System Release 7.17
ASTRO® 25
INTEGRATED VOICE AND DATA

Vote Scan Feature - Supplement for ASTRO Conventional Systems

NOVEMBER 2016

MN003377A01-A

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Document History

Version	Description	Date
MN003377A01-A	Original release of the *Vote Scan Feature - Supplement for ASTRO Conventional Systems* manual.	November 2016

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About Vote Scan Feature

This document introduces the subscriber vote scan feature and describes how it can be implemented for use on ASTRO® Conventional multicast systems. The intended audiences for this document are the following:

- System managers who need to familiarize themselves with the vote scan feature
- System technicians and administrators who implement or administer this feature on an ASTRO® Conventional System

This guide assumes the user has a thorough understanding of ASTRO® Conventional Systems concepts and topologies, and experience implementing and/or configuring such systems. Courses and documentation that help build this knowledge are listed under *Helpful Background Information* and *Related Information*.

What Is Covered in This Manual?

The guide is organized as follows:

- Conventional Mobility for Vote Scan on page 17 – Provides a basic overview of how mobility needs are addressed in an ASTRO® Conventional system.
- Vote Scan With Multicast System Overview on page 27 – Describes the features, benefits, and use cases for multicast systems that use the subscriber vote scan feature. Use this information to determine if this solution meets your system needs.
- Vote Scan Theory of Operation on page 35 – Presents the theory and concepts underlying the operation of a Vote Scan/multicast system.
- System Design for Vote Scan on page 39 – Details the aspects to consider when designing a Vote Scan/multicast system.
- Configuring the Infrastructure for Vote Scan on page 49 – Offers recommendations for settings that must be programmed into multicast infrastructure equipment to implement the subscriber vote scan feature. Use this chapter as a supplement to the standard infrastructure equipment manuals and the Conventional System Optimization Guide.
- Configuring Subscriber Radios for Vote Scan on page 55 – Offers recommendations for settings that must be programmed into subscriber radios to implement the vote scan feature.

Helpful Background Information

Motorola offers various courses designed to assist in learning about the system. For information, see http://www.motorolasolutions.com/training to view the current course offerings and technology paths.

Vote Scan Related Information

See the following documents for associated information about the radio system.

Related Information	Purpose
Standards and Guidelines for Communication Sites	This may be purchased on CD 9880384V8 by calling the North America Parts Organization at 800-422-4210 (or the international number: 302-444-9842).

Table continued…

Related Information	Purpose
System Documentation Overview	Provides an overview of the ASTRO® 25 new system features, documentation set, technical illustrations, and system-level disaster recovery that support the ASTRO® 25 radio communication system.
Unified Network Configurator	Covers the use of Unified Network Configurator (UNC), a sophisticated network configuration tool that provides controlled and validated configuration management for system devices including routers, LAN switches, site controllers and base radios, and is used to set up sites for the ASTRO®25 system. UNC has two components: Voyence Control and Unified Network Configurator Wizards (UNCW).

Chapter 1

Conventional Mobility for Vote Scan

Conventional mobility is used in conventional communication systems. Mobility is the ability of a subscriber to roam across the boundaries of single-site coverage in a wide-area, multi-site system where multiple RF sites combine to serve a large geographic area.

ASTRO 25 Conventional Radio Systems with Vote Scan

The ASTRO® 25 Conventional System is a digital system portfolio developed by Motorola Solutions offering the following features:

- APCO Project 25 common air interface
- APCO Project 25 compliant Over-the-Air-Rekeying (OTAR)
- Both digital and analog voice capability
- Enhanced digital Improved Multi Band Encoder (IMBE) vocoding
- Expanded signaling capabilities
- 25-kHz and/or 12.5-kHz bandwidth operation
- Integrated Voice and Data (IV&D)
- Centralized key management

The ASTRO® 25 systems can be configured using various topologies depending on your system requirements. The following are some typical configurations:

- Talkaround
- Repeater/base station single site
- Repeater/base station (non-voting)
- Control station
- Wide-area voting
- Simulcast
- Multicast
- Multicast with vote scan

The ASTRO® 25 Conventional portfolio includes voice-only systems, IV&D systems, and IV&D systems with OTAR. The vote scan feature can be implemented on each of these systems as long as the correct configuration is used. Design considerations for these systems are described in System Design for Vote Scan on page 39.

See the ASTRO® 3.1 Conventional System and ASTRO® 25 System documentation sets for more information on these systems, typical topologies, and the features or functionality of each system.

Mobility Considerations and System Design for Vote Scan

Many conventional communication system users require mobility. This requirement includes the ability of a subscriber to roam across the boundaries of single-site coverage in a wide-area, multi-site system where multiple RF sites combine to serve a large geographic area. This user need resulted in various system configurations, and multicast with the vote scan is one of them. Motorola Solutions offers many certified options for conventional roaming, with associated services certified for use on each topology.

NOTICE: Manual roaming implies that the subscriber user must know their location and so must manually change the mode of the subscriber radio. Automatic roaming is transparent to the subscriber user.

Table 1: Motorola Solutions-Certified Conventional Roaming Options with Certified Services

Manual or Automatic Roaming	Topology/Name	Certified Services		
		ASTRO® Voice	ASTRO® Signaling	ASTRO® Data
Manual: The subscriber user selects a mode based on the knowledge of independent site coverage areas.	ASTRO® 3.1 platform; Multiple transmit and multiple receive infrastructure	Yes	Yes	Yes
Automatic: The subscriber user always uses the same mode independent of location.	ASTRO® 3.1 platform; simulcast	Yes	Yes	Yes (uses data site steering for data)
Automatic: The Radio Network Controller (RNC) stores the table with data users' site affiliation.	ASTRO® 3.1 platform; Data Site Steering (used with simulcast voice)	No	No	Yes
Manual: The subscriber user selects a mode based on the knowledge of coverage area.	ASTRO® 3.1 platform; Multicast with manual channel select	Yes	Yes	Yes
Automatic: The subscriber user turns on conventional channel scan to locate a transmitter site, data scan feature required for data.	ASTRO® 3.1 platform; Multicast with conventional scan; data scan allows a single data channel to be added to the voice scan list.	Yes	No	Yes
Automatic: The subscriber radio automatically votes the strongest transmitter site with no user intervention.	ASTRO® 3.1 conventional **Vote Scan System**; Multicast with subscriber vote scan	Yes	Yes	Yes
Automatic: The subscriber radio automatically votes the strongest transmitter site with no user intervention.	ASTRO® 7.x **Vote Scan System**; Multicast with subscriber vote scan	Yes	Yes	Yes

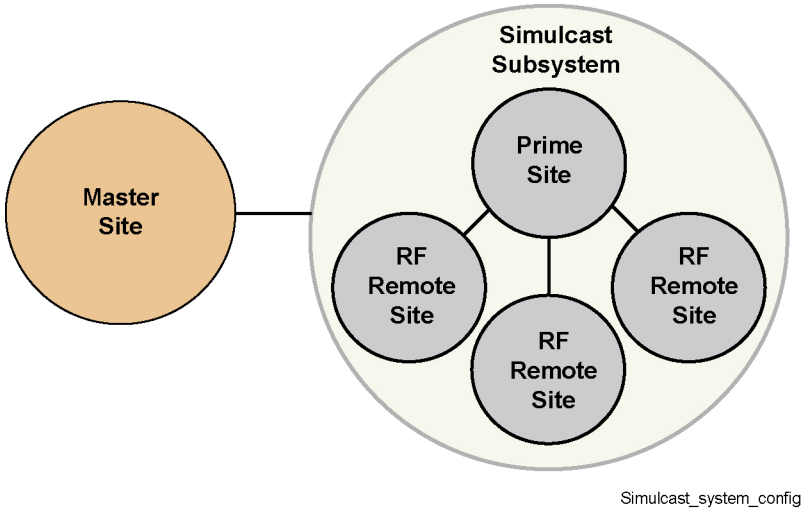
Simulcast System with Vote Scan

Simulcast system design uses multiple transmitter and receiver sites to extend the coverage area. Each site uses repeaters with identical frequencies. Because these sites are all linked, whenever a

user transmits a signal at any one site, all sites automatically retransmit the signal simultaneously and the entire coverage area receives the transmitted message.

Seamless roaming can be achieved by using a simulcast system design if the RF site configuration and your budget allow.

Figure 1: Example of a Simulcast System Configuration



If site distances are too great or if your budget does not allow for a simulcast configuration, seamless roaming can be achieved by using a multicast infrastructure and the subscriber vote scan feature.

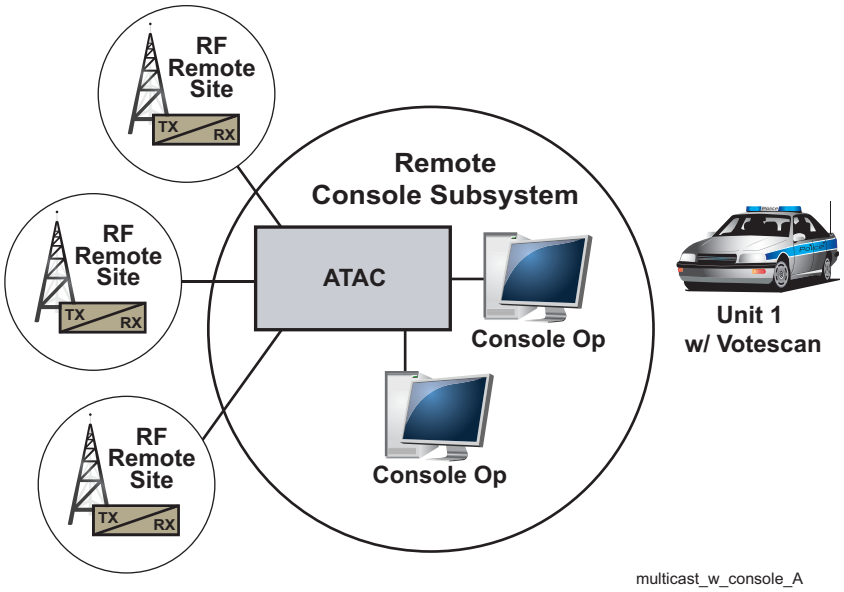
Multicast Systems and Mobility with Vote Scan

Wide-area vote scan systems are designed to improve inbound coverage from subscriber radios by utilizing multiple receivers strategically placed throughout the coverage area. The receivers pick up the radio signal and feed it back to a voting comparator. The comparator then selects the receiver with the best signal quality.

Multicast systems add a transmitter to each receiver site so the repeated and outbound signals are transmitted from multiple transmitters instead of the single transmitter used in the vote scan infrastructure. A multicast system design utilizes multiple, geographically separated RF sites, each transmitting on a different frequency (within the same band) to receiving subscriber radios. Unlike simulcast systems, the transmitters do not require expensive synchronization. Transmitter sites do not need to conform to the same geographic limitations used in a simulcast design. Interference zones are not a concern, unless the frequency reuse plan was poorly designed.

However, multicast system designs are frequency intensive and require subscriber users to manually switch between RF sites as they roam the coverage area.

Figure 2: Example of Multicast Infrastructure



The comparator (which is the single interface point for all transmitters in a multicast system) provides the inbound receiver voting. The comparator is typically situated at a central location and can be co-located with an RF site. Connections are made via an individual site links between each RF site and the comparator site.

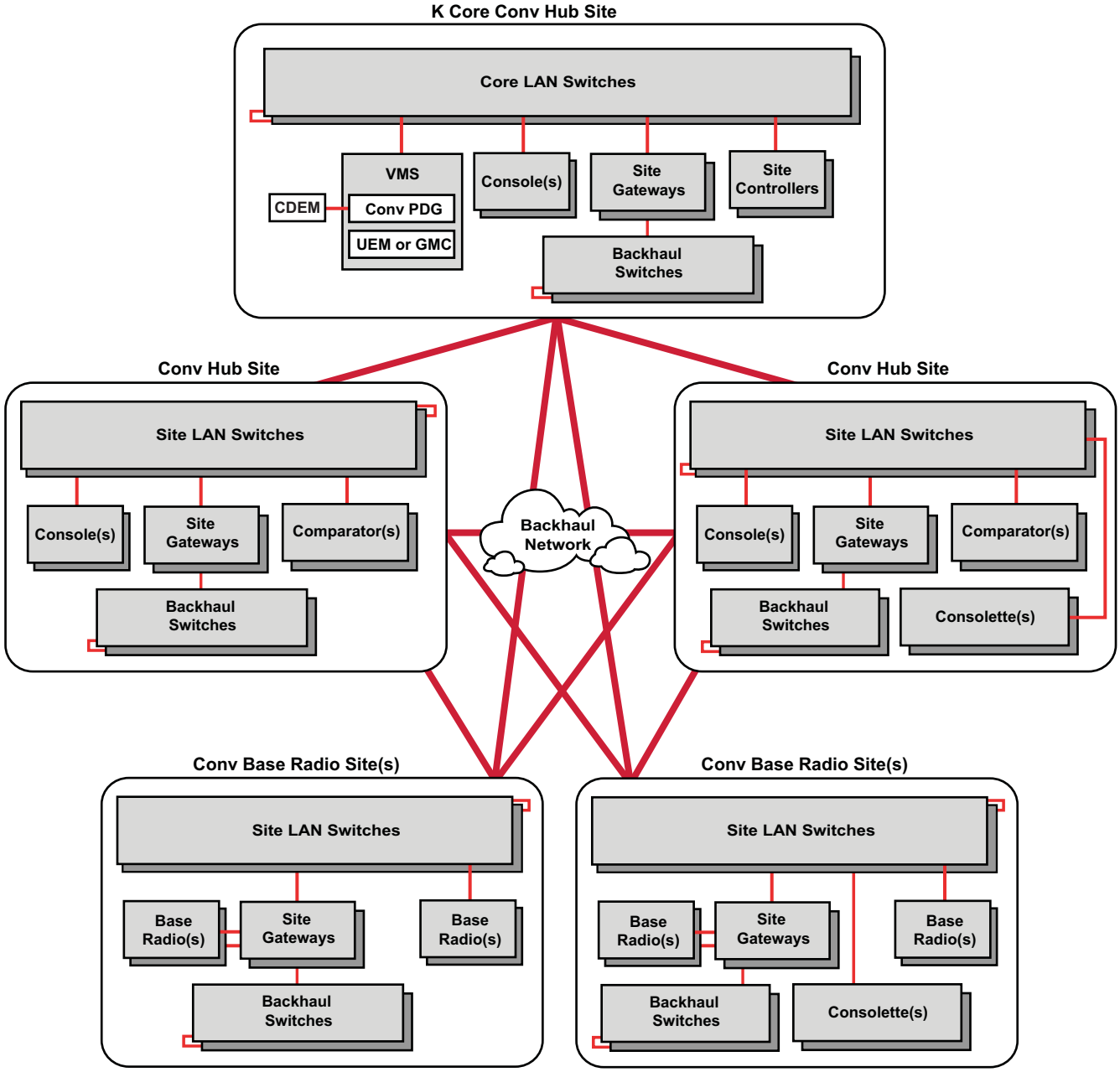
GCM8000 (IP) comparators, used in 7.x systems, and ASTRO-TAC 3000 comparators in their expanded configuration, support up to 64 transmitter sites. Because the same outbound message is multicast from all transmitters, the subscriber radio should receive the outbound message if the mode switch is set to the frequency of an in-range transmitter.

MLC 8000 analog comparators and MLC 8000 subsites link converters may be used to implement P25 or P25/analog vote scan systems.

NOTICE: Analog-only vote scan infrastructure is not supported due to the need for digital signaling between the digital comparator and base station.

A 7.x Conventional Subsystem employing the Distributed Conventional Architecture is supported by the M and K zone cores. Each Conventional Subsystem is made up of Conventional Hub Sites and Conventional Base Radio Sites. IP comparators and MCC 7500 dispatch consoles with VPM reside in the Conventional Hub Site.

Figure 3: Conventional Subsystem Employing the Distributed Conventional Architecture



Note: This high-level system architecture diagram shows a conceptual view of the sites and their relationships. Not all components are shown and connections shown are hypothetical not physical.

K_Core_system_arch_K_core_conv_hub_site_B

Multicast Systems with Vote Scan

When subscriber radios with a conventional channel scan are used in a multicast infrastructure system, seamless wide-area coverage can be attained with lower cost and complexity than with a comparable simulcast design.

The use of the vote scan subscriber feature (instead of a conventional channel scan) enables an improved scan function based on the quality of the received signal.

The vote scan feature automates the frequency-switching process in the subscriber as users move through the coverage area. Users are able to roam freely throughout an area served by multiple RF sites without the need to manually switch from one site to another. Unlike with the conventional scan, the subscriber radio scans frequencies and automatically selects a signal based on signal quality as indicated by the Received Signal Strength Indicator (RSSI).

