



SafeDispatchv4.0

Installation & SetUpGuide

Welcome!

SafeDispatch v4.0 is the essential data application for dispatchers and radio operators wanting to take control of their mobile assets. With the flexibility, control and performance of SafeDispatch, you now have the most cost-effective, professional MOTOTRBO solution right at your fingertips.

With important features to accommodate nearly any fleet management challenge, SafeDispatch interfaces with MOTOTRBO's professional radio systems seamlessly while providing the tools you need to most effectively monitor your employees, vehicles and materials.

SafeMobile has tailored features of the SafeDispatch information platform to enhance communication capabilities, data analysis and documentation, enabling you to control your fleet in a user-friendly, functional design. All elements are easy to use and accessible via any internet connected computer in the world.

This Installation Guide will help you to establish the necessary hardware and system requirements to run the installation of the SafeDispatch programs. Once installed, this section also will walk you through the necessary steps to configure and establish accounts and settings.

SafeDispatch® v4.0 will allow you to assess the components of a job or project, determine which tools in the suite are the most appropriate and combine their power to complete your mobile tasks effortlessly.

SafeDispatch is a set of modules primarily designed for monitoring distribution from your facility with GPS based location information and environmental data provided by your radio systems. The software modules perform a variety of analytical functions in an automated way, while allowing you to have instant communication with the field.

The real-time critical information, fast direct field communications and comprehensive reporting functions will enable you to manage your business safely, accurately and efficiently.

SafeDispatch v4.0 is your complete asset management solution.

The Installation and Set Up package you have just downloaded consists of two parts:

First, this manual, intended to serve as an installation guide of the software modules.

Second, the package also contains a tutorial with examples to set up and begin using SafeDispatch v4.0 today.

Copyright©2014 SafeMobile

All rights reserved.

No part of this publication may be copied, distributed, stored in a retrieval system, translated into any human or computer language, or transmitted, in any form or by any means, without the prior written consent of SafeMobile.

SafeMobile and SafeDispatch v4.0 are registered trademarks of SafeMobile. Any other brand names and trademarks appearing in this guide are the property of their respective holders.

Comments? Please email all comments on this document to: support@safemobile.com.



Table of Contents

Welcome!	1
Table of Contents	3
Architecture Overview.....	5
Software Architecture Overview	5
System Overview	6
Data Storage	8
SafeDispatch™	9
Functional capabilities	9
System Requirements.....	9
Software Installationand Configuration	12
AppServer PC Installation	12
Dispatcher PC Installation.....	16
Administrative Module (Admin Module)	17
Starting SafeDispatch	23
SafeMobile Support.....	24
Appendix A	25
Configuring the MOTOTRBO system for SafeDispatch.....	25
MOTOTRBO CPS Installation.....	25
Configuration of MOTOTRBO Radios.....	26
General Considerations	26
“Data Call Confirmed” Considerations	27
Emergency Considerations	27
Loading Considerations	28
GPS Revert and “Enhanced GPS” Considerations.....	28
Programming of Simplex Systems	30
Programming of the control radio.....	30
Programming of the subscriber radios	33
Programming of Dual-Capacity Simplex Systems	36
Programming of the control radios	36
Programming of the subscriber radios	39
Programming of Single-Site Repeater Systems	43
Programming of the ARS control radio.....	43
Programming of the GPS control radio	45
Programming of the subscriber radios	47
Programming of the repeater.....	50

Programming of IP Site Connect Systems.....	52
Programming of the ARS control radio.....	52
Programming of the GPS control radio	55
Programming of the subscriber radios	57
Programming of the repeaters	61
Programming of Capacity Plus Systems.....	64
Programming of the trunking control radio	65
Programming of the GPS control radios.....	69
Programming of the subscriber radios	71
Programming of the repeaters	75
Programming of Linked Capacity Plus Systems	78
Programming of the trunking control radio	79
Programming of the GPS control radios.....	82
Programming of the subscriber radios	84
Programming of the repeaters	89
SafeMobile Support.....	93

Architecture Overview

Software Architecture Overview

The system is composed of 3 main applications, 2 auxiliary apps and a PostgreSQL database.

Main applications:

- **Application Server** - This is the central application that connects all the other modules to the database. This application must always run for the system to work. It must be installed on the same PC that the database is installed.
- **Gateway** - connects the system to MOTOTRBO control radios.

SafeDispatch can have more than one Gateway app installed on different PC's. All the communication between the Gateways and the Application server is done via UDP multicast protocol. So if more than one PC is used in the SafeDispatch™ then all the PC's must be connected in a LAN with multicast enabled.

⚠ THE MOTOTRBO® GATEWAY APPLICATION MUST BE RUNNING IN ORDER TO RECEIVE ANY DATA FROM THE SUBSCRIBER RADIOS. THE APPLICATION MAY BE MINIMIZED IN YOUR TOOLBAR ONCE LAUNCHED.

- **SafeDispatch** - is the Dispatcher application. It provides the dispatcher with real time and history access to the system data. The application is customized to the actual dispatching needs by using the following available modules:
 - **GPS** – provides SafeDispatch with the *Live* tab, where provisioned GPS units and subscriber radios are tracked on a live map. For mapping engines, you can choose from Google, MapPoint Fleet Edition, or ESRI ArcGIS.
 - **Text Messaging** – allows a dispatcher to send and receive SDS Text Messages to and from subscriber radios.
 - **Reports** – a dispatcher or administrator can generate reports based on collected GPS and telemetry data.
 - **Voice** – provides a dispatcher with the ability to communicate with subscribers through the SafeDispatch interface. Note that this module requires extra equipment and added computer requirements.
 - **Geo-Fence and Landmarks** – works with the mapping engine to create virtual fences and landmarks. Units can generate alerts if they enter or leave a Geo-Fence, or approach a landmark.

SafeDispatch™ v4.0 dispatchers interact with the Application Server as well as the Gateways through UDP multicast. All the PC's in the system must be capable of using UDP multicast.

Auxiliary applications:

- **Administrative Module**- Subscriber and User Manager- used for system setup.
 - Add/edit Dispatchers and Gateways
 - Add/edit users and subscribers
 - Configure the control radios connections
- **SafeMobile Updater** - used to keep the system up to date by downloading and installing the latest updates form SafeMobile servers.

System Overview

SafeDispatch contains server software that works together with MOTOTRBO® radio systems to manage dispatchers, subscriber radios and store data. The Navigation Tools present data to you through the MOTOTRBO® Radio Server.

SafeDispatch connects to the subscriber radios through the control radio(s) (base station(s)) connected via USB cables to the computer(s) that use(es) the MOTOTRBO® Gateway application.

The communication between the SafeDispatch and Application Server is carried out via TCP/IP protocol. The communication between the MOTOTRBO® Radio Server and the subscriberradios is carried out via UDP/IP protocol.

A very basic SafeDispatch™ configuration consists of one Application Server, one Gateway (used for one MOTOTRBO® control radio)andoneSafeDispatch, all installed on a single PC. But, depending on the number of dispatchers and on the MOTOTRBO radio system configuration, a typical SafeDispatch deployment consists of one Application Server, multiple Gateways, and multiple SafeDispatch dispatcher PCs.

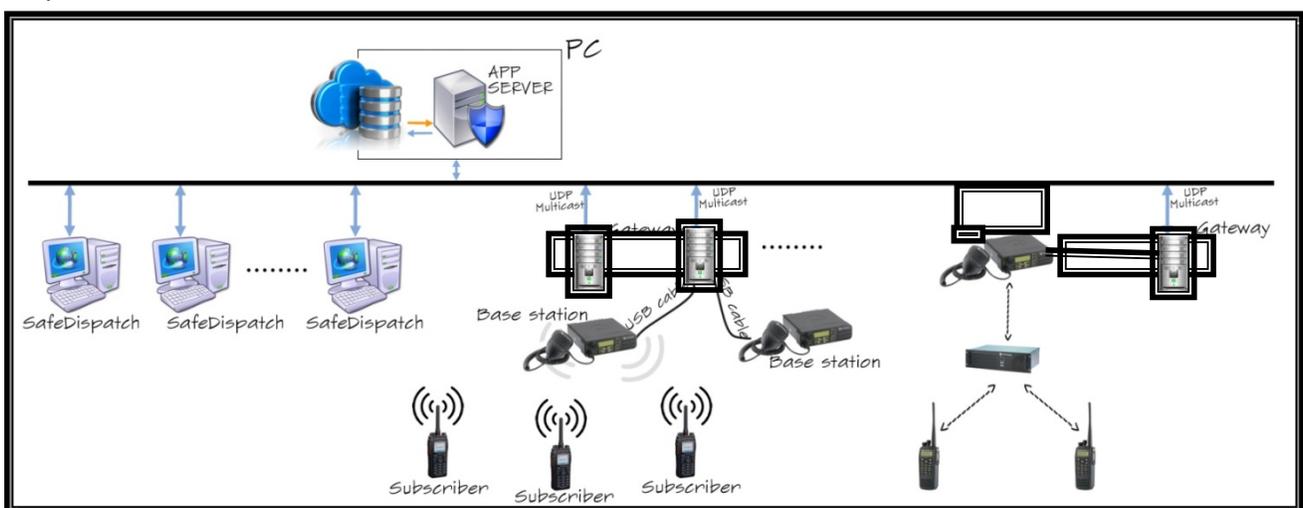


Figure 1 System Diagram

As mentioned before, if more than one PC is used in the SafeDispatch™ configuration then all the PC's must be connected in a LAN with multicast enabled.

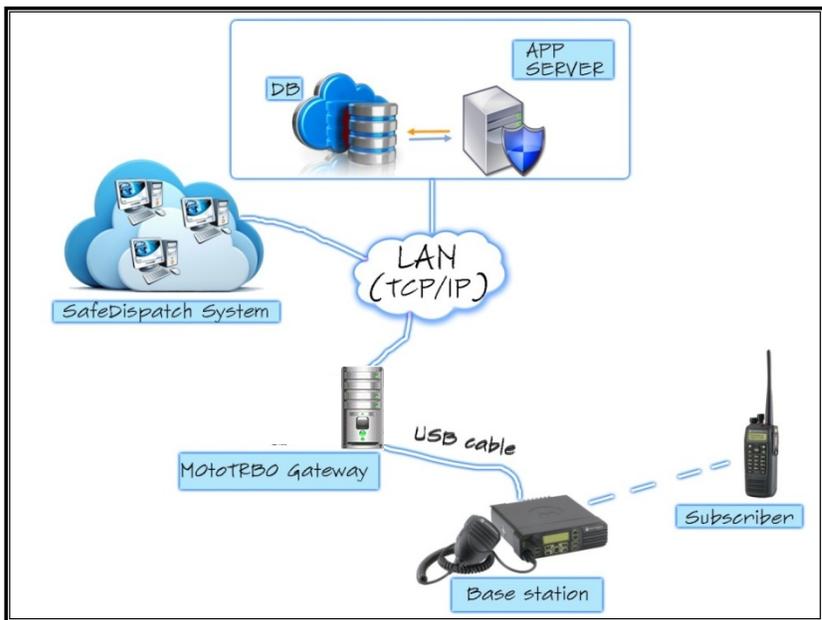


Figure 2 Communication diagram in a LAN

If the SafeDispatch™ system cannot use only LAN connections (due to its geographic configuration) the remote PC's can be connected using multicast capable VPN connections.

