MOTOROLA
intelligence everywhere™

THEORY OF OPERATION:

PASSPORT® SITE SEARCH

Version 02.00-D04

TABLE OF CONTENTS

1 INTRODUCTION

The PassPort® protocol provides a low cost solution for providing wide area coverage previously unavailable to system operators using LTR. With the ability to network sites into a PassPort system, programming of Motorola subscriber units takes on a new dimension. Every network is unique; the number of sites, topological locations, coverage overlap, signal strength, and network configuration is different between every system. As such, subscriber units need to be programmed for optimum performance as they travel within the sites of their specific systems.

This document covers the theory of operation of searching and mobility of Motorola Professional Series Radios (HT1250•LS+™ and CDM1550•LS+™). It also covers the different parameters of the PassPort Customer Programming Software (PPCPS) that affects the subscriber's search behavior. Through this document, system operators will understand the dependencies of the different PPCPS fields and will thus have the ability to program their subscriber units for optimal search performance within their respective networks.

2 VHF-specific operation

The VHF band has specific operation affecting the roaming and the registration.

2.1 TX/RX frequency pairs

First, for VHF channels the TX frequencies do not follow a fixed offset from the RX frequencies. A VHF radio can learn the VHF TX/RX frequency pairs as follows:

1. The VHF TX/RX frequency pairs can be entered with PPCPS in the VHF System Channel List table. This table can hold the TX/RX pairs of the system. The table is pictured in Figure 2.1.
2. The VHF TX/RX frequency pairs can be dynamically acquired from NTS messages.

If a TX/RX pair is not known to the radio, meaning that it is not programmed in the codeplug or the radio didn't receive from the NTS the pair yet, the radio will eventually acquire it from the NTS during or after registration. This process takes a certain delay based on the loading of the system and on the number of channel on the site.

Note: The NTS Dual channel card version 2.8.0107 and after is recommended to eliminate a known issue where the wrong TX/RX frequency pairs are broadcasted to the radios. This known issue occurs only in a specific scenario when upon a PTT press immediately after the radio has been redirected to its grouping channel, the radio may display an "RX Only" error message and generate an Inhibit tone.

VHF Recommendation:
For sites configured as Collect/Grouping, it is strongly recommended to add the TX/RX frequency pairs of the grouping channels in the "VHF System Channel List" of the radios.
If the recommendation is not followed, a PTT press of the radio requiring a trunk-off to a channel with an incomplet TX/RX pair information will result in a "RX Only" error message and an Inhibit tone. As soon as the missing channel information is acquired by the radio, the radio will be able to trunk-off to that channel.

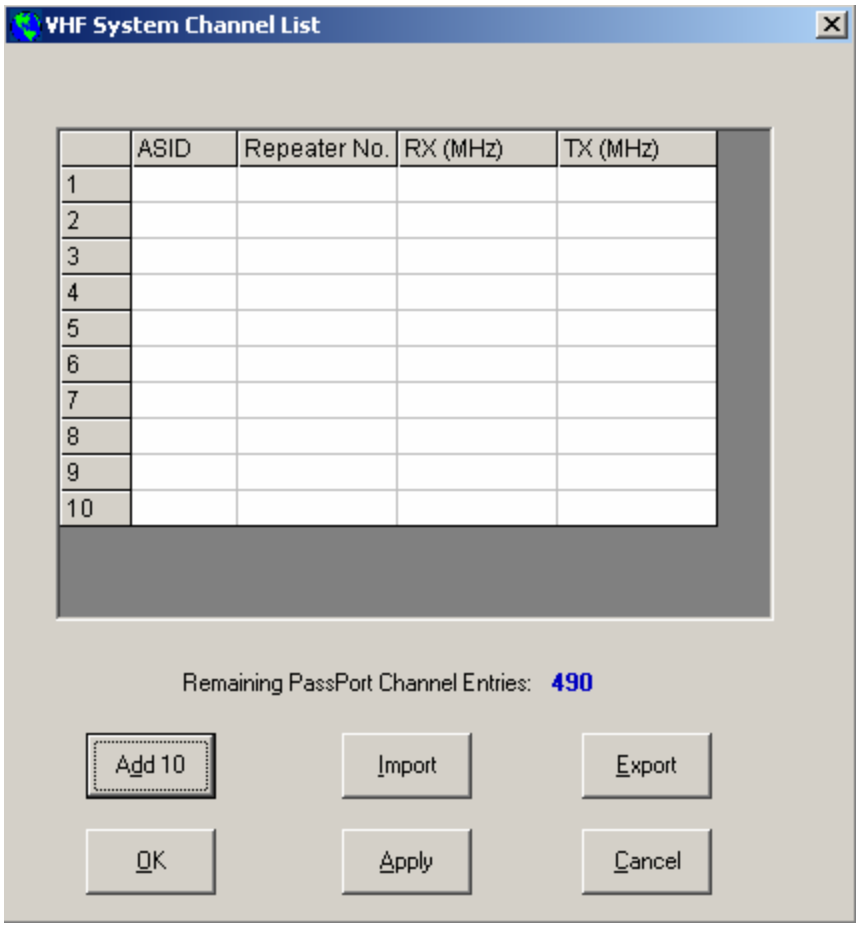


Figure 2.1 VHF System Channel List table

2.2 Non-Standard Frequencies

The other VHF-specific operation is the relationship between the frequencies and the DFAs. For other bands the relationship between the frequencies and the DFAs is fixed and documented (by either a formula or a table). The VHF DFAs from 1 to 1345 have defined frequencies. Those DFAs and corresponding frequencies are called Standard. The frequency of these DFAs is known and is hardcoded into the radio.

For the DFAs ranging from 1591 to 1791, the operator is free to assign them to any unassigned VHF frequencies. These frequencies are called non-standard. This assignment can be programmed into the radio codeplug using the Non-Standard Frequencies table pictured in Figure 2.2.

VHF Configuration Rule: All the Non-Standard Frequencies of the System, on which the radio will operate, shall be programmed into the radio using the Non-Standard Frequencies table.

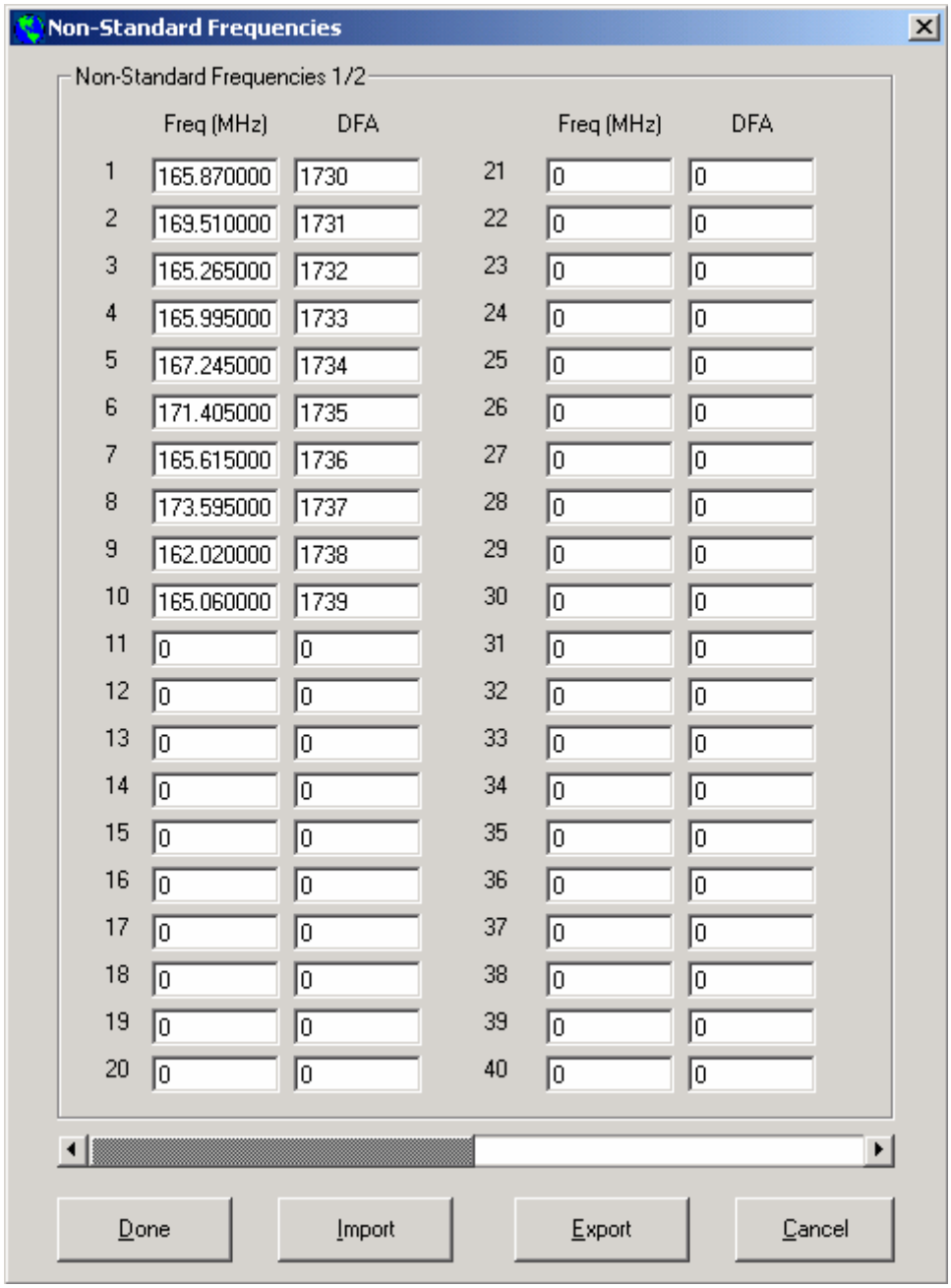


Figure 2.2 Non-Standard Frequencies table

3 ROAM DISABLE

There are some applications in which the system operator does not want subscribers to roam between PassPort sites. Some examples are when the PassPort system consists of a single site, or when the subscriber unit is being used as a stationary dispatch console. In these instances, the desired behavior is for the subscriber unit to remain on the home site. Subscribers unit will

scan its Primary Home Channel and Backup Home Channel if it is programmed and the value is different than Primary Home Channel.

