

Feature	Description
Automatic key generation	<ul style="list-style-type: none"> Automatically generates random keys for any algorithm. Can auto-generate a single key or a bulk set of keys.
Enhanced security	<ul style="list-style-type: none"> FIPS 140-2 Level 3 provides the highest level of security for your data. User timeout automatically logs out the user after a specified period of inactivity. User and administrator authentication allows users and administrators to perform and restrict firmware upgrades, changes, and key management.
Dead battery operation	Ability to operate the KVL, including key management and key downloading while charging.
Key Management Facility support	With store and forward capability, the encryption keys are downloaded from the KMF, stored in the KVL, and delivered to the end units.

2.3.13 System Access Features

To ensure system access, simplify radio operation, and limit operator involvement, the ASTRO 25 platform has many access features, as described below.

Busy Queuing/Call Back

This system has been designed to maximize availability to the end-user. In the unlikely event that all the channels are busy, a user depressing the Push-To-Talk (PTT) will be given a busy signal, and placed into a busy queue. When a channel becomes available, the system assigns the users to a channel via pre-assigned priority levels. Once a channel is assigned, the system notifies the user with a call back tone. This feature makes it unnecessary for the radio operator to waste valuable time rekeying the radio in order to gain channel access.

Automatic Retry

If a channel request is not received at the Zone Controller, the individual radio unit continues sending channel requests until the Controller acknowledges the request, or until a total of 16 automatic retries occur. This feature eliminates the need for the operator to continually key and de-key the radio, or to keep the radio keyed in order to gain system access.

Recent User Priority

To ensure uninterrupted communications, a recent radio user priority provides those users who have been recently assigned a voice channel priority over the other system users. Recent user priority ensures that a talkgroup engaged in a conversation receives priority system access for up to 10 seconds between transmissions.



Misdirected Radio Protection

To ensure a radio from one talkgroup cannot accidentally be assigned to a voice channel being used by a different talkgroup, the system utilizes embedded signaling. If a unit from a different talkgroup is accidentally assigned the same channel, the radio will recognize that it has been assigned incorrectly, and will automatically revert to the control channel.

Continuous Assignment Updating

Once a talkgroup is assigned a voice channel, the control channel continues to transmit the channel assignment for as long as that talkgroup is using the channel. This ensures a radio just coming into service will be sent to the appropriate voice channel to join the rest of its talkgroup.

Talk Prohibit Tones

In the event a user attempts to perform an unauthorized function as defined by system permissions, a talk prohibit tone is given.

User Talkgroup Features

To enhance user functionality, the ASTRO 25 platform has many talkgroup features, also known as group call, as described below. These features are configurable by the System Administrator.

Emergency Alarm/Call

Emergency alarm/call provides users the capability to inform dispatch personnel of a life-threatening situation. By pressing the radio's emergency alarm button, an audible and visible alarm and the user's ID is sent to the dispatcher and, potentially, other talkgroup members.

In emergencies, the dispatch center is notified immediately, regardless of whether the system is busy. If one or more voice channels are available, one of those channels will be assigned immediately to the emergency call when the user presses the PTT switch. The duration of the emergency call can be defined by the system administrator.

In the event that the system is busy, two alternatives are provided for handling emergency traffic:

- **Top of the Queue** - When an emergency is initiated and no channel is available, the emergency user is put at the top of the busy queue. As soon as the first user on any channel de-keys, the emergency caller is assigned that channel. The major advantage to this approach is that there is no contention for the channel.
- **Ruthless Preemption**— When an emergency is initiated and no channel is available, the Zone Controller selects the channel assigned to the lowest priority user and assigns it to the emergency caller—a feature unique to Motorola trunking systems.

Multiple Priority Levels

The system provides 10 priority levels, allowing administrators to segment their users according to their communications needs. Priority 1 is always reserved for emergencies. Priorities 2 through 10 can be assigned by the System Manager on a per radio or talkgroup basis. These priorities are only applicable when the system is busy.



Multi-Group Call

Multi-group call is used to make a simultaneous call to multiple talkgroups, and allows all units to be configured for talk back capability. The System Manager can program this call to operate in one of two ways:

- The requesting user waits for all requested talkgroups to finish all calls in progress.
- The requested call immediately interrupts other conversations in progress without waiting for active users to de-key. Radio users who are transmitting on a voice channel will not hear the call until they de-key.

Priority Monitor

Priority monitor allows the radio user to scan talkgroups in their system, and mark up to two talkgroups in their scan list as Priority. A non-priority conversation will be interrupted by Priority 1 or Priority 2 talkgroup activity.

Dispatch Console/Talkgroup Merge

Talkgroup merge is a dispatch function that allows multiple talkgroups to operate together on one voice channel, improving channel efficiency. This is a standard feature of Motorola wireline consoles.

2.3.14 Individual Call Features

To further enhance user functionality, the ASTRO 25 platform has individual call features in addition to user talkgroup features, as described below. These features are configurable by the system administrator.

Call Alert

Call Alert allows a dispatcher or radio user to selectively page an individual's radio. Call Alert signaling is conducted over the control channel and does not affect voice channel capacity. The Call Alert produces an audible and visual alert on the receiving radio. Indicators on the initiating radio acknowledge delivery of the Call Alert. If the receiving unit has a display, it will show and store the sending unit's ID.

In-Call User Alert

In-Call User Alert is a feature that builds upon Call Alert. When In-Call User Alert is enabled on the system, radios will be able to receive Call Alerts even when involved in voice and data services.

Radio Talkgroup Muting

Radio Talkgroup Muting is a feature that utilizes the Call Alert feature. Radio Talkgroup Muting allows the radio user to mute all voice traffic for the currently selected talkgroup.

The radio can be automatically un-muted by the console dispatcher or another radio user by sending the muted radio a Call Alert. With In-Call User Alert enabled, the Call Alert will reach the muted radio when it is on the voice channel or a data channel, as well as if it is idle on the control channel.

Private Call

Private Call allows a radio user or console dispatcher to selectively call and carry on a private conversation with another individual radio, as long as that unit is not already engaged in another Private Call. The calling unit will receive an acknowledgment of a successful Private Call. If the receiving radio has a display, it will show the calling party's unit ID.

2.3.15 User Accessibility Features

Affiliation Display

The Affiliation Display provides a dynamic view of the sites to which all operating units are currently affiliated, making it easy to track and troubleshoot radios in the system. Specifically, it provides a dynamic view of:

- Sites
- Talkgroups
- Individual radios

This allows a manager to understand the loading characteristics of their system in real-time. Graphing capabilities are also included. Figure 2-13 provides a selected site graph example.

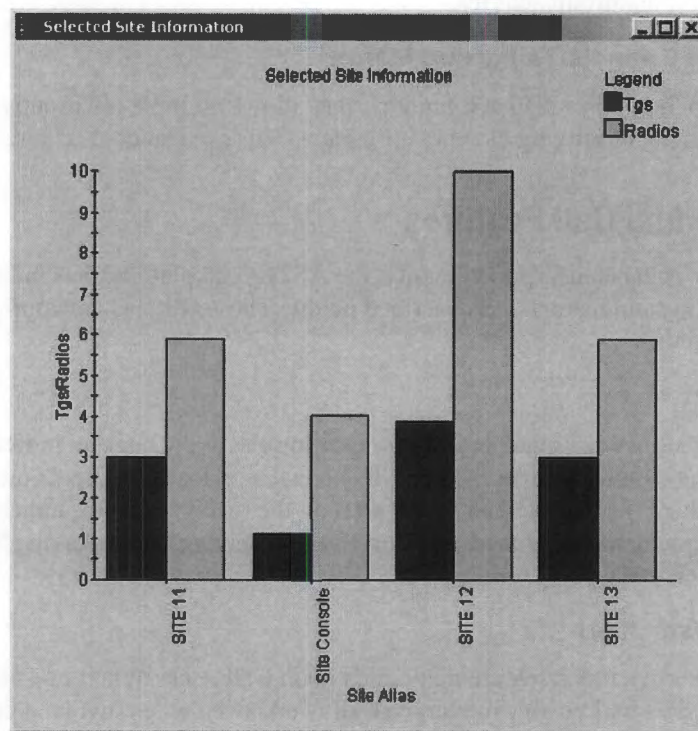


Figure 2-13: Selected Site Graph Example

SNMP Trap Forwarding

SNMP trap forwarding allows for the forwarding of alarms from the UEM application to an external third party application utilizing an industry standard protocol (SNMP v3 management system). This feature permits your existing network to actively monitor alarm conditions within the radio network; a developer's guide is provided.

Channel Partitioning

The Channel Partitioning feature provides agencies or departments, with exclusive use of specific RF channels. The use of this feature allows the segregation of one set of users from another to ensure dedicated resources for a specific group.



Email Alerting

Email alerting sends notifications for system alarms in the UEM to a specified email address. Alarms can also be forwarded to a mobile device such as a cell phone or PDA.

2.4 ASTRO 25 SYSTEM FAILURE MODE ANALYSIS

Motorola's ASTRO 25 trunking networks have three modes of operation for increased reliability. The normal mode of operation is wide-area trunking. In the event of multiple component failures that lead to system disruption, the system is equipped to continue operation in two reduced feature operational modes: site trunking and failsoft.

The following pages include a detailed description of each of these operational modes, as well as a comprehensive analysis of the possible infrastructure failure scenarios and the system redundancy for mitigating each scenario.

Wide-Area Trunking

Wide-area trunking is the ASTRO 25 system's normal mode of operation. Wide-area trunking implies that the Fixed Network Equipment is operating properly. All simulcast cells and ASTRO 25 repeater sites are communicating with the Master Site. Subscriber units automatically roam between the various network RF cells. Talkgroup calls occur in the appropriate RF cells if users are distributed throughout multiple cells. Data applications are properly assigned channels for communication between the subscriber units and the host application.

Site Trunking

Site trunking is the first failover mode of operation. Site trunking impacts individual RF cells within a network. In multiple RF cell systems, one RF cell can be in site trunking, while the rest of the system remains in wide-area trunking. Site trunking implies that the simulcast prime site controller or the ASTRO 25 repeater site has lost connectivity with the Master Site. Talkgroup calls initiated in the RF cell that is in site trunking will only be broadcast in that RF Cell. Dispatch consoles use control stations, or the operators use portable radios to communicate on a site trunking RF cell. Console priority is not available in site trunking. Data applications are not available on a site in site trunking and will have to be reinitiated once the system reverts to wide-area trunking.

Radios detect if a site is in wide-area trunking or site trunking. Radio models with a display will indicate to the user when the site is operating in site trunking. The radio alternately displays the selected talkgroup and "Site Trunking." Depending on how the system and user equipment are programmed, subscriber units will try to roam to an RF cell that is in wide-area trunking.

Failsoft by Talkgroup

Subsystem/site failsoft is the final fallback means of communication if a site no longer maintains wide-area or site trunking operation. Multiple failures have to occur for the system to enter failsoft. Failsoft impacts individual RF cells within a network. In multiple RF cell systems, one RF cell can be in failsoft, while the rest of the system remains in wide-area trunking. The subsystem goes into failsoft mode in any of these scenarios:

- The site controllers are not functioning properly.
- When all control channels are disabled or malfunctioned.
- When only one channel is enabled.