Figure 4: Example of a Multicast System with Subscriber Vote Scan Implemented in ASTRO 25 3.x Conventional System

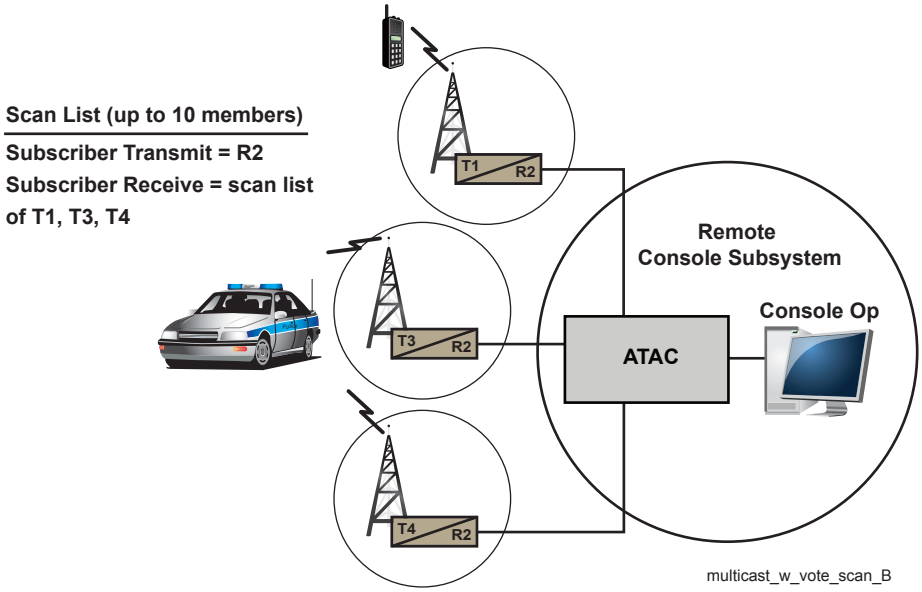


Figure 5: Example of a Multicast System with Subscriber Vote Scan Implemented in ASTRO 25 7.x Conventional System using GCM 8000 and IP Link

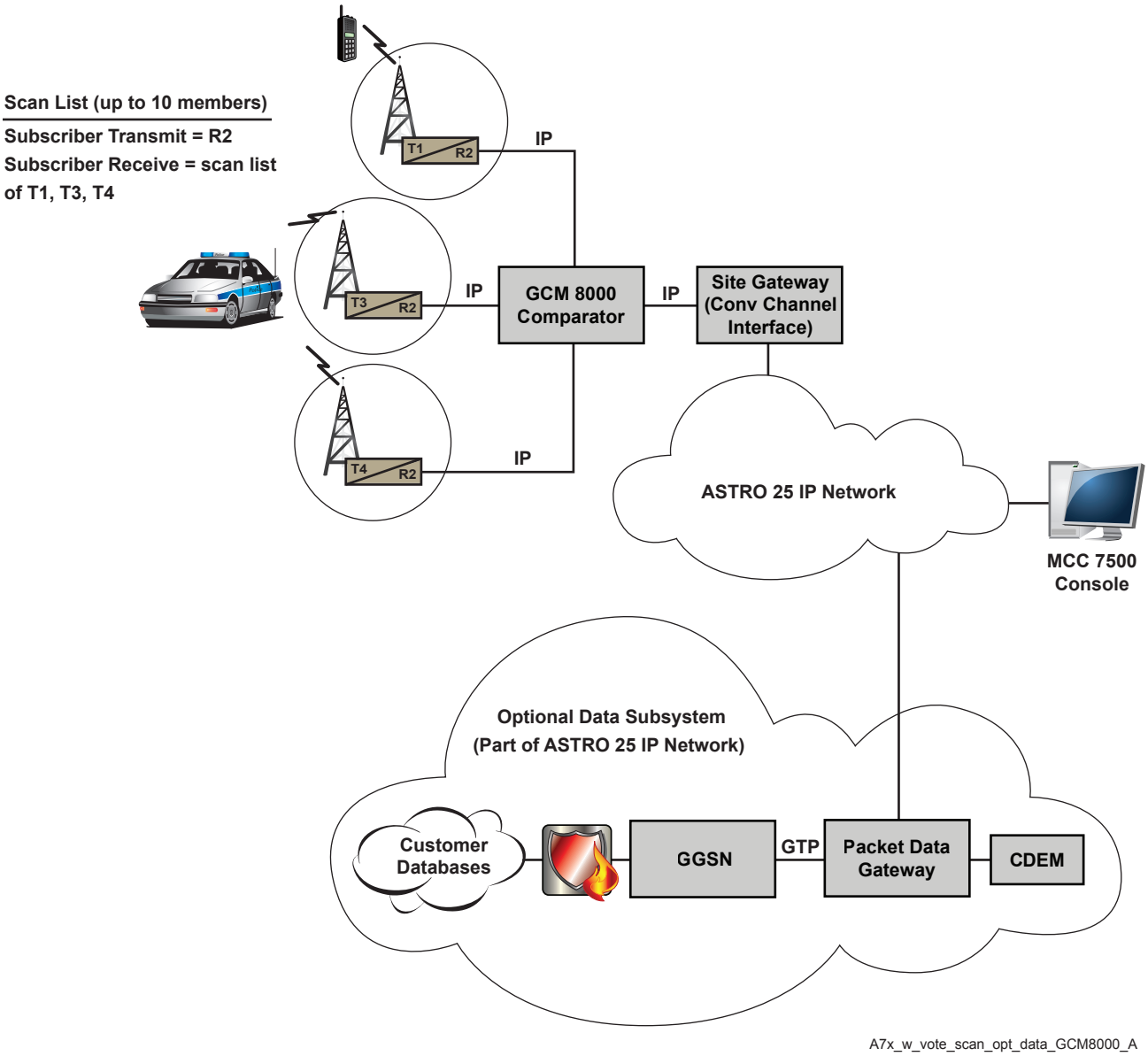


Figure 6: Example of a Multicast System with Subscriber Vote Scan Implemented in ASTRO 25 7.x Conventional System using ASTRO-TAC 3000 and V.24 Link

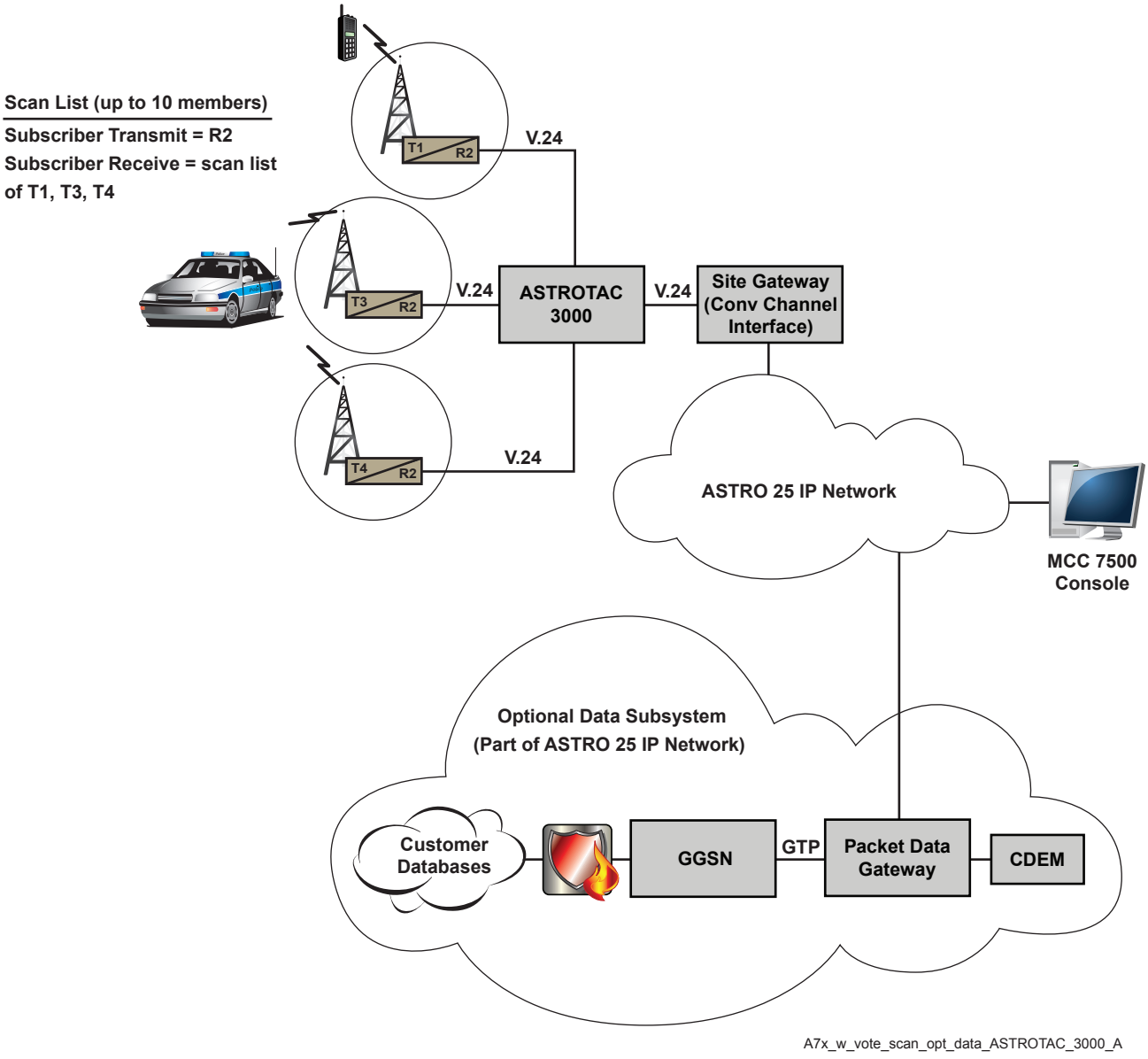
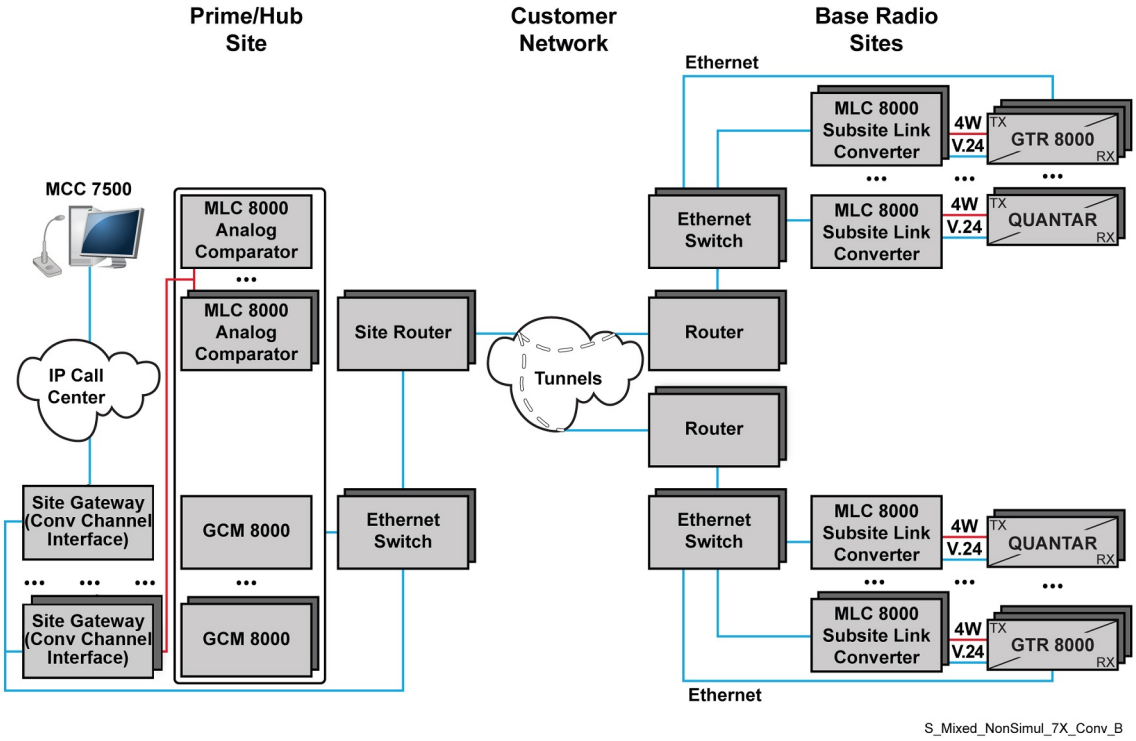


Figure 7: Example of a P25/Analog Multicast System with Subscriber Vote Scan Implemented in ASTRO 25 7.x Conventional System Using GCM 8000/MLC 8000 and IP Links



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Chapter 2

Vote Scan With Multicast System Overview

Multicast systems that use the subscriber vote scan have various uses, for example, when a wide-area coverage or an exclusive use of the channels in the system is required. The use of the vote scan feature also has many benefits, for example, seamless subscriber radio coverage throughout the network or the possibility of frequency reuse.

Vote Scan With Multicast

The term “vote scan” refers to the entire system, that is the use of the subscriber vote scan feature in a specific multicast infrastructure or topology.

Vote scan is a unique implementation of automatic roaming functionality in ASTRO® Conventional Systems. The operation of this feature is analogous to the operation of a comparator used in a voting infrastructure, except that voting is performed in the subscriber.

The multicast infrastructure in a vote scan system is configured such that multiple stations, all linked to a comparator, appear as a single infrastructure channel to the subscriber radio. Base stations are distributed geographically to provide the desired wide-area coverage. Each base station operates on the same receive frequency but on a different transmit frequency. All other transmit parameters are set up to be identical. All stations transmit the same outbound message at the same time but on a different frequency. A standard conventional comparator voting topology is used for the inbound path which enables the “automatic roaming” capability valued by subscriber end users.

ASTRO® Spectra Plus, XTS 5000, XTS 2500, XTL 5000, XTL 2500, and APX radios can be programmed for a vote scan delay when not all stations transmit at the same time (for example, when a link repeater is used for only one of the links). For more information, see the description for *Voting Scan Delay Timer* in Configuring ASTRO Spectra Plus, XTS 5000, XTS 2500, XTL 5000, and XTL 2500 Radios for Vote Scan on page 57. A more detailed discussion regarding vote scan system theory and concepts is provided in Vote Scan Theory of Operation on page 35.

Use Cases for Multicast Systems with Vote Scan

Multicast systems with a vote scan are used in various situations, such as when wide-area coverage or an exclusive use of the channels in the system is needed.

Vote scan is typically implemented under the following conditions:

- Your organization needs wide-area coverage.
- Your organization has access to sufficient frequencies.
- System traffic density is low. That is, a sufficiently low number of calls results in the infrastructure being idle between calls.
- Data usage is low if the system is data-capable.
- The system has exclusive use of the channels.
- Automatic operation is desired. That is, no subscriber user intervention is required to change sites as the subscriber roams.
- Simulcast is not feasible due to budget or system constraints.

Vote Scan Features and Benefits

Vote scan offers many benefits such as seamless subscriber radio coverage throughout the network or the possibility of frequency reuse.

The subscriber vote scan feature offers the following benefits:

- Seamless subscriber radio coverage throughout the network
- Data transfer capability throughout the network area
- User-transparent scan operation
- Alternative to an expensive simulcast systems
- Enabling of frequency reuse
- Compatible with the following subscriber radios:
  - ASTRO® XTS 5000 Portable
  - ASTRO® XTS 2500 Portable
  - ASTRO® XTS 3000 Portable
  - ASTRO® SABER Portable
  - ASTRO® Spectra Mobile
  - ASTRO® XTL 2500 Mobile
  - ASTRO® XTL 5000 Mobile
  - ASTRO® Spectra Plus Mobile
  - APX Series Mobile and Portable

In many scenarios, vote scan can make a significant difference in subscriber communication capabilities.

Table 2: Vote Scan Benefits

Scenario	Operation Without Vote Scan	Operation with Vote Scan
Catastrophic Loss: Catastrophic events result in complete loss of the comparator network.	• Communication is lost during the first critical moments of the event. • User intervention is required to switch to the designated interoperable channel. • Channel management is required – cannot assure communications to and from subscriber radios.	• Repeater stations can be programmed to operate in "local" in-cabinet repeat when comparator links fail. Subscribers can automatically scan to the optimum channel based upon its proximity to a repeater site allowing communications between other users that also scan to the same site. • User intervention is not required. • The feature provides continued communications with other users scanned to the same "local" repeater site. If the subscriber transmit frequency is programmed into the vote scan list, users can also communicate with other users directly when close to each other. (See the

Table continued…

Scenario	Operation Without Vote Scan	Operation with Vote Scan
		Note that follows this table for caveats.) • When the system is restored, subscribers automatically revert back to communications with the network infrastructure • As comparator-to-repeater site links are restored, subscribers automatically begin to vote sites within range. If subscribers are out of range of all sites, or repeater sites have failed, subscriber-to-subscriber radio communications can take place between radios close to each other if the subscriber transmit frequency is programmed into the vote scan list. (See the Note that follows this table for caveats.)
Power Outage: Experienced at one or more RF sites. **NOTICE:** Power outage at a comparator site results in the same operation as described in the Catastrophic Loss scenario.	• Communication is lost temporarily. • User intervention is required to maintain subscriber radio-to-radio communications during an outage. • Channel management is required – cannot assure communications to and from subscriber radios.	• Subscribers still find remaining active repeaters. Communication is maintained (if within the coverage area of other RF sites). • User intervention is not required. • The feature provides uninterrupted communications from non-affected sites. Subscribers within close proximity to each other can communicate directly if the subscriber transmit frequency is programmed into the vote scan list. (See the Note that follows this table for caveats.)
Storm or Hurricane: The RF network becomes inaccessible due to the severe storm, tornado, or hurricane damage.	• Communication is lost when the network goes down. • User intervention is required to maintain radio-to-radio communication during outage. • Channel management is required – cannot assure communications to and from subscriber radios.	• Repeater stations can be programmed to operate in "local" in-cabinet repeat when comparator links fail. Subscribers can automatically scan to the optimum channel based upon its proximity to a repeater site allowing communications between other users that also scan to the same site. Subscribers within close proximity to each other can communicate directly if the subscriber transmit frequency is programmed into the vote scan list. (See the Note that follows this table for caveats.) • User intervention is not required.

Table continued…

Scenario	Operation Without Vote Scan	Operation with Vote Scan
		• The feature provides uninterrupted communications from non-affected sites. Subscribers within close proximity to each other can communicate directly if the subscriber transmit frequency is programmed into the vote scan list. (See the Note that follows this table for caveats.)
Extended Coverage and Seamless Roaming: Users moves out of network coverage (for example, while on the road or in-building) or between coverage areas (for example, between two deployable systems or field offices)	• Communication is lost within and outside the RF network until the user manually changes channels (from network to simplex). • User must correctly identify the correct channel assignment. • Cannot assure communications to and from all subscriber radios.	• Subscribers within close proximity to each other can communicate directly if the subscriber transmit frequency is programmed into the vote scan list. (See the Note that follows this table for caveats.) • User does not have to manually change the channel. • The feature provides subscriber radio-to-radio communication between networks while on the road. • Communications is interrupted unless subscribers within close proximity to each other communicate directly while roaming between systems, that is, if the subscriber transmit frequency is programmed into the vote scan list. (See the Note that follows this table for caveats.) • If a vehicular repeater is used, enables communications to be relayed to and from networks for in-building users.

NOTICE: Benefits of adding the subscriber transmit frequency to the subscriber radios vote scan lists as described above exist, however system designers must be aware of some implications in the context of Vote Scan. Review the information provided in Conventional Scan Compared to Vote Scan on page 30 and Subscriber Vote Scan Feature Operation on page 32.

Conventional Scan Compared to Vote Scan

Vote scan differs significantly from the conventional scan feature. The main difference is that conventional scan unmutes the receiver upon reception of an RF signal with sufficient strength, and vote scan unmutes the receiver with the signal that has the strongest Received Signal Strength Indication (RSSI) value out of all the incoming signals. Conventional scan is typically used to scan multiple systems. It unmutes the receiver based simply upon the reception of an RF signal of sufficient signal strength to overcome the squelch level setting. It is typically used to scan multiple systems.