Each PassPort zone represents a unique identity that the subscriber unit has while in PassPort operation; each PassPort zone has its own Mobile Identity Number (MIN) that it uses to access the PassPort system. Thus a subscriber unit can have multiple identities with each identity operating on a specific PassPort system. Some of these systems may be single site systems. With this in mind, roam can be disabled on a per zone basis. In other words, in a subscriber unit with multiple PassPort zones, roam can be disabled in some zones while active in others.

One must remember that even when roam is disabled, the subscriber unit may still enter a state where "SEARCHING" will be shown on the display. This occurs when the subscriber experiences a complete loss of PassPort data or if RSSI threshold qualifications are not met. However, in this state, the subscriber unit will only be searching for its home site. For more information regarding complete loss of PassPort data and RSSI threshold qualification, please refer to the Basic Search and RSSI Search sections of this document.

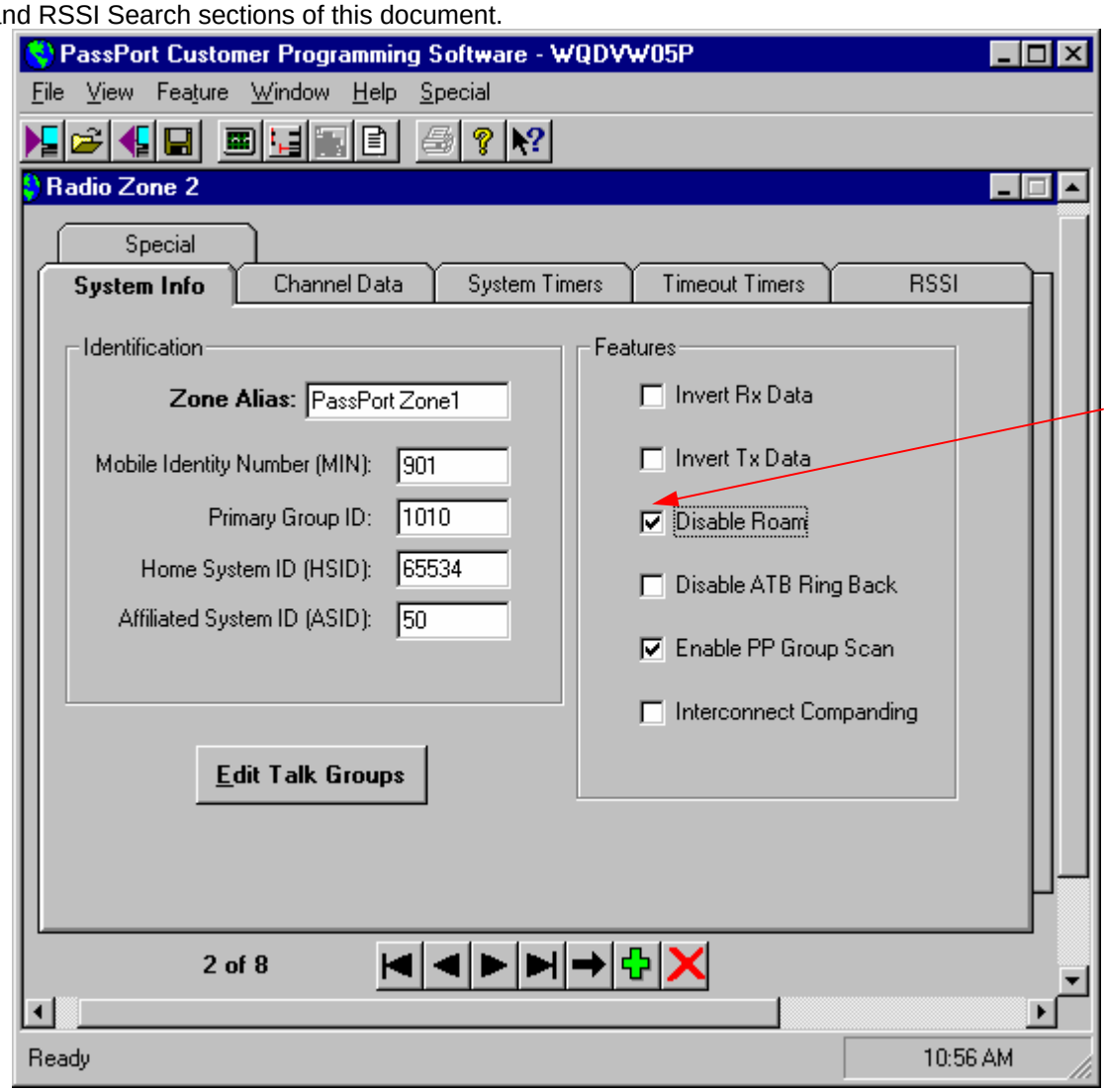


Figure 3.1 "Roam Disable" in PassPort Zone Window – System Info Tab

To disable roam, check the Roam Disable Checkbox in the PPCPS Zone Window, under the System Info Tab as shown in Figure 3.1. This disables roam for that PassPort zone. In addition, under the System Timers tab, it is recommended that Roam Delay Time and Roaming Wait Time be extended to at least 60 seconds each. Shorter values for these timers apply only to subscribers that have roam enabled. More information on these timers will be provided in the Basic Search section of this document.

4 BASIC SEARCH PATTERN

If the PassPort system contains more than one site, the subscriber unit will execute a specific search pattern in order to find a site upon which to register. This search pattern is highly customizable by the system operator.

4.1 Prefer Last Registered

The first frequency in basic search pattern can be either the home site or the last registered site. In applications where the subscriber unit is predominantly on its home site coverage area (which is prone to occur when there is significant coverage overlap between the PassPort sites), the home site is the desired first frequency. In systems with little coverage overlap and the subscriber unit travels extensively amongst the sites, the last registered site is the desired first frequency.

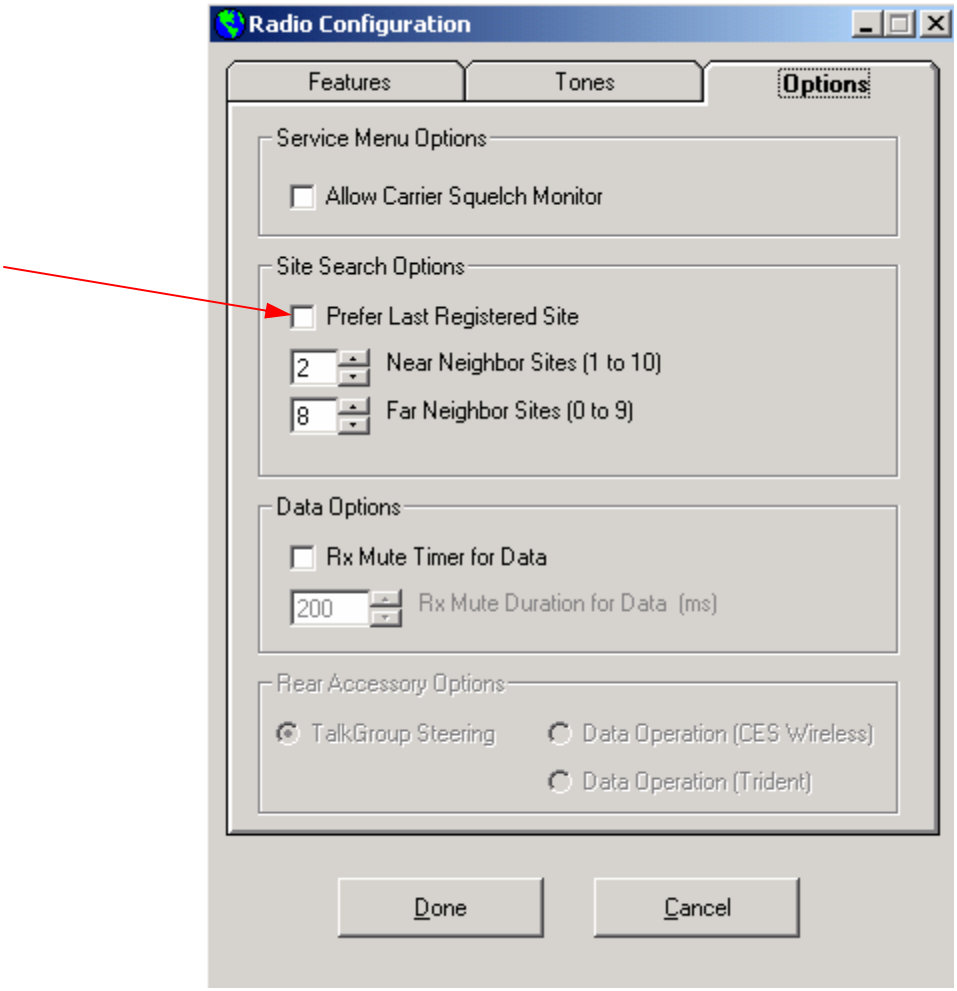


Figure 4.1 "Prefer Last Registered", "Near Neighbor Site" and "Far Neighbor Sites" in Radio Configuration Window

From the PPCPS Radio Configuration Window -> Options Tab as shown in Figure 4.1, if Prefer Last Registered is unchecked, then the home site will be the first frequency to be searched. If checked, then the last registered site will be the first frequency to be searched.

4.2 Backup Channels

The signaling of the Enhanced PassPort Protocol allows the system to activate (or deactivate) critical Backup Channels when necessary. These include a Backup Home Channel on a radio's Home System, Backup Registration Channels for Roamers and Backup Home Channels for Roamers. A radio is programmed with its Backup Home Channel on the Home System. Backup Channel assignments for Roam systems are provided over-the-air. The radio knows when a Backup Channel is active through PassPort messaging.