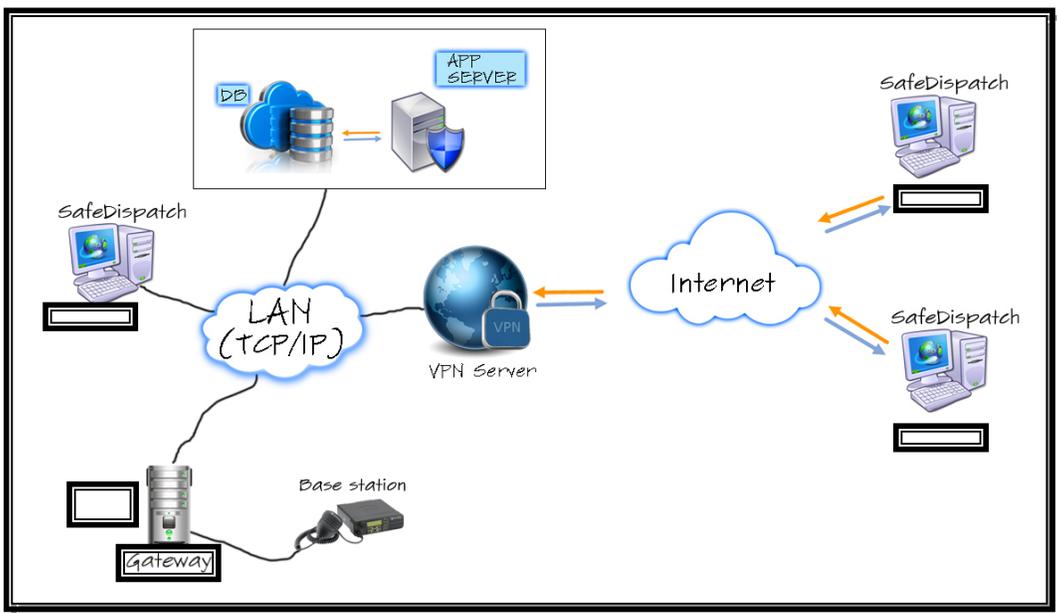


Figure 3 Communication diagram for virtual LAN via multicast VPN

An example of data (GPS) transfer through the system:

1. The subscriber radio acquires a fixed GPS position and sends it through air waves to the control radio. The control radio is the one attached to the PC running the Gateway application.
2. The control radio sends this message to the PC through the USB cable.
3. The Gateway App processes this message and sends it to the Application Server and all dispatchers through the UDP multicast.
- 4a. The Application Server adds this message to the database for future history reports.
- 4b. The dispatcher applications show the location of the subscriber on the map.

Data Storage

All system information is stored in a PostgreSQL database. PostgreSQL must be installed on the same computer where Application Server resides.



Figure 4 Data Storage

⚠ NOTE: Audio files are stored in the "recordings" subfolder, where Application Server was installed.

SafeDispatch™

Functional capabilities

General:

- ▣ Full monitoring: Radio Registrations (MOTOTRBO ARS), GPS, Telemetry Events, Text Messages
- ▣ Mapping Options: Microsoft Map Point, Google Maps, ESRI, Customer provided maps(any raster or vectorial format maps)
- ▣ Access to the Radio Network via PC: Multi-user access to Radio Server
- ▣ Channel Supported: Digital – any MOTOTRBO radio system (simplex, dual-channel simplex, standalone repeater(s), IP Site Connect, Capacity Plus, Linked Capacity Plus, Connect Plus)
- ▣ Automation Features: Scheduled Text Messages, Lone Worker, Email Gateway
- ▣ Telemetry Functions

System Requirements

Before you begin installation of SafeDispatchv4.0, your MOTOTRBO Radios and your PC(s) should be properly configured. You should have the following connected:

PC(s) with Internet Access and USB Port Availability

Minimum requirements for the Application Server PC:

- 2.8 GHz Intel i5 or better
- Installed memory (RAM): min. 4GB
- Hard Disk: min. 250GB
- Graphics: Intel HD 2000 or better
- LAN Connection
- Internet connection (for updates and Google maps)
- Sound card (if the SafeDispatch Voice Module is used)
- USB ports: min. 2 USB ports (plus one for each additional control radio)

This PC should also be a Desktop form factor **and not** a laptop or tablet.

Minimum requirements for the dispatcher PCs:

- Processor: 2 GHz Dual Core (Intel/AMD)
- Installed memory (RAM): min. 2GB
- Hard Disk: min. 160GB
- Graphics: Intel HD 2000 or better
- LAN Connection
- Internet connection (for updates and Google maps)
- USB ports: min. 2 USB ports (plus one for each additional control radio – if used)

Software

- Windows 7 Professional 32/64bit
- Microsoft.NET Framework 4
- Antivirus program disabled
- The user used for windows login should have administrator rights

The following applications need to be granted inbound connection exceptions in the PCs' firewall:

- AppServer.exe
- ConnectPlus_SOC.exe (if used)
- GateWAY.exe
- Dispatcher.exe

Note that these exceptions need to be granted for each computer running SafeDispatch, which includes the Dispatcher PCs in addition to the AppServer PC.

Network

The SafeDispatch System depends heavily on communication over IP. As a result, there are several requirements that must be met by your network to ensure that the system works properly:

Google Maps: If the SafeDispatch installation will be using Google for the Mapping solution, then an active Internet connection is required on each computer running SafeDispatch. Google's licensing agreement for Maps does not allow for offline map usage. Esri ArcGIS and Microsoft MapPoint Fleet Edition can be used offline.

Multicast: is a networking term that describes the process of a single transmission of information to a select group of destination computers. SafeDispatch requires a multicast capable network. If you are unsure of whether your network meets this requirement, please check with your IT Administrator.

IP address requirements:

An operational SafeDispatch system will be working on two networks. The first network is the one that a site might already have in place, which is any number of computers connected to one another via Local Area Network. When a control radio is attached to the AppServer PC, a second network is created. This network exists solely between the control radio and the AppServer PC for the purposes

of communicating Subscriber Radio information to the software. To avoid conflicts and ensure optimal performance the following requirements need to be met:

- Network Identifier: is a term that represents the first two sets of numbers in an IP address. By default, the Motorola Customer Programming Software sets this identifier 192.168.x.x. If your network requires that this number be different, please [contact support](#) with as much detail regarding your particular network configuration as you can provide.
- Node: The final two sets of numbers in the IP address are the node, which is representative of an individual device existing on that particular network. No two nodes can be the same number on the same network. Control radios in a SafeDispatch system will actually occupy two nodes. The first node is for the AppServer PC to identify the control radio itself while the second node is the Accessory IP. Subscriber radios communicate with the control radio over that Accessory IP. If a control radio is programmed with an IP of 192.168.10.20, then the accessory IP will automatically be 192.168.10.21. In systems with multiple control radios (such as one for voice and one for data), the IP addresses should be spaced out to avoid conflicts. It is recommended that you change the third octet in the IP address to achieve this spacing. For example, a voice control radio could be set with 192.168.10.20 while the GPS control radio could be set with 192.168.20.20.

Any computer running SafeDispatch on your LAN needs to be assigned a static IP address, as client registration is tied to the IP address and a dynamic IP will unregister a computer any time the IP is reassigned.

Port requirements:

Depending on the SafeDispatch modules used, the following ports need to be opened on the network over both UDP and TCP:

- 587 = SMTP (required for the Email Module)
- 995 = POP3 access (required for the Email Module)
- 5432 = Allows the access to the database
- 5680 = Program registration required for permission to access the database
- 8080 = Google Maps access (if used)
- 15768 = Required for Voice Recording with the Voice Module (if used)
- 15679 = Required for Voice Recording with the Voice Module (if used)
- 17233 = Required for messages to properly function

Control Radio(s)

Depending on your radio system size, you may need more than one control radio. They are provided by your Channel Partner and are connected with a custom USB cable to your PC.

⚠ THE MAXIMUM NUMBER OF MOTOTRBO® CONTROL RADIOS IN A SYSTEM IS 16.

USB Control Radio Cable

The USB Connector Cable is custom made and does NOT come with your Control Radio(s).The cable can be provided to you upon request by either your Channel Partner or by SafeMobile.

USB Registration Dongle

One Dongle is included with the Software Package purchase.

Software Installation and Configuration

AppServer PC Installation

Before installing the server, it's important to make sure you have the latest installation kit available. If a long period of time has passed between receiving your install disc and installing the software, please check with SafeMobile Support. Updated installation kits can be provided over the internet to avoid a delay while waiting for shipping. The steps for installing the SafeDispatch server are as follows:

Install and Update PreChecks

On the root of the installation kit, locate the "PreChecks" folder. Inside this folder is a file called *Setup_PreChecks.msi*. Running this installation file will be install the .NET Framework and Visual C++ runtime. These are Microsoft tools that SafeDispatch was developed with and are required to operate the software.

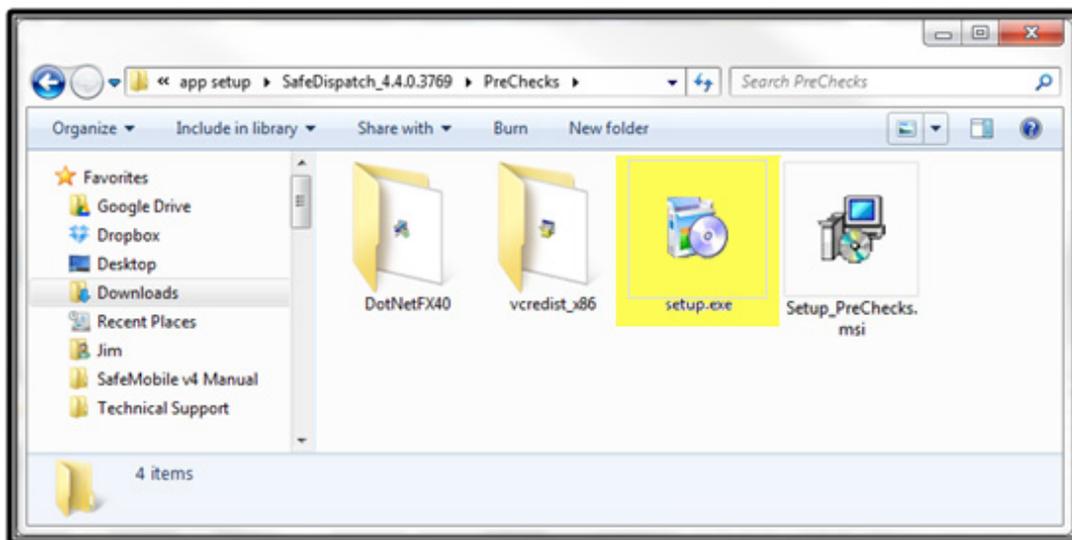


Figure 5 Run PrechecksSetup

Once PreChecks has been installed, run Windows Update to obtain the latest versions of these packages. When the updates are completed, please run Windows Update again. Some updates may require older updates as a prerequisite and will only become available in Windows Update when the prerequisites are installed.

Run the SafeDispatch Installer

After PreChecks is installed and updated, your AppServer PC is ready for installation. Open the folder called “SafeDispatchSetup” located in the root of the Installation Kit, then locate and run “SafemobileSetup.exe.” Please read the EULA and click “Accept” if you agree to the terms.



Figure 6 SafeDispatch Installer

If you accept the EULA, you will be presented with the Installer. In this window, you can customize certain aspects of the installation. In most setups, the AppServer PC will require that all of the available applications be installed. The AppServer hosts the database for a SafeDispatch system, so the *Database IP* across all fields should be set to 127.0.0.1. In networking, the 127.0.0.1 IP address is self referencing, so the software will know to look to the local machine when searching for the database on the network. The default port, in most cases, will not need to be changed.

Under the *Gateway* heading choose *Connect Plus* if the connection will be to a Connect Plus trunking infrastructure or choose *Mototrbo* for any other Mototrbo system.

Under the *Database* heading the *Administrator* and *Default User* passwords can be established. Enter a valid password for each (or you may leave the word *password* as your default). Make note of your password for future reference.

The installation folder should always be set to *C:/Program Files/SafeMobile*. An incorrect directory could result in issues receiving live updates. Note that on machines running a non-English version of Windows, the installer will automatically install to the correct Program Files directory. For example, even if the installer says “Program Files” when installing on a Spanish language machine, the installer will automatically install to *C:/Archivos de Programas/SafeMobile*.

Once the settings are configured to your specifications, click *Install*. The installer will provide you with a status window at the end of installation to verify that all applications installed correctly. If you experience issues with the installation, please refer to the knowledgebase article "[Applications Fail to Install](#)" (Registration required to view articles).

Check for SafeDispatch Updates

SafeDispatch comes with a Software Update application that connects to our servers and checks for updates. It is strongly recommended that you run this application when you first install the software to make sure that your client is up to date.

Configuring Connect Plus

If the Connect Plus Gateway version was installed, double click the Connect Plus Gateway icon on your desktop and locate the *Setup* tab. Under *Controller*, input the IP address of the MOTOTRBO Connect Plus Controller.