Failsoft operation provides communications in conventional mode via repeaters/base radios in order to maintain vital communications. In an IP multi-site simulcast subsystem, in subsystem-wide failsoft, received audio is routed to the comparator for voting and redistributed to all of the sites for simulcast transmission.

The subscriber's operation in failsoft mode is determined by the subscriber's programming. A subscriber can be programmed to behave in the following manner:

- Failsoft by control channel operation – The subscriber first scans for alternate control channels outside the multi-site subsystem, then scans the control channel frequencies for failsoft data.
- Failsoft by working group – The subscriber looks for Failsoft data on a pre-programmed frequency after a scan for alternate control channels outside the multi-site subsystem is unsuccessful. If the subscriber cannot decode failsoft data on the pre-programmed frequency, the subscriber then scans the control channels in the simulcast subsystem for failsoft data.

Subscriber units in an RF cell that is in failsoft will try to roam to an RF cell that is in either wide-area trunking or site trunking. Dispatch consoles use control stations or the operators use portable radios to communicate on a site trunking RF cell. Console priority is not available in site trunking. Data applications are not available on a site in failsoft and will have to be reinitiated once the system reverts back to wide-area trunking.

Simulcast Local Failsoft

This feature addresses two simulcast subsystem failure scenarios, prime site to sub-site link failure and prime site failure:

- Upon loss of communication (11 seconds or more) with comparators due to a sub-site link failure, the GTR 8000 Base Radio, when programmed with local failsoft "on," will automatically enter in-cabinet repeat mode and continuously transmit Failsoft signaling. Link failures of less than 11 seconds or more will not trigger a link failure condition.
- Provides continuity of operations within the coverage area of a simulcast sub-site, in case of loss of connectivity with Prime site, through local in-cabinet repeater mode operation. Prior to this feature, a prime site connectivity failure would cause the sub-site to be non-operational.
- This feature does not provide logic inputs to override and control this functionality, as was implemented on QUANTAR in SmartZone and SMARTNET systems. There is a change request in progress to enable this capability.
- TDMA-based systems will revert to FDMA conventional operation during local Failsoft.

2.5 ASTRO 25 IV&D SYSTEM OVERVIEW

With the advancements in telecommunications, the need to be more efficient in providing voice and data services becomes an increasing priority. With Motorola's ASTRO 25 digital voice and data networks, a more efficient means of communications is possible by combining voice and data into one flexible solution that allows for easy upgrades and migration. This capability now provides packet data service using the same radio infrastructure that is used for trunked voice communications. It also provides significant savings: the same radio can be used for both voice and data services, instead of a dedicated radio for each. This type of network is often referred to as an Integrated Voice and Data (IV&D) network, or in this case, a trunked IV&D system, and represents Motorola's first digital trunked system that provides voice and data services in the same mobile or portable radio.



The IV&D network is a cost-effective way to simplify administrative tasks and put more applications beyond voice communications into the hands of radio users. With an existing ASTRO 25 voice system, adding Integrated Data is simple, and can provide a host of additional high-value applications, including: fire station alerts, location, and text messaging. IV&D works with the ASTRO 25 portable and mobile family of radios. It enables users to share data such as text messages. There is no need to purchase specialized end-user equipment. It coexists with voice traffic over the same radio frequencies you are already using. The system dynamically reallocates channels to voice or data in real time as user demand requires, thus maximizing your use of available channels. IV&D always gives priority to voice over data so that data transmissions will not interfere with voice calls. ASTRO 25 provides an option to add encryption to integrated data, providing the same security level as voice networks.

Figure 2-14 shows how many current voice and data networks are comprised, requiring their own independent, circuit-switched infrastructure for data services.

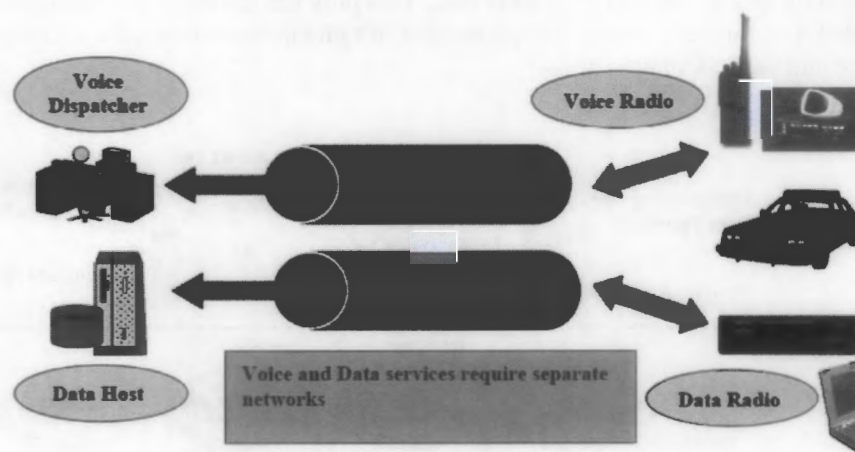


Figure 2-14: Independent Voice and Data Networks.

With the trunked IV&D system, as shown in Figure 2-15, the same infrastructure can be used to provide both types of services, potentially saving costs for implementation, maintenance, and upgrades.

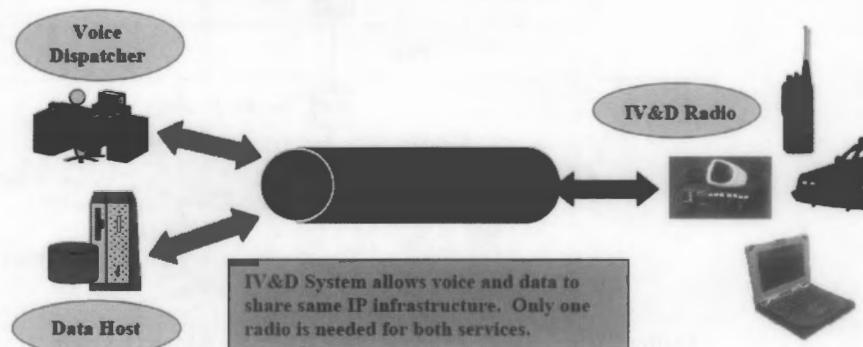


Figure 2-15: ASTRO Trunked IV&D System.

2.5.1 Network Components

The infrastructure of a trunked IV&D system consists of integrated radio and computer components that use an Internet Protocol (IP) to pass packet data, as well as voice traffic from each of the base sites to the rest of Pinellas' radio network and beyond, into Pinellas' private data network or Customer Enterprise Network (CEN). At each of the endpoints to the system, application packet data utilizes industry-standard IP protocols for transmission to the respective computing devices, such as Point-to-Point Protocol (PPP) between mobile computer and IV&D radio, etc.

In addition, the protocols used on the air interface between the wireless users and the base sites follow an industry standard for two-way radio communication, as defined by the Association of Public-Safety Communications Officials (APCO). Not only does APCO define the protocol for voice communications, but also for packet data. This provides the distinct advantage to the public safety market, i.e., they can choose from a number of radio manufacturers for the radios they wish to use for voice and data communications.

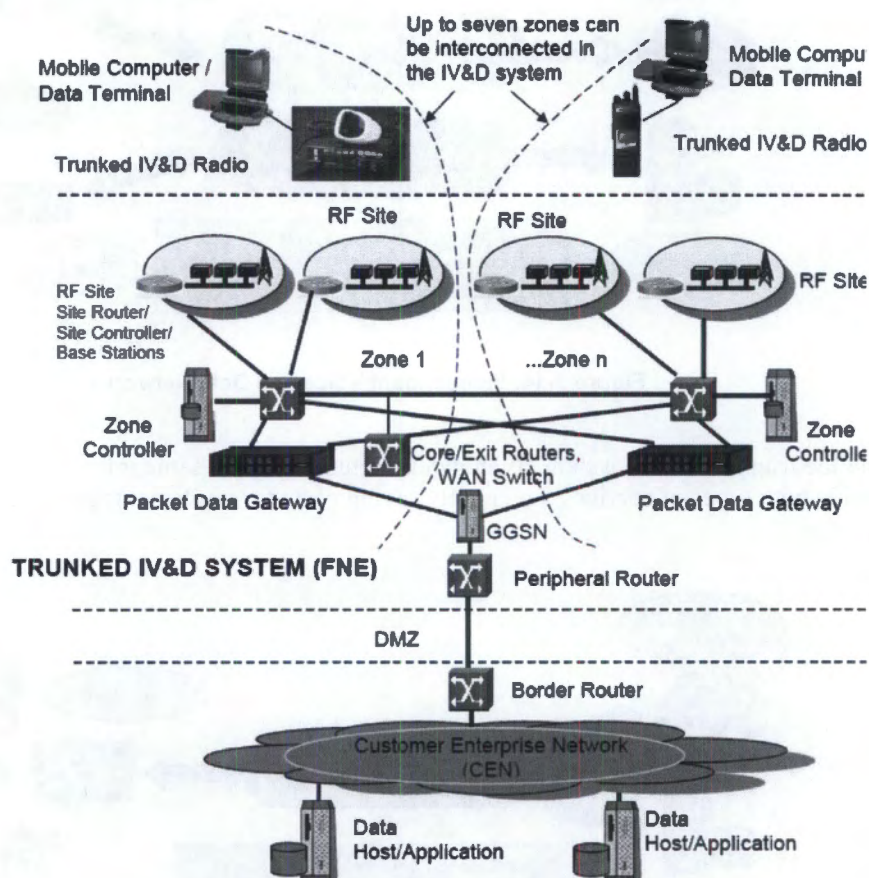


Figure 2-16: ASTRO Trunked IV&D Example Block Diagram.

Figure 2-16 shows the components that make up the data network of the trunked IV&D system, which are mostly the same components that comprise the voice network with a few additions. At a high level, the trunked IV&D system requires the following components:

- **Mobile Computer/Data Device** – A variety of mobile computers or data terminals are supported by the trunked IV&D system. Computers or terminals must be able to establish a PPP connection to the trunked IV&D radio.
- **Trunked IV&D Radio** – The trunked IV&D radio is a device that can act as a voice radio, a data radio, or both. The radio can be configured to give priority to voice calls, so that if the radio is transmitting or receiving data messages and a voice call starts, the radio can revert to the voice call.
- **Base Stations (RF Channels)** – The base stations are located at each RF site and provide coverage over a geographical area. The number of base stations at the site can vary from 2 up to 30. Each base station operates as a control channel, voice channels, or as a Packet Data Channel (PDCH). A maximum of three base stations can be assigned for data services on a site-by-site basis.
- **Site Controller** – Each RF site requires a site controller that manages the control, voice, and data communications between the portable and mobile radios and the rest of the communication infrastructure.
- **Site Gateway** – A site gateway is responsible for consolidating all control, voice, and data traffic, converting it to IP packets and feeding it into a central site, where the information is further processed and routed.
- **Zone Controller (ZC)** – A ZC is responsible for the allocation of resources for control, voice, and data services over a given number of RF sites. Previous versions of the ZC supported up to 64 sites; newer versions now support up to 100 RF sites per ZC. Up to seven ZCs can be interconnected into a single wide-area trunked IV&D system.
- **Core Routers, Exit Routers, WAN Switches** – These network transport components are the backbone of the packet-switched network that route all control, voice, and data traffic: from site to site, and even from zone to zone. Packet data is treated in relatively the same manner as voice traffic within the trunked IV&D system, as they are all converted to IP packets for transport on the network.
- **Packet Data Gateway (PDG)** – The PDG acts as a collection point for all the RF sites that support packet data services. A single PDG supports up to 64 sites, with the newer PDGs supporting up to 100 sites. The PDG is also the wireless network gateway device that interfaces with the GGSN, which communicates with the routers that bridge the gap to the CEN.
- **Gateway GPRS Support Node (GGSN)** – The GGSN is the collection point for all data sites in the trunked IV&D system. All PDGs in a multi-zone environment interface to a single GGSN that provides the physical connection to peripheral router that exists on the edge of the De-Militarized Zone (DMZ). Through the DMZ, Motorola is able to isolate the radio system's Fixed Network Equipment (FNE) from Pinellas' private network.
- **DMZ Switch** - Between the Gateway GPRS Support Node (GGSN) and the Peripheral Network Router, a network area called a DeMilitarized Zone (DMZ) must be created. The Demilitarized Zone is an isolated network segment that separates the data network from the customer network. This isolation is implemented with an IP Networking Switch. Establishing a DMZ also prevents IP address conflicts and provides a level of security for each network.