Backup Home Channel on the Home System is programmable via PPCPS Zone Window -> Channel Data Tab as shown in Figure 4.2

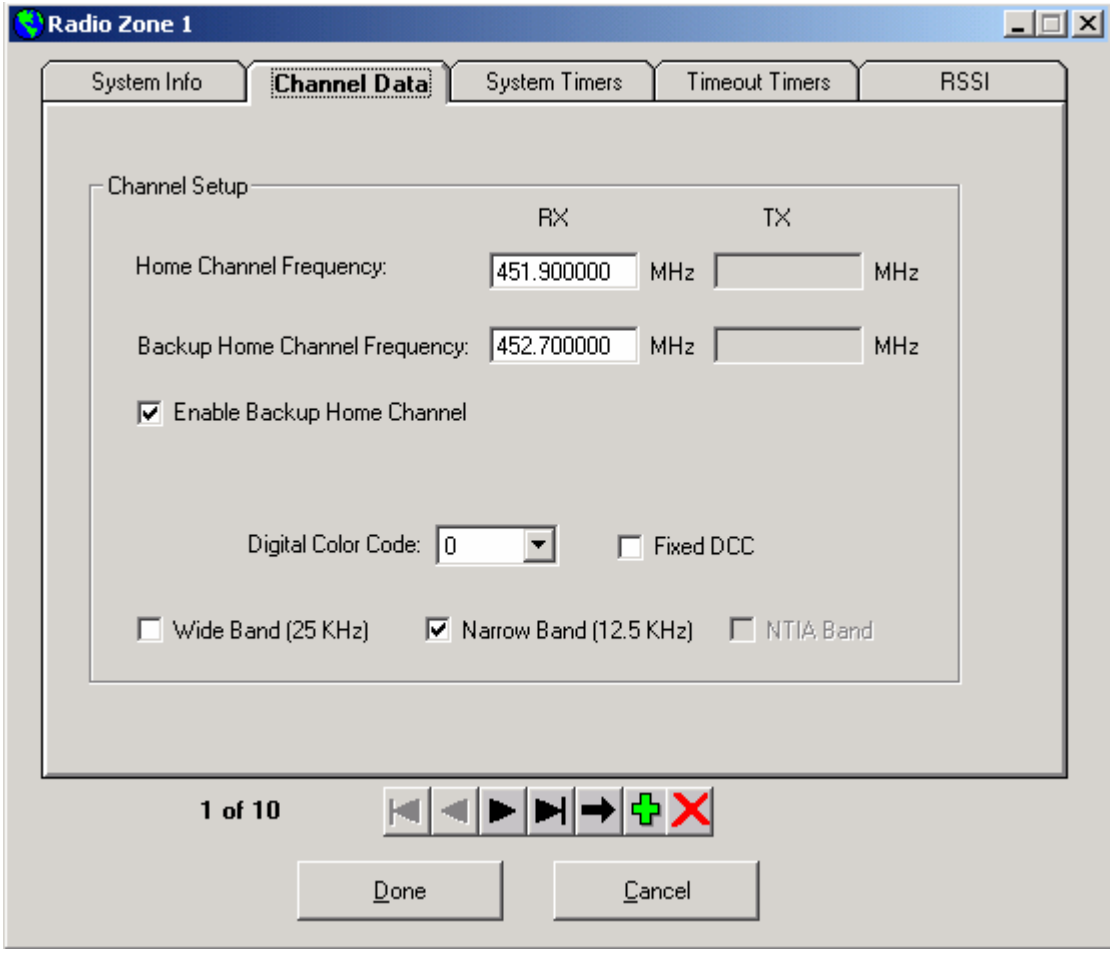


Figure 4.2 "Backup Home Channel Frequency" in PassPort Zone Window

When Backup Channel information is received by the radio, this channel information is incorporated into the radio search pattern. The search pattern will then alternate search frequencies with the Last Registered channel the Home channel and the Backup channel frequencies

Alternate Roamer Registration Channel is send by NTS over the air. If the Primary Roamer Registration Channel is up, the alternate Roamer Registration Channel is the Backup (Secondary) Roamer Registration Channel. If the Backup (Secondary) Roamer Registration Channel is up running, the alternate Roamer Registration Channel is the Primary Roamer Registration Channel. The radio knows where the alternate channel is primary or secondary through PassPort messaging.

.

4.3 Almanac

If the first frequencies, which include Home, Last Registered Channel, and Backup Home, searched do not yield a viable site to register to then the subscriber unit will begin to search its Almanac. Each PassPort site beacons (up to) seven frequencies that represent the roam home/collect frequencies of its neighboring site(s). Its also beacons its backup frequency for roamers. All These frequencies comprise the neighbor list of that PassPort site and are collected by the subscriber unit as it registers from site to site. The subscriber unit's Almanac is a dynamic list that stores and time stamps (up to) the last 10 neighbor lists collected. The Almanac is divided up into near and far neighbors sites.

4.3.1 Near Neighbor Sites

The most recent sites the subscriber unit has registered to are theoretically the sites that are most likely the closest sites (in terms of signal coverage) to the subscriber unit. Thus, statistically, those sites provide the best opportunities to register to. These sites are designated as the near neighbor sites and are the Almanac frequencies searched first and most often in the search pattern.

In the Basic Search Pattern, the Near Sites primary frequencies will be scanned first then the backup frequencies of the Near Site will be scanned. As the frequencies from the near neighbor sites are being searched, the subscriber unit will also periodically search for the home site (primary and backup frequencies) and last registered sites.

The number of Almanac neighbor lists designated as near neighbor sites is programmable via the PPCPS Radio Configuration Window -> Options Tab as shown in Figure 4.1.

4.3.2 Far Neighbor Sites

The least recent sites the subscriber unit has registered to are designated as the far neighbor sites. Once the near neighbor frequencies have been searched, the Far Sites frequencies will be added to the search pattern. The subscriber unit will now alternate searching near frequencies and far frequencies. As for the near frequencies, when the Far Sites frequencies are searched, the Basic Search Pattern will scan the Far Sites primary frequencies and then the Far Sites backup frequencies. It will also continue to periodically search for the home site (primary and backup frequencies) and last registered sites.

The number of Almanac neighbor lists designated as far neighbor sites is programmable via the PPCPS Radio Configuration Window -> Options Tab as shown in Figure 4.1.

4.3.3 Only Search Neighbors From Selected Zone's HSID

The Almanac is a radio wide list shared by all PassPort zones. Keeping in mind that each PassPort zone defines an identity that the subscriber unit takes on, these unique identities may or may not have access to the same PassPort sites. In other words, PassPort Zone 1 may not use the same sites as PassPort Zone 2. Thus when in PassPort Zone 1 and searching the Almanac, the subscriber unit should only search the neighbor lists collected by PassPort Zone 1. On the other hand if PassPort Zone 1 and PassPort Zone 2 share the same sites, then the subscriber unit should search the entire Almanac.

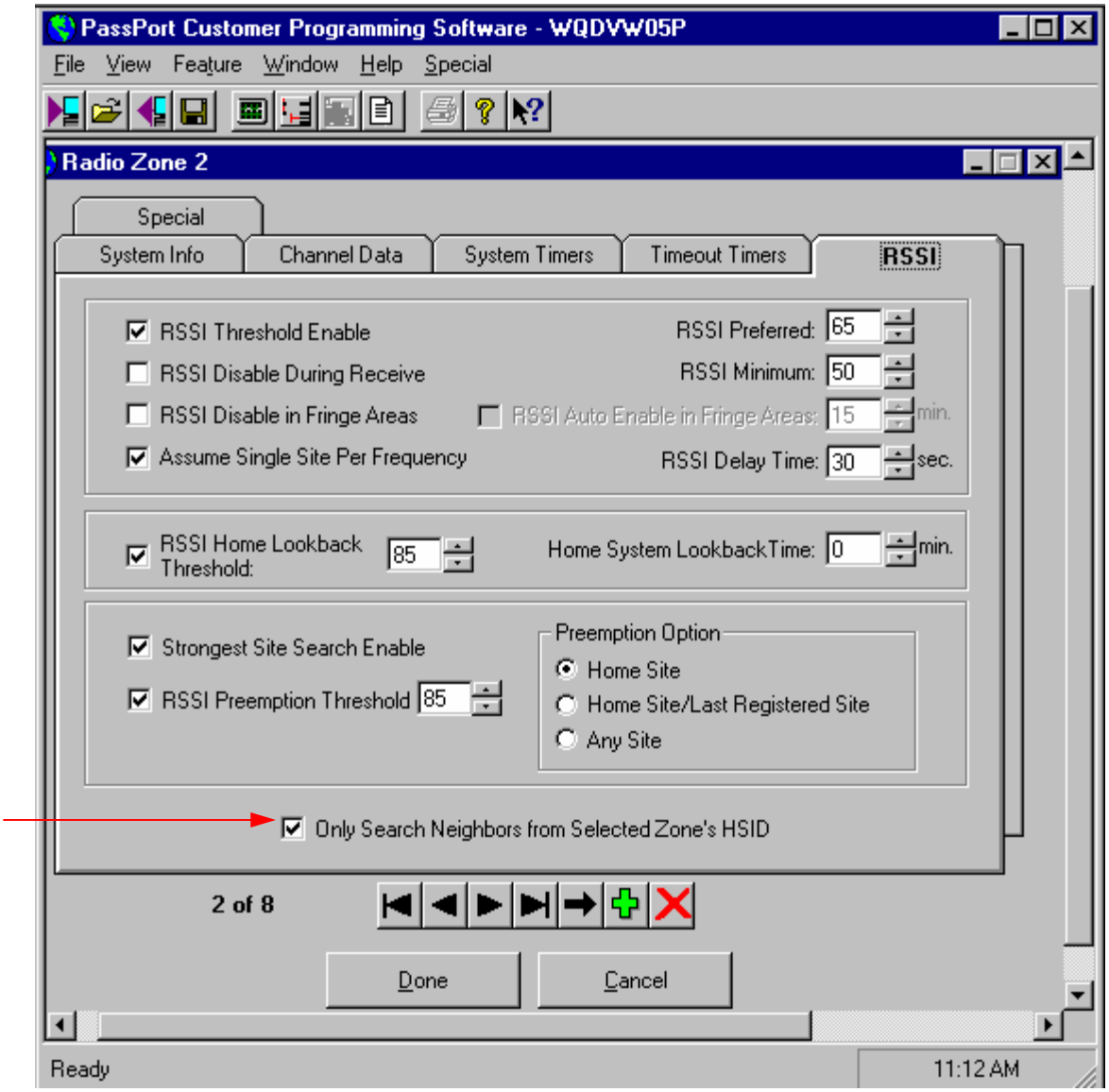


Figure 4.3 "Only Search Neighbors from Selected Zone's HSID" in PassPort Zone Window

In order to program the subscriber unit to search only the neighbor lists collected while in the current zone, Only Search Neighbors from Selected Zone's HSID should be checked in the PPCPS Zone Window -> RSSI Tab as shown in Figure 4.3.