On the other hand, vote scan typically receives multiple signals simultaneously from the same system infrastructure and unmutes the receiver with the signal that has the strongest RSSI value. If the received signal has a signal strength specified as the acceptable threshold, it uses that signal (if it

meets the appropriate access code qualifications) instead of expending time scanning through the rest of the list.

Table 3: Conventional Scan Compared to Vote Scan

Functionality	Conventional Scan	Vote Scan
Infrastructure restrictions	No restrictions on the infrastructure. The subscriber radio can scan between different systems and/or different channel content.	The infrastructure is restricted to a single system with common payload and parameters. Within the infrastructure, only the stations' transmit frequencies are varied.
Subscriber scan list permissions	The subscriber user has full access and control of the scan feature. Can add or delete channels, set priorities, and others.	The subscriber user cannot access this feature nor modify it.
Subscriber scan indicators	The subscriber radio displays the scanned channel name and an icon confirming that scan is in progress.	Vote scan indicators vary based on the subscriber radio model. When the vote scan is in progress, ASTRO® XTS 3000, ASTRO® SABER, and ASTRO® Spectra radios continue to show the selected personality or PTT-ID. ASTRO® Spectra Plus, XTS 5000, XTS 2500, XTL 5000, XTL 2500 and APX radios display a vote scan icon and the voted channel name. This is the default behavior unless the Display Strongest Channel feature is enabled in the Customer Programming Software (CPS) for the radio. If this feature is enabled, the radio displays the channel on which the call was received.
Talkback channel	The subscriber radios talkback channel can be slaved to a scanned channel. This is useful when the subscriber radio is traveling between systems.	Subscriber radio talkback is always on the same frequency.
Signal selection	When traffic is present on more than one channel, the scanner may select a weak channel.	When traffic is present on more than one channel, the scanner selects a channel based on signal strength.

Table continued…

Functionality	Conventional Scan	Vote Scan
Scanner selection	The subscriber user has some control over the scanner's selection by using user-selectable priorities, nuisance delete, and channel marking. The user turns off the scan by selecting the channel with the desired traffic.	The subscriber user has no control over the scanner's selection. With ASTRO® Spectra, ASTRO® SABER and ASTRO® XTS 3000 radios, if an interfering carrier is present at a high signal strength, the scanner could miss the desired carriers. The user turns scan off by switching to a mode programmed for a specific site.
Scan recommendations for various system operating types	Conventional scan is recommended for ASTRO® voice, but not recommended for ASTRO® signaling. It permits scanning of a data channel on the scan list when data scan parameters are enabled.	Vote scan is recommended for ASTRO® voice and has also been designed to improve performance for ASTRO® signaling and ASTRO® data.

Subscriber Vote Scan Feature Operation

Vote scan selects the carrier with the highest Received Signal Strength Indication (RSSI) value, checks if the signal matches the qualifiers for that channel, and then unmutes the speaker.

The user should find the transceiver with the strongest signal strength in the vote scan list of transceivers. Scanning is stopped and a channel is selected when the carrier is above a given threshold.

As the user moves through the coverage area and selects a personality programmed via the subscriber Radio Service Software (RSS) or Customer Programming Software (CPS) to access the vote scan list, the subscriber radio scans the vote scan list looking for a carrier detect on any of the channels that make up the list. Once a carrier is found, the radio checks all the channels in the scan list for their RSSI value and selects the channel with the best signal strength. When a carrier exceeds the RSSI threshold, the radio stops vote scanning and uses that channel. If no carrier is found above the threshold, the scanner selects the carrier with the greatest signal strength.

Once the carrier is selected, the scanner checks to see if the signal matches the qualifiers programmed in the RSS or CPS for that channel. In most cases, this step is to ensure that the signal has the correct access code, Private Line (PL) or Network Identification (NID) for that channel. If all qualifiers match, the subscriber radio unmutes the speaker with the voice message.

Vote scan is automatically suspended under the following conditions:

- The user selects a personality not programmed to access a vote scan list.
- During any transmit or receive activity for ASTRO® Spectra, ASTRO® SABER and ASTRO® XTS 3000 radios. (Unqualified signals do not suspend qualified receive activity on ASTRO® Spectra Plus, XTS 5000, XTS 2500, XTL 5000, XTL 2500, and APX radios.)

If the vote scan is automatically suspended, it resumes automatically as soon as a transmission is completed.

Vote scan indicators vary based on the subscriber radio model. When the vote scan is in progress, ASTRO® Spectra, ASTRO® SABER and ASTRO® XTS 3000 radios continue to show the selected personality or PTT ID. ASTRO® Spectra Plus, XTS 5000, XTS 2500, XTL 5000, XTL 2500, and APX radios display a vote scan icon and the voted channel name. (This is the default behavior unless the

Display Strongest Channel feature is enabled in the CPS for the radio. If this feature is enabled, the radio displays the channel on which the call was received.)

An advantage of vote scan over other types of scan is that it stops scanning and selects a channel immediately if a carrier is above the desired threshold.

A disadvantage of vote scan is that the user notices a truncation delay for the time the scanner takes to select and qualify the received signal. This delay can be mitigated by configuring the infrastructure and subscriber equipment appropriately. See Truncation Delay Mitigation - Vote Scan on page 43 for details.

Supported Subscriber Functionality — Vote Scan

Vote scan in an ASTRO® Conventional multicast infrastructure supports a range of functionalities for subscriber radios, for example the reception of ASTRO®-encrypted voice calls or the reception of ASTRO® interconnect voice calls.

Subscriber radios in an ASTRO® Conventional multicast infrastructure is capable of using vote scan to accomplish the following:

- Receive ASTRO® clear voice or analog voice calls on a mixed-mode channel.
- Receive digital ASTRO® clear voice calls on a digital ASTRO®-only channel.
- Receive ASTRO® encrypted voice calls.
- Transmit or receive standard signaling capability such as call alert and emergency alarm provided the interaction is through the infrastructure.
- Receive ASTRO® interconnect voice calls.
- Send and receive limited ASTRO® data or Over-The-Air Rekeying (OTAR) messages on channels shared with voice traffic.

NOTICE: For details regarding design considerations, exclusions, and limitations, see System Design for Vote Scan on page 39.

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Chapter 3

Vote Scan Theory of Operation

Theory of operation is the theory and concepts underlying the operation of a multicast system which employs subscriber vote scan.

Multicast Infrastructure with Vote Scan Topology

Multicast topology used with vote scan is the same as that of a voting topology except that the comparator audio is fed to multiple transmitters instead of a single transmitter.

In multicast topology used with vote scan, there is still only a single outbound audio signal from the system, sourced from either the console digital audio output or from the voted output of the comparator. This single outbound signal is routed to transmitters (up to 10 or 11 maximum unique frequencies based on the subscriber radio model) on the comparator ports. Outbound data messages are multicast by the radio network controller to all sites.

A physical link connects the outbound comparator ports with the transmitter sites. Each transmitter is on a different RF frequency to avoid a simulcast design. All transmitters are set up to use the identical access code, a Network Identifier (NID), so each transmitter delivers identical content. Subscribers enable vote scan to automatically select the strongest transmitter site.

Subscriber talk-in is always on a common channel (that is, the same frequency and NID).

NOTICE:
Securenet and analog-only systems are not supported.

Variations to this topology are not supported for vote scan/multicast systems.

Vote scan can also be used with distributed Conventional SUBsystem (CSUB) architectures

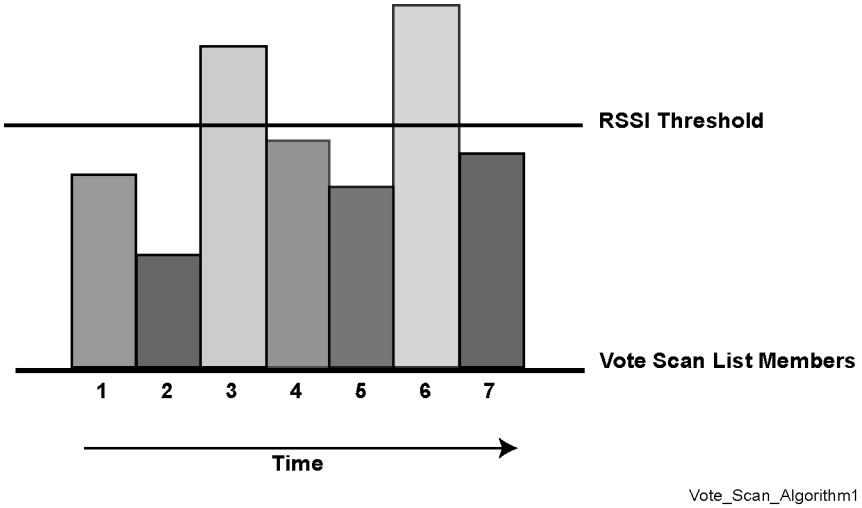
See the illustrations in Multicast Systems with Vote Scan on page 21.

Vote Scan Algorithm

Vote scan operation is based on the strength of received signals as represented by the Received Signal Strength Indicator (RSSI). RSSI is a DC voltage proportional to received signal strength.

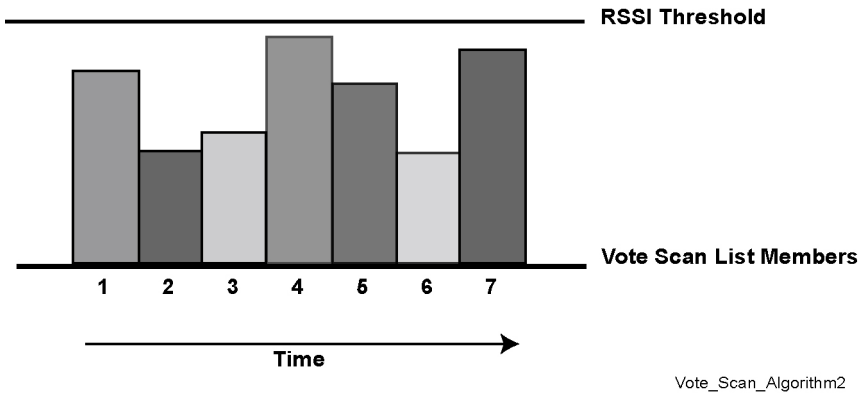
In vote scan operation, when a carrier frequency meets or exceeds RSSI threshold requirements, the subscriber radio locks on to that frequency for the duration of that carrier transmission.

Figure 8: Vote Scan Algorithm with Channel 3 Selected



If none of the frequencies meet the RSSI threshold requirements, the subscriber radio selects the signal with the highest RSSI value within the list for the duration of that carrier transmission.

Figure 9: Vote Scan Algorithm with Channel 4 Selected

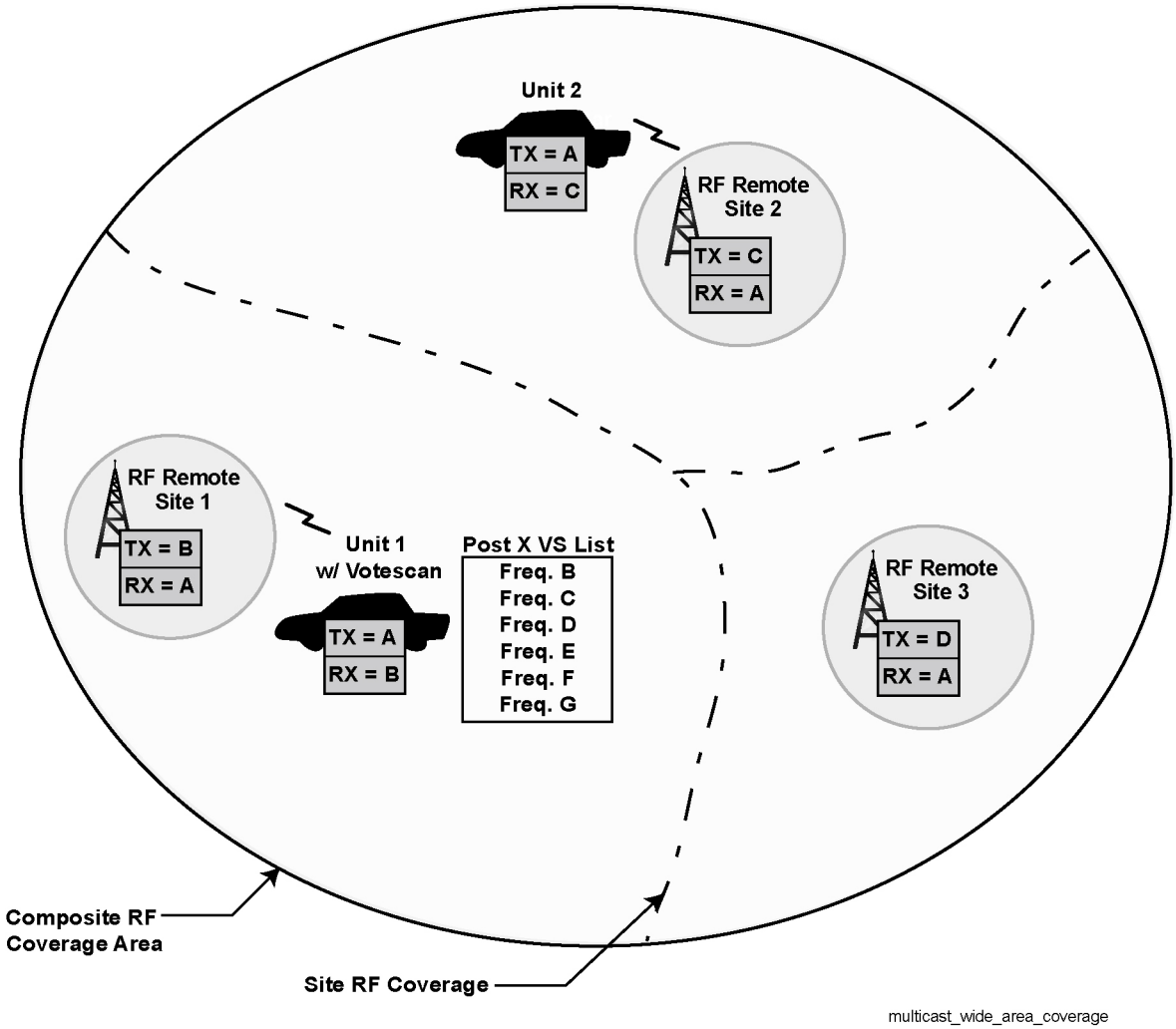


If a frequency fails to meet the carrier Network Identifier (NID) or Private Line (PL) qualifications, vote scan repeats steps one and two to re-acquire the best frequency.

Subscriber Vote Scan List Configuration

Vote Scan List is a special subscriber scan list that includes the base station transmit frequencies used in the respective multicast system.

Figure 10: Multicast Operation Using Vote Scan



Vote Scan Lists are programmed by Customer Programming Software (CPS) and cannot be modified by the subscriber end-user. Up to 64 Vote Scan Lists can be created. Each member in the Vote Scan List is a valid mode in the radio. The personality selected by the Carrier Selector Switch (CSS) is always one of the members of the Vote Scan List for that mode. The number of members (modes or personalities) each list can have varies based on the subscriber model:

- For ASTRO® Spectra, ASTRO® SABER and ASTRO® XTS 3000 subscriber radios, each list can have up to 10 members.
- For ASTRO® Spectra Plus, XTS 5000, XTS 2500, XTL 5000, XTL 2500, and APX subscriber radios, each list can have up to 11 members because these radios automatically add the selected channel to the Vote Scan List.

NOTICE: A mode in the subscriber radio that has a Vote Scan List assigned is not capable of any other type of channel scan.

The vote scan mode/channel type corresponds to the mode programmed in the subscriber for that personality. Some typical operational scenarios are:

- If a personality is programmed for digital-only operation, scan only qualifies digital ASTRO® carriers. Analog carriers are rejected.

- If a personality is programmed for mixed-mode operation, scan qualifies either analog or ASTRO® carriers. All base station transmitters within the system are in the same modulation (analog or ASTRO®) during a call.
- If the radio detects a carrier with an access code, Network Identifier (NID) or Private Line (PL), that does not match the access code programmed for that channel, it rejects that carrier and resumes scanning.
- If the personality is programmed for selective squelch, the radio only unmutes to a signal addressed to that radio's unique ID.

Call Processing with Vote Scan

When operating in vote scan mode, the subscriber radio's call processing varies slightly from call processing operation during other types of scan.

The two types of call processing are: **Inbound Call Message Flow** and **Outbound Call Message Flow**.

During Inbound Call Message Flow, the talk-in path uses a single frequency. Regardless of the subscriber location, the transmit channel on the vote-scan-enabled mode of a radio is the same as that on all receiver sites. The comparator passes its voted output to the console subsystem and to the base station transmitters.

During Outbound Call Message Flow, outbound messages, whether sourced from the console, interconnect, data host, or comparator (voted inbound mobile audio), are sent by the comparator to all transmitters. Each station transmits identical content, but on a different carrier frequency.

During Outbound Call Message Flow, the receiving subscriber radio must have selected a mode with a Vote Scan List assigned. As the subscriber travels through areas served by different transmitters, vote scan checks each receive frequency for a carrier signal strength above the Received Signal Strength Indicator (RSSI) threshold. Because all other receive qualifiers must be identical, the subscriber radio is able to save valuable time by not having to check these qualifiers until after the carrier with the strongest signal strength is detected and selected.

Chapter 4

System Design for Vote Scan

When designing a vote scan/multicast system, the user must consider many aspects of this process, for example supported products and options, or compatible system features.

Design and Planning Considerations for Vote Scan

When designing a multicast system with a subscriber vote scan, the user must consider many aspects, such as Received Signal Strength Indicator (RSSI) levels or interference mitigation.

Key factors to consider are:

- RSSI levels and vote scan operation
- Access code planning
- Subscriber transmit frequency and vote scan
- Frequency reuse planning
- Interference mitigation
- Truncation delay mitigation

RSSI Levels and Vote Scan Operation

In a vote scan system, the signal with the strongest Received Signal Strength Indicator (RSSI) unmutes the receiver unless parameters are set to allow differently. The setting for this parameter has a critical effect on system operation. Therefore, the value specified should depend on the design goals for the system.

The factory default for RSSI is $56/57.

Setting the threshold high reduces the likelihood of the scanner selecting a carrier above the threshold, and leads to increased truncation as a full scan through the list is more likely. Lower threshold settings reduces vote scanning time (truncation) as it is easier for the scanner to select a carrier that exceeds the threshold. The hex value does not correlate directly to signal strength in dBm, but $57 corresponds approximately to -90 dBm.

The appropriate setting for a specific system depends on coverage design, presence of co-channel transmitters, and individual system design goals. It is highly recommended that system installers experiment to determine the optimum setting for their specific system installations.