2.5.2 Network Features Supported in the Trunked IV&D System

Motorola's ASTRO 25 digital voice and data networks have features that provide or enhance wireless computer access to host computer networks.

IP Bearer Service

A bearer service is the basic methodology that host applications use to communicate with each other. The trunked IV&D system provides an IP bearer service as an industry-standard method to convey data between Pinellas' network and mobile computers. The IP bearer service follows the principles



normally used in the IP world; however, data over a wireless RF channel differs from that of a wired network. The unpredictability of a radio environment requires that certain methods/techniques are implemented to provide a reliable data transfer similar to that of a wired IP network. Some of these methods or techniques include automatic and selective retries, over-the-air coding schemes, and forward error correction. Overall, the system provides delivery of a datagram on a best effort basis, and if delivery cannot be achieved for some reason, the datagram is discarded. Attempting to overcome these characteristics by designing an application using a connection-oriented protocol, such as TCP/IP, is not recommended on the trunked IV&D system. Public safety reliability can be achieved using UDP, as long as the data application is written to handle the delivery of information. The system also supports the ICMP protocol, which means that normally any such non-deliveries will be reported back to the source. Note that certain types of failure conditions prevent the return of an ICMP response message, so ICMP responses to discarded IP datagrams are not guaranteed.

Mobility Management

The trunked IV&D system mobility services allow field users to move throughout the coverage area while maintaining communication services. System designers use the radio infrastructure components and radio channel design features of a trunked IV&D system to provide a coverage area that meets the wireless communication service needs. Configurations are available to support single or multiple radio channels and small or large coverage areas, depending on Pinellas' particular needs and resources.

Mobility throughout the trunked IV&D system is handled transparently to the application. IV&D radios are able to roam seamlessly throughout the system coverage and maintain data connectivity.

Customer Enterprise Network Connectivity

Each part of Pinellas' network connects to the trunked IV&D system via a router that is referenced in the system by an Access Point Name (APN). To provide IP isolation, Pinellas' network is connected to the IV&D system through an IP DMZ. The GGSN establishes an IP tunnel through the access point to Pinellas' network for transmission of all data between applications and mobile computers assigned to Pinellas' network APN. This IP tunnel is transparent to the application.

The Pinellas County network hosts simply need to be connected to the Pinellas County network that has IP connectivity to the trunked IV&D system. Applications in Pinellas' network communicate through their host platform's IP stack, with the mobile computer using assigned IP addresses.

In instances where there may be more than one customer network, an individual trunked IV&D radio and attached mobile computer can only communicate directly via IP with one CEN. Each CEN connects to the DMZ via a border router and is mapped in the trunked IV&D system by the APN. Each trunked IV&D radio can only be mapped to one APN. Therefore, the application programmer must consider this restriction when designing the application(s) and locating application servers in Pinellas' networks, when more than one network connection will be implemented. Desired network applications must be accessible through the trunked IV&D radio assigned access point.

Note: The trunked IV&D system allows mobile or portable data users to connect to only one CEN, as defined by the APN. If mobile or portable data users need to access more than one data network, routing to the other networks must be handled by the applications running on the system.

Mobile Host Network Connectivity

The trunked IV&D radio uses an industry-standard PPP connection for mobile host communication when using the USB 2.0 interface or an RS-232 connection via the serial port on the mobile computer.



Dynamic Host Configuration Protocol

The trunked IV&D system supports Dynamic Host Configuration Protocol (DHCP) to a DHCP server in the CEN for mobile computer IP address assignment. This feature allows Pinellas to manage the IP addresses assigned to the IV&D radios, which proxy for the mobile computers connected to them.

Network Management

The trunked IV&D system provides network management through Simple Network Management Protocol (SNMP) capable network elements. Motorola provides a suite of network management applications that are customized for Motorola communication systems, which manages, configures, and monitors the network elements from a single user interface point. In addition, the IV&D radio contains an SNMP Management Information Base (MIB) that facilitates local SNMP communications between a mobile computer and the IV&D radio for status information and configuration. The IV&D radio cannot be managed via SNMP from the Network Manager.

Performance Management

The trunked IV&D system provides network performance reporting, which gives a system manager the ability to monitor network operation. A set of basic reports tells the manager how the components in the system are used. Over time, the system manager can use this information to predict usage trends that can identify the need for network reconfiguration or future expansion. The performance management reports provide hourly and daily information, as information is kept in the network manager's data warehouse.

2.5.3 Wireless Computer Solutions

A variety of wireless computer configurations provides the flexibility to meet many other needs of Pinellas County. These configurations can be either mobile or portable devices to support Pinellas' different needs, without defining the specific application functions to be implemented. The trunked IV&D system's portable configurations include a Motorola handheld radio, which can be connected to a portable computing device (e.g., laptop, tablet, PDA). A mobile data terminal or mobile computer can also be connected to a Motorola mobile trunked IV&D radio to communicate with the fixed data host in the mobile environment.

2.5.3.1 Users on the System

The trunked IV&D system provides services that accomplish specific tasks for different users in the system, and can be thought of as having three ends. Figure 2-17 shows one end (the wireless end), which interfaces to field users: those people out and about in the RF coverage of the system. The other two ends are the part of the system collectively referred to as the fixed end. This is the network which is permanently installed in fixed facilities that connect the wireless end to Pinellas' enterprise. One of the two fixed ends is typically the voice dispatch network, which resides inside the FNE and provides the dispatch voice services for all the voice users in the trunked system. The other end is the data host network, which resides on the CEN, or the data network that resides within Pinellas' premises. Users at either the wireless or CEN end can be an individual or application. This CEN end of the network logically resides outside of the FNE, but physically may reside within the same facility as the radio network equipment.



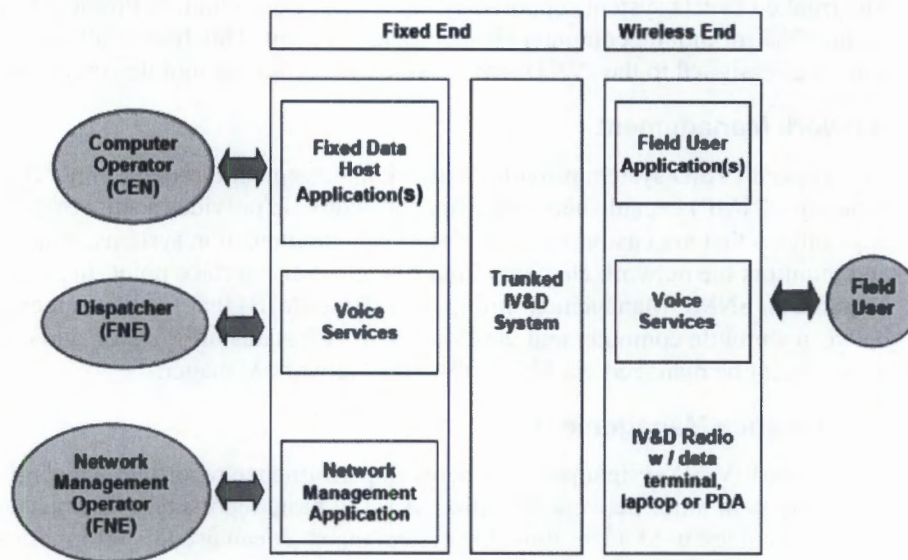


Figure 2-17: Users of the ASTRO Trunked IV&D System.

2.5.3.2 Wireless End-Users

The trunked IV&D system enables wireless end-users to maintain both voice and data communications while moving through the coverage area of the system. A wireless end-user can be a person (field user) or a software program (field application). A field user is an individual or device who may operate a data terminal, laptop computer, PDA, or other terminal device connected to an IV&D radio. The field user may also use the same IV&D radio for voice services as well.

Field Users

Field users are typically individuals, but can be devices, that perform daily tasks and utilize the voice or data services from the trunked IV&D system. This individual may be in a vehicle, on foot, or even at a fixed location. The field users, at minimum, will make use of the IV&D radio to communicate with the system. For data services, they will also need to use an application, and possibly a computing device or other terminal device.

Trunked IV&D Radio

The central component of the wireless end of the trunked IV&D system is the mobile or portable radio that is used by the field user. Currently, Motorola's ASTRO 25 digital voice and data networks support radios capable of both trunked voice and data services: five mobile radios, and five portable radios. The mobile radios are the APX 6500Li, APX 6500, APX 7500, XTL5000 and XTL2500 mobiles and consolettes. The portable radios are the XTS5000, XTS2500, APX 4000, APX 6000 and APX 7000. These radios provide both voice and data services to the field user in the same radio; however, the radio can physically perform only one of these services at a time. Thus, if the radio is involved in a voice call, data services are queued temporarily until it has the opportunity to service the data messages. The radios are not capable of exchanging voice and data simultaneously.



Note: The trunked IV&D radio is capable of both voice and data services in the same radio. While the radio supports both capabilities, it cannot do so at the same time.

Field Applications

Field users benefit from the data services of the trunked IV&D system by using software applications that allow them to exchange data: either with other field users or with operators/servers located at the fixed end. These applications can be internal to the IV&D radio (OTAR), or they may be a program that runs on a mobile computer (e.g., PDMC, Text Messenger, CAD, and AVL). They may also be software programs that are run on a PDA, or they may be a specialized third-party application that runs on a terminal device or computer connected to the IV&D radio. In order for any of these features to benefit the field user, there must be an application running at the wireless end that uses the trunked IV&D system as the pipe to connect it to the fixed end. While any one of these applications can use the trunked IV&D network, they all must restrict their attempt to make use of the data services. Since the overall data rate of the wireless link is a raw 9600 bps (including error correction, protocol headers, etc.), an application cannot expect to exchange data with the rest of the system as if it were on an Ethernet network (10 Mbps or 100 Mbps). Failure to limit how the application exchanges data will almost certainly cause it to fail in the field, due to an overloading of the RF channel resources used by the IV&D radios.