4.4 Seed List

There are some instances where the radio is in an area covered neither by its home site, the last registered site, nor the sites stored in its Almanac. In this case, the Almanac search will not yield a viable site to register to. The PPCPS Seed Frequencies Window provides the system operator a list of (up to) 20 frequencies and (up to) 20 backup frequencies to search if the Almanac does not yield a viable site. Once the Almanac has been searched, the subscriber unit will begin to add seed frequencies and backup seed frequencies along with the near, far, home (primary and backup frequencies) and last registered frequencies in the search pattern.

Because seed frequencies and backup seed frequencies are added very late into the search pattern, there will be a significant delay before the seed list is searched. As such, seed frequencies and backup seed frequencies should be considered last resort frequencies; one should not expect that the subscriber unit will normally register to a site on a seed frequency.

One final note on the search pattern deals with duplicate frequencies. Considering that adjacent sites are neighbors of each other, the neighbor lists in the Almanac may contain duplicate frequencies. Furthermore, frequencies in the Almanac may also be in the Seed List. When the search pattern is generated, redundant frequency searches are avoided by excluding duplicate frequencies.

Seed Frequencies and Backup Seed frequencies are programmed through the PPCPS Seed Frequencies Window as shown in Figure 4.4 and Figure 4.5. For the VHF band, the Seed Frequencies and Backup Seed frequencies Window is pictured in Figure 4. and Figure 4.7.

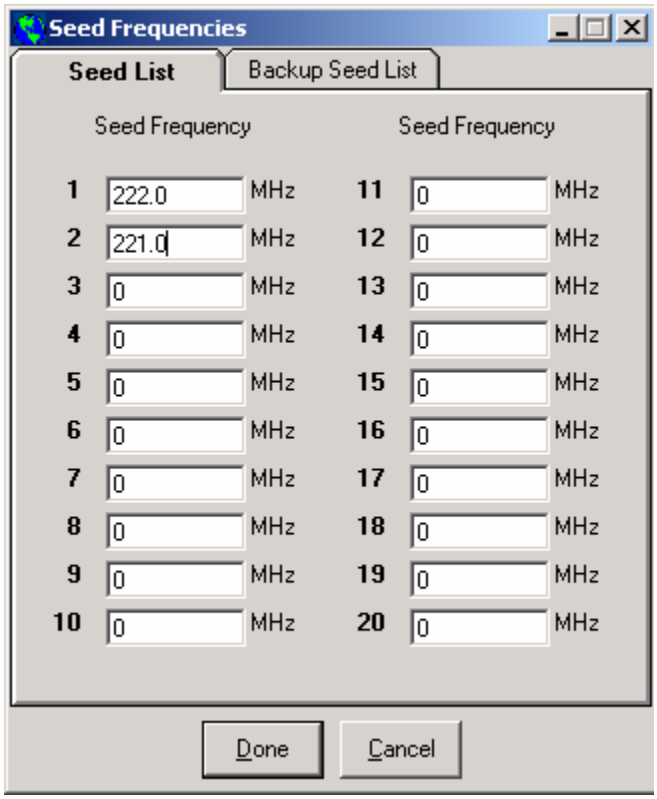


Figure 4.4 Seed Frequencies in Seed List Window

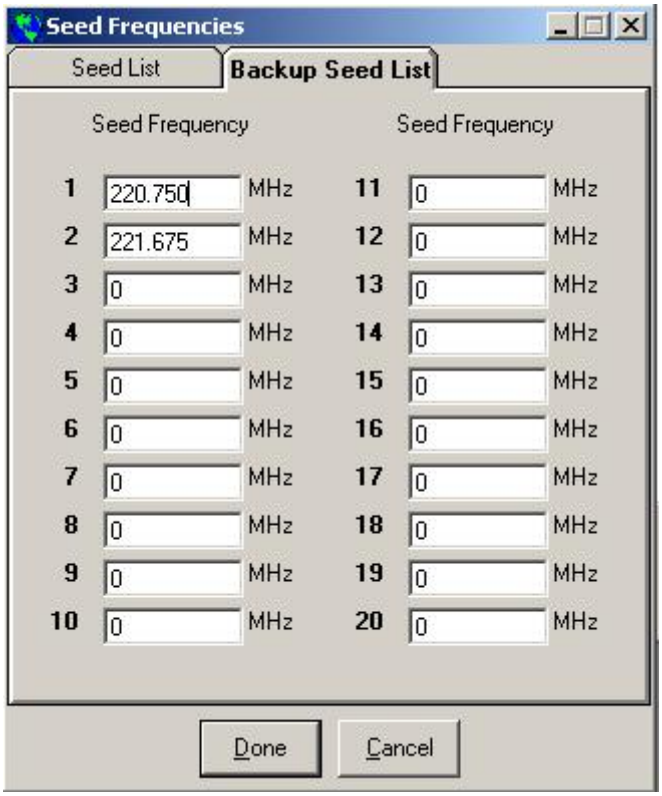


Figure 4.5 Backup Seed Frequencies in Backup Seed List Window

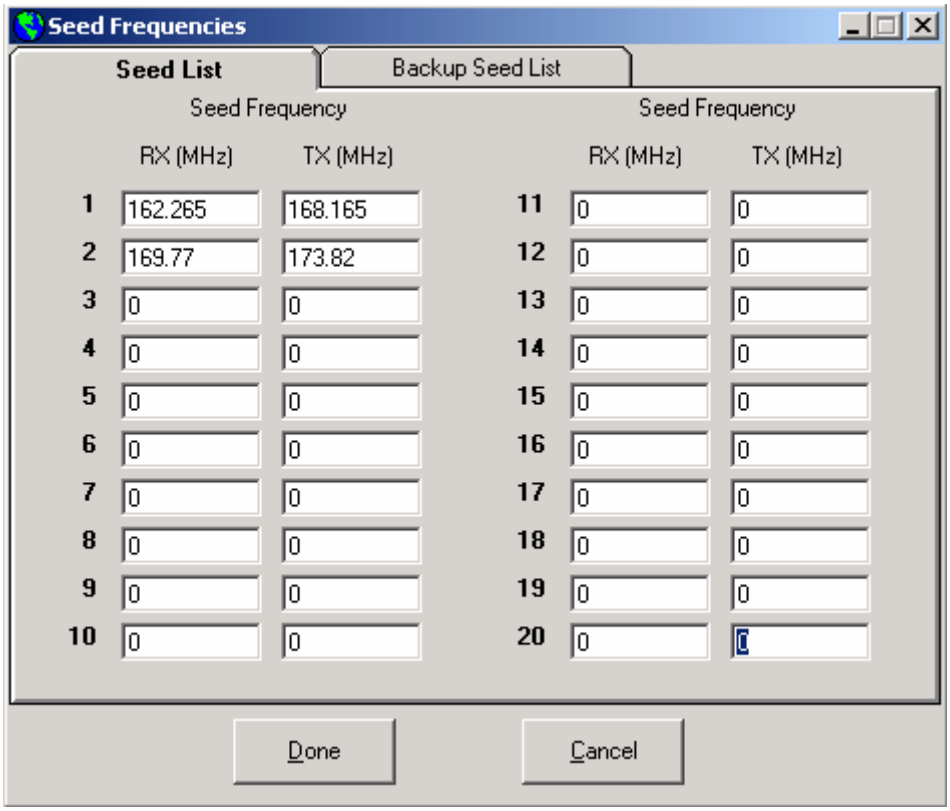


Figure 4.6 Seed Frequencies in Seed List Window (for VHF band)

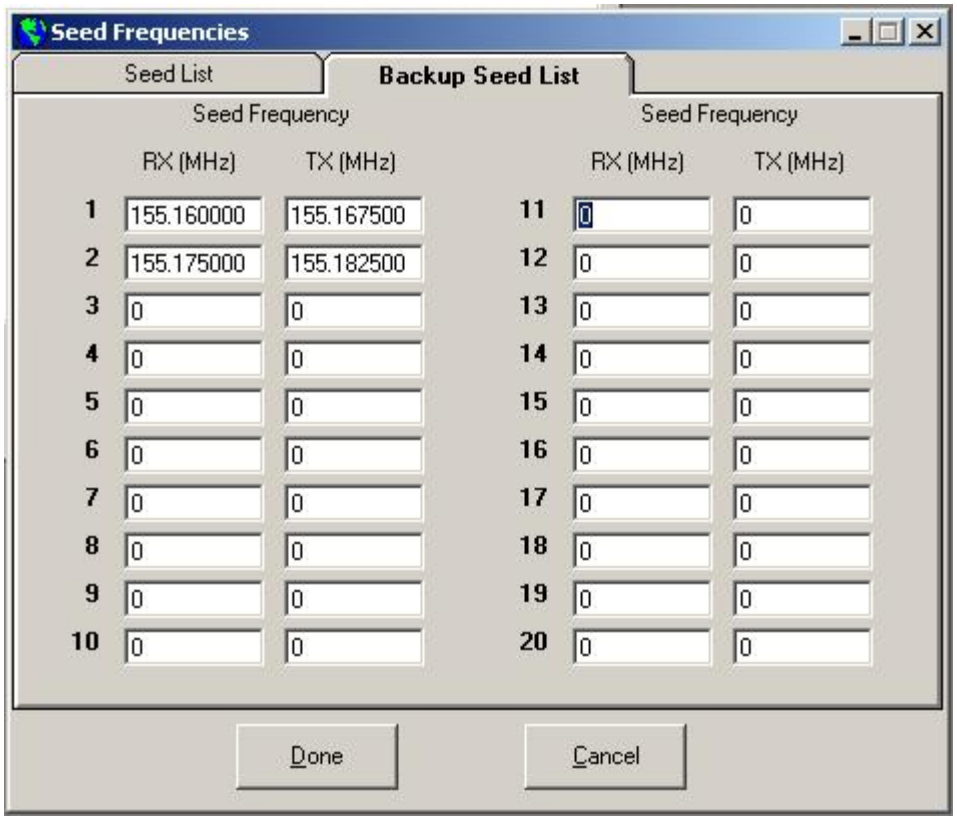


Figure 4.7 Backup Seed Frequencies in Backup Seed List Window (for VHF band)

4.5 System Timers

Within the PPCPS Zone Window -> System Timers Tab as shown in Figure 4.5, there is a set of Roaming Timers that affect the search timing.