Table 4: Guidelines for Determining RSSI Threshold Settings

Condition	Recommended Setting and Explanation
If the quality of the voted signal is more critical than the vote time and possible truncation ...	A high threshold value should be used. Setting the threshold high reduces the likelihood of the scanner finding a carrier above the threshold, and leads to increased truncation as a full scan through the list becomes more likely. This also ensures that the signal is strong and does not fade out during the call. The threshold tells the radio that if it finds a channel above the

Table continued…

Condition	Recommended Setting and Explanation
	threshold, the channel is strong enough to provide good quality audio for the duration of the call. For more information on truncation, see Truncation Delay Mitigation - Vote Scan on page 43
If it is critical to minimize truncation and voting time ...	The threshold can be set lower. Lower threshold settings reduce vote scanning time (truncation) as it is easier for the scanner to find a carrier that exceeds the threshold, though the selected carrier may not be the strongest. Setting the RSSI threshold low may be desirable in systems where strong interfering carriers are present because once the interferer is rejected, the scanner immediately selects the next carrier above the threshold. If no other carrier is above the threshold, the scanner votes on all carriers and the same interferer may be selected again. **NOTICE:** Care must be taken not to set the threshold too low or the subscriber radio may vote a very weak signal that is not useful. In addition, the radio may select a channel that is not the best channel available to it since it has not had a chance to complete a full scan through the Vote Scan List.

Access Code Planning for Vote Scan

The ASTRO® Network ID (NID) is embedded ASTRO® signaling used to achieve the same function provided by the Continuous Tone Coded Squelch System, also known as Private Line (PL), and Digital Coded Squelch, also known as Digital Private Line (DPL) in analog systems. The NID is a three-digit hexadecimal number between 000 and FFF. The factory default is 293 and should be changed to avoid interference from default users.

IMPORTANT: Members of the same Vote Scan List must have the same NID. In large system designs that use multiple multicast systems (subsystems), a NID reuse plan must be developed to help reduce interference between the multicast systems (where each individual multicast system has a different NID).

A NID different from the one used for the base station receive frequency may be used for the base station transmit frequency, except for the special configuration described in Subscriber Transmit Frequency and Vote Scan on page 40

NOTICE: The use of the custom NIDs – F7E and F7F – are not recommended.

Subscriber Transmit Frequency and Vote Scan

When two subscriber radios are in close proximity and operating in duplex mode, interference occurs due to receiver desensitization in the UHF and VHF bands. This interference can be mitigated by

including the subscriber transmit frequency in the Vote Scan List since it allows subscriber radios to directly receive on the adjacent subscriber radio's transmit frequency.

This configuration solves the desensitization problem, but other system issues must be considered. When including the subscriber transmit frequency in the Vote Scan List, it is important to ensure that the same Network Identification (NID) is used for both transmit and receive frequencies in the respective multicast system. In addition, once vote scan "locks" onto an adjacent subscriber radio, it remains there and misses any audio coming from the multicast infrastructure, including prioritized dispatcher audio (console priority). The dispatcher's audio is transmitted over the multicast infrastructure. However, the respective mobile radios are already "locked" to the adjacent subscriber radio's transmit frequency in the Vote Scan List. Once the adjacent subscriber radio de-keys, vote scan begins a new scan (unless the subscriber radio is programmed to wait before beginning a scan).

IMPORTANT: These operational issues should be considered carefully prior to adding the subscriber transmit frequency to the Vote Scan List. The system designer must communicate the risks of this design and ensure that they are fully understood.

Frequency Reuse Planning for Vote Scan

Some systems reuse frequencies and Network Identifiers (NIDs) based on a frequency and NID reuse plan. Frequencies are reused because a limited number of frequencies are available, and NIDs are reused to reduce interference and to conserve subscriber memory.

It is possible to reuse the same frequency within the same multicast system when the RF sites are sufficiently spaced to avoid interference above acceptable limits. In this situation, a single Vote Scan List entry suffices for both RF sites, allowing for the benefits gained from a shorter Vote Scan List and/or allowing an additional RF site in the coverage area.

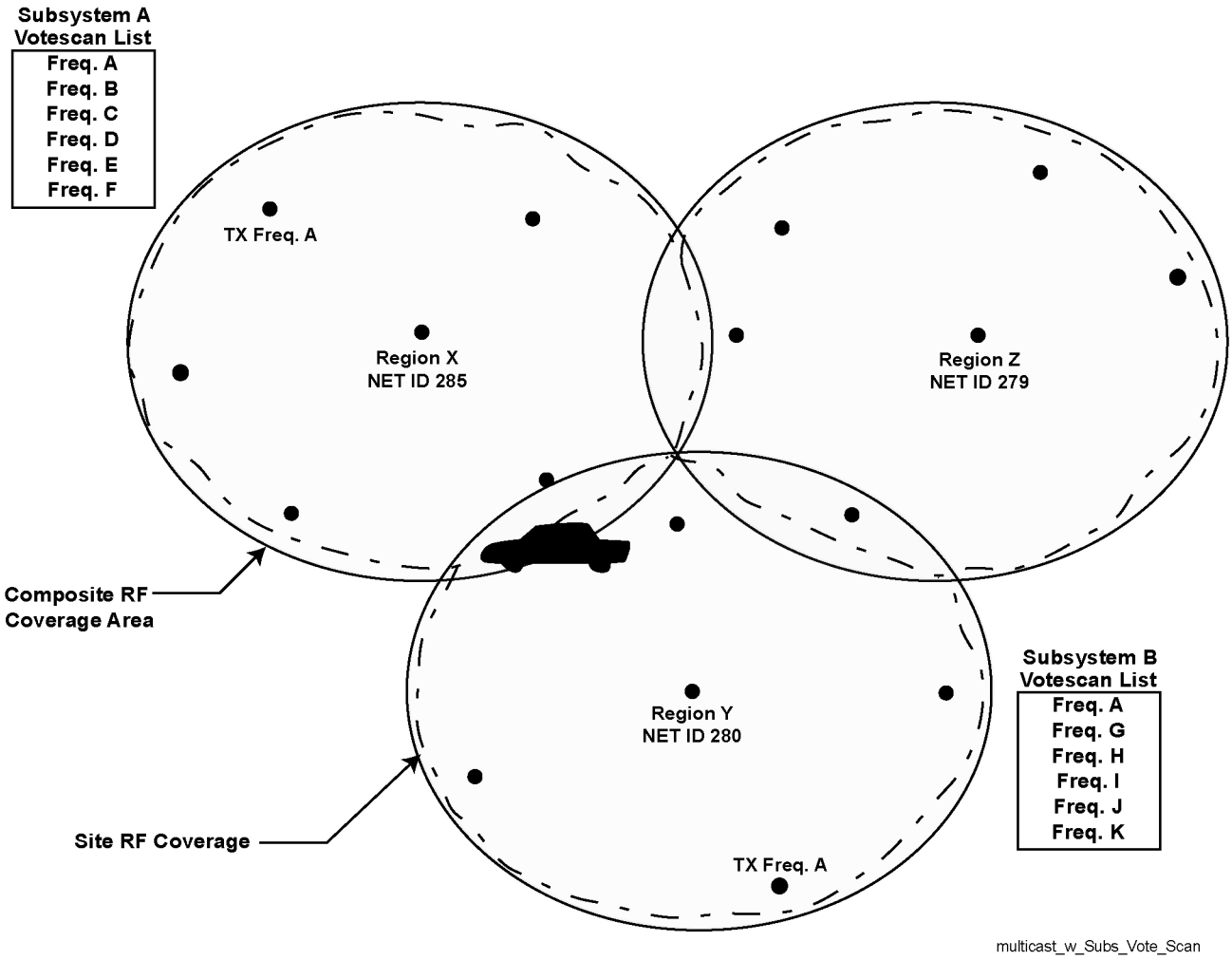
The Vote Scan List is configured, or "built", in Customer Programming Software (CPS) by pointing to the zone/channel table where the desired frequency/NID combination resides. If an exact frequency/NID combination is reused in different geographic regions, only one channel entry is required in the subscriber for that frequency or NID. If a frequency is reused with different NIDs, two channel entries are required.

NOTICE: More than one Vote Scan List can point to a single channel in the subscriber, thus allowing only one entry to be used.

In system designs using multiple multicast systems, one important point regarding frequency reuse must be considered. When determining the locations where a particular base station transmitter frequency can be reused, the location of the subscriber within an adjacent multicast subsystem must also be considered, although it may be acceptable to reuse the frequency based on coordination and FCC requirements. This consideration is important because the subscriber's operational area may bring it within the RF coverage area of the reused frequency and slow down the particular subscriber's vote scan process.

NOTICE: Frequency A is in the Vote Scan List for both multicast subsystems, and the RF sites are distant from each other.

Figure 11: Frequency Reuse and Subscriber Vote Scan



Interference Mitigation - Vote Scan

Subscribers sometimes experience interference from transmitters in other locations that are operating on reused frequencies. The interfering transmitters, using reused frequencies and different Network Identifiers (NIDs) are received by subscribers roaming within the operational area of their respective location.

Frequencies used in a particular base station may be relatively close together for the following reasons:

- A single base station receive frequency is used throughout the multicast system.
- Frequencies are limited by constraints of availability.
- Frequencies are limited by constraints of the frequency reuse plan.

The result is the potential for a duplex base station to interfere with itself, resulting in receiver desensitization. The potential for interference must be noted and considered early in the system design. However, specific remedies cannot be developed until a frequency plan is generated. If the Transmit-to-Receive (T-R) frequency spacing is too close to be accommodated by a duplexer, it may be necessary to utilize separate antennas for transmit and receive.

Adequate tower spacing is required to provide sufficient T-R isolation. Although this measure may not be required, it should be considered early to set expectations regarding tower loading and additional equipment requirements. No adverse effects may be felt as a result of the configuration described

above, since vote scan does not unmute and continues to scan for a “qualified” signal. Interfering transmissions may also be of relatively low signal strength when received, compared to the transmissions received by the subscriber.

It should be carefully noted that if the interfering signal level is above the Received Signal Strength Indicator (RSSI) voting threshold, vote scan does not continue to seek a “qualified” signal. It remains on the frequency of the “unqualified” signal in the unmuted state. This situation results in missed audio from “qualified” signals until the “unqualified” signal is removed.

UHF and VHF band users inevitably encounter distant co-channel users operating in the ASTRO® or analog modulations. Vote scan first determines the signal with the best signal strength (or one that is above the RSSI threshold), and then determines if that signal meets the other expected qualifications, for example, the correct NID. If a signal is selected based on signal strength, but has the wrong NID, vote scan continues to look for a “qualified” signal, one with the correct qualifiers. This process can increase the effective vote scan delay period resulting in audio truncation of a desired signal.

Truncation Delay Mitigation - Vote Scan

Voice truncation is defined as the delay experienced before the receiver unmutes with the qualified signal. The typical delay associated with the vote scan is approximately 500 ms. The length of the delay is determined by several factors including the number of channels in the Vote Scan List and the amount of co-channel interference.

A direct relationship exists between the number of Vote Scan List members and the time required before the receiver unmutes. As the number of Vote Scan List members increases, so does the time before the receiver unmutes. This time increases because the vote scan must sample each member of the Vote Scan List before deciding which signal to choose.

At least three techniques exist, the combination of some or all of which can help to decrease the vote scan delay.

Table 5: Vote Scan Delay Mitigation Techniques

Technique	Explanation
Listing frequencies in an orderly progression in the Vote Scan List	The subscriber radio must synthesize each frequency listed in the Vote Scan List as each is sampled. A slight decrease in vote scan delay may be gained by listing frequencies from highest to lowest.
Adjusting the Received Signal Strength Indicator (RSSI) voting threshold setting	The RSSI voting threshold setting helps to decrease vote scan delay by allowing the receiver to unmute immediately on a vote scan member (frequency) if the signal level is considered acceptable based on this setting. • If a Vote Scan List member is found to have an RSSI greater than the threshold value, that frequency is unmuted without the subscriber radio having to examine the rest of the list. • If no Vote Scan List member exceeds the threshold value, vote scan searches the entire list to determine the frequency with the highest RSSI value. This process increases the time required for the receiver to unmute.

Table continued…

Technique	Explanation
	The factory default RSSI is $56/57. The default can be modified to an acceptable level to decrease the vote scan delay.
Reducing the number of frequencies in the Vote Scan List	Depending upon the RSSI voting threshold setting, vote scan must traverse the entire list before making a determination on which frequency to unmute (in some instances). Therefore, the fewer list members required, the less time it takes to traverse the list.

Supported Products Options – Vote Scan

Vote scan supports a range of subscriber and infrastructure products, such as a G387 option on ASTRO® and ASTRO-TAC 300 Comparator.

The following ASTRO® 3.1 conventional products are supported in a vote scan system:

- ASTRO-TAC 3000 Comparator Radio Service Software (RSS)
- RNC 3000 Controller (both VME and cPCI models)

The following ASTRO® 7.x conventional products are supported in a vote scan system:

- ASTRO-TAC 3000 Comparator (including expanded chassis version)
- GCM 8000 comparator
- CCGW site gateways
- ASTRO® 7.x conventional Packet Data Router (PDR)
- MCC 7500 and MCC 7100 console
- MLC 8000 analog comparator (when used in combination with a GCM 8000 comparator on an analog/P25 mixed-mode channel)
- MLC 8000 subsite link converter

The following subscriber products are supported in both ASTRO® 3.x and ASTRO® 7.x vote scan systems:

- Subscriber radio: ASTRO® Spectra, ASTRO® SABER, and ASTRO® XTS 3000 radios
- Subscriber radio: ASTRO® Spectra Plus, XTS 5000, XTS 2500, XTL 5000, XTL 2500
- Subscriber radio: ASTRO® APX family radios

Mobile radios require the G387 vote scan option, and portable radios require the Q387 vote scan purchased option. Vote scan operation is included without requiring a purchased option in the infrastructure.

Compatible System Features with Vote Scan

Multicast systems with subscriber vote scan are compatible with many system features, for example, data service compatibility or encryption.

The multicast systems with subscriber vote scan are compatible with the following system features:

- Mixed-mode ASTRO®/analog, ASTRO®-only operation, or ASTRO® conventional talkgroup operation
- ASTRO® Stat-Alert (non-Mobile Data Communications (MDC) signaling) features
- Data service compatibility

- Encryption
- Over-The-Air-Rekeying (OTAR)

Mixed-Mode ASTRO/Analog or ASTRO-Only Operation with Vote Scan

Vote scan/multicast systems are based on the ASTRO® Conventional platform. All system components, both infrastructure and subscriber radios, must be current ASTRO® models with the appropriate model/options installed. The system can be configured for analog only, ASTRO® only, ASTRO® conventional talkgroup, or mixed mode, and can be used for analog or ASTRO® digital calls.

IMPORTANT: The station transmitters must all be in the same modulation (ASTRO® or analog) during a call.

ASTRO Stat-Alert (non-MDC-signaling) Features with Vote Scan

ASTRO® Stat-Alert (non-Mobile Data Communications (MDC) signaling) features such as call alert and paging initiated by subscriber radios and consoles are compatible with vote scan/multicast systems as long as the system is properly configured. This compatibility involves programming the comparator to add a preamble to outbound signaling messages, giving the subscriber radio extra time to lock the scan onto the short control message.

All standard ASTRO® control and signaling features between the console and the subscriber radio are compatible with vote scan/multicast systems.

Data Service Compatibility with Vote Scan

Subscriber vote scan can be implemented on multicast systems configured for ASTRO® Integrated Voice and Data (IV&D) operation, and have limited data transmission needs.

The ASTRO® 25 IV&D system enables data messages to be exchanged between subscriber data terminals and a central computer using wireless communications. The conventional IV&D system solution is intended for users with very low data usage requirements. The Radio Network Controller (RNC) and Wireless Network Gateway (WNG) are added to the ASTRO® 25 RF voice system to enable the system to process data messages in 3.1 conventional systems. In 7.x conventional data systems, a Packet Data Gateway (PDG) is added.

When the vote scan is added to an IV&D implementation, the system must be configured to key the transmitters with a preamble before sending data. This configuration allows vote scan to “lock” onto the selected signal and increase the probability of successful data reception by the radio. This “pre-time” is configured in the RNC/PDG and the system designer should determine the optimum setting based on system specifics.

While mixed data and voice use are supported in vote scan/multicast systems, an analysis of system traffic capacity must account for the additional time that a channel is occupied for each message. It is recommended that the subscriber vote scan feature is used in systems with low voice/data traffic needs.

For more information, see Vote Scan Data Applications on page 46 and Data Scan Compared to Vote Scan on page 46.

Encryption Vote Scan

Vote scan/multicast systems can be used to transport digital ASTRO® calls that are clear or encrypted. All encryption types currently offered are supported.

As with non-scanning subscribers, additional truncation could occur during the time the receiving radio detects and processes the decryption information. This truncation time must be accounted for in the system design.

Over-the-Air-Re-keying (OTAR) Vote Scan

A vote scan/multicast system can be used to provide Over-the-Air-Rekeying (OTAR) service to the subscriber radios. The section describing Data Service Compatibility with Vote Scan on page 45 applies equally to OTAR compatibility, except that the Key Management Facility (KMF) serves as the data host. This configuration is only recommended for a system with very low voice and data traffic loading needs.

Vote Scan System Limitations

A few limitations exist in the vote scan system design , for example, incompatible system features or uncertified data applications.

Incompatible System Features with Vote Scan

Multicast systems employing vote scan are not compatible with the following system features:

- VSELP functionality
- Securenet (12 kb)
- Other scan types on the same channel
- Vehicular Repeater System (VRS)

NOTICE: Digital Vehicular Repeater System (DVRS) systems are supported.

Vote Scan Subscriber Feature Interactions

Be aware of the following vote scan and subscriber radio feature interactions:

- Using monitor on a vote-scan-enabled personality causes the subscriber to disregard received qualifiers on any of the frequencies in the vote scan list. Monitor does not suspend the vote scan.
- Talkaround enables simplex radio-to-radio communications without using the system infrastructure. Call alerts and emergency alarm display features are not supported when two subscriber units are communicating with each other directly (without the use of the infrastructure).
- The selectable talkback channel function available with vote-scan-capable radios during a scan is incompatible with the subscriber vote scan feature.

Vote Scan Data Applications

Multicast systems using subscriber vote scan are certified for data service in cases where the data usage is low. However, specific data applications are not certified. Common Air Interface (CAI) standard data service is certified, but specific applications such as Premier Mobile Data Computer (PMDC) record inquiries or GPS location are not tested.