Data Terminals, Laptop Computers, PDAs, and Other Terminal Devices

If the application being used by the field user is not internal to the IV&D radio, a compatible external device, such as a mobile computing station, must be connected to the radio. The computing device must be able to establish a PPP connection to the IV&D radio in order to begin using the data services of the trunked IV&D system.

2.5.3.3 Fixed End-Users

Fixed end-users can be dispatchers, network managers, data host applications, or the computer operators who use the data host applications. Table 2-13 lists the types of fixed end-users and defines their function within the system.

Table 2-13: Fixed End-Users

Type	Definition
Dispatchers	Individuals who communicate primarily through voice, usually from a console position.
Network Managers	Individuals who perform network management, configuration, and system administrative functions.
Data Host Applications	Software programs that can communicate with both fixed and wireless end field users.
Computer Operators	Individuals who perform data communication functions with the data host application at the fixed and/or wireless ends.

Dispatchers

Dispatchers are individuals who utilize the voice services of the communication system to verbally convey information to the field users. Dispatchers may or may not also be computer operators who use data host applications as well.



Network Managers

Network managers use the Motorola-supplied network management applications to monitor network fault alarms, monitor network performance, identify and isolate component failures, and provide information and procedures that allow network management personnel to take corrective action.

The network manager receives feedback from field users regarding network service performance problems and supports troubleshooting activities for network management personnel to resolve field user performance complaints.

Data Host Applications

Data host applications reside on one or more host network computers that use the trunked IV&D system data services. Host applications provide the functions to accomplish specific tasks that supplement the use of the trunked IV&D system, such as CAD, database inquiry and update, user-to-user messaging, and AVL.

Host applications are responsible for authorizing individual wireless end-users for services and for interpreting and processing the data messages from those users. The host application is responsible for making its own interpretation as to whether or not the connectivity to the radio network infrastructure is present. The trunked IV&D system is not a connection-oriented service, and it is best interfaced by using a UDP/IP connectionless approach from the host applications. In most cases, but not all, the radio network infrastructure will provide some level of feedback to the host application when an attempt to send a data message to a field user has failed. This feedback will be in the form of an Internet Control Message Protocol (ICMP) message, which will provide some level of indication as to why the message may not have made it to the wireless end field user.

In addition to the wireless end field users, the host application may also provide the interface and functions for the computer operators. Computer operator functions may or may not have any direct association with the trunked IV&D system data services. Although host applications reside outside the trunked IV&D system, they are still considered an integral part of the overall system solution.

Computer Operators

A computer operator is an individual who supports or directs the activities of the field users through data communication functions with them. A data host application makes use of the trunked IV&D system data services to provide the functions between the computer operators and the wireless end field users. Not every system may have computer operators. Some of Pinellas' data host application solutions may use a client-server data query service over the trunked IV&D system, where an individual at the fixed end is not needed. The host application provides the fixed end functions automatically.

2.5.4 Wireless Data Communications Fundamentals

Developing an effective design for a data application on a trunked IV&D system requires understanding the fundamentals of wireless data communications. A summary of the important concepts of wireless data communications is provided in this section.

Packet Switched Communications

Packet switched communications is a method for providing shared access to a communications media. The trunked IV&D system provides packet switched communications that allow multiple hosts to share the system's communications resources. When a host sends data, the data is sent to the trunked IV&D system internal protocol packets that will be switched through the network. Data from



multiple hosts can be interleaved as it passes through the network such that each host is able to share the system communication resources simultaneously.

Packet switched communications is contrasted by circuit switched communications. Circuit switched communications require the media to dedicate resources to the host establishing the circuit connection for the duration of the circuit connection. With packet switched communications, the resource is only used for the duration required to process the packet, after which the resource becomes available for another packet.

Inbound Versus Outbound Communications

Inbound communications refers to data that is sent from a mobile computer or the IV&D radio itself to the CEN. Outbound communications refers to data that is sent from Pinellas' network to a mobile computer, illustrated in Figure 2-18 below.

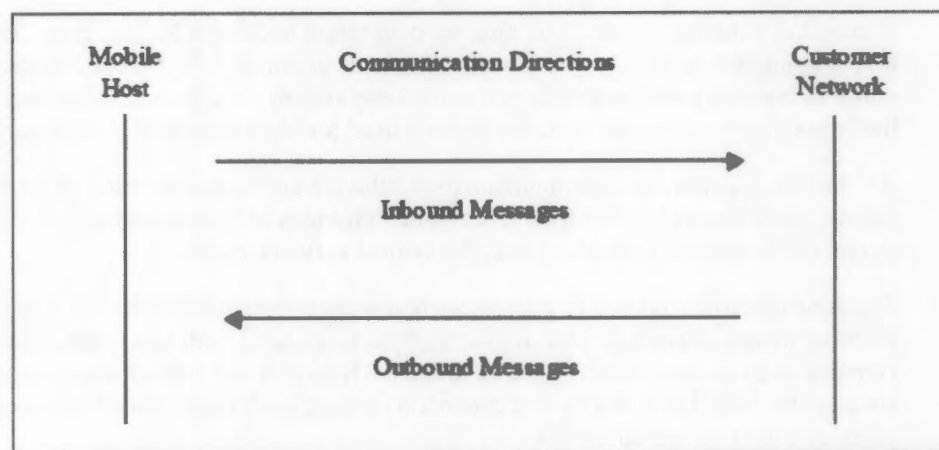


Figure 2-18: Communications Directions.

Half-Duplex versus Full-Duplex Communications

Half-duplex means that a device cannot send and receive data at the same time, but it must stop receiving data while it transmits. Full-duplex means that a device can both send and receive at the same time. There is normally a short amount of time after transmitting that a half-duplex device needs in order to receive data again. This time is used to resynchronize with the receive data stream. The trunked IV&D radios are not capable of full-duplex operation, but can only receive or transmit at any instant in time. The base stations located at the RF sites are capable of full-duplex operation, which allows them to send and receive data to multiple IV&D radios at essentially the same time.

Network Address Translation

Network Address Translation (NAT) allows a single device, such as a router, to act as an agent between the Internet (public) network and a local (private) network. This means a single, unique IP address is required to represent an entire group of computers. When an inside host sends data to an outside host whose address has been translated, the network between the two hosts (somewhere along the way) is changing, or translating, the inside host's destination address into the actual destination host's known local address. Likewise, when a host whose address has been translated sends data to another host, the inside host address is changed or translated to the address known by other outside hosts when delivered to the destination outside host.

There are many reasons to use NAT in networks, but it is sufficient to know that this can occur in some networks. The translated host's address is known to other hosts by an address that is different from what the translated host recognizes. This is not normally a problem for applications, since they are typically agnostic about the host address they are known by, as long as the data sent to them is received and the data they send reaches the correct destination. However, application programmers must be aware that NAT can occur and be careful to not be dependent on specific IP addresses or port numbers that may be "NATed," as this is commonly called. Note that NAT does occur for mobile computers in the trunked IV&D system.

2.6 ASTRO 25 INFRASTRUCTURE

2.6.1 Master Site Components

A zone has a master site that contains the computing backbone for that zone. The master site contains all the components necessary for controlling calls within a zone and for communicating with other zones to manage InterZone calls in a multi-zone system. In addition, the master sites provide the hardware and software components that are used for Network Management and system configuration.

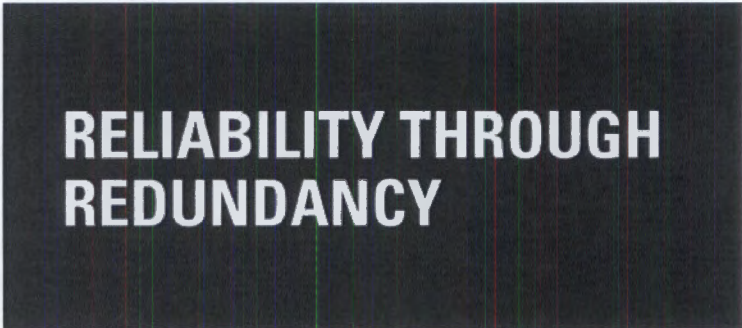
All the components that communicate over Ethernet are connected through a central switch called the master site Ethernet LAN switch. This switch provides two separate internal LANs which are integrated to provide redundant links for critical network traffic.

The zone controller is used to process system-wide commands and handle call processing and mobility management functions for the system. In systems with two zone controllers, there is a connection from each zone controller to the LAN switch and a direct connection between the two zone controllers. The LAN switch connection allows each zone controller to communicate with the gateway routers/Core Gateways.

2.6.1.1 Zone Controller

The Zone Controller provides trunking call processing for ASTRO 25 system operation. The Zone Controller forms the heart of a wide-area radio system by providing the central processor for the zone, with the necessary hardware and software capabilities to provide call processing and mobility management.

The Zone Controller builds upon the strength and experience of Motorola wide-area trunking systems to deliver multiple layers of reliability for business-critical, Mission-Critical and life-critical applications.



**RELIABILITY THROUGH
REDUNDANCY**



The Zone Controller is supplied in a redundant controller configuration, and provides the following:

- **System Availability** – The Zone Controller allows software upgrades once loaded, providing enhanced system availability.
- **Intelligent Switchover** – The Redundant Configuration provides automatic switchover to the standby controller if a loss of wide-area communications is detected. Notification can be sent to the user if other components fail, allowing the user to manually switch to the standby controller if desired.
- **Cross Controller Compatibility** – Capable of running two different versions of software simultaneously, ensuring upgrades are fully functional with one controller before upgrading the second controller.
- **Redundant Configuration** – The Redundant Zone Controller is a computer platform with redundant processors that provide trunking call processing for ASTRO 25 wide-area radio communication systems. It is designed to detect failures by automatically switching operation to the standby controller, minimizing the interruption of call processing functionality.

2.6.2 ASTRO 25 RF Sites

ASTRO 25 RF sites provide communications for radio users both inside and outside the ASTRO 25 network. RF Sites may include ASTRO 25 repeater sites, simulcast cells, High Performance Data (HPD) RF sites, and ASTRO 25 conventional channel sites.

The RF Site types applicable to this system design are described briefly in this section.

2.6.2.1 Repeater Sites

An ASTRO 25 Repeater Site consists of a single site with up to 20 channels and two site controllers (in a redundant configuration), in a standalone GTR 8000 configuration.

The GTR 8000 Subsystem in a repeater site is set up in a single trunked site, with one active control channel and a number of voice channels at the site. If packet data services are supported at the site, a number of voice channels can be configured with packet data channel capability. Voice traffic is routed from each of the base radios to the system for distribution to other sites and is repeated by the base radios to support other local subscribers. However, data traffic is routed to the GCP 8000 Site Controller. The site controller routes these packets upstream to the zone controller for further processing and routing.

The ASTRO 25 Repeater Site consists of the following components, described in the Component Descriptions section of this System Description.

- GTR 8000 Repeater/Base Radio
- GCP 8000 Site Controller
- Radio Frequency Distribution System (RFDS)
- Sub-Site Ethernet Switch
- GGM 8000 Site Gateway



2.6.2.2 Simulcast Sites

A simulcast land mobile radio system provides continuous coverage over a large geographic region using a single set of frequencies. Simulcast solutions extend a system's RF coverage, especially in areas where available frequencies are limited, and in areas where physical barriers (e.g., mountains and buildings) can cause reduced signal coverage. The current Pinellas County system has four ASTRO 25 simulcast sites. These sites will be upgraded to 7.14 release.