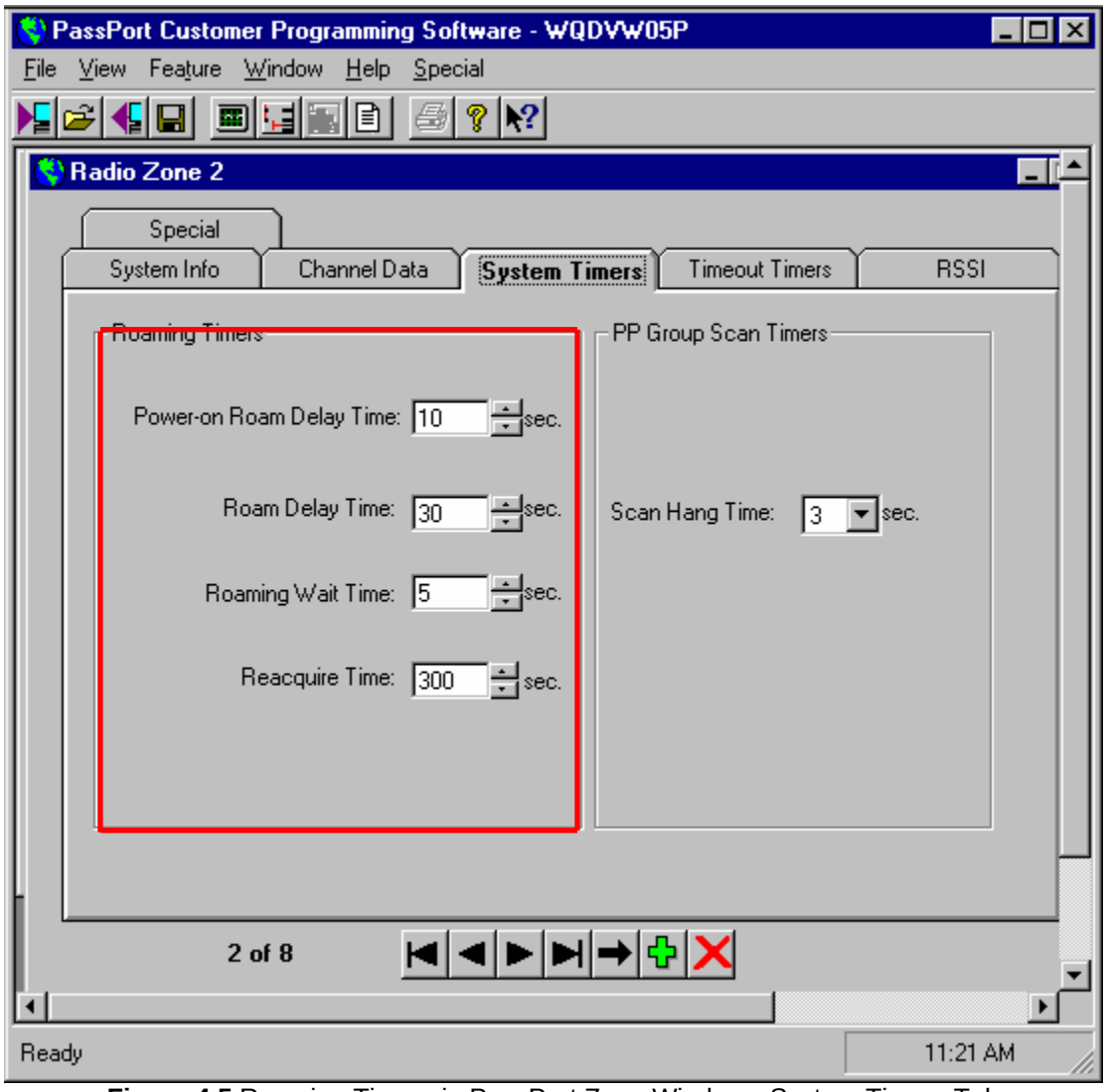


Figure 4.5 Roaming Timers in PassPort Zone Window - System Timers Tab

4.5.1 Power-on Roam Delay Timer

When radio is powered on, this is the amount of time the unit monitors the first frequency for a PassPort system message in order to determine that the site is in range. If no PassPort system message is decoded during this time, the subscriber unit will proceed to the next frequency in the search pattern.

4.5.2 Roam Delay Timer

When registered to a site, this is the amount of time a subscriber unit does not decode any PassPort system message before entering search mode.

4.5.3 Roam Waiting Timer

When searching, this is the amount of time the unit monitors a frequency for a PassPort system message in order to determine that the site is in range. If no PassPort system message is decoded during this time, the subscriber unit will proceed to the next frequency in the search pattern.

When registered to a site, this is the maximum amount of time within which the subscriber unit expects to receive a PassPort system message in order to compute the site's RSSI average. If no PassPort system message is decoded during this time, the subscriber unit will assume it has missed a PassPort system message due to weakening RF coverage and accordingly drops the RSSI average.

Note: Roam Waiting Timer should not be set less than the Idle Message Timer on the PassPort NTS Channel Card. The recommended adjustment is to set the Roam Waiting Timer two (2) seconds longer than the Idle Message Timer in the PassPort NTS Channel Card.

4.5.4 Reacquire Timer

When the subscriber loses affiliation to the site and enters a search mode, the subscriber unit may reacquire the home channel of the site it was previously registered to. If this occurs within the duration of the Reacquire Timer, the subscriber unit will soft-register back to the site.

Soft registration means the subscriber unit will assume it is still registered to a site because it had not left the site for an extended period of time. The benefit of a soft registration is that the radio does not engage the site in a registration session that uses up system resources. This feature is useful on systems that are loaded heavily.

However, because a soft registration entails a subscriber assumption that it is still registered to the site, the timer should not be too long. Consider the scenario where a site has reset due to a power failure. While the site is rebooting, no PassPort messages are being sent over the air. Thus the subscriber unit would enter a search mode. If the site comes back up before the reacquire timer has expired, the subscriber unit would reacquire the site believing that it is still registered to the site. However, because the site had rebooted, all registration information was actually lost. Thus the subscriber unit is not actually registered to the site.

Due to the above scenario, it is highly recommended that Reacquire Timer be used only in systems that are heavily loaded. If system resources are available, the subscriber unit should be configured to a minimal value.

5 RECEIVED SIGNAL STRENGTH INDICATOR (RSSI) SEARCH

Note: Radios compatible with Passport operation are Factory tuned for RSSI. This tuning logs the Rx performance of each radio and uses an algorithm to standardize the reported RSSI value based on signal strength. There should be no need to retune this value in the field, unless the value has been lost through failure or repair.

Some networks are configured so that there is a significant amount of overlap in coverage. In these networks, it is not uncommon for the subscriber unit to be within the coverage area of multiple sites. Other user applications require that a minimum audio quality level be maintained in order to remain affiliated to a site. In short, there are some applications that require the subscriber unit to be registered to a site with a certain signal quality level. If that signal quality level is not satisfied, then the subscriber unit should search for another site.

The Motorola subscriber unit continually monitors the signal strength of the registered site upon reception of a PassPort system message. It stores the signal strength in the form of an RSSI average. By using this RSSI average, the subscriber unit can determine if it is in a poor coverage area. The system operator can consequently define RSSI thresholds that must be satisfied in order to register to or stay registered on a site.

5.1 RSSI Test Mode

Prior to defining these RSSI threshold levels, the system operator needs to have intimate knowledge on the strength of coverage that their PassPort system provides. The system operator needs to know where the weaker areas of their system are located. Drawing RSSI contour maps of each site can attain this characterization in signal coverage. Systems that have been optimally configured generally already possess signal contour maps.

The subscriber unit does provide a tool, RSSI Test Mode, which allows the system operator to view the RSSI readings the radio receives. RSSI Test Mode is accessible via the front panel:

1. Push the Menu Button
2. Immediately Push < then >
3. “Service Menu” will appear on the display
4. Push the Menu Button
5. Push ^ until “Show RSSI” appears on the display
6. Push the Menu Button
7. Push ^ until “Show RSSI On?” appears on the display
8. Push the Menu Button
9. “Show RSSI On” will appear on the display
10. Push the menu Exit button to return to PassPort operation

While RSSI Test Mode is active, the following will periodically appear on the screen:

± 57 – 104 ± 108

a. The first character (**±**) represents whether or not the home channel is in use. A’+’ signifies it is in use. A ‘-‘ signifies it is free.
b. The first number (57) represents the site number
c. The second number (104) represents the instantaneous RSSI reading
d. The next character (**±**) indicates whether or not the subscriber unit is in a fringe area. (‘+” means fringe, ‘-‘ means non-fringe)
e. The third number (108) represents the average RSSI of the last two RSSI samples.

By taking RSSI readings as the subscriber travels throughout the PassPort system, the system operator will be able to generate RSSI contour maps. The RSSI readings can be converted into applied signal strength readings via the RSSI charts included with the PPCPS. The RSSI charts (specific to radio model and band) are RSSI vs. Applied Signal Strength (in dBm or µV) graphs.