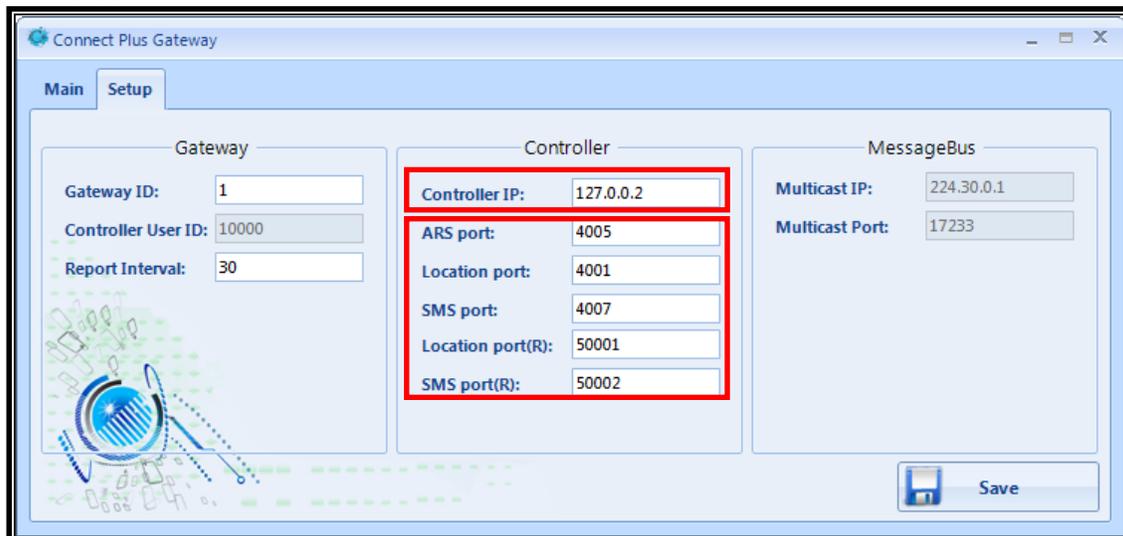


Figure 7 Connect Plus Gateway Configuration

Also verify that the ports for ARS, Location, and SMS match up with what is configured in the Controller. Below is an edited screenshot highlighting the appropriate fields on the Configuration tab

of the Connect Plus Controller:

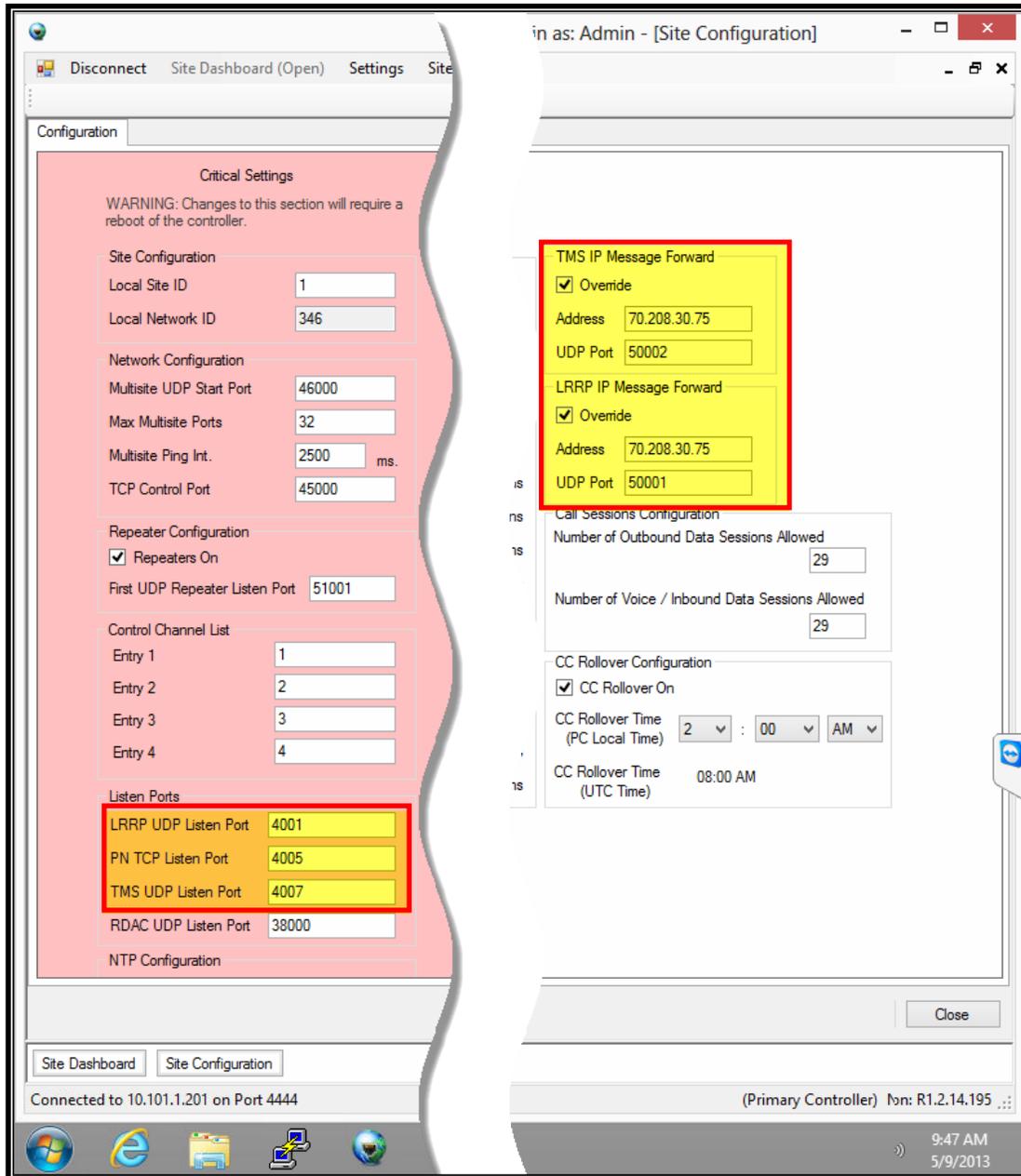


Figure 8 Connect Plus Gateway Configuration Checking

Install the Mototrbo USB drivers

Prior to connecting any MOTOTRBO radio to the PC(s), please be sure to install the Motorola MOTOTRBO Radio Drivers. This will ensure that the PC's operating system will recognize the control radio(s) when connected to the computer USB port(s). Contact SafeMobile Support to obtain the

latest version of drivers.

⚠ Note: The drivers are automatically installed if you install the Mototrbo CPS on the computer.

Dispatcher PC Installation

If additional modules for the SafeDispatch system are purchased, the client software can be installed onto an additional PC. The requirements for additional Dispatcher PCs are as follows:

- Additional SafeDispatch PCs must be on the same Local Area Network as the AppServer PC. It is possible to configure SafeDispatch over a VPN, but this may introduce performance issues to the SafeDispatch System.
- The AppServer application must always be running on its PC for the client to function.

In addition, there are a few more points to consider before proceeding with a Dispatcher PC installation. By default, every application is enabled for installation. However, a Dispatcher PC typically needs only the SafeDispatch application installed with the exception of the following:

- The Admin Module can be installed alongside any SafeDispatch Client if the user of that workstation requires SafeDispatch Administrative access
- If a control radio needs to be installed on a Dispatcher PC, an additional Gateway Application needs to be installed on that Dispatcher PC. In this case you will also have to install the Mototrbo Radio Drivers (see above).

Obtain a SafeDispatch installation kit

To avoid potential compatibility issues, make sure that you are using the same version of the installation kit used on your AppServer PC. If you are not sure whether you have the same version, please contact SafeMobile Support.

Install the PreChecks Package

On the root of the installation kit, locate the “PreChecks” folder. Inside this folder is a file called *Setup.exe*. By running this installation file, you will be installing the .NET Framework and Visual C++ runtime. These are Microsoft tools that SafeDispatch was developed with and are required to operate the software.

Once the PreChecks package has been installed, run Windows Update to obtain the latest versions of the included framework and runtime. When the updates are completed, please run Windows Update again. Some updates may require older updates as a prerequisite and will only become available in Windows Update when the prerequisites are installed.

Run the SafeDispatch Installer

From the root directory of your installation kit, navigate to `\SafeDispatch Setup\` and run *SafemobileSetup.exe*. The first window to open will be our End User License Agreement. If you choose to accept the agreement after reviewing it, please click *Accept*.

On the Installer screen, ensure that the only boxes checked are the applications that are needed on the Client. Next to each checked application, enter the IP address of the AppServer PC into the Database IP field.

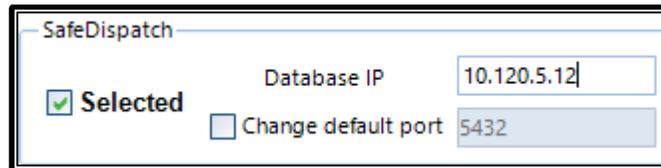


Figure 9AppServer IP address configuration

Like the AppServer PC installation, verify that the installer is pointing to */Program Files/SafeMobile*, set the default passwords and click *Install* when all of the settings have been properly configured. If there are issues installing, please refer to knowledgebase article "*Applications Failed to Install.*"

When everything is installed correctly, return to the AppServer PC and refer to the Administrative Module section to register and configure the software.

Administrative Module (Admin Module)

The Admin Module is where a user can configure various settings for SafeDispatch, as well as provision units and register additional Dispatcher PCs.

Registering SafeDispatch

Once SafeDispatch has been installed on the AppServer PC and any Dispatcher PCs, the Admin Module will need to be configured in order to register the software and allow the different clients to communicate with each other over the network.

Begin by ensuring that the black USB registration dongle is plugged into an available USB port on your AppServer PC. If you do not have a USB Registration Dongle, the SafeDispatch v4.0 Application will still work, however, it will run only in a demonstration mode that expires after 30 days.

Then launch the Admin Module from the shortcut on your desktop. By default, the Admin Module will open up to the *Units* tab. Locate and open the *Registration* tab.

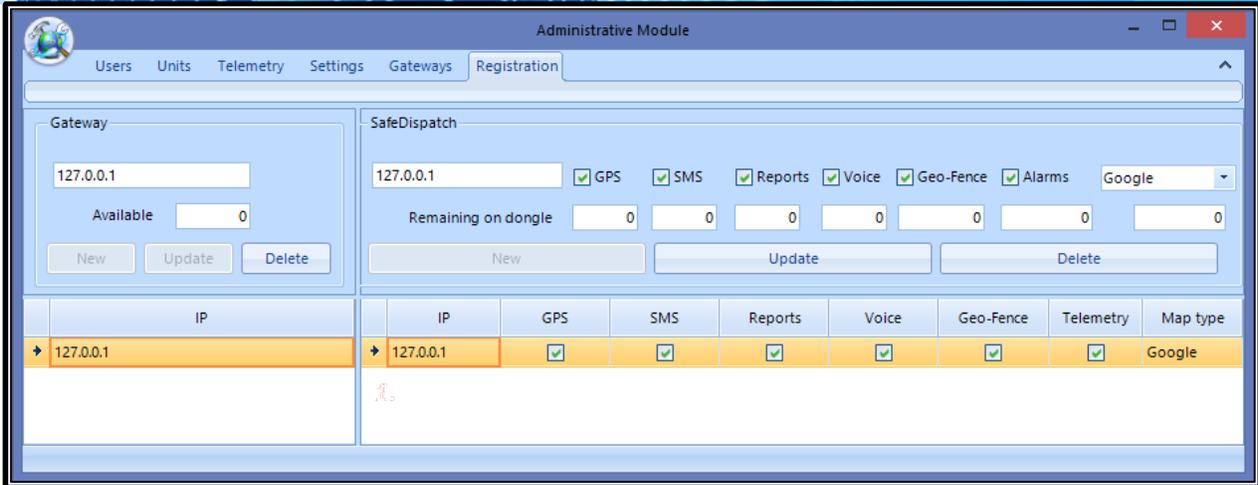


Figure10TheRegistration tab

On the right side of the Registration window, locate the SafeDispatch section.