Trunked simulcast was developed by Motorola to meet the needs of users who were outgrowing their single-site radio systems. Simulcast offers the following advantages:

- **Improved Coverage** – One radio site may not provide the coverage necessary for the application in question. Simulcast expands the coverage area by expanding the number of radio sites without adding additional frequencies.
- **Efficient Use of Frequencies** – Adding sites typically requires more frequencies. In a simulcast system, the same frequencies are used at every site in the system. This makes very efficient use of the available spectrum.
- **Simplified Radio Operations** – Because the simulcast architecture operates like a single-site system, operations are simplified and radios are easy to use.

The ASTRO 25 simulcast infrastructure consists of a central simulcast prime site (a typical prime site is shown in the Figure 2-19) and up to 32 distributed simulcast remote sites, each with up to 30 channels (a typical remote site is shown in Figure 2-20). The prime site acts as a control and digitized audio center for the simulcast subsystem. Audio is routed to the prime site from each simulcast remote site. To ensure that the best audio from the simulcast receivers is processed, a voting comparator selects the best signal.

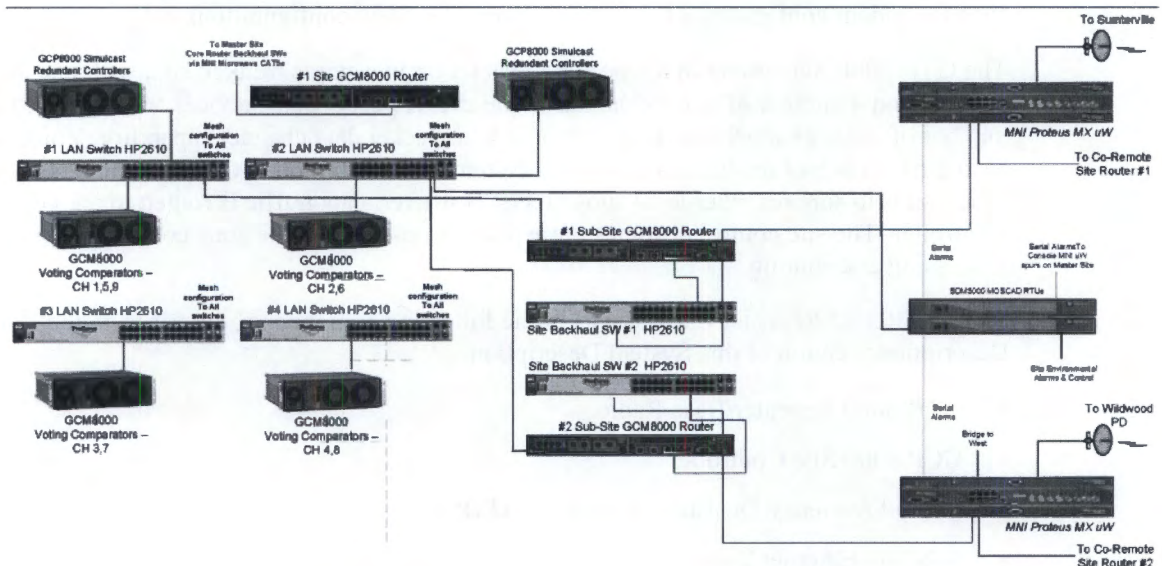


Figure 2-19: Basic Diagram of a Typical ASTRO 25 Simulcast Prime Site.

The prime site contains the prime site simulcast controller, simulcast comparators, and networking equipment to interface to the remote simulcast sites. The simulcast RF transmitters and receivers are located at the simulcast remote sites. These sites simultaneously transmit identical information from each site to the radios. The receivers at these sites receive the audio from the user radios, and pass the audio back to the prime site for voting. Audio and site control comes from the prime and master sites.

Equipment at a simulcast remote site includes a simulcast base radios, fault management equipment, and networking equipment to interface to the prime site.

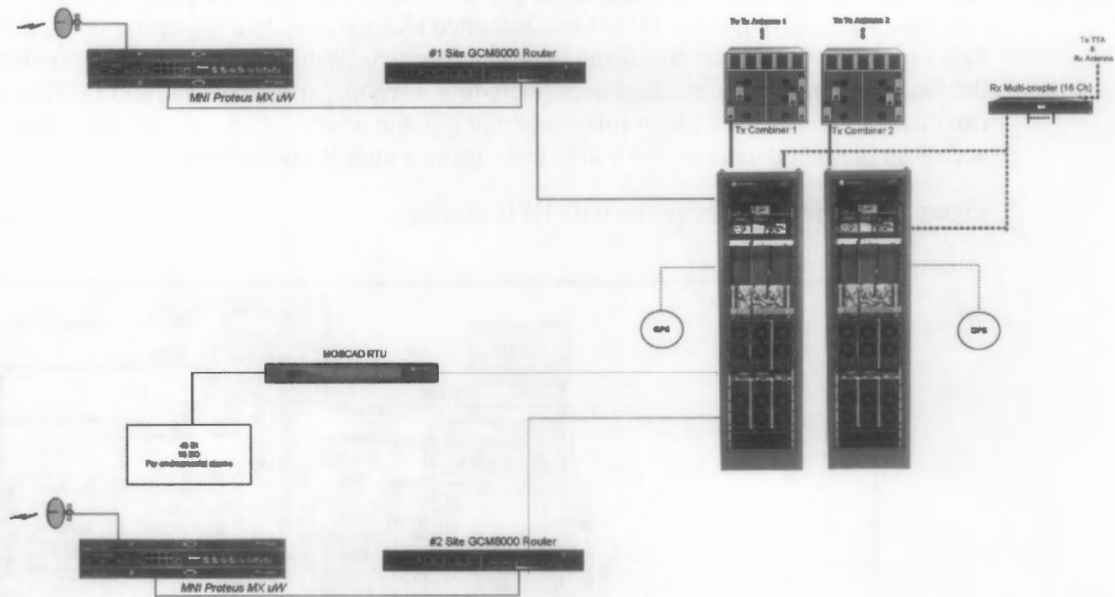


Figure 2-20: Basic Diagram of a Typical ASTRO 25 Simulcast Remote Site

2.6.2.2.1 Simulcast Prime Site

The ASTRO 25 Simulcast Prime Site consists of the following components, described in the Component Descriptions section of this System Description:

- GCP 8000 Site Controller
- GCM 8000 Comparator
- GGM 8000 Site Gateway
- TRAK 9100 Simulcast Site Reference
- Sub-site Access Router
- Prime Site Ethernet Switch
- Sub-site Ethernet Switch

2.6.2.2.2 Simulcast Remote Site

The ASTRO 25 Simulcast Remote Site consists of the following components, described in the Component Descriptions section of this System Description:

- GTR 8000 Repeater/Base Radio
- GGM 800 Site Gateway
- TRAK 9100 Simulcast Site Reference
- Radio Frequency Distribution System (RFDS)
- Sub-Site Ethernet Switch

2.6.3 ASTRO 25 with High Performance Data Overlay Infrastructure

HPD introduces higher bandwidth to support a portfolio of mobile data applications that run on vehicle-mounted computers. HPD uses dedicated channels for data applications to provide maximum data capacity without compromising your voice system. With HPD and the right applications, users in the field can directly access databases (including warrants, arrest records, and DMV records). They can display photographs, blueprints, and other graphic images. They can also capture fingerprints, access an intranet database, and match them using a mobile ID application.

Figure 2-21 depicts a Master site with HPD overlay.

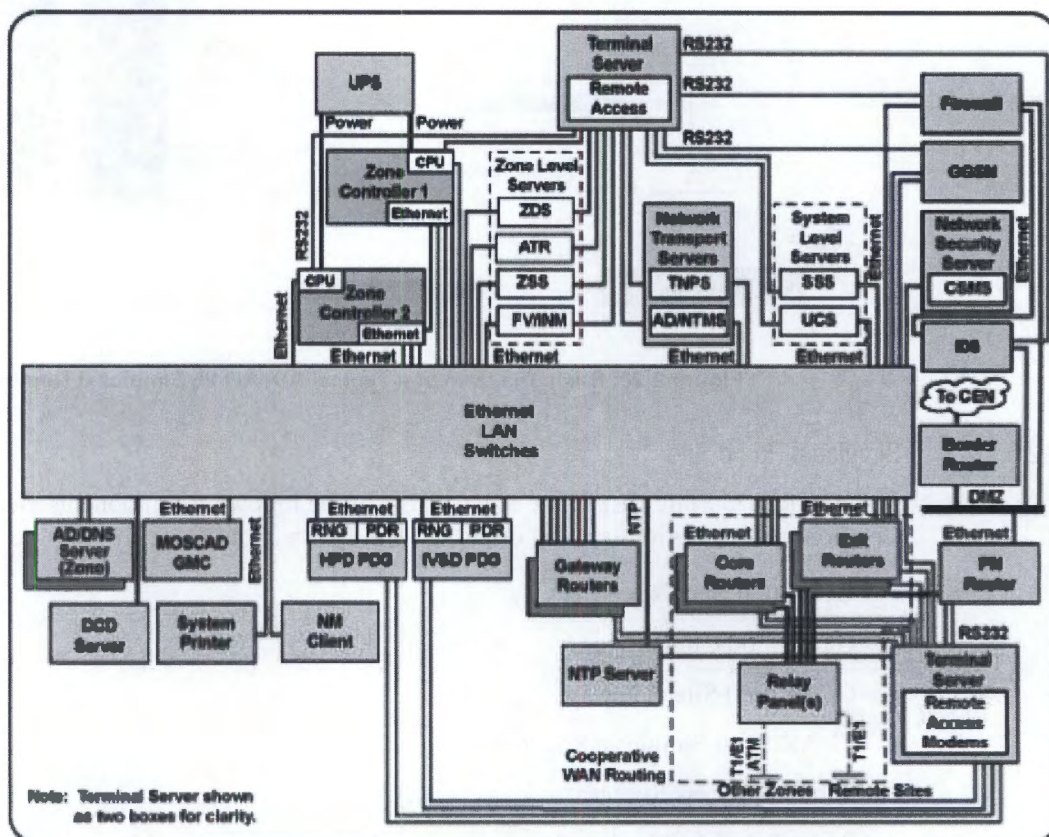


Figure 2-21: Master Site with HPD Overlay.

2.6.3.1 HPD Remote Site

The HPD Remote sites provide the RF interface for the mobile data subscribers. Each remote site is connected to the Master site through a T1 (or fractional T1, FT1) WAN/CWR connection (please refer to the figure below). An optional redundant link configuration is also available, which allows two T1/FT1 WAN or CWR connections to the Master site. These links transport traffic for system control, network management, and HPD traffic between the Remote and Master sites. A Remote site can also be collocated with the Master site equipment.



Each HPD Remote site includes a site controller with redundant modules, which locally manages the channels and MSUs that are active at the site. Up to five HPD base radios may be installed at each HPD Remote site to provide the physical RF channels for HPD traffic. See Figure 2-22.