Doing the following can turn off RSSI Test Mode:

1. Push the Menu Button
2. Immediately Push < then >
3. “Service Menu” will appear on the display
4. Push the Menu Button

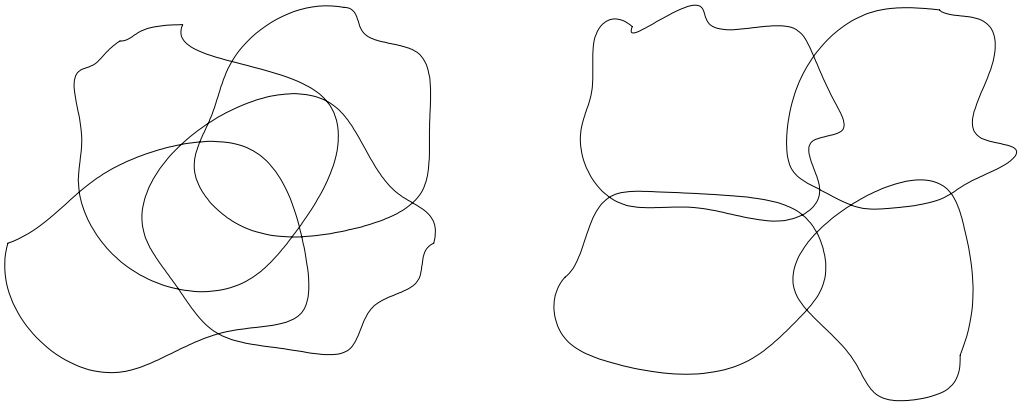
5. Push ^ until “Show RSSI” appears on the display
6. Push the Menu Button
7. Push ^ until “Show RSSI Off?” appears on the display
8. Push the Menu Button
9. “Show RSSI Off” will appear on the display
10. Push the menu Exit button to return to PassPort operation

An example of using contour maps to determine RSSI thresholds is included in Appendix A.

5.2 RSSI Threshold Enable

If there is only one site, or if there is no overlap in coverage of sites, RSSI threshold qualification should not be used. In that case, it would be desirable for the subscriber units to stay registered to a site as long as they can possibly decode the PassPort data. RSSI threshold qualification should be used when the system consists of multiple sites with some overlap in coverage of the sites. The RSSI threshold qualification will allow the PassPort radio to roam from site to site to provide the best possible coverage.

The RSSI thresholds programmed depend on the actual system configuration. Systems with significant overlap in coverage between sites should typically have higher RSSI thresholds. Systems with little overlap should typically have lower RSSI thresholds.



Examples of PassPort systems with significant and little overlap

This allows systems with significant overlap to search for a stronger site when the signal starts to degrade. With significant overlap, there will most likely be another site that provides satisfactory coverage. In a system with little overlap, the subscriber should accept minor degradation in signal quality in order to stretch the range of the site as far as possible. In short, the acceptable operating ranges for RSSI depend on site overlap.

However one must keep in mind that when a radio is searching for a site to roam to, it will not receive calls. Also as the number of roamed subscriber units increases, the loading of the system also increases. When all the units on a specific talkgroup are registered on their home site, a dispatch call on that talkgroup uses only 1 channel. However, for each roamed unit (in that talkgroup) an extra channel on each of the roamed sites is occupied during each dispatch call.

Thus, though roaming provides better signal coverage, one must be aware of the trade-off in terms of increased channel usage.

In order to enable RSSI threshold qualification, the RSSI Threshold Enable Checkbox (PassPort Zone Window -> RSSI Tab as shown in Figure 5.1) should be checked. This activates the rest of the RSSI specific parameters.

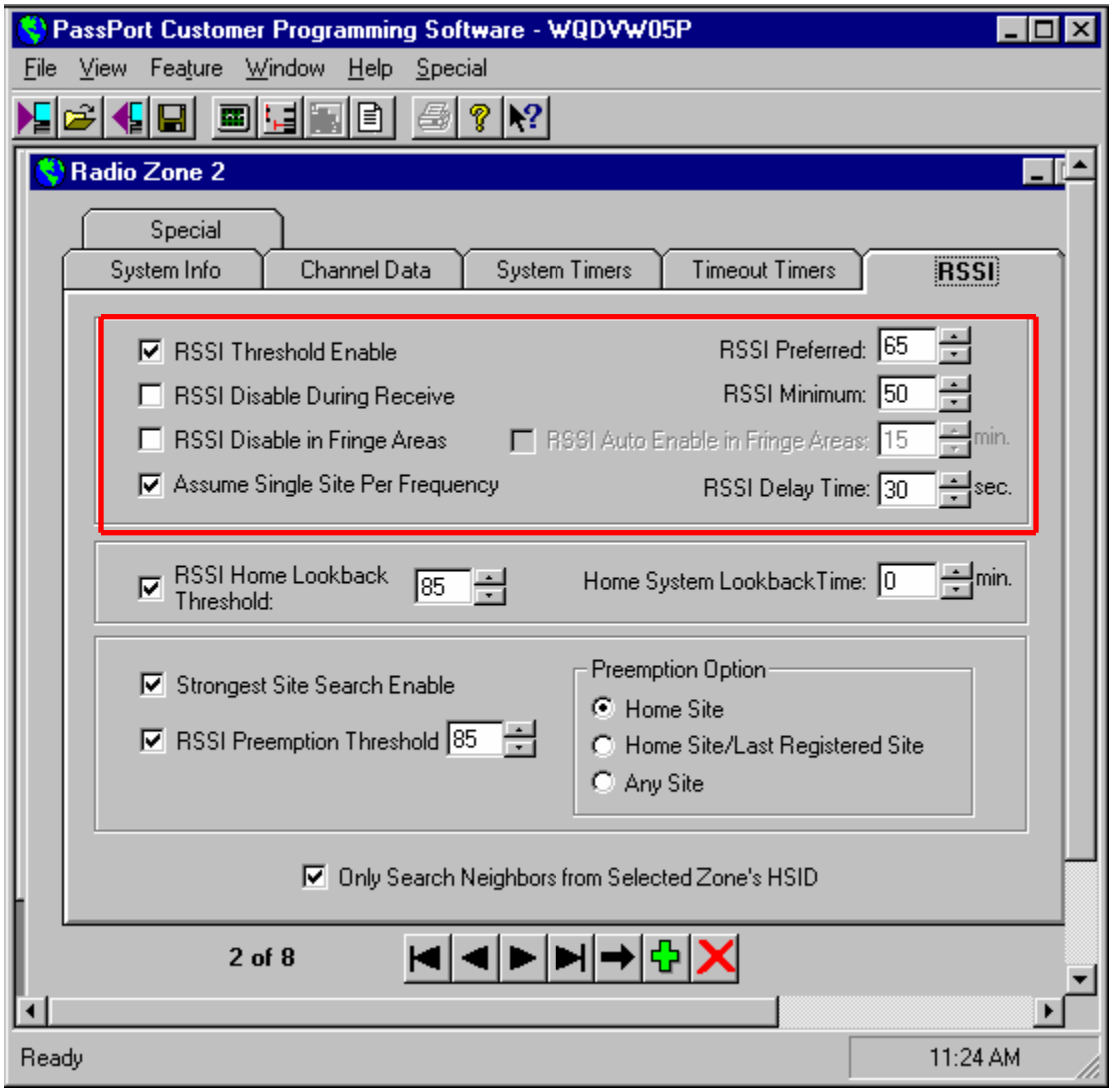


Figure 5.1 RSSI Threshold Enable in PassPort Zone Window – RSSI Tab

5.3 RSSI Preferred

RSSI Preferred is the minimum level required to qualify for registration. If the sampled RSSI is below the RSSI Preferred, the subscriber unit will not register on the site, but will continue to search for a site that is above the RSSI Preferred.

In general, system operators want to set this threshold to the median value of their acceptable operating RSSI range. Setting a value too high prevents the subscriber unit from registering. On

the other hand, setting a value too low makes the subscriber unit prone to frequent site searches because RSSI Preferred is too close to RSSI Minimum.

5.4 RSSI Minimum

The RSSI Minimum is the minimum signal level that the subscriber unit requires to maintain affiliation. In other words, once the subscriber unit is registered, it will stay registered on that site as long as the average RSSI is above the RSSI Minimum**.** If the average RSSI falls below the RSSI Minimum and stays below the RSSI Minimum for as long as the programmed duration for RSSI Delay Time, the subscriber unit will begin to search for a better site.

5.5 RSSI Delay Time

The RSSI Delay Time is the time that RSSI average must be below the RSSI Minimum before the subscriber unit starts to search for a better site. This time allows for the mobile or portable to pass through momentary fades in signal strength without roaming unnecessarily. If the time is set too low, the subscriber unit will roam more than necessary. If it is set too high, the subscriber unit may be out of adequate signal coverage for too long before it starts to search for a better site.

5.6 RSSI Disable During Receive

If this box is checked, the subscriber unit will not roam due to RSSI while receiving a transmission from another subscriber unit. If the signal drops below the RSSI Minimum while receiving, it will stay registered until the end of that transmission then revert to site search. This prevents the subscriber unit from being interrupted during a dispatch call.

5.7 RSSI Disable in Fringe Areas

There are instances when the subscriber unit may be in an area where there is no site with an RSSI level above RSSI Preferred. If RSSI Disable in Fringe Areas is checked, rather than remaining in a continuous search state, once the subscriber unit exhausts its search pattern (and does not find a site above RSSI Preferred) it will then disable RSSI threshold qualification. Once RSSI threshold qualification is disabled, it will then register to the next detected site. With RSSI threshold qualification disabled, the subscriber unit will then remain registered to the site until total signal loss occurs for the duration of the Roam Delay Time. RSSI threshold qualification will remain disabled during this search meaning the subscriber unit will then register to the next available site in its search pattern (regardless of that site being above RSSI Preferred).

RSSI threshold qualification will be re-enabled if:

1. The RSSI reading rises above RSSI Preferred for the duration of the RSSI Delay Time
2. The RSSI Auto Enable in Fringe Areas time expires.
3. PassPort Zones are switched
4. Power is cycled on the subscriber unit.