Configure the AppServer:

By default, the AppServer PC is registered under the self-referencing 127.0.0.1 IP address and will have all available modules provisioned. To Unregister certain modules from the AppServer PC, perform the following steps:

- 1. Select the IP address of the server from the list.
- 2. Make the desired changes.
- 3. Click *Update*

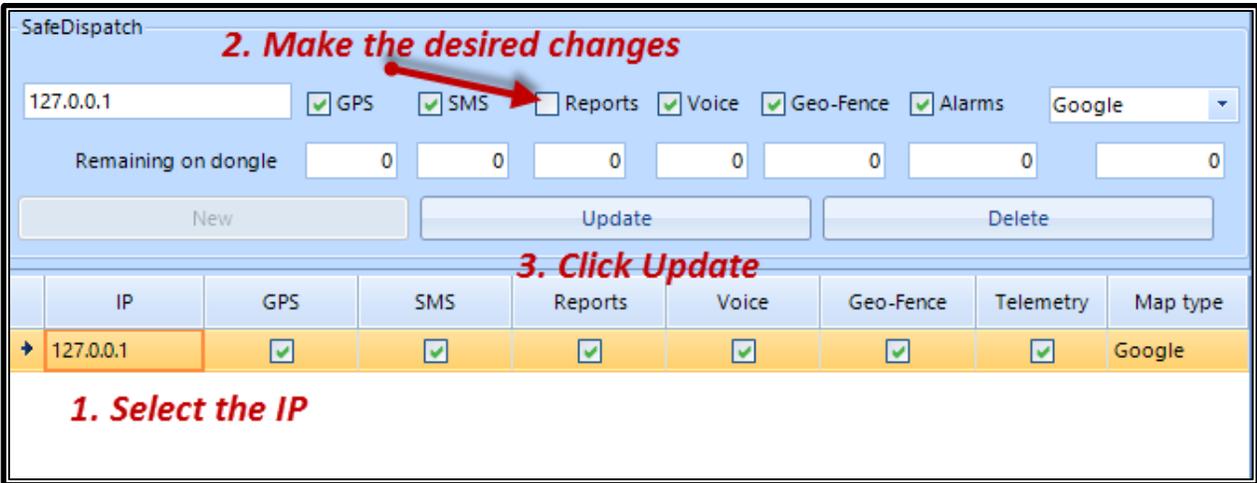


Figure 11AppServer Configuration

Register the Gateway Application:

The Gateway application is what manages any control radios connected to a SafeDispatch PC. In most systems, the control radios are typically only connected to the AppServer PC. In those cases the default 127.0.0.1 IP is all that is needed. If the IP Address field displays anything other than 127.0.0.1, it should be changed. Note that this field does not refer to the IP address assigned to the control radio in the CPS, this is strictly for registration of the Gateway application.

There are certain systems, such as those using the Voice module or systems spanning several sites, where control radios may be connected to multiple PCs in the system. In this case the following steps should be taken to register the additional Gateway applications:

1. Input the IP address of the **Dispatcher PC** hosting the additional control radio, not the IP address assigned to the control radio in the CPS.
2. Click **New** to add it to the list of registered Gateways.

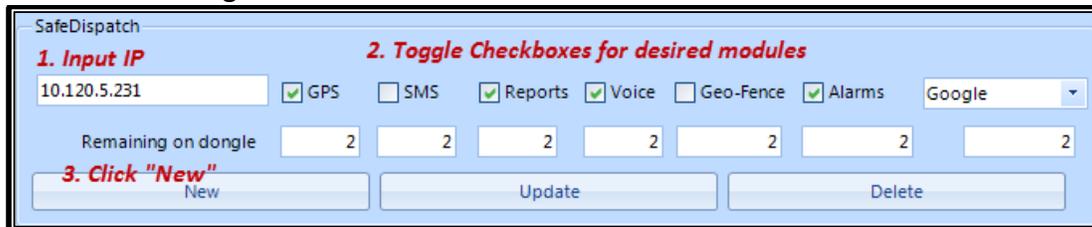


Figure 12 Registering additional Gateway applications

Configure the Dispatcher PCs:

Each additional Dispatcher PC will have to be manually added. The procedure is as follows:

1. Input the IP address of the new Dispatcher PC into the IP address field.
2. Toggle the checkboxes of each module you want to provision for the new Dispatcher PC.
3. Click *New* to register.



The screenshot shows a window titled "SafeDispatch" with the following fields and controls:

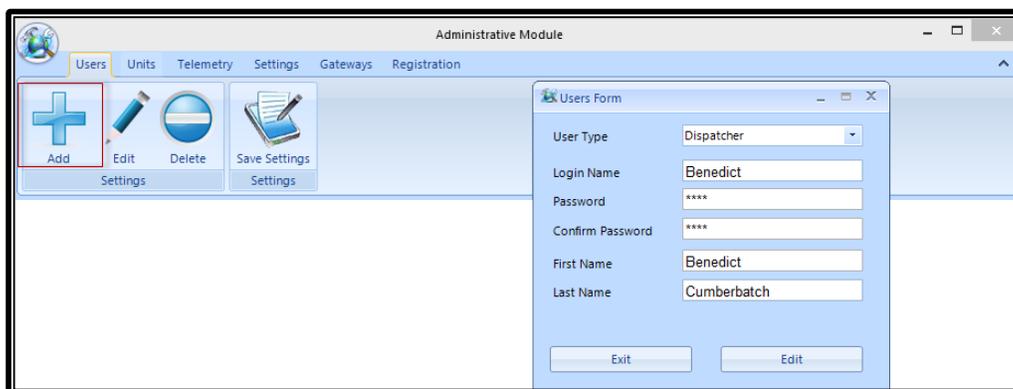
- 1. Input IP:** A text field containing "10.120.5.231".
- 2. Toggle Checkboxes for desired modules:** A row of checkboxes for "GPS" (checked), "SMS" (unchecked), "Reports" (checked), "Voice" (checked), "Geo-Fence" (unchecked), and "Alarms" (checked). A "Google" dropdown menu is on the right.
- Remaining on dongle:** A row of seven input fields, each containing the number "2".
- 3. Click "New":** A "New" button, an "Update" button, and a "Delete" button.

Figure 13 Registering additional Dispatcher PCs

Creating and Modifying User Accounts

SafeDispatch allows for multiple users to utilize the system, and if given permission, be an administrator to make changes to system settings as needed. To create a user, locate and click the "Users" tab from the menu bar of the Admin Module.

Once on the user tab, click "Add" on the Ribbon interface to bring up the *Users Form* dialogue box.



The screenshot shows the "Administrative Module" window with the "Users" tab selected. The "Users Form" dialog box is open, containing the following fields:

- User Type:** A dropdown menu set to "Dispatcher".
- Login Name:** A text field containing "Benedict".
- Password:** A text field containing "****".
- Confirm Password:** A text field containing "****".
- First Name:** A text field containing "Benedict".
- Last Name:** A text field containing "Cumberbatch".

At the bottom of the dialog box are "Exit" and "Edit" buttons.

Figure 14 Adding Users

From this window, an administrator can provision a new user with a username, password, and the first and last name of the user. In user type, permissions for this particular user can be assigned. The different permissions are as follows:

- Dispatcher - Only has access to the SafeDispatch application
- Administrator - Can make changes to system settings via the Admin Module
- Lite Dispatcher - Only has access to the SafeDispatch application with limited features (only voice calls and map display – no radio commands, no messaging, no Telemetry, no polling)

Once a new user has been added, an Administrator can modify individual settings for that user. These settings can be found at the bottom of the Users tab, just below the user list.

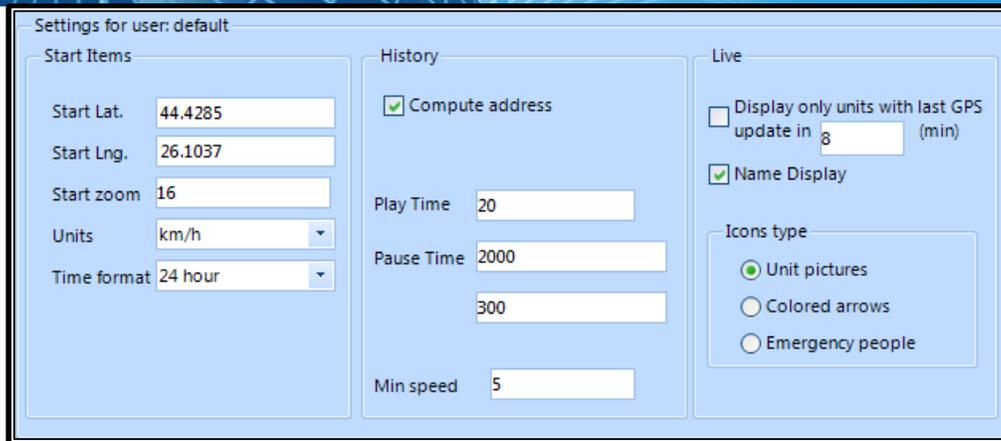


Figure 15 User Settings

Creating and Modifying Units

Each subscriber radio utilized in the system will be tied to a unit in SafeDispatch. To add a subscriber to SafeDispatch, begin by clicking on the *Units* tab from the menu bar of the Admin Module. From the ribbon interface, select *Add* from the Unit Group. From the *Unit Settings* dialogue box, you can provision the following settings:

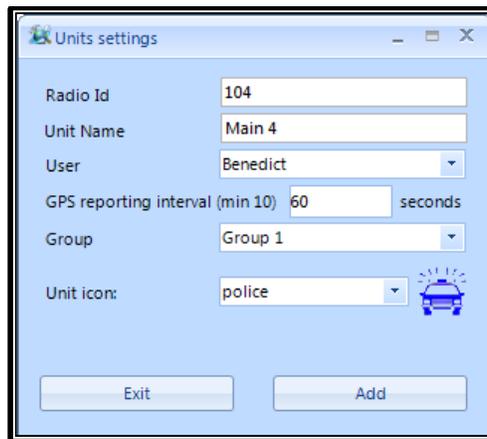


Figure 16 Units Settings

- Radio ID - This ID number corresponds to the ID assigned to a radio in the Customer Programming Software under *General Settings*.
- Unit Name - A name for the unit – this does not depend on any field from the CPS.
- User – set a specific user to have access to this unit.
- GPS Reporting Interval – this setting tells the software how often should this unit send the GPS data. Shorter intervals put an increased load on the network, so please use caution when adjusting this setting for more frequent reporting intervals.
- Group – assigns the unit to a particular group.

- Unit Icon – assign an icon to the unit to help identify it on the map. As of SafeDispatch 4.4.3, custom icons are supported.

When all of the settings have been configured, clicking *Add* will add the unit to the database.

Programming the Gateway Application

For all the systems using a mobile radio as a control radio, certain settings need to be configured in the Admin Module to ensure proper communication between the control radio and the Gateway application.

First, ensure that the PC hosting the Gateway application is registered as outlined above. Then, locate and select *Gateways* from the menu bar of the Admin Module.

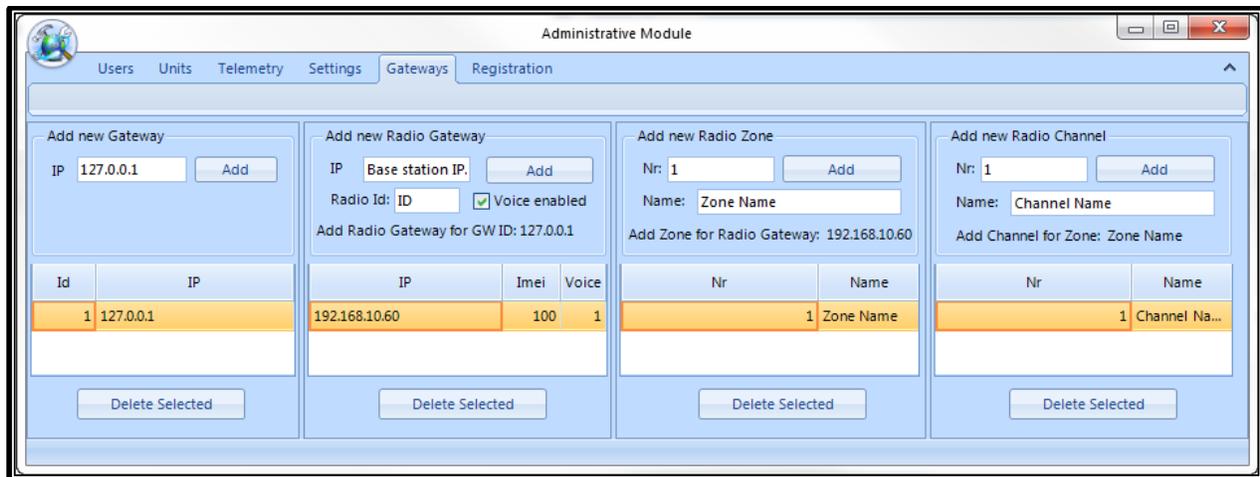


Figure 17 Programming the Gateway Application

Registration for each control radio is done across all four columns, which are:

- **Add New Gateway**– The IP address entered in this field should be the IP address of the PC hosting this control radio. If a control radio is going to be attached to the AppServer PC, then the self-referential 127.0.0.1 should be used as an IP address. Otherwise, this address should be the static IP address of another PC on the Local Area Network.