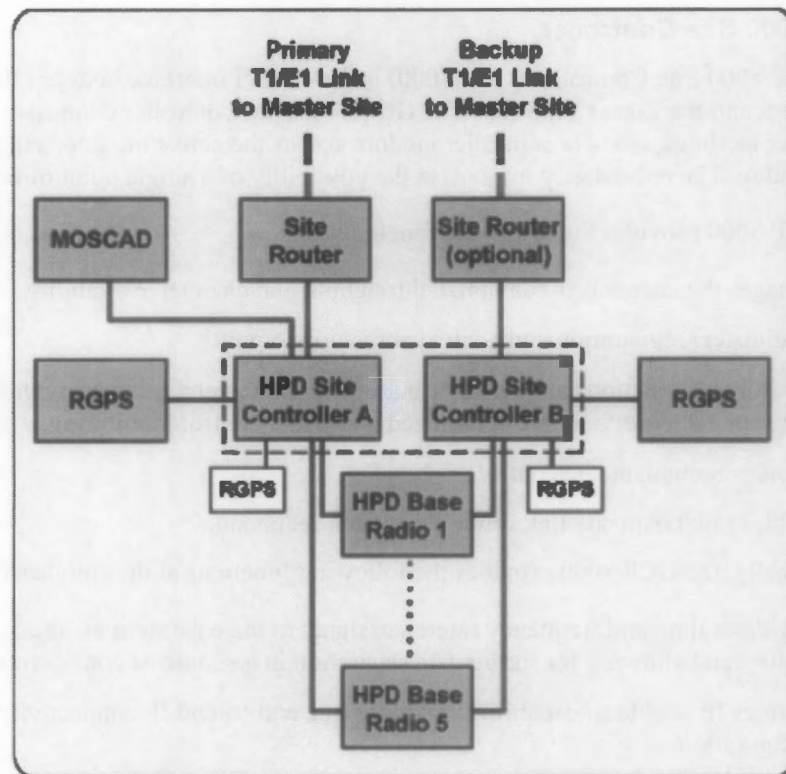


Figure 2-22: HPD Remote Site.

The HPD remote site includes the following components:

- Site router
- Site controller with redundant modules
- Up to five base radios
- MOSCAD (optional)

A number of site controller and base radio hardware configurations are available for the HPD Remote site. The actual configuration selected may depend on the number of channels being supported or the type of RF distribution being used at the site:

- GCP 8000 site controller
- GTR 8000 base radio
- GTR 8000 site subsystem

The GTR 8000 base radio and GCP 8000 site controller (with redundant modules) are standalone components.

2.6.4 ASTRO 25 Component Descriptions

Each site type in an ASTRO 25 system contains various components. Components included in this system design are described in this section.

GCP 8000 Site Controller

The GCP 8000 Site Controller (GCP 8000) is the control interface between the transmitter/receiver subsystem and the Zone Controller. The GCP 8000 Site Controller comprises redundant site controller modules; one site controller module acts as the active module, and the second module acts as a standby. The redundancy minimizes the possibility of a single point of failure at the site.

The GCP 8000 provides the following functions:

- Manages the channels to maximize throughput and channel availability.
- Administers registration and context activation requests.
- Monitors base stations and RF distribution equipment and interacts with the MOSCAD site device manager to facilitate centralized alarm and control monitoring.
- Provides redundant site control.
- Enables redundant site link routing for patch redundancy.

Additionally, the GCP 8000 provides the following functions at the simulcast site:

- Provides a time and frequency reference signal to the base stations, maximizing frequency stability and allowing for further site separation in a simulcast configuration.
- Provides IP simulcast capability, enabling true end-to-end IP connectivity in a simulcast configuration.

GCM 8000 Comparator

The GCM 8000 Comparator ensures the broadcast of the best possible voice signal by combining the best parts of a single signal that has been received by multiple sites in a Multisite (simulcast) system.

The comparator features a digital voting methodology: Frame Diversity Reception. The comparator selects the data frame or signals with the lowest Bit Error Rate (BER) and forwards it. By using the best pieces of each input signal, the result is the best possible composite signal.

GTR 8000 Site Repeater/Base Radio

The GTR 8000 Base Radio consists of a transceiver module, power amplifier module, fan module, and power supply. The transceiver module includes the functionality for the exciter, receiver, and station control. The base radio software, configuration, and network management, as well as inbound/outbound traffic handling, are performed through this transceiver module. On-board serial and Ethernet ports are located on this module for local servicing via CSS. The power amplifier module amplifies the low-level modulated RF signal from the transceiver module and delivers the amplified signal on the path to the transmit antenna. The power supply module supports the transceiver and power amplifier modules, and can also provide auxiliary power to a connected site controller or Receive Multicoupler/Low Noise Amplifier (RMC/LNA).

Radio Frequency Distribution System

The Radio Frequency Distribution System (RFDS) provides interconnect between the base radios and antennas, allowing for a completely contained and more compact installation footprint. For the transmitters, this can include isolators, combiners, TX filters, diplexers, and power monitors.



For the receivers, this can include duplexers, site preselectors, and multicouplers. Various RFDS options exist for each of the GTR 8000 Base Radio.

RF Site Gateway

The Site Gateway provides an interface that handles all of the IP Network Management traffic between the Core Site and the RF Site. The Site Gateway provides the following:

- Media conversion – the gateway converts Ethernet to the selected transport medium.
- Traffic prioritization – the gateway applies a prioritization marking to the packets leaving the site.
- Fragmentation – the gateway fragments large IP packets per industry standards.
- Site LAN Switch.

The site LAN Switch provides a LAN interface for site equipment and a LAN port for the site gateway. Through the switch, the service technicians gain access to service the site, and also access the system's Graphical User Interface (GUI).

TRAK 9100 Simulcast Site Reference

The TRAK 9100 Simulcast Site Reference is a GPS-based frequency and time reference. The TRAK frequency reference provides the simulcast system 1 PPS (Pulse per Second), 5 MPPS, and 1 PPS + 5 MPPS composite signals. These signals are used to synchronize the transmission of a simulcast system to improve overall performance and coverage.

This unit provides a high-level redundancy, including redundant GPS receivers, backup rubidium standard, and redundant power supplies.

Sub-Site Access Routers

The sub-site access routers, located at the prime site, provide the IP network routing interfaces between the prime site and all of the sub-sites. In the single sub-site link configuration, two sub-site access routers are deployed in a cooperative WAN routing arrangement for T1/E1 subsystems. In the dual sub-site link configuration, two sub-site access routers each serve as the endpoint for one of the sub-site's WAN links. The sub-site access routers support T1, FT1, E1, FE1 and Ethernet sub-site links.

Note that the total number of access routers utilized at a trunking IP multi-site subsystem depends on the number of sub-sites. IP multi-site subsystems with 15 or less sub-sites require two access routers. Subsystems with more than 15 sub-sites, however, require two access router pairs (i.e., four access routers) where each access router pair can support up to 16 sub-sites.

Prime Site Ethernet Switches

Two paired Ethernet switches form the prime site LAN in an IP multi-site subsystem. They are paired for redundancy so if one of them fails, half of the hosts (site controllers, comparators) on the LAN are still connected to a working Ethernet switch. In addition to these switches, a third Ethernet switch is required for IP multi-site subsystems equipped with more than 15 sub-sites. For this configuration, all four access routers will have their LAN 2 ports connected to the third Ethernet LAN switch (crossover Ethernet cable is no longer utilized). It should be noted that although the third switch provides additional available ports, these ports should not be utilized for devices affecting critical services (e.g., comparators).

Customers may choose to improve resource availability further via the “Simulcast Prime Site High Availability” feature. This feature replaces the standard two LAN switch configuration (three switches for more than 15 sub-sites) at the simulcast prime site with four LAN switches set up in a mesh configuration. When the same site resources are spread across four LAN switches, the failure of a single switch will remove fewer resources hence improving the general availability of resources as well as improving the likelihood of preserving redundancy. Note, for subsystems with greater than 15 sub-sites, all four access routers will utilize the fourth switch for their LAN 2 connections.

In a single prime site link configuration, there is a single prime site router which is attached to one of the Ethernet switches. The entire subsystem is therefore, dependent on this Ethernet switch for its connection to the master site.

In a dual prime site link configuration, there are two prime site routers, each of which is attached to a different prime site LAN switch. This ensures that if either switch fails, there is still a path to a prime site router for connectivity to the master site.

Sub-Site Ethernet Switches – Non-Dual LAN Remote Sub-Site

There may be either one or two Ethernet switches at the sub-site to form the sub-site LAN. In a single sub-site link configuration, only one switch is used unless a second switch is needed to provide enough port capacity for all of the hosts at the sub-site. In a dual sub-site link configuration, two switches are used so that there is no single point of failure for the sub-site’s entire IP network.



TRAINING

3.1 OVERVIEW

Motorola Solutions understands that the successful implementation and use of your communications system depends on effective training. We have developed a training proposal for Pinellas County to ensure a comprehensive understanding of your proposed system and all user equipment. We are leveraging over 75 years of training experience working with customers just like you to provide recommendations for your consideration. The training proposal detailed in the following pages incorporates customer feedback coupled with a best practices systematic approach to produce effective course delivery and content.

Our commitment to Pinellas County is to provide unsurpassed services that ensure the equipment operates efficiently for the life of the system, and in doing so, directly train your personnel to acquire a level of knowledge to utilize the system at its maximum potential.

Pinellas County personnel will gain in-depth understanding of the power of your new system through education and proficient daily use. Our high-quality training focuses attention on student needs. Training is complemented by our detailed documentation and available continuing education program.

We will collaborate with Pinellas County to develop a final customized training plan that fits your needs and assures that System Administrators, Maintenance Technicians and End Users are skilled in using your new system.



3.2 TRAINING APPROACH

Our training solution delivers a combination of online training and field based instructor led training at Pinellas County locations using the operational equipment and classrooms. Motorola Solutions will employ knowledgeable and experienced instructors, well-designed courseware and integrated lab activities.

Training is based upon several key criteria:

- Course design is driven by an analysis of student needs and focuses on how-to rather than theory.
- Learning objectives are based upon what students need to accomplish on the job and focus on specific applications or components.
- Hands-on lab opportunities using Pinellas County specific job aids are incorporated into training to maximize the transfer of skills and the retention/reuse of information.

Our instructors bring invaluable experience and first-hand knowledge of public safety systems into their training approach. This experience and knowledge provides them a better understanding of and insight into the practical aspects of the role of Pinellas County Managers, Technicians and End Users. Each has a proven ability to communicate with novice as well as expert personnel.





3.3 COURSES PROPOSED


Motorola Solutions has identified the following course(s) that are necessary to achieve the training goals for Pinellas County. Course description files for the recommended courses are provided in the matrix below and/or in the training appendix. Class delivery for instructor-led courses in the field will be tailored for your system and features.

Specifically, our proposed training plan addresses the following categories as identified in your request for proposal:



- Radio System Administrator Upgrade Training
- Console Operator Upgrade Training

It is recommended that students bring their laptop computers for all System Administrator and Technician classes.