Data Scan Compared to Vote Scan

Data scan and vote scan are two independent subscriber features used in two entirely different scenarios. Data scan is enabled in the subscriber radio when a subscriber radio uses conventional scan to scan multiple channels with different content, and one of those channels is used for ASTRO® Common Air Interface (CAI) data. This situation causes the subscriber radio to send a flag to the Radio

Network Controller (RNC) during data registration instructing the controller to add a preamble to outgoing data messages to accommodate the scanning time before data messages. The subscriber radio can only transmit data messages on that scan list member channel designated for data. The radio can have only one channel in its conventional scan list marked as the *dedicated data channel*.

Because vote scan infrastructure is configured to appear as a single channel to the subscriber radio, the radio has no *dedicated data channel*. The radio still sends a flag on registration, and the RNC still adds a preamble to allow for scan time. The system acts as a single channel which can be configured for shared data and voice.

Use of Subscriber Transmit Frequency in Vote Scan List

When interference mitigation is enabled through the Customer Programming Software (CPS), the radio adds the subscriber transmit frequency into the Vote Scan List to mitigate the receiver desensitization being experienced by receivers within close proximity of subscriber transmissions when operating in high band (150 MHz) and UHF (450 MHz) frequency bands (see: Subscriber Transmit Frequency and Vote Scan on page 40). However, the following operational issues should be considered prior to enabling interference mitigation:

- During normal operation, if other transmitting subscriber radios are in close proximity to a receiving vote scan radio, the subscriber transmit frequency may be selected over the infrastructure frequency by the receiving radio. This situation may occur due to either a higher received signal strength or the relative time delay of the signal passing through the infrastructure.
- If a subscriber receiver has been captured by a nearby subscriber transmitter, outbound infrastructure transmissions are not heard until the nearby subscriber de-keys. During this time, if a different subscriber has been captured and repeated by the infrastructure, or if there is any dispatcher-originated transmission, the vote scan receiver may miss these transmissions.

NOTICE: Because the interference mitigation option permits the addition of the subscriber transmit frequency to the Vote Scan List for ASTRO® Spectra Plus, XTS 5000, XTS 2500, XTL 5000, XTL 2500, and APX subscriber radios, this option is disabled by default in the CPS.

Transmit Steering for Vote Scan

The transmitter steering option enables programming ASTRO® Spectra Plus, XTS 5000, XTS 2500, XTL 5000, XTL 2500, and APX subscriber radios with Vote Scan Lists containing unique transmit frequencies for each list member using Customer Programming Software (CPS).

However, this option is not supported with vote scan operation because a transmitter steering necessitates a different infrastructure than that of the multicast system certified for the vote scan. If this feature is enabled in the subscriber radio, the radio does not communicate with the infrastructure described in this document.

Truncation and Reduced Channel Capacity with Vote Scan

When any channel scan is used in the subscriber radio, a delay occurs while the scanner selects a channel before the received signal is processed. This delay is noticeable to the user as truncation. The formula for the typical value of additional delay during the vote scan can be computed as follows:

- Additional delay = (number of channels *2)-1) *35 ms or less.
- For a ten–channel list, this adds approximately 665 ms.
- Once the channel has been selected, an additional truncation occurs while the radio qualifies the channel.
- For more information on mitigating the effects, see Truncation Delay Mitigation - Vote Scan on page 43.

NOTICE: The channel loading capacity of a voice system is reduced due to the preambles used for signaling. It also is reduced in Integrated Voice and Data (IV&D) systems due to the data message preambles. Any analysis of system traffic capacity based on sharing voice and data on a channel must account for the additional time the channel is occupied for each message. Specific maximum channel loading recommendations have not been determined.

Interfering Carrier and Vote Scan

With ASTRO® Spectra, ASTRO® SABER, and ASTRO® XTS 3000 radios, if an interfering carrier is the strongest signal received, or if the interfering carrier exceeds the Received Signal Strength Indication (RSSI) threshold, the scanner may repeatedly select that carrier and end up missing the desired signals until the user moves to another coverage area where interfering carriers are not encountered. This limitation should be factored into consideration when designing a vote scan/multicast system that includes the above-mentioned radios. This is not an issue with ASTRO® Spectra Plus, XTS 5000, XTS 2500, XTL 5000, XTL 2500, and APX radios.

Chapter 5

Configuring the Infrastructure for Vote Scan

The correct programming of infrastructure and subscriber settings is one of the keys to the successful operation of a vote scan/multicast system. A number of recommendations for settings must be programmed into multicast infrastructure equipment to implement the subscriber vote scan feature.

NOTICE: This chapter is designed as a supplement to, and is not meant to replace, the infrastructure equipment manuals and the *Conventional System Optimization* guide.

Infrastructure Configuration Overview - Vote Scan

This section lists the following goals in setting up the vote scan/multicast system:

- To make the Radio Frequency SubSystem (RFSS) appear as a single station/RF channel both to the subscriber and to the console.
- Minimize subscriber radio voting time by adjusting the Received Signal Strength Indication (RSSI) voting threshold setting so that the signal strength of the desired channel is consistently above the RSSI voting threshold. See RSSI Levels and Vote Scan Operation on page 39 for details.
- Optimize the length of preambles so the subscriber radio's scanner locks on a channel without additional retries, but still maintains the preamble to a length where throughput is least affected.

Programming QUANTAR Base Stations for Vote Scan

To implement the vote scan, it is necessary to program the QUANTAR® base station with the recommended settings using Radio Service Software (RSS).

Table 6: QUANTAR® Base Station Field Settings for Vote Scan Using RSS

Field Name	Field Setting
Drop-out Delay	0
Tx NAC	Identical throughout the system
Rx NAC	Identical throughout the system

Programming GTR 8000 Base Radios for Vote Scan

To implement the vote scan, it is necessary to program the GTR 8000 Base Radios with the recommended settings in Configuration/Service Software (CSS).

Table 7: GTR 8000 Base Radios Field Settings for Vote Scan in CSS

Field Name	Field Setting
Drop-out Delay	0
Tx NAC	Identical throughout the system
Rx NAC	Identical throughout the system

Programming RNC 3000 Controllers for Vote Scan

To enable vote scan/multicast system operation, it is necessary to program the Radio Network Controller (RNC) 3000 controller with the following recommended settings. These settings must be set for each port using the Command Line Interface (CLI).

Table 8: RNC 3000 Controller Port Settings

Setting	Value
Vote Scan Mode	Enabled
Transmitter Dekey Mode	Linger
RNC Preamble Time	Ceiling ((N*2)-1)*35 ms/100 ms, where N = number of members in the radio's Vote Scan List. A non-zero preamble time must be entered when vote scan is enabled. If one or more ports are vote-scan enabled, the RNC preamble length must be optimized for vote scan instead of being optimized for data scan.
RNC Scan Suspend Time (Configuration Editor on Screen 1, Page 2 – Configuration Parameters, Air Protocol)	Leave this field at its default. The **Scan Suspend Time** setting is ignored for base station ports operating in vote scan-enabled mode. The RNC 3000 controller uses zero scan suspend time on ports configured for vote scan independent of this scan suspend timer field setting. If the scan suspend timer value is used elsewhere in the RNC system, it should continue to be optimized for data scan.
Port Configuration	Non-subsite steered – ASTRO® Infrastructure Signaling (AIS), not AIS Site-Steered (AIS-S). Steering is set up in this manner so the RNC 3000 controller always sends all messages with the broadcast Terminal Endpoint Identifier (TEI) address and never steers data to a single RF site. Describes at depth the behavior of various ASTRO® 25 system infrastructure components and subscriber radios as they process calls and manage subscriber mobility. **NOTICE:** Vote scan/multicast channels and single non-multicast channels configured for data scan can be mixed within a single RNC system if they are not using the same RNC 3000 port.

Programming ASTRO-TAC 3000 Comparators for Vote Scan

To implement vote scan operation, it is necessary to program the ASTRO-TAC comparator with the recommended field settings in Radio Service Software (RSS).

When the vote scan option is enabled, the comparator can add a preamble before any ASTRO® Stat-Alert Trunk Signaling Block (TSBK) message.

Table 9: ASTRO-TAC 3000 Field Settings for Vote Scan in RSS

Field Name	Field Setting
RSS Hardware Configuration Settings	
Simulcast	Disabled

Table continued...

Field Name	Field Setting
	NOTICE: When Simulcast is enabled, the **Vote Scan** field is **not** visible.
Vote Scan	Enabled **NOTICE:** When configuring an expanded-mode comparator for vote scan, the **Vote Scan** option should be set individually on each comparator.
TSBK preamble duration	((N*2)-1)*35 ms, where N = number of members in the radio's Vote Scan List. Range: 35 ms to 999 ms in 1– ms increments. The input value is rounded up by the comparator to be expressed as an integer number of multiple short terminator messages.
RSS Conventional System Settings	
Voice Repeat Operation	Enabled
Digital Voice Repeat Hangtime	0 ms
Digital Voice Console Hangtime	0 ms Comparator hangtime settings should be determined based on the specific needs of individual systems. Long hangtimes keep the Radio Frequency Subsystem (RFSS) keyed and the subscriber radio scanner locked, thus reducing the probability of truncation. However, this also prevents re-voting by the subscriber radio. The typical intention of a vote scan system is to force the subscriber radio to re-vote and not hold on a channel so the scanner is always re-selecting the strongest signal. This intention would dictate hangtime settings of 0 (zero).
Digital Data Console Hangtime	200 ms This field setting must always be set to minimum 200 ms to keep the RFSS from de-keying during data preamble.
Default Transmit Steering Address	$3F
Hangtime High-level Data Link Control (HDLC) Address	$3F **NOTICE:** Neither payload nor hangtime should ever be steered. Always use the broadcast address.

Comparator Hangtime Configuration for Vote Scan

Comparators can be configured for various hangtimes. Comparator hangtime is the time that the comparator continues to hold the transmitters active once the subscriber or console signal is absent. Hangtime can improve or adversely affect system performance depending upon the system design parameters.

Comparator hangtime can be adjusted to help improve conversation continuity and vote scan signal selection time. Hangtime between user transmissions allows the outbound signal to remain active temporarily, keeping subscribers "locked" onto the voted signal. This hangtime reduces instances of audio truncation in a multi-exchange communication, before vote scan locks onto a signal. The hangtime length should be carefully determined based on the amount of RF coverage overlap in the system. In a system where the RF coverage overlap exists, relatively long periods of hangtime (5 seconds) may be acceptable. In systems where very little RF coverage overlap exists, less hangtime

should be used because as the subscriber moves through the RF coverage area, better coverage may be achieved from another RF site than the one initially used in the conversation. Longer hangtimes would tend to keep vote scan locked unless a longer pause occurs between user transmissions.

Programming GCM 8000 Comparators for Vote Scan

To implement vote scan operation, it is necessary to program the GCM 8000 Comparators with the recommended settings in Configuration/Service Software (CSS).

Table 10: GCM 8000 Comparators Field Settings for Vote Scan in CSS

Field Name	Field Setting
CSS Site Settings	
Simulcast Operation	Disabled **NOTICE:** When Simulcast is enabled, the **Vote Scan** field is **not** visible.
CSS Configuration Settings, Conventional Systems Tab	
Simulcast	Disabled **NOTICE:** When Simulcast is enabled, the **Vote Scan** field is **not** visible.
Vote Scan	Enabled **NOTICE:** When configuring an expanded-mode comparator for vote scan, the *Vote Scan* option should be set individually on each comparator.
Vote Scan Preamble Length (msec)	Default is 385
Voice Repeat Operation	Enabled
Data Console Hangtime (sec)	200 This field setting must always be set to minimum 200 ms to keep the Radio Frequency Subsystem (RFSS) from de-keying during data preamble.
Voice Console Hangtime (sec)	0 ms Comparator hangtime settings should be determined based on the specific needs of individual systems. Long hangtimes keep the RFSS keyed and the subscriber radio scanner locked, thus reducing the probability of truncation. However, this also prevents re-voting by the subscriber radio. The typical intention of a vote scan system is to force the subscriber radio to re-vote and not hold on a channel so the scanner is always re-selecting the strongest signal. This intention would dictate hangtime settings of 0 (zero).
Voice Repeater Hangtime (sec)	0 ms
Default Transmitter Address	Disabled

Table continued...

Field Name	Field Setting
Hangtime Steering Address	Disabled

Programming Packet Data Gateway Controllers for Vote Scan

To enable vote scan/multicast system operation, it is necessary to program the ASTRO® 7.x Packet Data Gateway (PDG) controller with the following recommended settings.

The Unified Network Configurator (UNC) parameters must be set for each PDG in the system. Depending on your system, either the User Configuration Manager (UCM) parameter or the Provisioning Manager (PM) parameter must be set for each channel on which vote scan is to be used.

Table 11: PDG Controller Port Settings for ASTRO 7.x Systems

Setting	ASTRO® 7.x Value
User Configuration Manager/Provisioning Manager, Conventional Channel (Conventional Site) – Basic Tab, Conventional Vote Scan	Enable This parameter designates a channel as vote scan enabled or disabled. This parameter is used when sending outbound data to the channel. **Enable** enables preamble to be transmitted before the start of every data transaction to a scan enabled-subscriber. **Disable** enables a preamble to be transmitted when Scan Suspend Timer has expired for a scan-enable subscriber.
RNC Preamble Time	Ceiling ((N*2)-1)*35 ms/100 ms, where N = number of members in the radio's Vote Scan List. A non-zero preamble time must be entered when vote scan is enabled. If one or more ports are vote-scan enabled, the RNC preamble length must be optimized for vote scan instead of being optimized for data scan.
RNC Scan Suspend Time	Leave this field at its default. The **Scan Suspend Time** setting is ignored for base station ports operating in vote scan-enabled mode. The RNC 3000 controller uses zero scan suspend time on ports configured for vote scan independent of this scan suspend timer field setting. If the scan suspend timer value is used elsewhere in the RNC system, it should continue to be optimized for data scan.

NOTICE: To set Conventional Integrated Voice and Data (IVD) System Configuration, see "Updating a System-Level Setting" in the *Unified Network Configurator* manual.

Programming MCC 7500 Consoles for Vote Scan

Recommended field settings need to be programmed in MCC 7500 consoles deployed in a vote scan/ multicast system.

Table 12: MCC 7500 Console Field Settings

Field Name	Field Setting
Acknowledge Delay Timer (ms)	0
Retry Delay Timer	2
Pre-Time Delay (ms)	0

Programming MLC 8000 Comparator and Link Converter for Vote Scan

MLC 8000 components require no unique programming for vote scan operation.

Chapter 6

Configuring Subscriber Radios for Vote Scan

Subscriber radios that operate on a vote scan/multicast system should be configured with the recommended field settings.

Configuring ASTRO Spectra, ASTRO SABER, and ASTRO XTS 3000 Radios for Vote Scan

To configure ASTRO® Spectra, ASTRO® SABER, and ASTRO® XTS 3000 radios for vote scan operation, it is necessary to modify the Radio Service Software (RSS) and Customer Programming Software (CPS) field settings.

NOTICE: This procedure assumes the user has experience in procedures used to program subscriber radios in the RSS or CPS.

Table 13: RSS/CPS Field Settings for ASTRO XTS 3000, ASTRO SABER, and ASTRO Spectra Radios

Field Name	Field Setting
`Radio Wide Scan Lists and Options` Screen	
Scan Type	Vote scan
Designated Voice Tx Member	Select the desired setting. This field setting does not impact vote scan operation.
Designated Data Member	Select the desired setting. This field setting does not impact vote scan operation. This field is used in data scan only and does not appear when scan type is set to **Vote Scan**.
Vote Scan List	Configure up to 10 members (channels). **NOTICE:** Adding a vote scan-enabled personality to a conventional channel scan list only adds the conventional personality and not the vote-scan functionality.
`RSS Radio Wide Scan Options` Screen	
All Priority Parameters	Select the desired setting. This field setting does not impact vote scan operation. However, because the radio may have scan lists of other types and **scan option** field settings are global to all scan lists, this field setting should be configured considering the non-vote scanning scan lists.
Nuisance Mode Delete	Select the desired setting. This field setting does not impact vote scan operation. However, because the radio may have scan lists of other types and **scan option**

Table continued…

Field Name	Field Setting
	field settings are global to all scan lists, this field setting should be configured considering the non-vote scanning scan lists.
Data Tx/Rx Hold Time	Select the desired setting. This field setting does not impact vote scan operation. However, because the radio may have scan lists of other types and **scan option** field settings are global to all scan lists, this field setting should be configured considering the non-vote scanning scan lists.
Voice Tx/Rx Hold Time	0 ms
RSSI Voting Threshold	Choose a setting that is right for your system. The default field setting is $56/57. **NOTICE:** This field setting has a critical effect on system operation, and depends on the system design goals. The hex value does not correlate directly to signal strength in dBm, but $57 corresponds approximately to -90 dBm. See RSSI Levels and Vote Scan Operation on page 39 for guidelines on determining the appropriate setting for this field.
`RSS Personality` Screen	
Scan List	The personality should point to the designated vote scan list. Field settings for the personality should be programmed to match the infrastructure talk-in plan, including the appropriate subscriber transmit frequency and common transmit and receive Network Identifiers (NIDs), Private Lines (PLs), and other channel parameters. The scan list type should be designated as vote scan. The list should contain the appropriate list of frequencies based on the transmitter frequencies in the system.
`RSS ASTRO Radio Wide` Screen	
Common Air Interface (CAI) Data Response Timer	3,300 ms (default) This timer determines the maximum amount of time a subscriber waits for a CAI data acknowledgement before sending a retry. In a system using full scan lists and maximum preamble, be sure to review the worst-case timing for inbound data and outbound acknowledgement. The CAI data response timer should be set such that it is significantly longer than the round trip time.
CAI Data Min Response Timer	700 ms (default) This timer determines the minimum amount of time a subscriber waits for a CAI data acknowledgement before sending a retry. In a system that uses the maximum number of scan lists and the maximum preamble, review the worst-case timing for inbound data and outbound acknowledgement. The CAI data min response timer should be set to be significantly longer than the round-trip time.
Adaptive Power	Leave at its default (unchecked)

Field Name	Field Setting
	If enabled, this setting modifies the subscriber radio's transmit power and affect the talk-in signal strength. It is therefore recommended that this option is disabled.