- **Add New Radio Gateway**– The IP address entered in this column should be the IP address assigned to the control radio in the Customer Programming Software under *Network*. This is the radio-to-radio IP address that is independent of anything configured on the LAN. Radio ID is the ID assigned to the radio under *General Settings* in the CPS. If the radio is attached to the computer with a Voice Dispatch cable provided by SafeMobile, the "Voice Enabled" checkbox should be marked to enable voice functionality. Note that in some setups, the checkbox might be enabled for non-voice radios. This is a method of troubleshooting and **will not** impact systems which are not using voice.
- **Add New Radio Zone**– Each Zone programmed into the control radio should also be programmed in this column.
- **Add New Radio Channel**– Each Channel programmed into the control radio should also be programmed in this column.

Other Settings

The Admin Module has several settings that can be configured within the *Settings* tab:

- **Database Backups**– A utility is built into the Admin Module to provide a convenient method of backing up the database. The backup and restore process is automated by the software with one-click, but for increased data security it is recommended to back up the file created by the software. To do so, simply navigate to the backups folder and move the file to a secure location. The backups folder is located in *C:\Program Files (x86)\SafeMobile\AppServer\backups*.
- **Adding Custom Unit Icons** – New in SafeDispatch 4.4.3 is the ability to add custom unit icons. Icons must be a .PNG format.
- **Deleting Icons** – By selecting an icon from the drop down list and clicking *Delete Selected Icon*, that icon will be permanently removed from the database. This cannot be undone, so exercise caution when using this feature.

Starting SafeDispatch

To Start SafeDispatch, **FIRST** activate both the Application Server and the  MOTOTRBO

Gateway via the  desktop icons. Double click the icon and allow the programs to run in the

background.  The Application Server and the Gateway **MUST** be running in

order to properly connect to the SafeDispatch programs.

Next, double click on the **SafeDispatch Icon**  on your desktop, or from the Start menu select *Programs/SafeDispatch*. Once selected, the Login Screen will appear. The user must enter a **Username** and **Password** into the available edit fields in order to gain access to the program.

Then, select your preferred user Language and **Login**. [Fig. 18]

The default Password is established at Installation. The default language for SafeDispatch software is English.



Fig.18 Start SafeDispatch

SafeMobile Support

Email Support

Please email your technical support questions to support@safemobile.com.

SafeMobile Technical Support Online Forum

Please visit our SafeMobile Technical Support Online Forum for all your SafeMobile and Motorola questions at www.safemobile.com/forum.

Sales and Installation Support

Please contact your SafeMobile Channel Account Manager directly for assistance.

Appendix A

Configuring the MOTOTRBO system for SafeDispatch

MOTOTRBO CPS Installation

To install MOTOTRBO Customer Programming Software (CPS):

⚠ To CONFIGURE MOTOTRBO RADIOS, YOU NEED TO INSTALL MOTOTRBO CPS.

1. Run the installation of MOTOTRBO CPS (a copy of this application is available to your Motorola dealer)
2. Follow the onscreen installation.

Note: The CPS installer will also automatically install the MOTOTRBO drivers.

3. Launch MOTOTRBO CPS
 - a. Set the view option to "Expert" mode to be able to access all CPS features
 - b. Connect a radio to the PC using the corresponding programming cable
 - c. Click "Read" button.
 - d. The reading of your radio configuration will start.

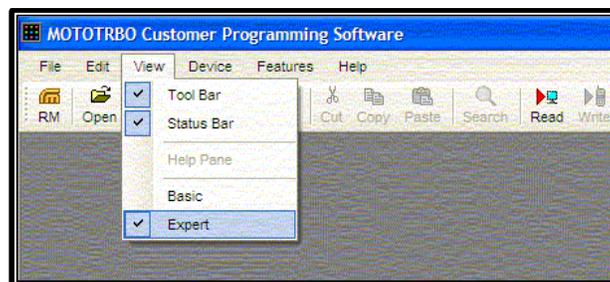


Figure 1 Setting the CPS view option to "Expert" mode

Configuration of MOTOTRBO Radios

General Considerations

Programming of the radios to work with SafeDispatch depends on the radio system type and topology. Currently, the following MOTOTRBO system types are supported:

- Simplex
- Dual-Capacity Simplex
- Single Site Repeater(s)
- IP Site Connect
- Capacity Plus
- Linked Capacity Plus
- Connect Plus

Each of these systems needs customized programming, as described below.

For proper functionality of a MOTOTRBO based GPS location system the following must be considered:

- In a SafeDispatch system the radios are automatically registering (when powered on or when changing channels) and (during this process) are instructed to send periodically their position. This time interval is set (for each individual radio) using the Administrative Module of the SafeDispatch v4.0.
- In conventional systems the registrations are made on the voice channels, so the ARS control radio can also be used for dispatcher's voice communication but only if the dispatcher doesn't need to use different RF channels (defined by frequency & timeslot) – in the second case a configuration with separate ARS control radio and dispatcher voice radio must be used.
- MOTOTRBO voice calls have higher priority than GPS data transmissions – as a result, during a voice call the periodic transmissions are delayed until the call ends. This can cause collisions in sending the GPS data – mostly at the end of a group call, when more radios have to do that. To minimize this effect we recommend to avoid having large groups of radios. We also recommend to use short "RX Group Lists" or to avoid them completely, as the radios using such lists might be involved in too many calls to have time to send their GPS data.
- Depending on the radio system, the GPS data can be sent on the voice channel(s) or on dedicated GPS revert channels. We recommend to use, whenever possible, GPS revert channels – separating voice calls from the GPS traffic is a first step in increasing the reliability of GPS transmissions.
- In all systems that use repeaters the "Enhanced GPS" feature can be used, greatly improving the capacity of a GPS revert channel (as described below).

“Data Call Confirmed” Considerations

The “Data Call Confirmed” (DCC) feature of MOTOTRBO radios can be used in any data transmissions but here we are interested in the use of it for the radio registrations and GPS data sending. This feature can be enabled on each channel, by checking the *Data Call Confirmed* field in the TX section of the channel. If used, it will determine the radio to:

- Confirm any data messages that are successfully received
- Expect to receive confirmations for any transmitted data messages – if there is no confirmation the radio will repeat the data transmission

It’s obvious that if the DCC feature is used, all the radios should be programmed to use it – otherwise, unnecessary re-sending of messages will occur. The problem of using it or not is that it adds some time to each data transmission, increasing the data load of the channel (and hence decreasing the data capacity). But because some data transmissions can be affected by RF propagation problems or by TX collisions, not using DCC will automatically lead to lost data – how acceptable is this?

In the case of radio registrations (made on the voice channels) a radio that misses to register will not send any GPS data (it will not be instructed how to do that) so it will also not appear on the SafeDispatch map. This is not acceptable, so DCC should always be used on the voice channels.

If the GPS data is also sent on the voice channel then it will follow the same rule as the registration.

If the GPS data is sent on a data revert channel you can choose either to use or not the DCC on that channel. In the first case you will have a greater GPS traffic (not only because of the added confirmations but mainly because of the retrials) but more successfully sent GPS positions while in second case the traffic will be lower but the number of lost positions will be significantly higher.

If “Enhanced GPS” revert channels are used (available in all repeater systems) the GPS data is always sent unconfirmed (to save time and because the collisions are avoided) – this might however lead to some lost GPS data if RF propagation problems are present (but this is anyhow inevitable because re-sending the messages in such conditions will lead most probably to the same result).

Emergency Considerations

If the radio system uses Emergency then (regardless of how other Emergency features are programmed in the radios) when the radio user presses the Emergency button the radio will automatically send an “Emergency Alert” message. This type of message will be considered only by those radios that are programmed with the *Emergency Alarm Indication* field checked (in the RX section of the channel window). One (and ONLY one) of those radios must also be programmed to confirm the receiving of this alarm – by checking the *Emergency Alarm Ack* field (failing to do this will cause repeated alert messages). Note that this confirmation is not related to the above DCC feature. As the ARS control radio is also used by the dispatcher for voice communication, it is the best to use this radio to send this type of confirmation (because it is always “on” and always present on the voice channel). In this case it must be an alphanumeric/graphic display radio.

Loading Considerations

Proper loading of the voice and GPS revert channels (if used) is very important. While overloading a voice channel will impact the radio users' experience and cause lower efficiency in using the radio system, any overload of the GPS transmissions will result in more and more collisions and loss of GPS data. To estimate the loading of a MOTOTRBO radio system, Motorola uses the concept of "radio user profile", based on specific average voice, GPS and SDS message traffic. The below table shows these profiles:

Profile Name	Traffic Type	Call Description	Traffic Per User Per Hour	
High Voice	Group Voice Call	10 second call, 2 transmissions per call	3.0 Calls per User per Hour	90%
	Individual Voice Call	20 second call, 4 transmissions per call		10%
Low Voice	Group Voice Call	10 second call, 2 transmissions per call	1.0 Calls per User per Hour	90%
	Individual Voice Call	20 second call, 4 transmissions per call		10%
High GPS	Location Updates	660 milliseconds (for Single Repeater and IP Site Connect) per transmission and 540 milliseconds (for Capacity Plus mode) per transmission	60 GPS Transmissions per User per Hour i.e. 1 Minute Update Period (Cadence)	
Low GPS	Location Updates	660 milliseconds per transmission	6 GPS Transmissions per User per Hour i.e. 10 Minute Update Period (Cadence)	
High Text Messaging	Text Messaging	100 characters per message	2.5 Text Messages per User per Hour	
Low Text Messaging	Text Messaging	100 characters per message	0.5 Text Messages per User per Hour	

These profiles will be used to estimate the proper loading for each of the MOTOTRBO systems. Note that the impact of text messaging is minimal, so it can be almost neglected.

The loading provided by the radio registrations must also be considered. If the radio users work in shifts and switch on their radios in a short interval of time, a flood of registrations will result, with many collisions and retries, having a great impact on the voice channel(s) for up to 15-30 minutes. To avoid this, the radio users must be instructed to switch on their radios at different moments of time (Motorola recommends not to exceed an average of 3 registrations per minute per RF channel).

GPS Revert and "Enhanced GPS" Considerations

As already mentioned, a first step in increasing the efficiency of sending the GPS data is the use of the "GPS Revert" feature of the Mototrboradios, which allows to separate the voice and GPS traffic by using RF channels dedicated only for GPS transmissions. Even in this case, Motorola recommends not

to exceed 20 GPS updates per minute on such a channel – for High GPS usage this is equal to the number of radios that can use the channel. It's easy to notice that for systems that use many High GPS radios the number of needed GPS Revert channels can become unacceptable (for Low Voice and High GPS radios three GPS Revert channels are needed for each voice channel).

The above limitations in sending GPS data on a GPS revert channel are caused by the potential collisions and retrials made by the radios. In all systems that use repeaters, the “Enhanced GPS” feature of MOTOTRBO radios offers a synchronized manner of sending the GPS data by allocating to each radio a precise time window for doing that – after the radio registers, at the first attempt to send its position the repeater will reserve the time window (in an internal table) and all following GPS transmissions will be made in this reserved moment of time. This eliminates any collisions, allowing a much greater number of updates per minute.