System Administrator						
Course	Target Audience	No. of Sessions	Duration (days)	Location	Date	No. of Attendees
ASTRO 25 IV&D 7.13/7.14 Trunking with M Core System Overview Part 1 of 3 (Self-Paced/Online)	System Managers	NA	6 hrs	Online	Prior to Part 2	Up to 12
Course Synopsis: The ASTRO 25 Integrated Voice and Data System Overview course is intended to provide an overview of the ASTRO 25 System in order to familiarize the various audiences with the overall system capabilities, components, features, and benefits.						 ASTRO 25 IV&D Trunking with M C
ASTRO 25 IV&D 7.13/7.14 Introduction to Radio System Management Applications Part 2 of 3 (Self-Paced/Online)	System Managers	NA	6 hrs	Online	Prior to Part 3	Up to 12
Course Synopsis: virtual, interactive course provides a high-level overview of the Motorola Radio System management applications through recorded demonstrations of common system tasks.						 ASTRO 25 IV&D Introduction to Ra

System Administrator						
Tailored New Features Introduction for ASTRO® 25 IV&D Systems: PM and CSA Part 3 of 3 (Instructor Led)	System Managers	1	2 days	Largo, FL	Right after the upgrade	Up to 12
Course Synopsis: This course describes the new features introduced in the ASTRO® 25 7.13 system release. Major features introduced in the system release include Provisioning Manager (PM) and Common Server Architecture (CSA). High-level descriptions of additional system features are also covered.						 ASTRO_New Features Introduc



End User Training						
Course	Target Audience	No. of Sessions	Duration (days)	Location	Date	No. of Attendees
MCC 7500 Console Admin/Operator Upgrade Differences Train-the-Trainers (Instructor-led) 4 training consoles (2x1 Ratio)	Dispatch Supervisors and Trainers	1 (8 hr session)	1	Largo, FL	Prior to Cut-over	Up to 4
Course Synopsis: This course provides participants with an introduction to the dispatch console, its basic operation and tailored job aids which will be available for assistance in operation. Through facilitation and hands-on activities, the user learns how to perform common tasks associated with the console operation.						 MCC7500 Operator.DOC
Course Synopsis: This course provides participants with the knowledge and skills to manage and utilize the MCC 7500 console administrator functions. Through facilitation and hands-on activities, the participant learns how to customize the console screens.						 MCC7500 Admin and Operator.DOC



3.4 ASTRO 25 IV&D TRUNKING WITH M CORE SYSTEM OVERVIEW

Duration

4 hours

Delivery Method

Online Self-paced

Course Overview

The ASTRO 25 with M Core Overview self-paced course is the starting point of all ASTRO 25 with M Core systems. In order to take other classes, students are required to complete this course and obtain a passing score in the corresponding test. It presents a high-level description of the system's call flow capabilities, components, features and benefits.

Audience

System Managers, Technical System Managers, System Technicians and other Application Users

Course Objectives

- List and describe the ASTRO 25 with M Core system features and capabilities.
- Describe the ASTRO 25 with M Core system sites and their components.
- Describe in detail the paths used for control, voice, and data in an ASTRO 25 with M Core.
- List the servers and databases used in an ASTRO 25 with M Core.

Prerequisites

Completion of the following courses or equivalent experience:

- Bridging the Knowledge Gap – Technicians (ACT100-E)
- Networking Essentials in Communication Equipment (NST762)
- Advanced Networking in Motorola Communications Equipment (NWT003)



Course Outline

I. Multiple Zone Trunking

A. Definitions

- a. Master Site
- b. Zone Core
- c. Zone
- d. Site

B. Site Statuses

- a. Wide Area Trunking: InterZone
- b. Wide Area Trunking: Intrazone
- c. Site Trunking
- d. Failsoft

C. Information Types

- a. Control
- b. Voice
- c. 9600 bps Data
- d. High Performance Data
- e. Network Management

D. GTR 8000 Expandable Site

- a. GTR 8000 Expandable Site Subsystem
- b. GTR 8000 Repeater Site
- c. HPD Overlay
- d. GTR 8000 Repeater Site Switch Redundancy
- e. GTR 8000 Repeater Site Gateway Redundancy

E. IP Simulcast Subsystem

- a. Basic Simulcast Concepts
- b. Prime Site
- c. Information Paths
- d. Timing

F. Console Site

- a. Dispatch Consoles
- b. Recording Equipment
- c. Console Site Configurations

G. Conventional Channel Support

- a. Conventional in a Colocated Console Site
- b. Conventional in a GTR 8000 Repeater Site
- c. Conventional in an IP Simulcast Remote Site
- d. Coexistence with a 3.1 System
- e. Conventional Only Remote Site



H. Zone Core

- a. LAN Switch
- b. Zone Controller
- c. Core Router
- d. Relay Panel
- e. Exit Router
- f. Subnets
- g. Subnets for Consoles
- h. Gateway Routers
- i. Scalability

I. System Features

- a. Flexible Site and Interzone Links
- b. Channel Partitioning
- c. Other Band Trunking
- d. Dynamic Dual Mode
- e. Fire Station Alerting
- f. Telephone Interconnect
- g. Digital Mutual Aid
- h. SmartX Site Converter
- i. ISSI.1 Network Gateway
- j. Dynamic System Resilience
- k. Radio Authentication

II. Voice Processing

A. Turning on the Radio

- a. Finding the Control Channel
- b. Affiliation & Registration

B. Making a Call

- a. Channel Request
- b. Authorizing the Call
- c. Assignment of Resources
- d. Busy Queue
- e. Call in Progress
- f. Finishing the Call

C. Information Paths

- a. Control Path
- b. Voice Path
- c. Connectivity vs. Routing
- d. Routing Failure Scenarios



III. Data Processing

- A. Common Uses of 9600 bps Data
- B. Elements of 9600 bps Data Path
- C. Signal Flow of 9600 bps Data
- D. Elements of HPD Data Path
- E. Signal Flow of HPD Data

IV. Mobility Management

- A. Affiliation and Registration
 - a. Valid Sites for an Individual
 - b. Valid Sites for a Talkgroup
 - c. Site Access Denial Type
 - d. Dynamic Site Assignment
 - e. Continuous Assignment Updating
 - f. Deregistration
- B. Roaming
 - a. Adjacent Sites
 - b. RSSI Threshold
 - c. Preferred Site
 - d. Always Preferred Site
 - e. Least Preferred Site
- C. Out of Range
 - a. Inbound and Outbound Coverage
 - b. Balanced Coverage
 - c. Out of Range Indications
- D. Scan
 - a. Priorities in Scan
 - b. Requested Site

V. Servers and Databases

- A. Servers
- B. System Level Servers
- C. Zone Level Servers
- D. Databases
- E. Zone Controller Databases
- F. Backup and Restore
 - a. Description
 - b. BAR Architecture
 - c. BAR Clients



3.5 ASTRO 25 IV&D INTRODUCTION TO RADIO SYSTEM MANAGEMENT APPLICATIONS

ACS713201

Delivery Method

OLT = Online Training

Duration

10 hours

Target Audience

System Managers, Technical System Managers, System Technicians, and other Application Users.

Course Overview

This virtual, interactive course provides a high-level overview of the Motorola Radio System Management applications through recorded demonstrations of common system tasks.

Prerequisites

Completion of the following courses or equivalent knowledge:

- Bridging the Knowledge Gap – Technicians (ACT100)

Required:

Take one of the following depending on system supporting:

- ASTRO 25 IV&D with M Core System Overview (ACS713200)
- ASTRO 25 IV&D Conventional with M Core Overview (ACS713420)
- ASTRO 25 IV&D with L Core System Overview (ACS713430)



3.6 LEARNING OUTCOMES

After completing the course the participant will be able to:

- Describe the purpose of Network Management applications used in an ASTRO system
- Identify high-level capabilities of those Network Administrator applications
- Familiarize with common operations allowed by those Network Administrator applications

3.6.1 Course Modules

Module 1:

- System Profile
- Zone Profile
- ZoneWatch
- ATIA Log Viewer

Module 2:

- Unified Event Manager (UEM)
- Affiliation Display

Module 3:

- Radio Control Manager (RCM)
- Reports

Module 4:

- Provisioning Manager

Module 5:

- EMC Ionix Network Configuration Manager



3.7 NEW FEATURES INTRODUCTION FOR ASTRO 25 IV&D SYSTEMS –

PM and CSA

Delivery Method

VILT (Online/Instructor Led)

Duration

10 hours / 2 hrs per day over 5 days

Class size

Maximum of 12

Target Audience

System Administrators

System Technicians

Field Technicians

Application Users

Course Description

This course describes the new features introduced in the ASTRO® 25 7.13 system release. Major features introduced in the system release include Provisioning Manager (PM) and Common Server Architecture (CSA). High-level descriptions of additional system features are also covered.

Prerequisite:

Completion of the ASTRO 7.9 or 7.11 Radio System Administrator Workshop and the ASTRO 7.13 online overviews below:

- ACS713200-E – System Overview for ASTRO 25 IV&D with M Core
- ACS713201-E – ASTRO 25 IV&D Introduction to Radio System Management Applications



3.8 LEARNING OUTCOMES:

By the end of the course, you will be able to:

- Describe the functionalities of Provisioning Manager (PM)
- Describe the function of Common Server Architecture (CSA)

Course Modules

1. Provisioning Manager
 - a. Description
 - b. Feature and Functions
 - c. Installation
 - d. Configuration
 - i. Logging on to the Provisioning Manager
 - ii. Customer User Interface
 - iii. Configuration Objects Overview
 - iv. Common Operating Procedures
 - v. Creating and Administering Applications Users and Accounts
 - vi. Creating Talk Group, Multi-group, Agency Group and Foreign Group Records
 - vii. Attaching Talkgroups to Users
 - viii. Logging Out
 - e. Operation
 - f. Troubleshooting
2. Common Server Architecture (CSA)
 - a. Master Site Description
 - i. L1/L2 Zone Core CSA
 - ii. M1/M2 Zone Core CSA
 - iii. M3 Zone Core CSA
 - b. Master Site Installation
 - i. M1 Zone Core Racking – CSA
 - ii. M1 Zone core Installation Process
 - iii. M2 Zone Core Racking – CSA
 - iv. M2 Zone core Installation Process
 - v. M3 Zone Core Racking – CSA
 - vi. M3 Zone core Installation Process
 - c. Master Site Configuration
 - d. Master Site Optimization



- e. Master site Operation
- 3. Other features in the ASTRO 25 7.13 Release
 - a. High-Level Descriptions



3.9 MCC 7500 OPERATOR

Duration

4 hours

Delivery Method

Instructor-led

Target Audience

Dispatch Console Operators, Supervisors, System Administrators, and Support Personnel

Course Synopsis

This course provides participants with an introduction to the dispatch console, its basic operation and tailored job aids which will be available for assistance in operation. Through facilitation and hands-on activities, the user learns how to perform common tasks associated with the console operation.

Course Objectives

- Perform basic operational tasks of the dispatch console
- Utilize the provided job aids to perform specific tasks associated with the console
- Understand a high level view of the system configuration
- High-level overview of the customer system configuration
- General console operation
- Proper operating procedures for specific customer features

Recommended Prerequisites

None



Key Topics

- Overview
- Communicating with Radios
- Advanced Signaling Features
- Resource Groups
- Working with Configurations
- Working with Aux IOs
- Troubleshooting



3.10 MCC 7500 ADMIN. AND OPERATOR

Duration

4 hours Operator, plus

4 hours Admin

Delivery Method

Instructor-led

Target Audience

Dispatch Supervisors, System Administrators

Course Synopsis

This course provides participants with the knowledge and skills to manage and utilize the MCC 7500 console administrator functions. Through facilitation and hands-on activities, the participant learns how to customize the console screens.