Configuring ASTRO Spectra Plus, XTS 5000, XTS 2500, XTL 5000, and XTL 2500 Radios for Vote Scan

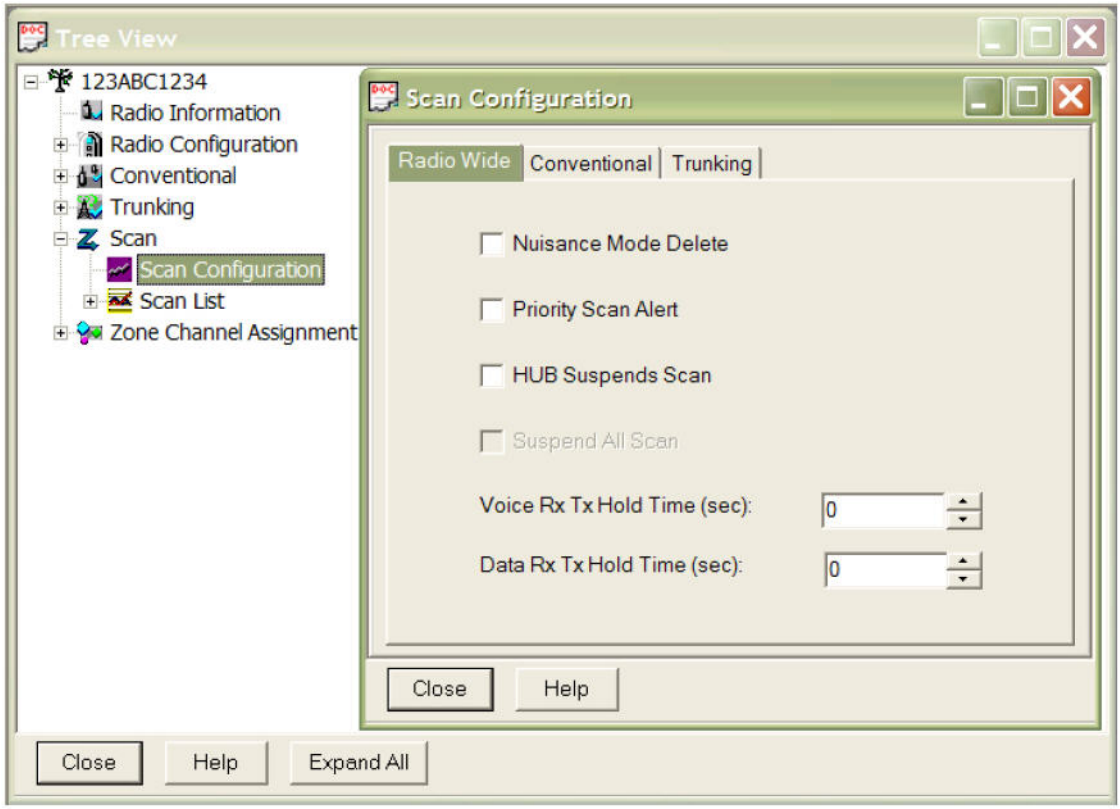
Configure ASTRO® Spectra Plus, XTS 5000, XTS 2500, XTL 5000, and XTL 2500 Radios for vote scan operation in Customer Programming Software (CPS). The figures shown in this section are based on the ASTRO® 25 CPS Version R07.00.01.

NOTICE: This section assumes the user has experience in procedures used to program subscriber radios in the CPS.

Table 14: CPS Field Settings for ASTRO Spectra Plus, XTS 5000, XTS 2500, XTL 5000, and XTL 2500 Radios

Field Name	Field Setting
Scan → Scan Configuration → Radio Wide Tab	

Figure 12: CPS Scan Configuration Window

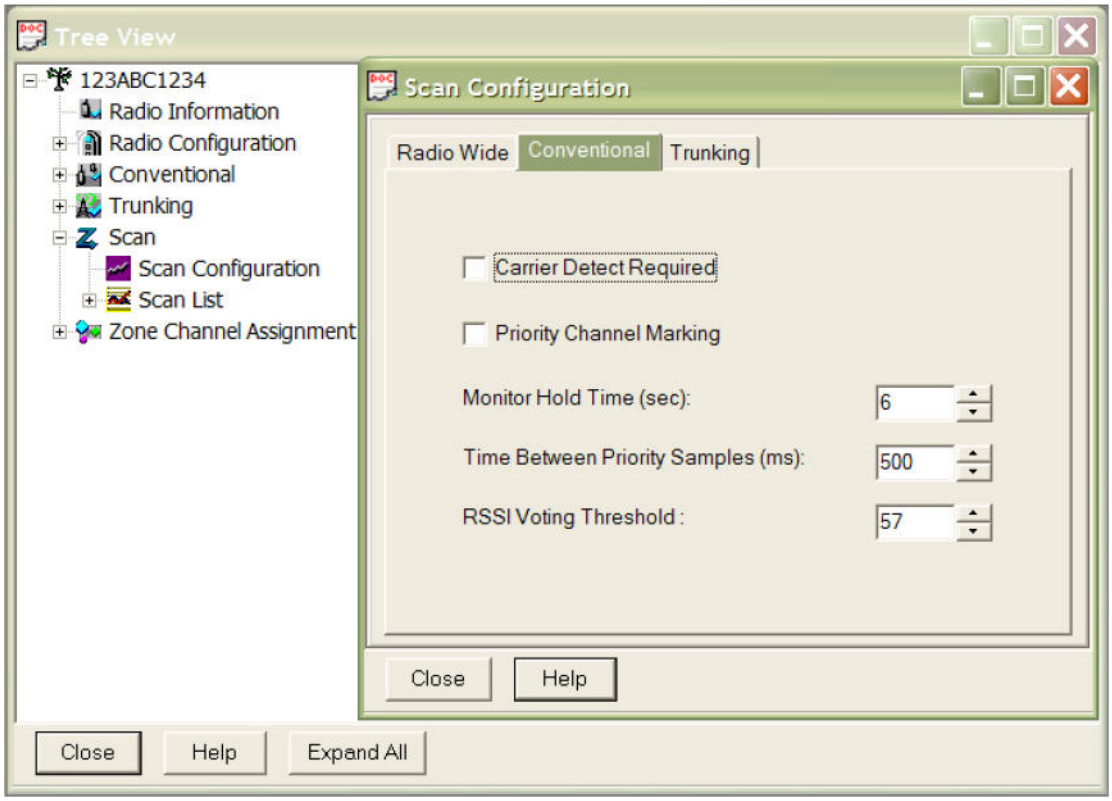


Nuisance Delete	Leave this field at its default (unchecked)
Priority Scan Alert	Leave this field at its default (unchecked)
HUB Suspends Scan	Leave this field at its default (unchecked)

Table continued…

Field Name	Field Setting
NOTICE: The following settings for the **Voice Rx/Tx Hold Time (sec)** and **Data Rx/Tx Hold Time (sec)** have a critical effect on system performance and must be optimized for individual systems. When both fields are set to 0 (zero), the subscriber radio is forced to re-scan and re-vote each transmission, thus finding the strongest signal. Longer settings (up to 3 seconds) holds the scanner for response on the same carrier. Depending on coverage and site design, this may or may not be desirable.	
Voice Rx/Tx Hold Time	3 seconds default, recommended setting for vote scan is 0 (zero)
Data Rx/Tx Hold Time	3 seconds default, recommended setting for vote scan is 0 (zero)
Scan → Scan Configuration → Conventional Tab	

Figure 13: CPS Scan Configuration Window: Conventional Tab

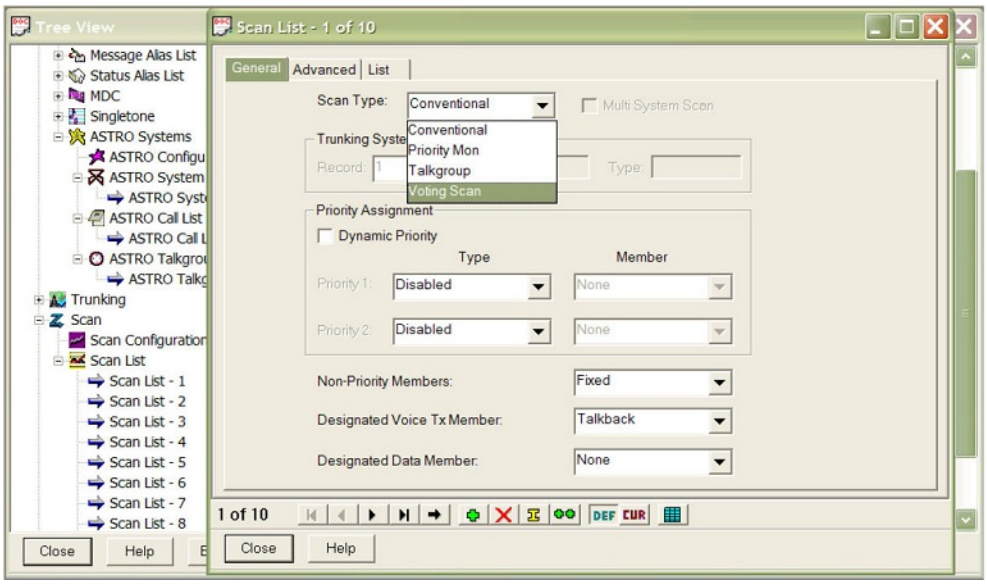


Carrier Detect Required	Leave this field at its default (unchecked)
Priority Channel Marking	Leave this field at its default (unchecked)
Monitor Hold Time (sec)	Leave this field at its default (6 sec)
Time Between Priority Samples (ms)	Leave this field at its default (500 ms)
RSSI Voting Threshold	This field setting determines the Received Signal Strength Indication (RSSI) signal level required from a Vote Scan List member channel to unmute the subscriber radio. If no Vote Scan List member exceeds the threshold, the channel with the highest RSSI value is selected. The default value is $56/57.

Table continued…

Field Name	Field Setting
	Experiment to determine the optimum setting for your system because the appropriate setting depends on factors such as coverage designs and the presence of co-channel transmitters which vary by system. **NOTICE:** The setting for this field has a critical effect on system operation. The hex value does not correlate directly to signal strength in dBm, but $57 corresponds approximately to -90 dBm. See RSSI Levels and Vote Scan Operation on page 39 for guidelines on determining the appropriate setting for this field.
Scan → Scan List → General Tab	

Figure 14: CPS Scan List Window: General Tab

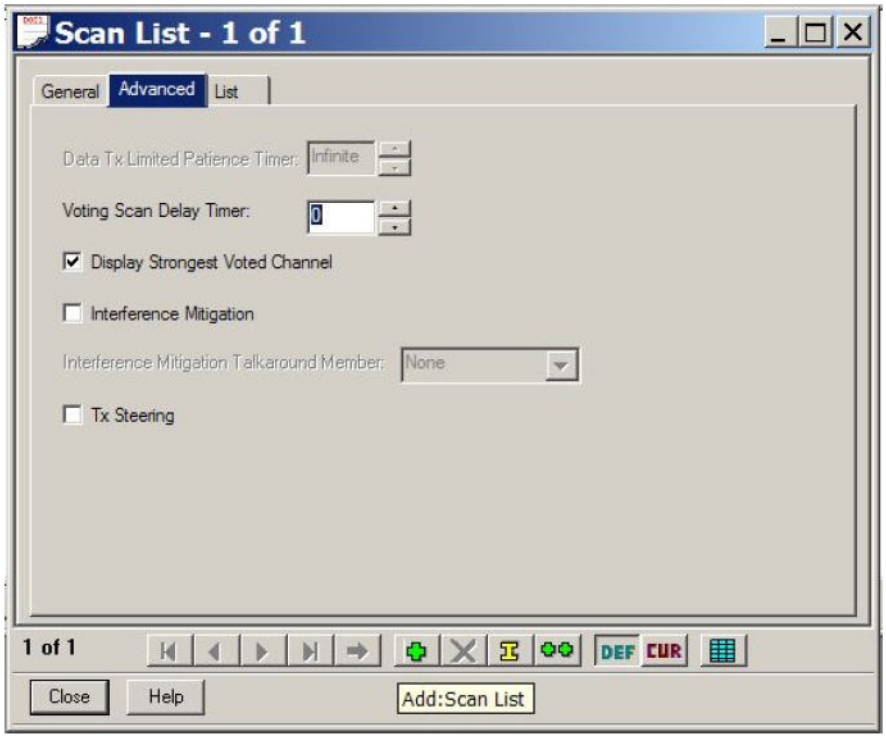


Scan Type	Voting Scan
Designated Voice Tx Member	The setting in this field is ignored for vote scan operation because the common transmit frequency in the scan list is always used if vote scan is enabled. If the transmitter steering option is enabled, this field is disabled and grayed out.
Scan → Scan List → Advanced Tab	

Table continued…

Field Name	Field Setting

Figure 15: CPS Scan List Window: Advanced Tab



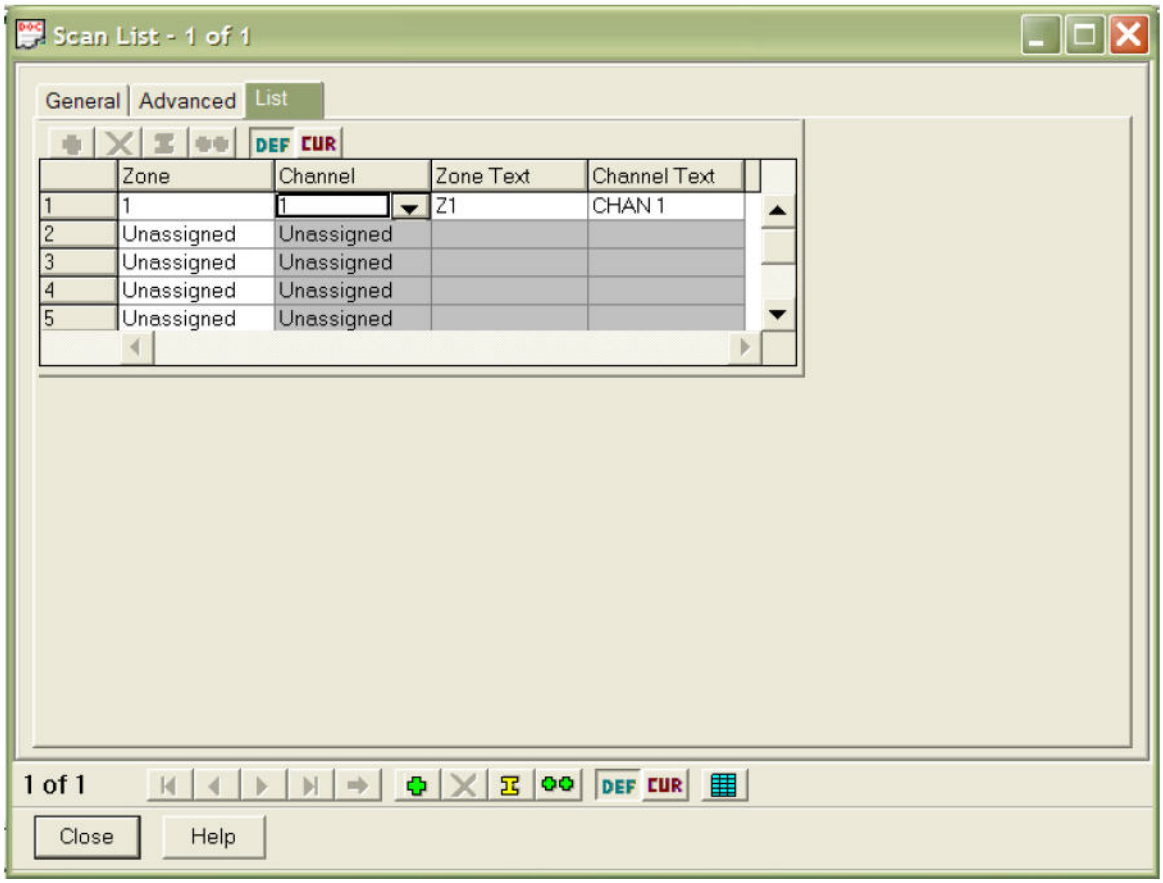
Voting Scan Delay Timer	Specifies the amount of time in milliseconds the radio waits prior to voting/selecting while scanning in the vote scan. This delay is required if all stations do not transmit at the same time, allowing for the configuration of a delay before channels are voted so all stations are transmitting when the radio votes. This selection applies for the current Vote Scan List. The default is 0. For vote scan operation, this setting should be left at its default of 0. **NOTICE:** An alternate setting is NOT recommended unless the user is familiar with exact delays in each Radio Frequency SubSystem (RFSS) outbound path and wants to delay the scan to compensate for outbound delays. Setting this field to a value other than zero adds directly to truncation and reduce system capacity.
Display Strongest Voted Channel	Enables the voted channel name (as programmed in the zone channel list) to be shown on the radio's display. This setting applies to the current Scan List. For vote scan operation, check this field to enable.
Interference Mitigation	Enables interference mitigation for the current Vote Scan List. This feature applies only to vote scan. Setting up interference mitigation is useful when clear and undistorted communications are desired at-all-times. This communication is sometimes needed because of the closeness of transmit and receive frequencies for UHF/VHF band radios; thus, interference from an adjacent radio transmission can sometimes cause a loss of clarity in the receiving radio. (See Interference Mitigation - Vote Scan on page 42 for details.)

Table continued…

Field Name	Field Setting
	If this field is set to enabled, the subscriber radio/user could miss other important transmissions generated from other repeaters because the radio is tuned to a direct unit-to-unit frequency. This field should therefore be left unchecked for vote scan operation unless special circumstances justify the addition of the subscriber transmit frequency to the Vote Scan List.
Tx Steering	Enables the transmit frequencies of each Vote Scan List member to vary in a vote scan system (see the **Scan Type** field, **Voting Scan** selection). When disabled, it is assumed that all repeaters on the vote scan system receive on the same frequency, thus all transmit frequencies must be equal. For vote scan operation, this field should be unchecked. **NOTICE:** This feature requires a unique, non-certified RFSS configuration. Enabling it in a standard vote scan/ multicast system disables the system. See Transmit Steering for Vote Scan on page 47 for details.