Because not all transmissions can be made in this way (while the radios are involved in voice calls they might miss the reserved window moment) the repeater is programmed to reserve only a certain percentage of windows for periodic GPS updates – in the remaining time the radios can ask for extra windows to empty their GPS data queue. The available values are 90%, 75%, 60% and 45%.

The size of the window depends on what information is sent and if Enhanced Privacy is used – for SafeDispatch systems the needed value (which covers all the cases) is 7. This value must be programmed both in the repeater and the radios.

The above 2 parameters give the maximum number of updates per minute. In most of the cases the 75% reservation time can be used – this will allow (for window size = 7) up to 107 periodic updates per minute. This reverses the need for GPS traffic versus voice traffic – for large number of radios only one Enhanced GPS channel can serve more voice channels (up to 6 with High Voice profile radios or up to 2 with Low Voice profile radios). But if large groups of radios are used (which increases the probability that many radios will miss their reserved windows due to the voice traffic) lower reservation percentages are needed and the maximum number of periodic updates per minute will also decrease: 86 for 60% and 64 for 45%.

Note that the percentage reserved for periodic updates can be also chosen based on real number of radios used in the system (considering also future growth). For example, if only one repeater is used and the radios are Low Voice & High GPS profiles ones then the repeater can be programmed with 45% (which allows up to 64 such radios, more than the 51 limit for voice traffic).

Finally, note that this system introduces a limitation in the allowed intervals for GPS transmissions – the only possible values are 30 sec, 1, 2, 4, 8 min.

⚠ ANY OTHER VALUE PROGRAMMED IN THE ADMINISTRATIVE MODULE WILL BE REJECTED BY THE RADIOS, CAUSING NO GPS DATA SENT.

Considering all the above, **we strongly recommend using the “Enhanced GPS” feature in all repeater systems.** In the below programing examples we indicate the use of this feature and give additional information to implement it efficiently.

Programming of Simplex Systems

In a simplex system the communication area is very limited, especially for the portable radios. As a result these systems are suitable only for limited perimeters or for radio-to-dispatcher communications. SafeDispatch will need in this case only one control radio(used for voice, ARS and GPS data). Because voice and GPS data must coexist on the same channel the capacity can be very limited – the recommended limits are:

- 34 radios with Low Voice & Low GPS profiles
- 16 radios with High Voice & Low GPS profiles
- 12 radios with Low Voice & High GPS profiles
- 8 radios with High Voice & High GPS profiles

It's easy to see that simplex systems are totally unsuitable either for High Voice or for High GPS usage.

⚠ NOTE: We do not consider the use of simplex GPS revert channels – instead of using two simplex channels (frequencies) it is much more efficient to use a half-duplex frequency pair with a repeater, which offers a better coverage and the possibility to use the “Enhanced GPS” feature.

Programming of the control radio

Read the radio codeplug and make the needed changes in the following CPS windows:

General Settings

A control radio must have a *RadioID* – this ID will be used by the subscriber radios to register to the system and to send GPS data and will also be used to make private voice calls to the dispatcher – for this last reason we recommend to use an easy to remember value.

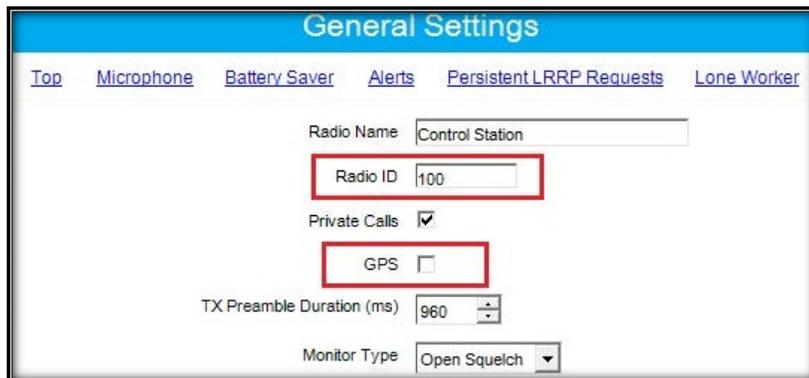


Figure 2 Control Radio Radio ID

The above figure shows a *RadioID* of 100, however, this can be any number that you choose. As this is a base radio (that will never send GPS data) the *GPS* field should be left unchecked.

We also recommend to change the *Talkaround Group Call Hang Time* and the *Talkaround Private Call Hang Time* (used by the radios on simplex channels) to lower values (1-2 seconds) to minimize the voice calls duration, allowing more time for registration and GPS traffic.

⚠ ALL THE RADIOS IN THE SYSTEM SHOULD BE PROGRAMMED WITH THE SAME VALUES FOR THESE TWO FIELDS.

Network Settings

The network settings of the control radio should be configured as follows:

The control radio must have a *Radio IP* address – this is used for the USB connection between this radio and the PC. The below figure shows an IP address of 192.168.10.60, however this may be different, depending on your IT network settings.

Check the *Forward to PC* field – in this way all text messages this radio receives are passed to the connected PC.

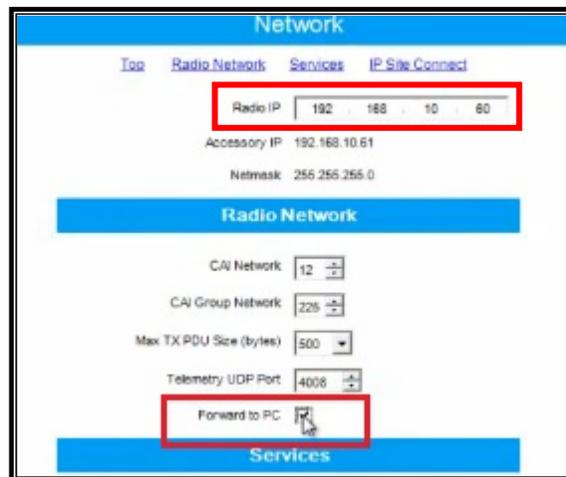


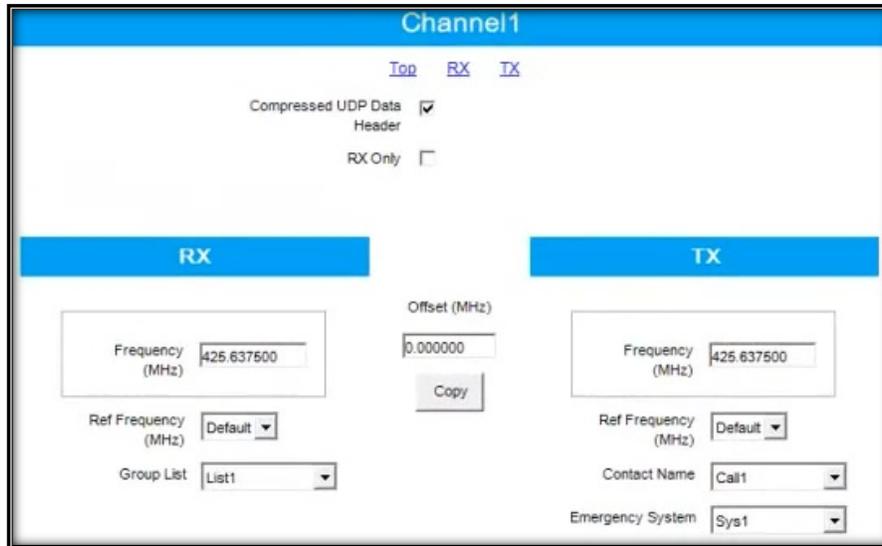
Figure 3Control Radio Network Settings

Channel Settings

Normally the control radio can have only one channel but if the dispatcher has to talk to different groups that use the same RF channel the radio can use more channel positions – but all should use the same settings (except the *Contact Name* field), as indicated below:

The *ARS* field should be set to *Disabled* as this radio will never register.

The frequency must be the same for both the RX (receive) and TX (transmit). Set the *Repeater/Time Slot* to 1.



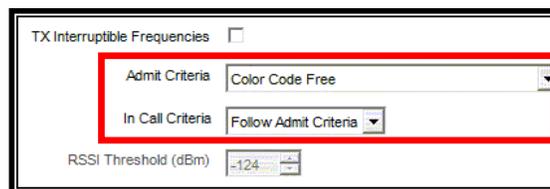
The screenshot shows the 'Channel 1' configuration page. At the top, there are links for 'Top', 'RX', and 'TX'. Below these are checkboxes for 'Compressed UDP Data Header' (checked) and 'RX Only' (unchecked). The main area is divided into two sections: 'RX' and 'TX'. Both sections have a 'Frequency (MHz)' input field set to '425.637500', a 'Ref Frequency (MHz)' dropdown set to 'Default', and a 'Group List' dropdown set to 'List1'. The 'TX' section also includes a 'Contact Name' dropdown set to 'Call1' and an 'Emergency System' dropdown set to 'Sys1'. A 'Copy' button is located between the RX and TX sections, and an 'Offset (MHz)' input field is positioned above it.

Figure 4 Set the RX and TX frequency

We also recommend to check the *Compressed UDP Data Header* field – using this feature will reduce the duration of all data messages.

⚠ ALL THE RADIOS IN THE SYSTEM SHOULD BE PROGRAMMED WITH THE SAME SETTING FOR THIS FIELD.

Program the radio not to transmit over a busy channel when starting a call or during a call.



The screenshot shows the 'TX Interruptible Frequencies' configuration section. It includes a checkbox for 'TX Interruptible Frequencies' which is unchecked. Below it are two dropdown menus: 'Admit Criteria' set to 'Color Code Free' and 'In Call Criteria' set to 'Follow Admit Criteria'. At the bottom, there is an 'RSSI Threshold (dBm)' input field set to '-124'.

Figure 5 Admit Criteria / In Call Criteria

Check the *Data Call Confirmed* field (to be sure that the subscriber radios will register).

⚠ ALL THE RADIOS IN THE SYSTEM SHOULD BE PROGRAMMED WITH THE SAME SETTING FOR THIS FIELD.

Write the configuration to the radio.

Programming of the subscriber radios

Read the radio code plug and make the needed changes in the following CPS windows:

General Settings

A subscriber radio must have a *Radio ID*.

Fig.6 shows a *Radio ID* of 101, however, this can be any number that you choose.

⚠ ALL SUBSCRIBER RADIOS MUST HAVE A UNIQUE RADIO ID.

The *GPS* field **MUST** be checked. The Subscriber radio must have GPS enabled in order to transmit location data.

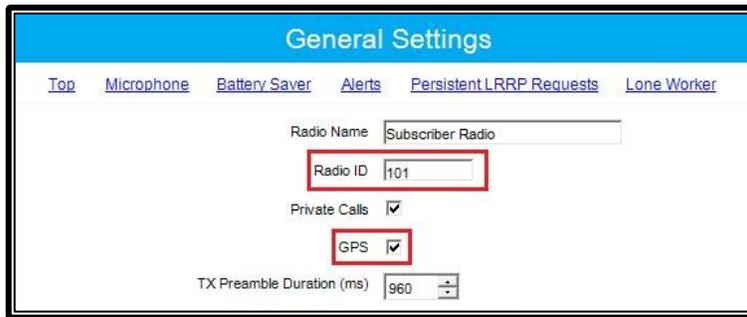


Figure 6 Subscriber Radios General Settings

We also recommend to change the *Talkaround Group Call Hang Time* and the *Talkaround Private Call Hang Time* (used by the radios on simplex channels) to lower values (1-2 seconds) to minimize the voice calls duration, allowing more time for registration and GPS traffic.

⚠ ALL THE RADIOS IN THE SYSTEM SHOULD BE PROGRAMMED WITH THE SAME VALUES FOR THESE TWO FIELDS.

Network Settings

The network settings of the subscriber radios should be configured as follows:

The *Radio IP* field can be left unmodified. The *Forward to PC* field should be set to *Disabled* as these radios do not connect to a PC.

In the *ARS Radio ID* field **MUST** be entered the ID of the control radio.

⚠ FAILING TO ENTER THE PROPER CONTROL RADIO ID WILL RESULT IN REPEATED UNSUCCESSFUL REGISTRATION ATTEMPTS.