Course Objectives

- Understand the menu items and tool bar icons
- Edit folders, multiselect/patch groups, auxiliary input output groups, windows and toolbars
- Add/delete folders

Recommended Prerequisites

None

Key Topics

- Introduction
- Configurations
- Folders and Resource Setup
- Customizing Folders
- Auto Starting the MCC 7500 Dispatch Console
- Editing Preferences
- Configuring the Toolbar
- Setting Up Aux IOs
- Resource Groups



WARRANTY

4.1 INTRODUCTION

4.1.1 Overview

Motorola has over 75 years of experience supporting mission critical communications for public safety and public service agencies. Motorola's Support Services ensure peak network and operational performance by offering a diverse portfolio of scalable support services. Motorola has an extensive service organization to provide local, trained, and qualified service personnel to manage your communications network. Motorola's Support Services focuses on performance, both technological and operational, to maximize the efficiency and security of your communications network. These services can help increase both the availability and the operating efficiency of your network, while effectively managing costs and ensuring the safety of your employees and the citizens they protect.

4.2 WARRANTY YEAR SUPPORT

4.2.1 Technical Support

Motorola Technical Support service provides an additional layer of support through centralized, telephone consultation for issues that require a high level of communications network expertise and troubleshooting capabilities. Technical Support is delivered by the SSC and is staffed 24 hours per day, 365 days a year. The SSC is staffed with trained, skilled technologists specializing in the diagnosis and swift resolution of network performance issues. These technologists have access to a solutions database as well as in house test labs and development engineers. Technical Support cases are continuously monitored against stringent inbound call management and case management standards to ensure rapid and consistent issue resolution.

Technical Support service translates into measurable, customer-specific metrics for assured network performance and system availability.

4.2.2 Premiere On-Site Infrastructure Response

On-Site Infrastructure Response provides local, trained and qualified technicians who arrive on location to diagnose and restore the communications network. The field technician performs first level troubleshooting, provides information regarding the system condition, removes any failed components for repair, and reinstalls new or reconditioned components. If the technician is unable to resolve the issue, the case is escalated to the SSC or product engineering teams as needed.



4.2.3 Infrastructure Repair with Advanced Replacement

Infrastructure Repair with our Advanced Replacement upgrade supplements your spares inventory with Motorola's centralized inventory of critical equipment. In advance of Motorola repairing the malfunctioning unit, a replacement unit is sent to you within 24 hours to ensure a spare unit is available. Upon receipt of the malfunctioning unit, Motorola repairs the unit and replace it in our centralized inventory.



EQUIPMENT LIST

7.9 to 7.13 Upgrade: List Price: \$2,009,482 Sale Price: \$1,173,499

- One (1) Master Site Configuration Upgrade
- Three (3) PDG Upgrades
- Five (5) NM Client Upgrades
- Nine (9) KVL3000 Plus Upgrades
- Sixty-nine 69 MCC7500 Dispatch Console Upgrades
- Ten (10) MCC7500 AIS Upgrades
- Twelve (12) MCC7500 SDM3000 Aux_IO Upgrades
- Twelve (12) MCC7500 Conventional Site Controller Upgrades
- Eight (8) GCP8000 Site Controller Upgrades
- 361 GTR8000 Simulcast BR Upgrades
- Fifty-six (56) GCM8000 Upgrades
- Eight (8) GCP8000 HPD Site Controller Upgrades
- Eleven (11) GTR8000 HPD BR Upgrades
- Three (3) MOSCAD Client Upgrades
- 100 SDM3000 Upgrades
- Nine (9) NICE Inform Upgrades
- Eighty-four (84) FSA4000 Upgrades
- 3000 Subscriber Refresh Flashes

7.13 to 7.14 Upgrade: List Price: \$3,519,112 Sale Price: \$1,254,695

- One (1) Master Site Configuration Upgrade
- Three (3) PDG Upgrades
- Five (5) NM Client Upgrades
- Nine (9) KVL3000 Plus Upgrades
- Sixty-nine 69 MCC7500 Dispatch Console Upgrades
- Ten (10) MCC7500 AIS Upgrades
- Twelve (12) MCC7500 SDM3000 Aux_IO Upgrades
- Twelve (12) MCC7500 Conventional Site Controller Upgrades
- Eight (8) GCP8000 Site Controller Upgrades
- 361 GTR8000 Simulcast BR Upgrades
- Fifty-six (56) GCM8000 Upgrades
- Eight (8) GCP8000 HPD Site Controller Upgrades
- Eleven (11) GTR8000 HPD BR Upgrades
- Three (3) MOSCAD Client Upgrades
- 100 SDM3000 Upgrades
- Nine (9) NICE Inform Upgrades
- Eighty-four (84) FSA4000 Upgrades

Dynamic System Resilience (DSR) Upgrade List Price: \$487,345 Sale Price: \$414,243

Ridgecrest (RC) Site:

- One (1) Master Site DSR Configuration Upgrade
- One (1) Astro 25 High Availability Trunked Integrated Data and HPD Upgrade.
- One (1) Radio Authentication Upgrade
- One (1) A1 Message Only Upgrade
- One (1) Unified Network Services Upgrade
- Two (2) SSG140 Firewall upgrades
- One (1) HP3800 High Tier Core Lan Switch
- One (1) KVL4000 Key Loader and cables
- One (1) GGM8000 Gateway Router
- One (1) SRC 7500 Switching Routing Center Upgrade
- One (1) Set of DSR Master Site Spares
- One (1) MNI Proteus Microwave link Ethernet Upgrade

Pinellas County Public Safety Complex: List Price: \$1,190,612 Sale Price: \$1,012,020

- Communications Shelter Upgrade Consisting of:
 - Four (4) Bard 6-Ton HVAC Systems
 - One (1) Liebert APM 3-Phase UPS Upgrade from 15 kVA to 90 kVA
 - One (1) Liebert APM 3-Phase UPS 90 kVA
- One (1) Master Site DSR Configuration
- One (1) Astro 25 High Availability Trunked Integrated Data and HPD
- One (1) Radio Authentication
- One (1) A1 Message Only
- One (1) Unified Network Services
- One (10) HP LaserJet Printer
- One (1) NM Client
- One (1) MOSCAD Client
- Two (2) SSG140 Firewall
- Two (2) 2620-24 Ethernet Switches
- One (1) HP3800 High Tier Core Lan Switch
- One (1) Track 9100 Redundant Modular Frequency Timing System
- One (1) KVL4000 Key Loader and cables
- Two (2) GGM8000 Gateway Routers
- One (1) SRC 7500 Switching Routing Center
- One (1) Set of DSR Master Site Spares
- One (1) MNI Proteus Microwave link Ethernet Upgrade
- One (1) APX7500 Control Station
- One (1) Test Antenna with 7/8" Line
- One (1) GenWatch 3 ATIA Upgrade



Geographically Redundant 7.14 MZ Prime Upgrade List Price \$135,000 Sale Price: \$114,750

Ridgecrest (RC) Site:

- One (1) Geographically Redundant Prime Configuration Upgrade
- One (1) 2620-48 Ethernet Switch
- One (1) 2620-24 Ethernet Switch
- Two (2) GGM8000 Gateway Routers

Geographically Redundant 7.14 MZ Prime List Price: \$584,714 Sale Price: \$497,007

Public Safety Complex

- One (1) Geographically Redundant Prime Configuration
- One (1) 2620-48 Ethernet Switch
- One (1) 2620-24 Ethernet Switch
- Two (2) GGM8000 Gateway Routers
- Fourteen (14) GCM 8000 Comparators
- One (1) Prime/Master Track 9100 Redundant Modular Frequency Timing System
- One (1) Set of Prime Site Spares

20 Channel ASR Back Up Site at the PSC List Price: \$1,476,629 Sale Price: \$1,255,135

Pinellas County Public Safety Complex (PSC) Site:

- Two (2) GGM8000 Gateway Routers
- Twenty (20) GTR 8000 800MHz BRs
- Two (2) GCP 8000 Site Controllers
- Two (2) WAV-G 851- 869 Ten (10) Channel Combiners
- Two (2) WAV-G 851- 869 Eight (8) Channel Combiners
- Two (2) Multicouplers with TTA and Test port
- Six (6) BMR 12 Antennas, Accessories, and Line
- One (1) SDM3000 MOSCAD Site

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PRICING

Motorola's has provided pricing to install the Mid-Zone P25 Migration Equipment as detailed within this proposal. The total system price including equipment, installation, system integration, one-year full warranty, and system purchase allowance is:

Description	Price
Equipment	\$9,402,894
Services	\$3,399,508
System Sub-total	\$12,802,402
Less: Purchase Allowance	-\$4,352,552
System Total	\$8,449,850

P25 7.14 software:	\$830,300
SUA II (inclusive of SMA) Software:	\$2,300,100
Order by November 22, 2013 Equipment:	\$622,152
Order by November 22, 2013 Services:	<u>\$600,000</u>
Total Discount:	\$4,352,552

The pricing shown in this document and on the related Work Order is predicated upon the Work Order being approved by the County, signed by appropriate County representative, and delivered to Motorola Solutions Inc. on or before November 22, 2013. If the signed Work Order is delivered to Motorola after November 22, 2013 the pricing and schedules shown are subject to modification by Motorola.

A formal contract is considered in effect upon execution of the Work Order by both Parties.



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OUR COMMITMENT

Motorola products are growing and changing, as they have over the years, and Motorola's drive for excellence has strengthened and intensified. From the five-pound Handie-Talkie™ radio to the lightweight models of today, Motorola has been the leading provider of two-way radio services to public safety, government, transportation, utility, and manufacturing enterprises. Motorola changed the way the world communicates, from the introduction of the DynaTAC cell phone in 1983 to today's sleek handsets and innovative technology for mobile telephone service. It is also a key supplier of integrated systems for automobiles, portable electronic devices, and industrial equipment.

Throughout its history, Motorola has transformed innovative ideas into products that connect people to each other and the world around them. Moving forward, the company strives to keep its commitment of make things better and life easier, to make sound recommendations that will guide you in linking your current and future communication needs and objectives with technology's ever-evolving promise.

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EXHIBIT B

EXHIBIT B

Customer will make payments to Motorola within forty-five (45) days after the date of each invoice, in accordance with Florida state law. Customer will make payments when due in the form of a check, cashier's check, or wire transfer drawn on a U.S. financial institution and in accordance with the following milestones.

25% of the Contract Price upon CDR Completion;

40% of the Contract Price upon Shipment of Equipment;

20% of the Contract Price upon Installation Completion;

10% of the Contract Price upon System Acceptance and Beneficial use; and

5% of the Contract Price upon System Final Acceptance

Motorola reserves the right to make partial shipments of equipment and to request payment upon shipment of such equipment. In addition, Motorola reserves the right to invoice for installations or civil work completed on a site-by-site basis, when applicable.



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