Scan → Scan List → List Tab

Figure 16: CPS Scan List Window: List Tab

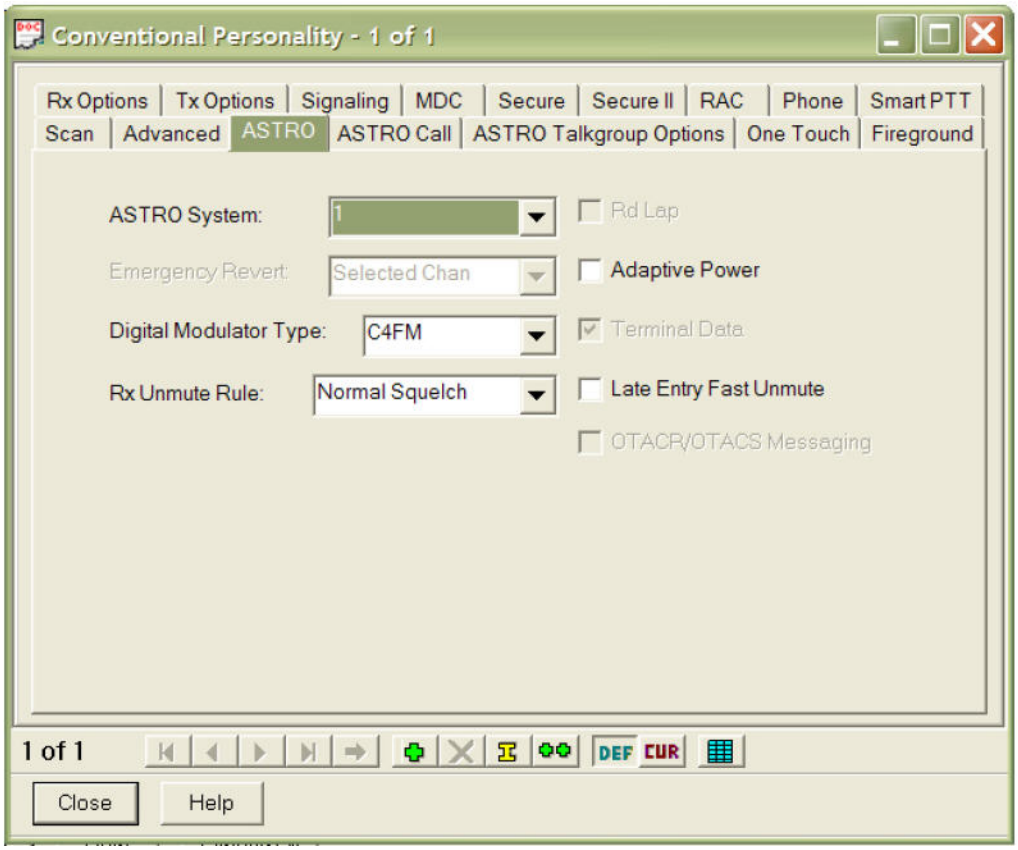


Scan List	Up to 10 entries within the same zone.

Table continued…

Field Name	Field Setting
	NOTICE: Adding a vote scan-enabled personality to a conventional channel scan list only adds the conventional personality, not the vote-scanning functionality.
Conventional Personality → ASTRO tab	

Figure 17: CPS Conventional Personality Window: ASTRO Tab

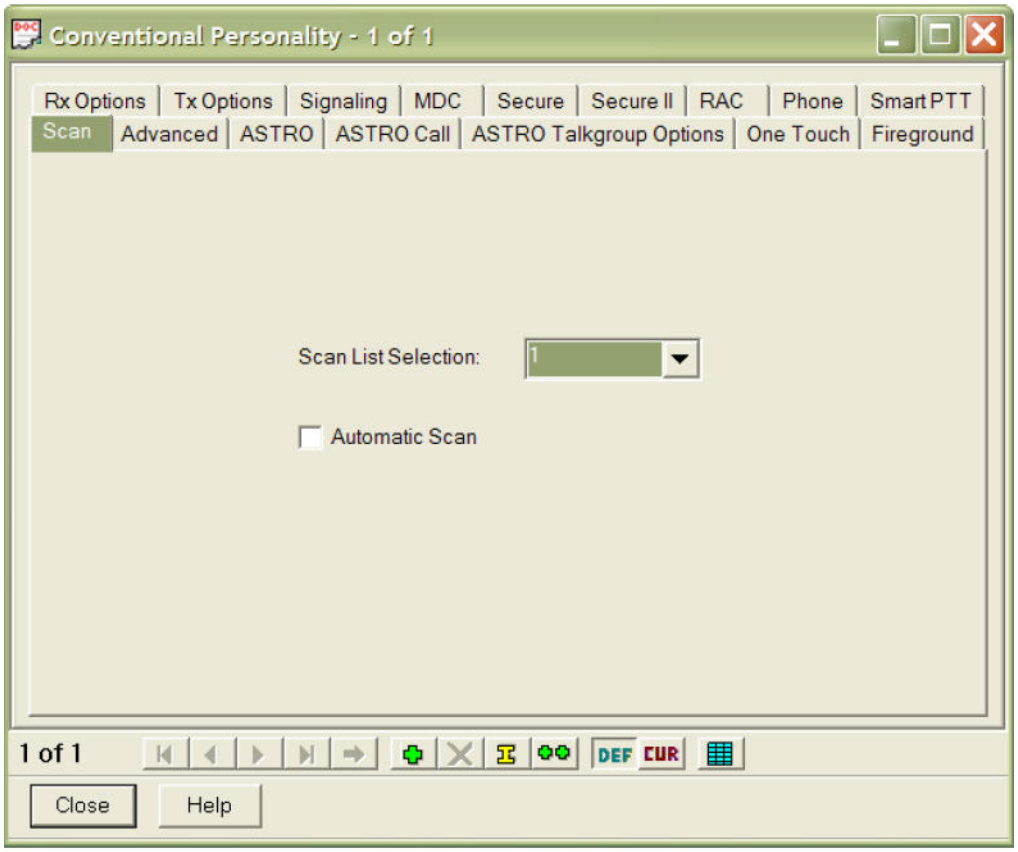


Adaptive Power	Leave this field at its default (unchecked). If enabled, this setting modifies the subscriber radio's transmit power and affects the talk-in signal strength. It is therefore recommended that this option disabled.
Conventional Personality → Scan tab	

Table continued…

Field Name	Field Setting

Figure 18: CPS Conventional Personality Window: Scan Tab



Scan List Selection	Point to the vote scan list
Zone Channel Assignment	

Table continued…

Field Name	Field Setting

Figure 19: CPS Zone Channel Assignment Window: Zone Tab

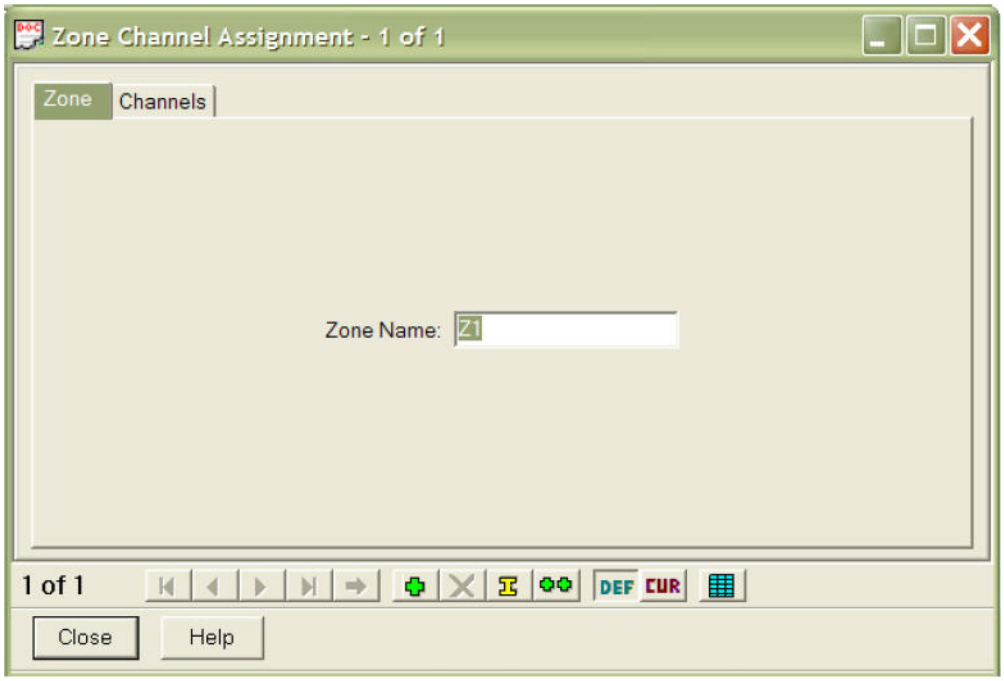


Figure 20: CPS Zone Channel Assignment Window: Channels Tab

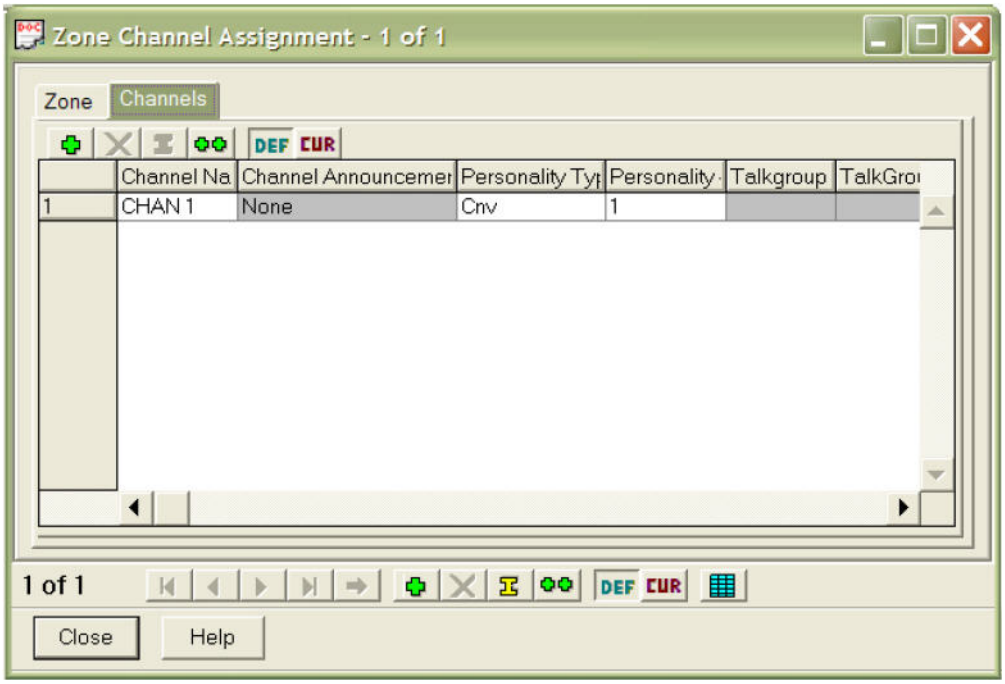


Table continued…

Field Name	Field Setting
Channel List	Within a zone, add the channels to be used in the Vote Scan List. **NOTICE:** All channel parameters except receive frequency must be identical. Channels can point to different personality numbers as long as all parameters except receive frequency are identical.

Configuring ASTRO APX Series Mobile and Portable Radios for Vote Scan

Configure ASTRO® APX Series Mobile and Portable Radios for vote scan operation in the Customer Programming Software (CPS). The figures shown in this section are based on the ASTRO® 25 CPS Version R07.00.01.

Prerequisite: This section assumes the user has experience in procedures used to program subscriber radios using the CPS.

NOTICE:
Legacy Vote Scan is defined as a scan type that uses a vote scan list with scan members that are representations of the individual frequencies within a vote scan system. A zone channel assignment must be created and added to the vote scan list for each frequency within the system. Typically, each zone/channel combination uses the same conventional personality.

Mixed vote scan is defined as a scan type that uses a conventional scan list with scan members that could be representations of individual conventional frequencies or vote scan systems. Mixed vote scan treats “mixed-vote-scan-enabled” scan members as a self-contained vote scan system with a potential of 10 frequencies. Additionally, mixed vote scan can have conventional frequencies as part of the list, and they are treated as separate entities from the vote scan systems. Thus, the scan list has a mixture of members.

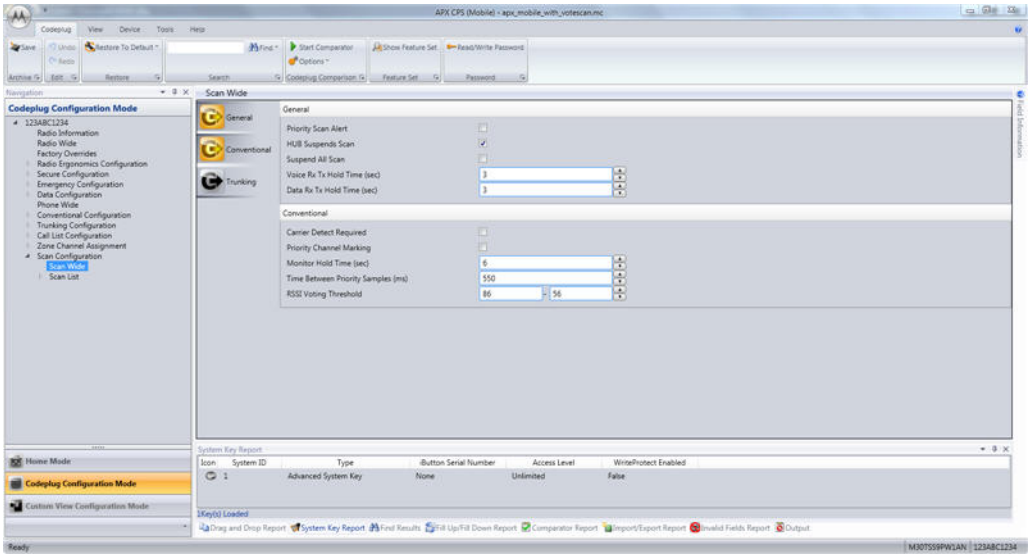
Table 15: APX CPS Codeplug Configuration Settings for ASTRO APX Series Mobile and Portable Radios

Field Name	Field Setting
	NOTICE: The following illustrations are for APX mobile radios. Differences between mobile and portable radios are indicated in the table.
Codeplug Configuration → Scan Configuration → Scan Wide → General	

Table continued…

Field Name	Field Setting

Figure 21: Scan Wide Window: General and Conventional Tab



Priority Scan Alert	Leave this field at its default (unchecked)
HUB Suspends Scan *(not used for portable radios)*	Leave this field at its default (unchecked)
Suspend All Scan *(not used for portable radios)*	Leave this field at its default (unchecked)

NOTICE: The following settings for the **Voice Rx/Tx Hold Time (sec)** and **Data Rx/Tx Hold Time (sec)** have a critical effect on system performance and must be optimized for individual systems. A setting of 0 may cause data transmissions to fail due to the radio roaming away from the current channel after receiving each data packet.

Voice Rx/Tx Hold Time	Leave this field at its 3 seconds default
Data Rx/Tx Hold Time	Leave this field at its 3 seconds default
Codeplug Configuration → Scan Wide → Conventional	
Carrier Detect Required	Leave this field at its default (unchecked)
Priority Channel Marking	Leave this field at its default (unchecked)
Monitor Hold Time (sec)	Leave this field at its default (6 sec)
Time Between Priority Samples (ms)	Leave this field at its default (500 ms)
RSSI Voting Threshold	This field setting determines the Received Signal Strength Indication (RSSI) signal level required from a Vote Scan List member channel to unmute the subscriber radio. If no Vote Scan List member exceeds the threshold, the channel with the highest RSSI value is selected. The default value is $56/57. Experiment to determine the optimum setting for your system since the appropriate setting depends on factors such as coverage designs and the presence of co-channel transmitters which vary by system.

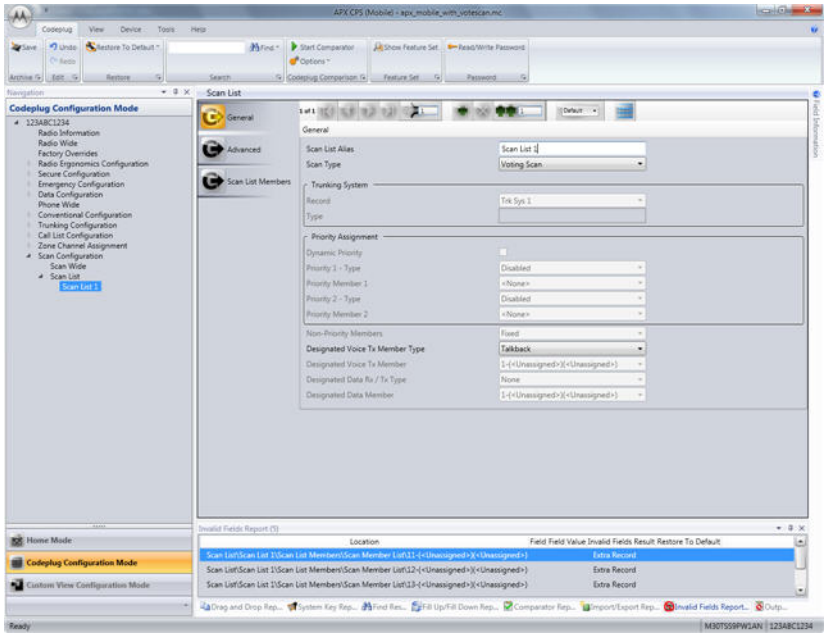
Table continued...

Field Name	Field Setting
	NOTICE: The setting for this field has a critical effect on system operation. The hex value does not correlate directly to signal strength in dBm, but $57 corresponds approximately to -90 dBm. See RSSI Levels and Vote Scan Operation on page 39 for guidelines on determining the appropriate setting for this field. In addition, the RSSI reading is instantaneous, which can cause a variance in the accuracy of the reported value.

NOTICE: For ASTRO® APX portable radios, **Scan List 1** is labeled **My Scan List**.

Codeplug Configuration → Scan Configuration → Scan List → Scan List 1 (My Scan List) → General Tab

Figure 22: Scan List 1 (My Scan List) Window: General Tab — Voting Scan Selected for Legacy Vote Scan

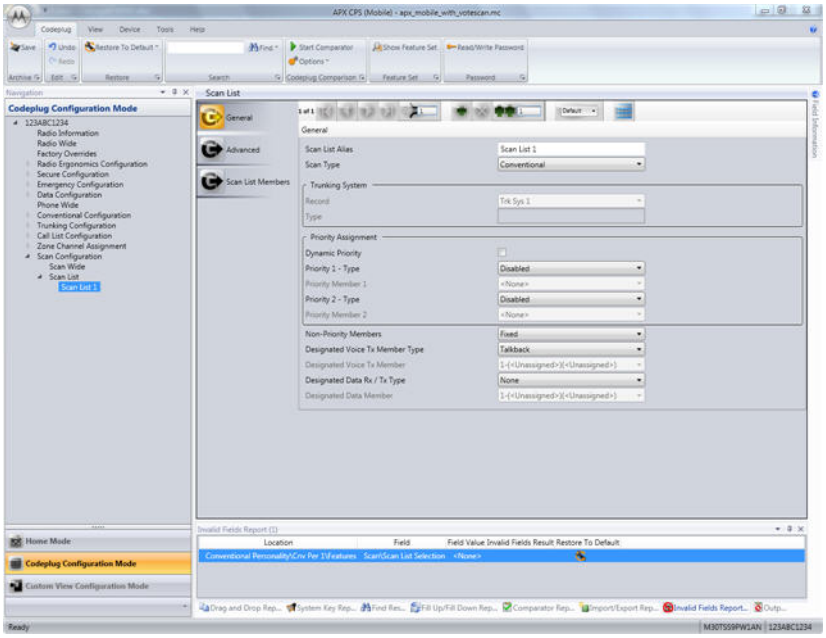


Scan Type	Voting Scan
Scan List Alias	This field is used to provide a better description of the scan list type and members.
Designated Voice Tx Member Type	The setting in this field is ignored for legacy vote scan operation because the common transmit frequency in the scan list is always used if the legacy vote scan is enabled.