5.8 RSSI Auto Enable in Fringe Areas

When the subscriber unit registers to a site in a fringe area, it is possible that the subscriber unit will stay in the fringe area of that site for an extended period of time. Yet, portions of this site's fringe area are located in the other site's strong coverage area. The subscriber unit should then periodically re-enable RSSI threshold qualifications. By doing so, the subscriber unit will begin searching (because while in a fringe area the RSSI is below RSSI Minimum) and eventually find

the stronger site. This time interval is the RSSI Auto Enable in Fringe Areas timer. Note that RSSI Auto Enable in Fringe Areas is activated/de-activated via the associated checkbox.

5.9 Assume Single Site per Frequency

If the PassPort system is configured such that there is only a single site operating on a given frequency, the subscriber unit can be configured to reduce the duration of the site search. By selecting Assume Single Site per Frequency, the subscriber unit can make its decision on whether a site meets RSSI threshold qualification on the first PassPort system message it receives from that site. Because the subscriber unit assumes there is only one site per frequency, it concludes that this message can only have originated from the site it is searching for. As such, if the RSSI of this message is not above RSSI Preferred, the subscriber unit can then proceed onto the next frequency in the search pattern.

This faster search mechanism also applies to Strongest Site Search.

If Assume Single Site Per Frequency is not selected, the subscriber unit will wait the duration of the Roaming Wait Timer prior to proceeding to the next frequency in the search pattern (if RSSI Preferred is not met).

6 STRONGEST SITE SEARCH

Rather than simply registering to a site that is above RSSI Preferred, some system operators want their subscriber units to register to the strongest site. Strongest Site Search searches the near neighbor sites in the Almanac and determines which of those sites is the strongest and will then proceed to register to that site.

However, if none of the near neighbors are above RSSI Preferred, then the subscriber unit will proceed to search the far neighbor sites and eventually the seed list for a site above RSSI Preferred. If the entire list is exhausted and still no site was above RSSI Preferred and RSSI Disable in Fringe Areas is selected, the subscriber unit will attempt to register to the strongest of the searched sites.

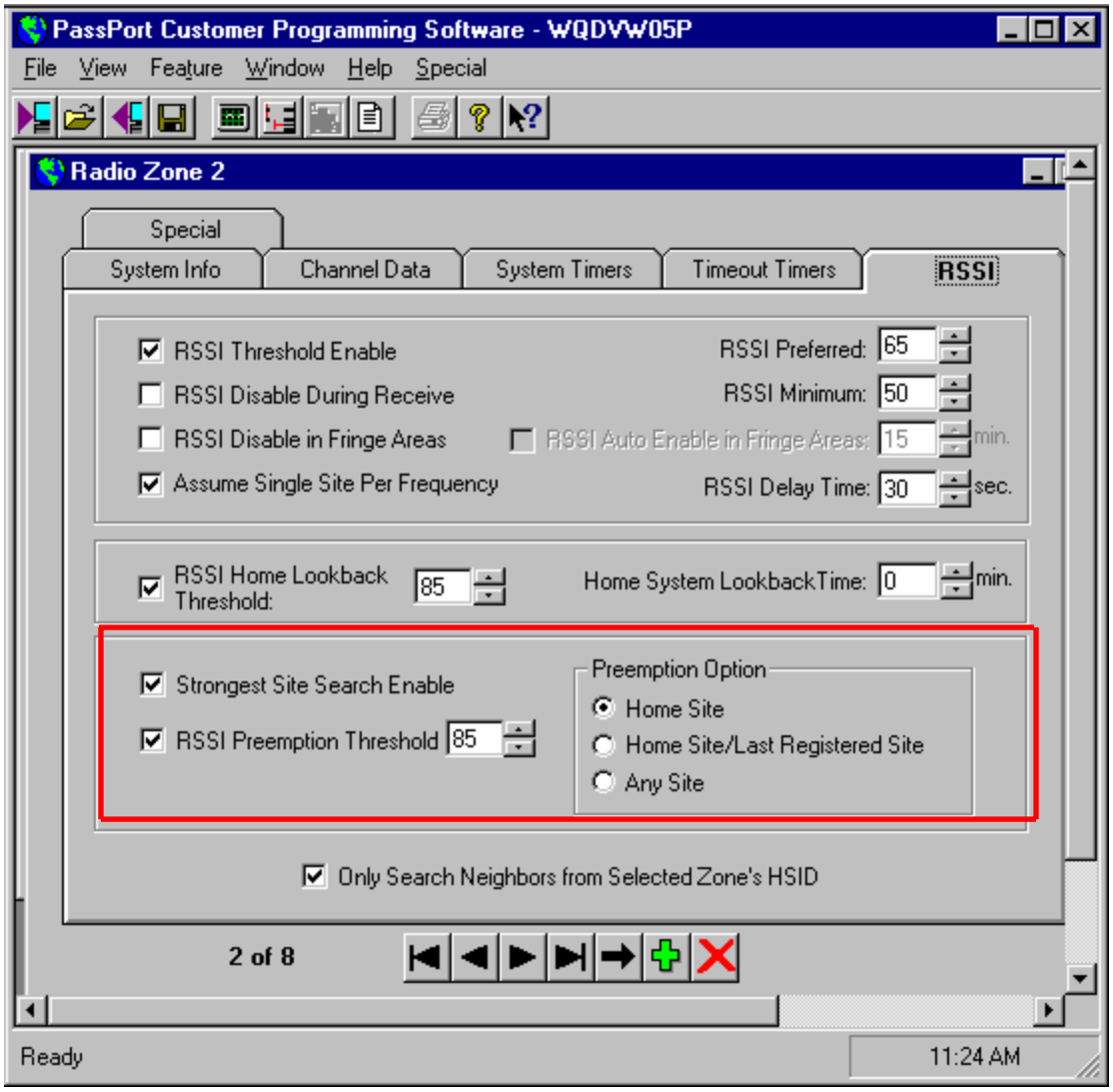


Figure 6.1 Strongest Site Search feature in PassPort Zone Window –RSSI Tab

6.1 Strongest Site Search Enable

Selecting Strongest Site Search Enable activates the strongest site search feature.

6.2 RSSI Preemption Threshold

In certain instances where the subscriber unit is searching the neighbor list and detects a site that is not necessarily the strongest of the near neighbors but is judged to be strong enough, Strongest Site Search can be preempted and registration to that site attempted.

For example, consider a scenario where the RSSI Preferred is set at 65 and there are six (6) near neighbors programmed in the Almanac. Now the first site in the search pattern has an RSSI of 105 yet the strongest site is truly the last site (28th frequency to be sampled) with an RSSI of 107. Once the site has an RSSI above 100, there really are very negligible differences in terms of signal quality to the system operator. Thus, rather than waiting for the entire 28 frequencies to be

searched, the subscriber unit can preempt Strongest Site Search after the first frequency because it located a site that was strong enough. This value is the RSSI Preemption Threshold.

Note that RSSI Preemption Threshold can is enabled/disabled via the associated check box as shown in Figure 6.1.

6.3 Preemption Option

The system operator also has the ability to determine what kind of site can preempt Strongest Site Search.

If Preemption Option is Home Site, then only if the Home Site is sampled above the RSSI Preemption Threshold will Strongest Site Search be preempted.

If Preemption Option is Home Site/Last Registered Site, then only if the Home Site or the Last Registered Site is sampled above the RSSI Preemption Threshold will Strongest Site Search be preempted.

If Preemption Option is Any, then any site sampled above the RSSI Preemption Threshold will preempt Strongest Site Search.

In Enhanced network, both Primary Home Channel and Backup Home Channel can preempt Strongest Site Search.

7 HOME LOOKBACK

7.1 RSSI Home System Lookback Time

When registered to an affiliate site, the subscriber unit can be programmed to periodically search for its home site. This is the RSSI Home System Lookback Time. Periodically performing this search ensures that the subscriber unit will be registered to its home site as much as possible. Being registered to the home site maximizes efficient use of system resources.