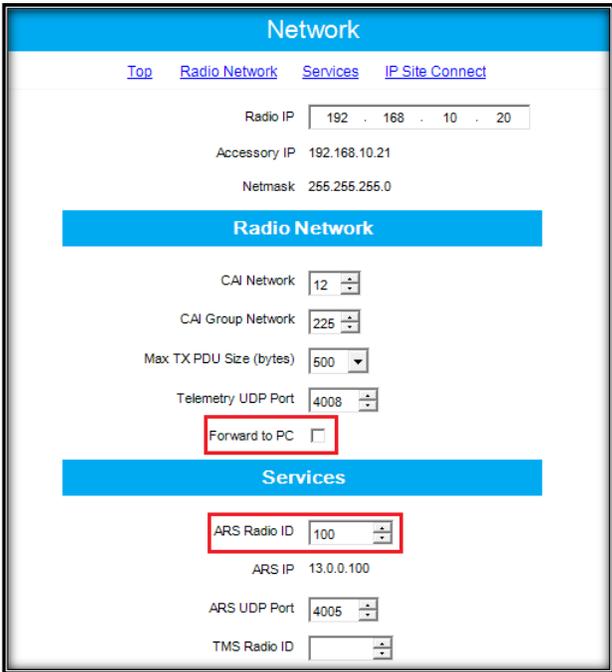


Figure 7 Subscriber RadiosNetwork Settings

Channel Settings

The last important configuration for the subscriber radio stakes place in the channel settings. All channel positions used in the radio system should be programmed as below:

- ⚠ The subscriber radios MUST have ARS enabled. This is responsible for transmitting presence notification to the MOTOTRBO Gateway Application.

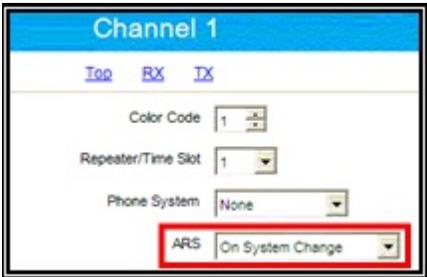
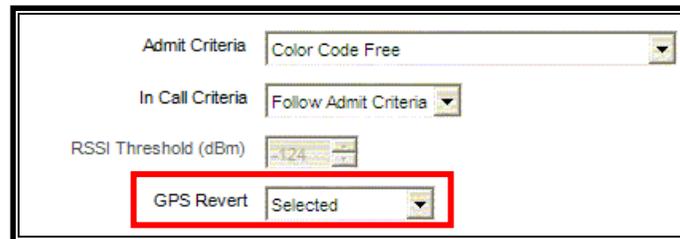


Figure 8 ARS On System Change

Set the same frequency RX and TX frequency, timeslot, TX admit criteria and in call criteria as for the control radio.

Set the *GPS Revert* field to *Selected* to allow GPS updates transmitted on the current channel.



The screenshot shows a configuration window with the following fields:

- Admit Criteria: Color Code Free
- In Call Criteria: Follow Admit Criteria
- RSSI Threshold (dBm): -124
- GPS Revert: Selected (highlighted with a red box)

Figure 9 GPS Revert–Selected

Check the *Data Call Confirmed* field (to be sure that the radio will register). We also recommend to check the *Compressed UDP Data Header* field – using this feature will reduce the duration of all data messages.

⚠ ALL THE RADIOS IN THE SYSTEM SHOULD BE PROGRAMMED WITH THE SAME SETTINGS FOR THESE TWO FIELDS.

Write the configuration to the radio.

Programming of Dual-Capacity Simplex Systems

Dual-capacity simplex offers the possibility of using both timeslots on a simplex channel. This operation mode is available only for the second generation of MOTOTRBO radios and uses a special synchronizing mechanism performed by the radios (in the absence of a repeater). However this doesn't allow to separate the voice and GPS traffic by using each of them on different timeslots because dual-capacity channels cannot be used as GPS revert channels – the only advantage is that a double number of radios can be used on a single simplex frequency. In a dual-capacity simplex system the communication area is very limited, especially for the portable radios. As a result these systems are suitable only for limited perimeters or for radio-to-dispatcher communications. SafeDispatch will need in this case two control radios (each one used on one of the timeslots for voice, ARS and GPS data) – so two dispatchers will be used. Because voice and GPS data are on the same channel the capacity per timeslot is the same as for the simplex channels:

- 34 radios with Low Voice & Low GPS profiles
- 16 radios with High Voice & Low GPS profiles
- 12 radios with Low Voice & High GPS profiles
- 8 radios with High Voice & High GPS profiles

Programming of the control radios

Read each radio code plug and make the needed changes in the following CPS windows:

General Settings

A control radio must have a *Radio ID* – this ID will be used by the subscriber radios to register to the system and to send GPS data and will also be used to make private voice calls to the dispatcher – for this last reason we recommend to use an easy to remember value.



Figure 10 Control Radios Radio ID

The above figure shows a *Radio ID* of 100, however, this can be any number that you choose. As this is a base radio (that will never send GPS data) the *GPS* field should be left unchecked.

For the second control radio we recommend to use the same Radio ID (there will be no conflict as they will use different timeslots) – this becomes mandatory if there are subscriber radios that have to work on both timeslots.

We also recommend to change the *Talkaround Group Call Hang Time* and the *Talkaround Private Call Hang Time* (used by the radios on simplex channels) to lower values (1-2 seconds) to minimize the voice calls duration, allowing more time for registration and GPS traffic.

⚠ ALL THE RADIOS IN THE SYSTEM SHOULD BE PROGRAMMED WITH THE SAME VALUES FOR THESE TWO FIELDS.

Network Settings

The network settings of the control radios should be configured as follows:

The control radios must have a *Radio IP* address – this is used for the USB connection between the radio and the PC. The below figure shows an IP address of 192.168.10.60, however this may be different, depending on your IT network settings. Although the two control radios are connected in this case to different computers, we recommend to use different IP addresses – for the second control radio use a value similar to the one used for the first control radio by changing the second byte value (for example, if the first control radio IP address is set to 192.168.10.60, then use for the second control radio the value 192.168.20.60).

Check the *Forward to PC* field – in this way all text messages these radios receive are passed to the connected PC.



Figure 11 Control Radios Network Settings

Channel Settings

Normally a control radio can have only one channel but if the dispatcher has to talk to different groups that use the same RF channel the radio can use more channel positions – but all should use the same settings (except the *Contact Name* field), as indicated below:

Check the *Dual Capacity Direct Mode* field and set the *Timing Leader Preference* field to *Preferred* (as these radios are fixed ones, they have a good RF coverage and they also will be always “on” – both make them the ideal radios for synchronizing the timeslots in the radio system).

The *ARS* field should be set to *Disabled* as these radios will never register.

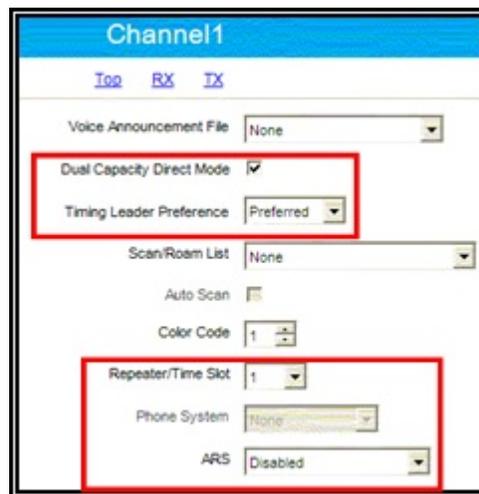


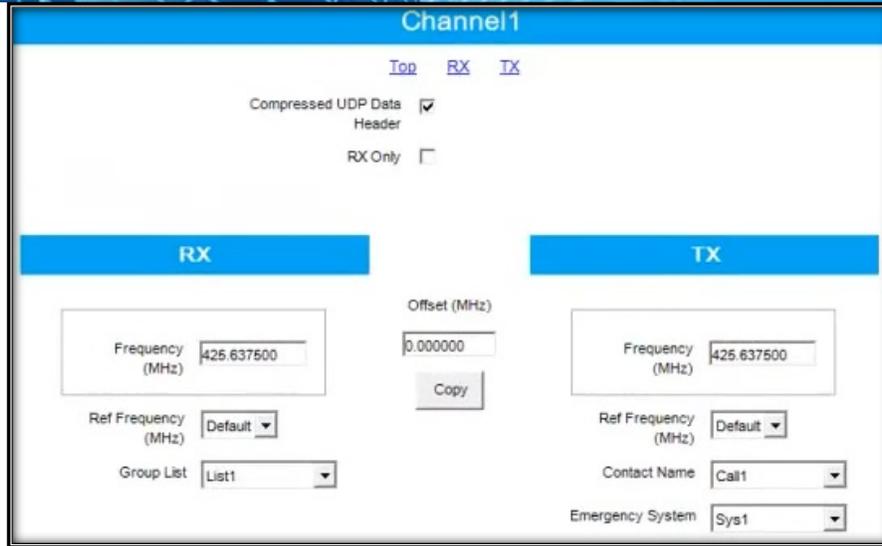
Figure 12 Control Radios Channel Settings

Set the same frequency for both RX (receive) and TX (transmit). Set the *Repeater/Time Slot* to 1 for the first control radio and 2 for the second one.

Check the *Data Call Confirmed* field (to be sure that the subscriber radios will register).

We also recommend to check the *Compressed UDP Data Header* field – using this feature will reduce the duration of all data messages.

⚠ ALL THE RADIOS IN THE SYSTEM SHOULD BE PROGRAMMED WITH THE SAME SETTINGS FOR THESE TWO FIELDS.



The screenshot shows the 'Channel 1' configuration window. At the top, there are links for 'Top', 'RX', and 'TX'. Below these are checkboxes for 'Compressed UDP Data Header' (checked) and 'RX Only' (unchecked). The main area is divided into two sections: 'RX' and 'TX'. Both sections have a 'Frequency (MHz)' field set to '425.637500'. The 'RX' section also has a 'Ref Frequency (MHz)' dropdown set to 'Default' and a 'Group List' dropdown set to 'List1'. The 'TX' section has a 'Ref Frequency (MHz)' dropdown set to 'Default', a 'Contact Name' dropdown set to 'Call1', and an 'Emergency System' dropdown set to 'Sys1'. A 'Copy' button is located between the two sections, and an 'Offset (MHz)' field is set to '0.000000'.

Figure 13 Set the RX and TX frequency

Program the radios not to transmit over a busy channel when starting a call or during a call.



The screenshot shows the 'TX Interruptible Frequencies' configuration window. It has a checkbox for 'TX Interruptible Frequencies' which is unchecked. Below this are two dropdown menus: 'Admit Criteria' set to 'Color Code Free' and 'In Call Criteria' set to 'Follow Admit Criteria'. At the bottom, there is an 'RSSI Threshold (dBm)' field set to '-124'.

Figure 14 Admit Criteria / In Call Criteria

Write the corresponding configuration to each radio.

Programming of the subscriber radios

Read the radio code plug and make the needed changes in the following CPS windows:

General Settings

A subscriber radio must have a *Radio ID*. Fig.15 shows a *Radio ID* of 101, however, this can be any number that you choose.

⚠ ALL SUBSCRIBER RADIOS MUST HAVE A UNIQUE RADIO ID.

The *GPS* field MUST be checked. The Subscriber radio must have GPS enabled in order to transmit location data.

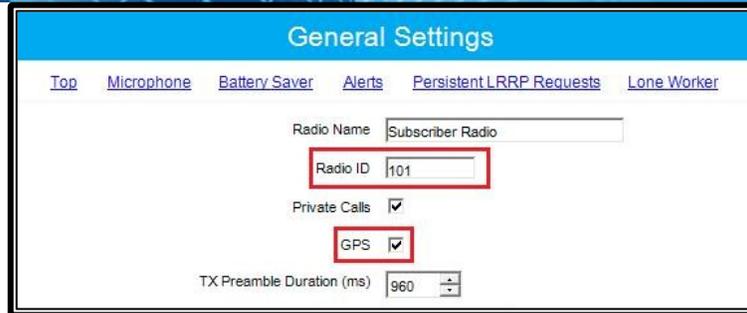


Figure 15 Subscriber Radios General Settings

We also recommend to change the *Talkaround Group Call Hang Time* and the *Talkaround Private Call Hang Time* (used by the radios on simplex channels) to lower values (1-2 seconds) to minimize the voice calls duration, allowing more time for registration and GPS traffic.