Table continued…

Field Name	Field Setting

Figure 23: Scan List 1 (My Scan List) Window: General Tab — Conventional Selected for Mixed Vote Scan



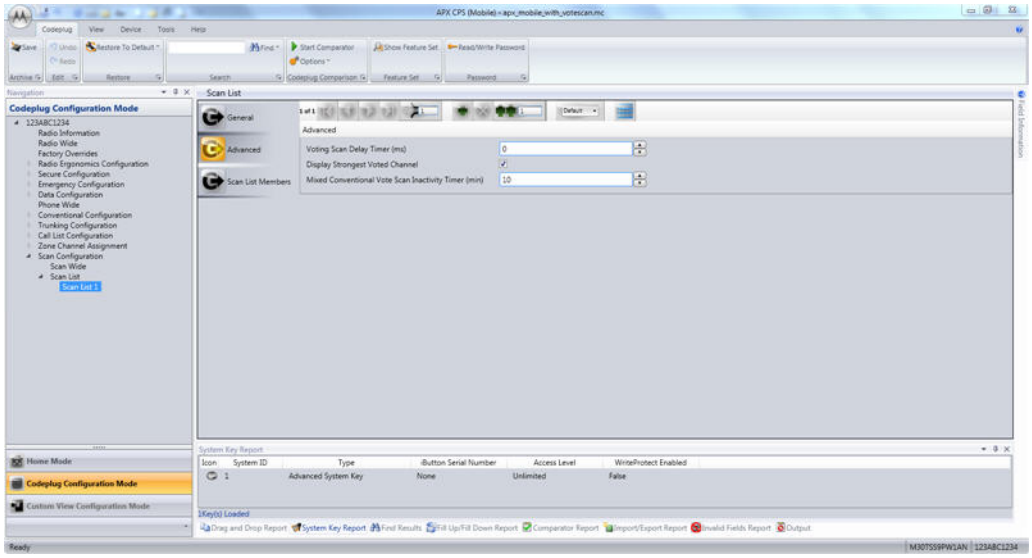
Scan Type	Conventional
Scan List Alias	This field is used to provide a better description of the scan list type and members.
Designated Voice Tx Member Type	This field must be set for mixed vote scan operation.
Designated Data Rx/Tx Member Type	This field must be set for mixed vote scan operation.
Designated Data Member	This field must be set to the scan member receiving the data. **NOTICE:** Priority members are allowed with the mixed vote scan, but not legacy vote scan.

Codeplug Configuration → Scan Configuration → Scan List 1 (My Scan List) → Advanced Tab

Table continued…

Field Name	Field Setting

Figure 24: Scan List 1 (My Scan List) Window: Advanced Tab

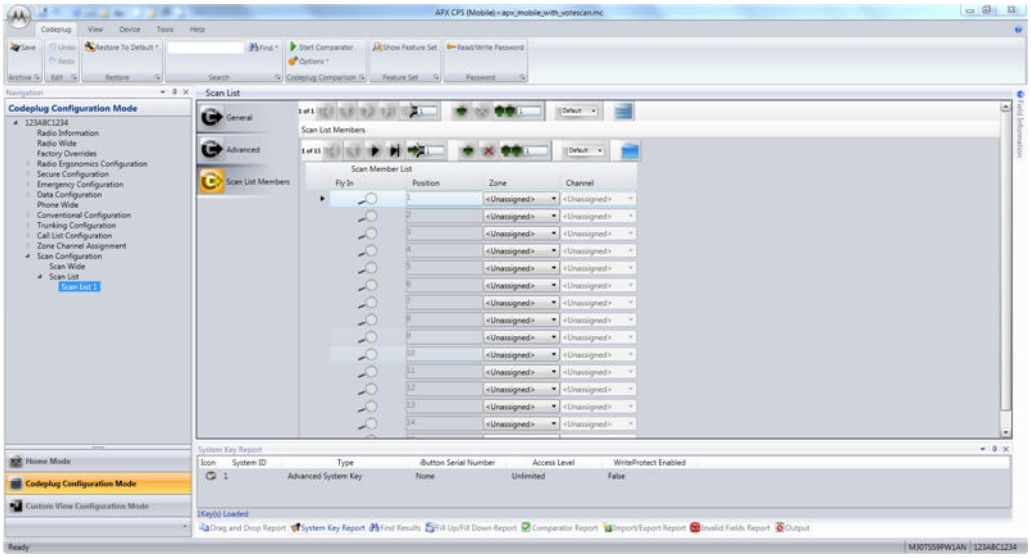


Voting Scan Delay Timer	Specifies the amount of time in milliseconds that the radio waits prior to voting/selecting while scanning in the vote scan. This delay is required if all stations do not transmit at the same time, allowing for the configuration of a delay before channels are voted so all stations are transmitting when the radio votes. This selection applies for the current Vote Scan List. The default is 0. For vote scan operation, this setting should be left at its default of 0. **NOTICE:** An alternate setting is NOT recommended unless the user is familiar with exact delays in each Radio Frequency SubSystem (RFSS) outbound path and wants to delay the scan to compensate for outbound delays. Setting this field to a value other than zero adds directly to truncation and reduce system capacity.
Display Strongest Voted Channel	Enables the voted channel name (as programmed in the zone channel list) to be shown on the radio's display. This setting applies to the current Scan List. For vote scan operation, check this field to enable. For Mixed vote scan, the Frequency Option Name from the personality is displayed along with the Zone/Channel name.
Mixed Conventional Vote Scan Inactivity Timer (min)	**NOTICE:** This field is used for mixed vote scan only. In the **Scan List 1 (My Scan List)** window, General Tab, Conventional must be selected. Is used to determine when the radio should look through the entire frequency list for each voting system after the strongest frequency has been determined. The default value is set to 10 minutes. The desired value is determined by the user based on the coverage area and the frequency of switching between sites.
Tx Steering	Enables the transmit frequencies of each Vote Scan List member to vary in a vote scan system (see the **Scan Type** field, **Voting Scan**

Table continued…

Field Name	Field Setting
	selection). When disabled, it is assumed that all repeaters on the vote scan system receive on the same frequency, thus all transmit frequencies must be equal. For vote scan operation, this field should be unchecked. **NOTICE:** This feature requires a unique, non-certified RFSS configuration. Enabling it in a standard vote scan/ multicast system disables the system. See Transmit Steering for Vote Scan on page 47 for details.
Codeplug Configuration → Scan Configuration → Scan List 1 (My Scan List) → Scan List Members	

Figure 25: Scan List 1 (My Scan List) Window: Scan List Members



Scan Member List	A limitation of up to 10 entries within the same zone is set for Legacy Vote Scan. Mixed Conventional Vote Scan does not have a limitation of the scan list members from the same zone. **NOTICE:** Enabling the vote scan functionality within the vote scan-enabled personality applies only to Mixed Vote Scan and the Mixed Vote Scan Enabled check box.

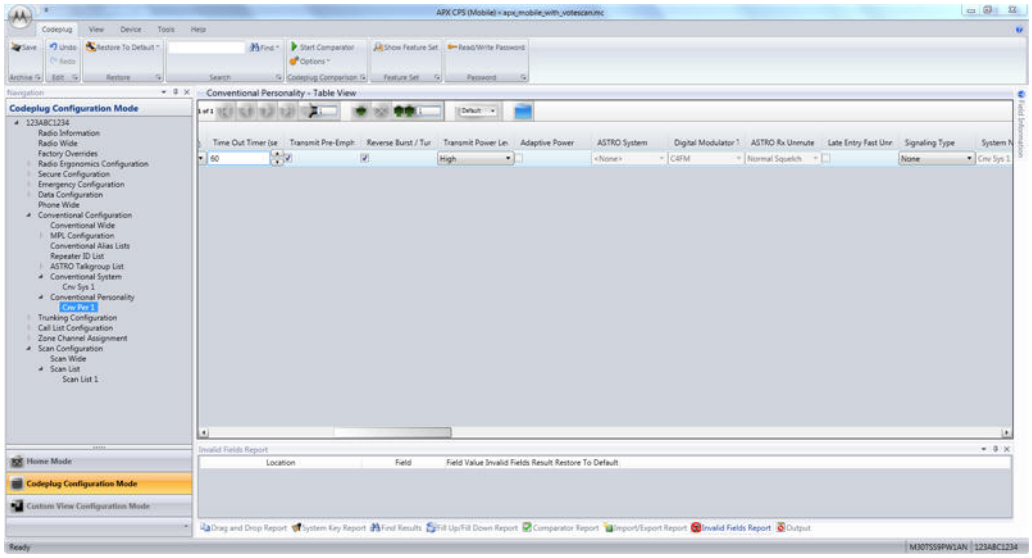
NOTICE: For ASTRO® APX portable radios, **Cnv Per 1** is labeled **H1 Digital**.

Codeplug Configuration → Conventional Personality → Cnv Per 1 (H1 Digital)

Table continued…

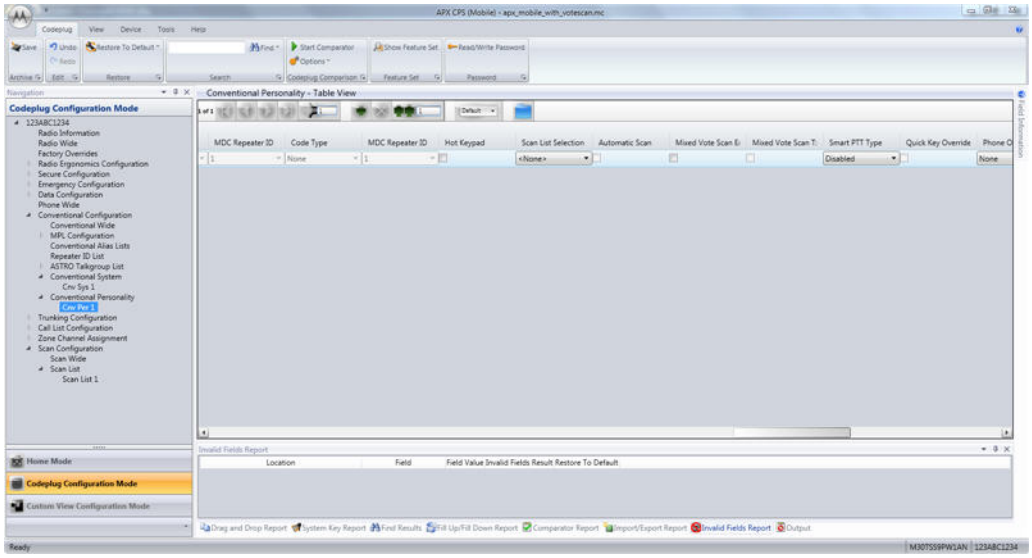
Field Name	Field Setting

Figure 26: Conventional Personality Window: Adaptive Power



Adaptive Power	Leave this field at its default (unchecked). If enabled, this setting modifies the subscriber radio's transmit power and affects the talk-in signal strength. It is therefore recommended to leave this option disabled.

Figure 27: Conventional Personality Window: Scan List Selection

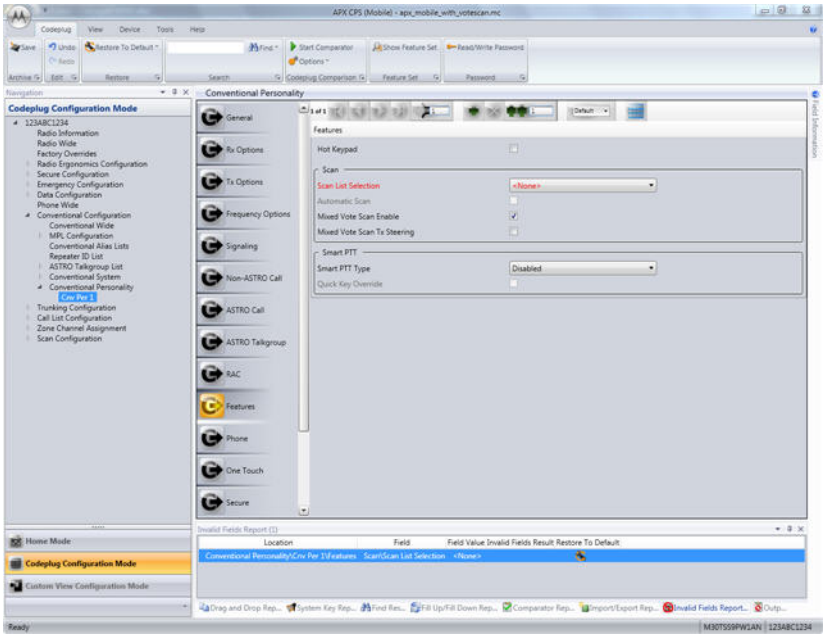


Scan List Selection	The Scan List Selection within the Conventional Personality must be set to a Voting Scan List Type for Legacy Vote Scan, and set to a Conventional Scan List Type for Mixed Vote Scan.

Table continued…

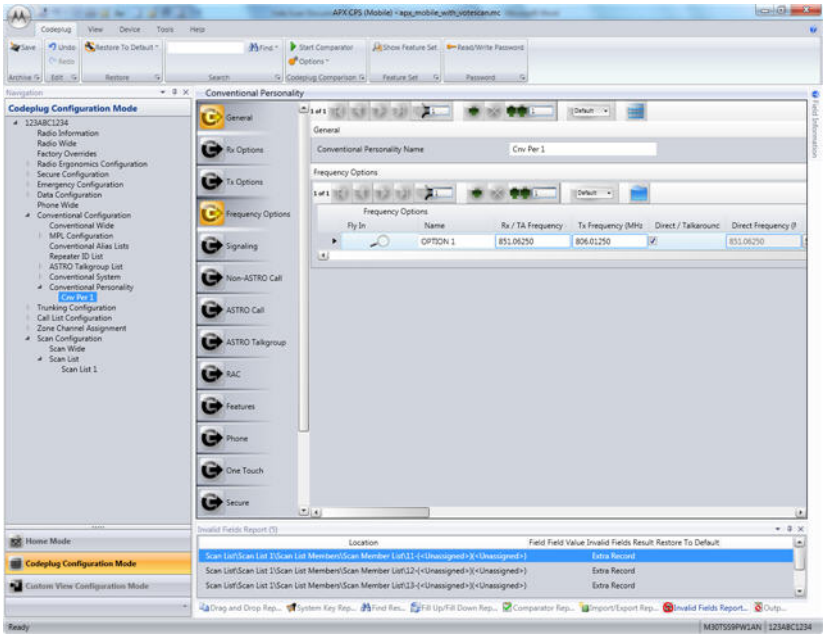
Field Name	Field Setting

Figure 28: Conventional Personality Window: Features Options



Mixed Vote Scan Enable	Selecting this option permits the configuration settings to represent a mixed vote scan.

Figure 29: Conventional Personality Window: Frequency Options

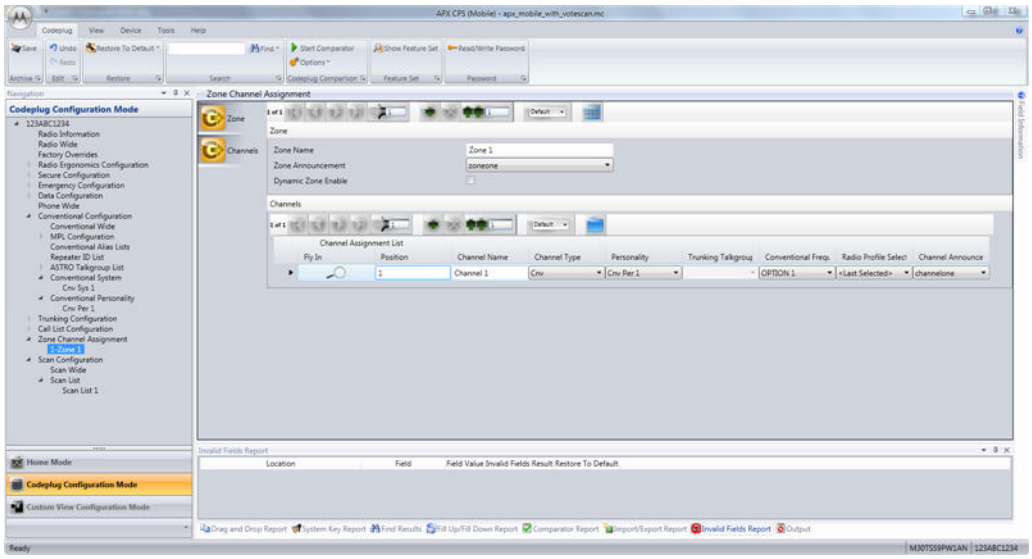


Frequency Options	The Frequency Options from the Conventional Personality are used to represent a vote scan system when the personality is Mixed Vote Scan Enabled. Additionally, the Frequency Option name is displayed when Display Strongest Voted Channel is enabled and the radio has unmuted to a Mixed Vote Scan Enabled personality.

Table continued…

Field Name	Field Setting
	With a mixed vote scan enabled, the system permits a maximum of 10 frequencies in this personality. The user adds all corresponding frequency options and creates a zone channel assignment, for example, vote scan system 1. The user then selects the personality containing all frequencies, and adds the zone channel to scan list in the **Scan List 1 (My Scan List)** window, **Scan List Members** fields.
Codeplug Configuration → Zone Channel Assignment → 1–Zone 1	

Figure 30: Zone Channel Assignment Window



Zone Name	
Channel Assignment List	Within a zone, add the channels to be used in the Vote Scan List. **NOTICE:** All channel parameters except receive frequency must be identical. Channels can point to different personality numbers as long as all parameters except receive frequency are identical. The Channel Assignment List places no restriction for Mixed Vote Scan members to be in the same zone. When a Mixed Vote Scan Enabled personality is added to a channel, that Zone/Channel combination is added as a scan member. The entire vote scan system is added as part of the scan list. The frequencies for the vote scan system are located in the Frequency Options section of the **Conventional Personality** window.

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