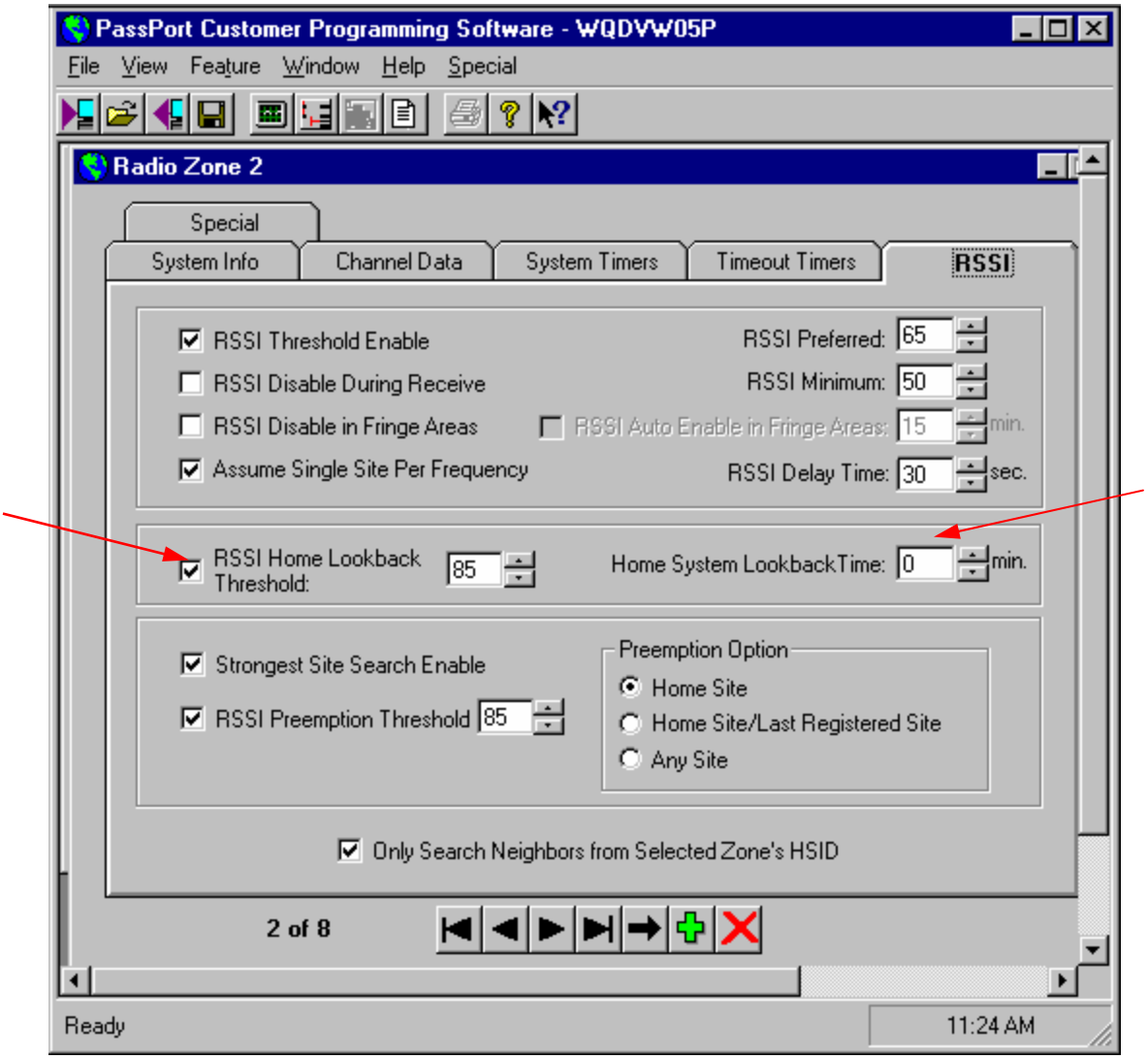


Figure 7.1 RSSI Home Lookback Feature in PassPort Zone Window – RSSI Tab

Note in Figure 7.1 that the Home System Lookback feature can be disabled by setting the time to zero (0) minutes. With this setting, the subscriber unit does not periodically search for its home site.

7.2 RSSI Home Lookback Threshold

The system operator can define a threshold level that the home site must qualify when performing a Home System Lookback. If the home site is above the RSSI Home Lookback Threshold, the subscriber unit will leave the current site and register back home. If the home site is not above the RSSI Home Lookback Threshold, then the subscriber will remain registered to the current site.

7.3 Home Lookback Search

In Enhanced network, when a subscriber unit does Home System Lookback, it will scan first its Primary Home Channel, if it can not register on its Primary Home Channel, it will scan its Backup Home Channel if programmed.

In Classic network, when a subscriber unit does Home System Lookback, it will scan its Primary Home Channel.

8 NTS DEPENDENCIES

There are some settings that reside primarily in the NTS Commander yet greatly affect subscriber performance. As such they have been included in this document.

8.1 Collect / Grouping Channels

The subscriber unit via Basic Search, RSSI search, Strongest Site Search, or Home System Lookback can readily identify the most viable site to attempt to register to.

PassPort includes a feature, Collect/Grouping Channel. By design, the collect channels are kept as free as possible to allow roamers to register to the site. Once the roamer has registered it is redirected to a grouping channel that will act as that roamer's virtual home channel.

For more information on how to configure collect/grouping channels, please refer to the NTS configuration manual and follow this VHF Recommendation.

On enhanced network, i.e. PassPort protocol 4.0 or newer, the subscriber unit, when attempting to register to an affiliate site, can trunk off to another repeater on that site if registration channel is busy, no matter the registration channel is Collect, Roam Home, Home or Backup Home Channel.

8.2 Invalid Zero (0) DFA in Neighbor Lists

Each channel card on the NTS 4.0 is programmed to beacon neighbor sites in the form of a DFA (Direct Frequency Assignment) number. This DFA number represents the frequency that the subscriber unit should monitor in order to register to the neighbor site. A DFA zero (0) will be considered as the last DFA to be broadcasted in the NTS. There is a maximum of 7 DFAs beaconed per channel card (which determine the neighbor list).

In classic passport network based on NTS2.8 or earlier, it's recommended that zero (0) should not be beaconed as a DFA. For systems that are made up of less than five (5) sites, the DFA numbers should be repeated.

In enhanced passport network, the DFA number does not need to be repeated.

8.3 Site & Group Restriction

A subscriber unit may be restricted from an affiliated site based on current NTS settings. If the subscriber unit is totally restricted from a site, the unit will not have any registered user capabilities (i.e. PTT, etc.). Upon site restriction, the unit will display "SiteRestrict" for approximately 3 seconds and proceed to roam for an available PassPort site.

A subscriber unit may also be restricted based on the selected talkgroup. If the selected talkgroup of the unit is restricted, the unit will have limited user capabilities. Upon group restriction, the subscriber unit will display “GrpRestrict” until valid user input is entered. When group restricted, the user has the capability to change the selected talkgroup or force roam to an available PassPort site.

For more information on how to site and group restriction, please refer to the Access Privileges section of the NTS configuration manual.

8.4 Roam Lock

In certain situations, the user may have the desire to lock on to a particular site to prevent the subscriber unit from roaming. If the user enters an elevator, the user has knowledge that the subscriber unit will have reduced signal strength for a brief period of time. In this scenario, the user may wish to remain on the currently registered site while on the elevator to eliminate the time associated with registering to a PassPort site after exiting the elevator. PassPort feature roam lock provides this capability.

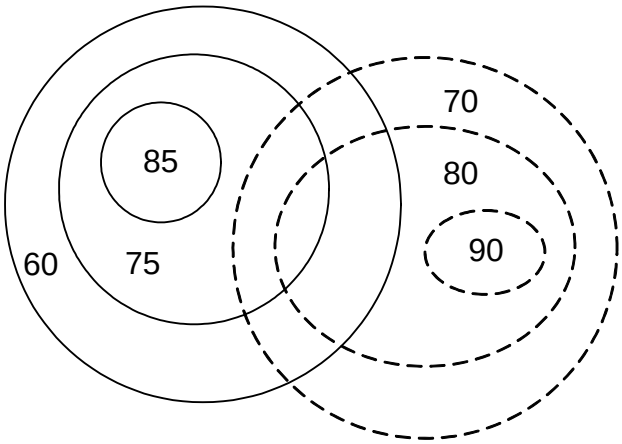
Roam lock allows the subscriber unit to lock to a particular site regardless of signal strength or RSSI threshold settings. When roam locked, the subscriber unit will toggle the display between the talkgroup alias and “Roam Locked”. When a subscriber unit is roam locked and falls below RSSI threshold, the unit will toggle the display between “SEARCHING” and “Roam Locked”. In this situation, the subscriber unit is still locked to the current site but has fallen below minimum RSSI threshold.

If the subscriber unit was registered on its home site, it will only search its programmed primary home channel and backup home channel. If the subscriber unit was registered on a roam site, it will only search the last registered channel and the alternate registration channel.

APPENDIX A: Using Contour Maps to Determine RSSI Thresholds

Contour maps provide a valuable tool to determine the various RSSI thresholds that affect the subscriber unit's performance. Following is an example of how a contour map can be used to determine the optimal value of RSSI Preferred to maximize system coverage overlap.

Consider a PassPort system consisting of two sites with overlapping coverage as follows:

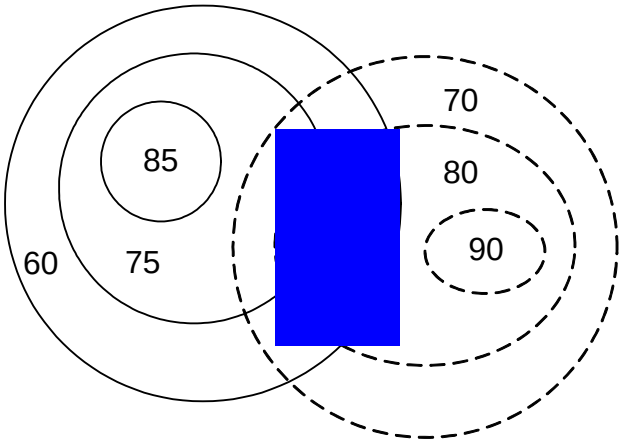


Suppose the user application requires:

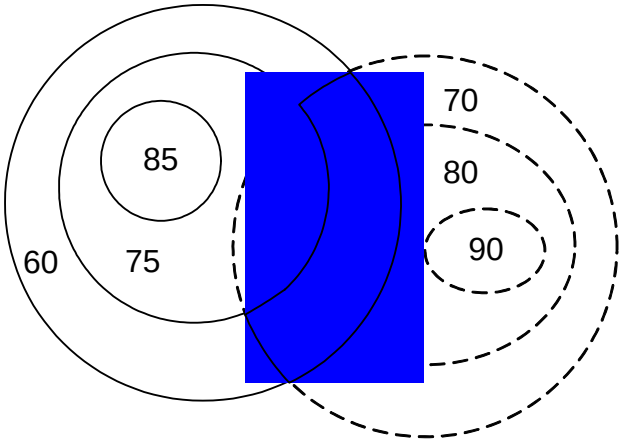
1. The unit shall search when RSSI is below 65
2. Maximized coverage overlap.

Requirement 1 implies RSSI Minimum should be set to 65. In order to determine RSSI Preferred for requirement 2, analysis using the contour map is necessary.

With RSSI Preferred set to 80, the effective overlap of the 2 sites is shown in blue below:



However, with RSSI Preferred set to 70 the effective overlap increases significantly as seen below:



Thus one can see that RSSI Preferred of 70 maximizes system coverage overlap.

Also, selecting RSSI Disable in Fringe Areas further increases system coverage. Please refer to section 4.6 for more detail.

Similar analyses can be conducted to determine optimal values for the other RSSI threshold parameters. Sections 4 through 6 provide detailed explanations of those parameters.

One must always keep in mind the tradeoffs between system coverage (roaming) and channel usage. RSSI thresholds that increase the number of roamers (i.e. more coverage overlap) also increase the loading of the system. However, the lower the coverage overlap, the lower the signal quality as the radio will remain affiliated on lower RSSI threshold levels. Contour maps help give more quantitative information with respects to these tradeoffs.

Please refer to section 4.1 for instructions on how to use the RSSI Test Mode tool to draw contour maps.