⚠ ALL THE RADIOS IN THE SYSTEM SHOULD BE PROGRAMMED WITH THE SAME VALUES FOR THESE TWO FIELDS.

Network Settings

The network settings of the subscriber radios should be configured as follows:

The *Radio IP* field can be left unmodified. The *Forward to PC* field should be set to *Disabled* as these radios do not connect to a PC.

In the *ARS Radio ID* field MUST be entered the ID of the control radio.

⚠ FAILING TO ENTER THE PROPER CONTROL RADIO ID WILL RESULT IN REPEATED UNSUCCESSFUL REGISTRATION ATTEMPTS.

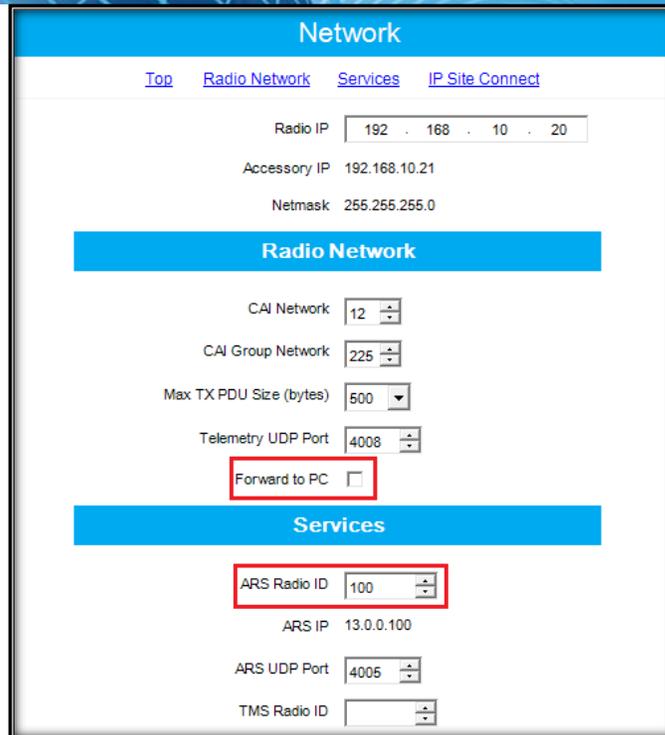


Figure 16 Subscriber RadiosNetwork Settings

Channel Settings

The last important configuration for the subscriber radios takes place in the channel settings. All channel positions used in the radio system should be programmed as below:

- ⚠ The subscriber radios **MUST** have ARS enabled. This is responsible for transmitting presence notification to the MOTOTRBO Gateway Application.

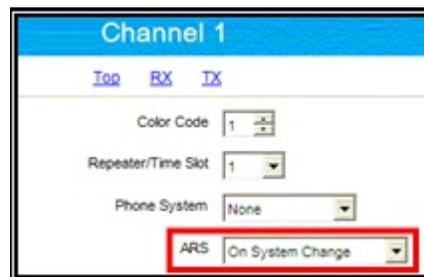
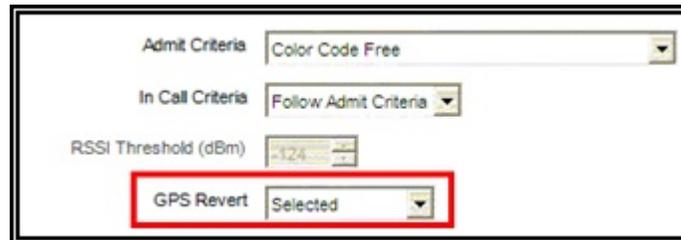


Figure 17 ARS On System Change

Check the *Dual Capacity Direct Mode* field and set the *Timing Leader Preference* field to *Eligible* (so that these radios can be used for synchronizing the timeslots outside the coverage area of the control radios).

Set the same frequency RX and TX frequency, timeslot, TX admit criteria and in call criteria as for the corresponding control radio.

Set the *GPS Revert* field to *Selected* to allow GPS updates transmitted on the current channel.



The image shows a configuration window with several fields. The 'GPS Revert' field is highlighted with a red box and is set to 'Selected'. Other fields include 'Admit Criteria' (Color Code Free), 'In Call Criteria' (Follow Admit Criteria), and 'RSSI Threshold (dBm)' (-124).

Figure 18 GPS Revert – Selected

Check the *Data Call Confirmed* field (to be sure that the radio will register). We also recommend to check the *Compressed UDP Data Header* field – using this feature will reduce the duration of all data messages.

⚠ ALL THE RADIOS IN THE SYSTEM SHOULD BE PROGRAMMED WITH THE SAME SETTINGS FOR THESE TWO FIELDS.

Write the configuration to the radio.

Programming of Single-Site Repeater Systems

Using a repeater offers great advantages. First, it offers a much wider communication area as compared to a simplex system. Second, it always transmits continuously (not on one timeslot) and offers the synchronization information to the subscriber radios, enabling the full use of two timeslots. This allows to separate the voice and GPS traffic by using each of them on different timeslots, through the GPS revert feature of the radios. SafeDispatch will need in this case two control radios (one used on one of the timeslots for voice and ARS and one used on the other timeslot for GPS data). Because voice and GPS data are on different channels the capacity can be limited by either of the two types of traffic – the recommended limits per timeslot are in this case:

- 51 radios with Low Voice profile
- 18 radios with High Voice profile
- 20 GPS updates per minute

As a result, a repeater system can use up to 18 High Voice & High GPS radios or up to 51 Low Voice & Low GPS radios (in this case the GPS interval can be in fact lowered to 153 sec. (2.55 min.) per radio). However, if High GPS profile is needed, you should either limit the number of radios to 20 or use more repeaters (for Low Voice & High GPS you should use 2 repeaters with up to 51 radios – one timeslot for voice and 3 timeslots for GPS – a costly and low efficiency solution). The real solution is to use the “Enhanced GPS” feature (for Low Voice & High GPS this will allow to use only one repeater, with 45% reserved windows on the Enhanced GPS timeslot).

Programming of the ARS control radio

Read the radio code plug and make the needed changes in the following CPS windows:

General Settings

A control radio must have a *Radio ID* – this ID will be used by the subscriber radios to register to the system and to send GPS data and will also be used to make private voice calls to the dispatcher – for this last reason we recommend to use an easy to remember value.

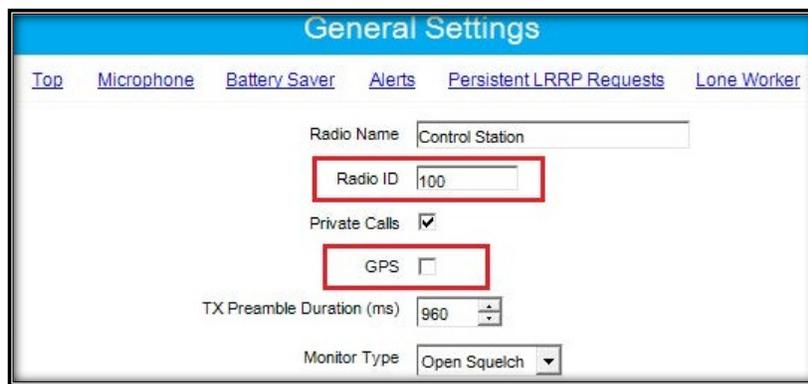


Figure 19 ARS Control Radio ID

The above figure shows a *Radio ID* of 100, however, this can be any number that you choose. As this is a base radio (that will never send GPS data) the *GPS* field should be left unchecked.

Network Settings

The network settings of the ARS control radio should be configured as follows:

The control radio must have a *Radio IP* address – this is used for the USB connection between this radio and the PC. The below figure shows an IP address of 192.168.10.60, however this may be different, depending on your IT network settings.

Check the *Forward to PC* field – in this way all text messages this radio receives are passed to the connected PC.

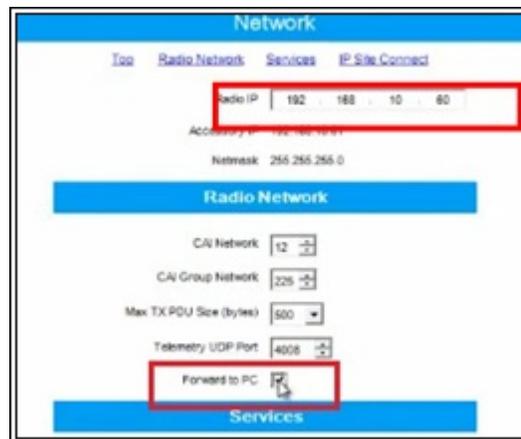


Figure 20 ARS Control Radio Network Settings

Channel Settings

Normally the control radio can have only one channel but if the dispatcher has to talk to different groups that use the same RF channel the radio can use more channel positions – but all should use the same settings (except the *Contact Name* field), as indicated below:

The *ARS* field should be set to *Disabled* as this radio will never register.

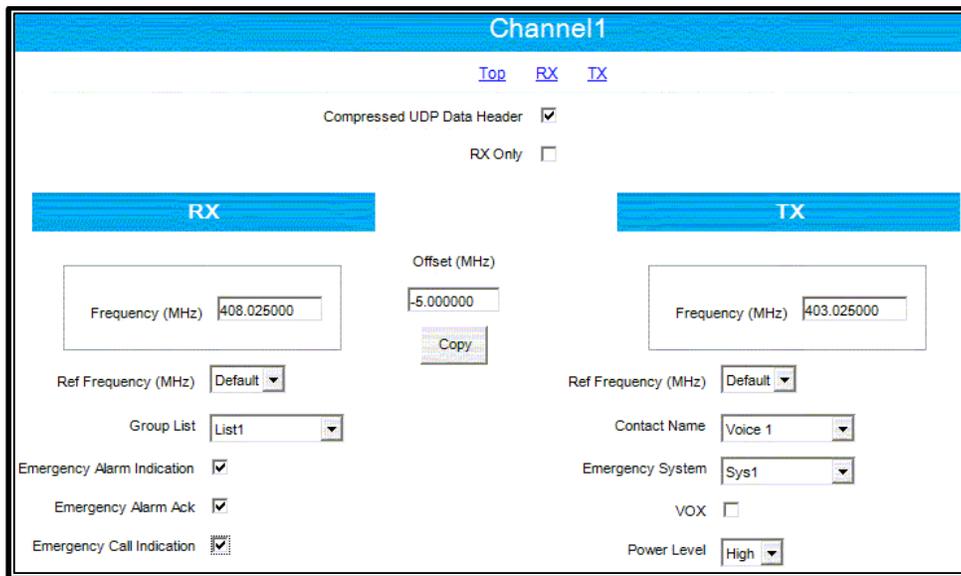


Figure 21 ARS Control Radio Channel Settings

Set the frequencies for RX (receive) and TX (transmit). Set the *Repeater/Time Slot* to 1.

Check the *Data Call Confirmed* field (to be sure that the subscriber radios will register). We also recommend to check the *Compressed UDP Data Header* field – using this feature will reduce the duration of all data messages.

⚠ ALL THE RADIOS IN THE SYSTEM SHOULD BE PROGRAMMED WITH THE SAME SETTINGS FOR THESE TWO FIELDS.



The screenshot shows the 'Channel 1' configuration window. At the top, there are tabs for 'Top', 'RX', and 'TX'. Below these are checkboxes for 'Compressed UDP Data Header' (checked) and 'RX Only' (unchecked). The interface is split into two main sections: 'RX' on the left and 'TX' on the right. In the RX section, the 'Frequency (MHz)' is set to 408.025000, the 'Offset (MHz)' is -5.000000, and the 'Ref Frequency (MHz)' is set to 'Default'. In the TX section, the 'Frequency (MHz)' is set to 403.025000, and the 'Ref Frequency (MHz)' is also set to 'Default'. Other settings include 'Group List' set to 'List1', 'Emergency Alarm Indication' (checked), 'Emergency Alarm Ack' (checked), 'Emergency Call Indication' (checked), 'Contact Name' set to 'Voice 1', 'Emergency System' set to 'Sys1', 'VOX' (unchecked), and 'Power Level' set to 'High'.

Figure 22 Set the RX and TX frequencies

Program the radio not to transmit over a busy channel when starting a call or during a call.



The screenshot shows the 'TX Interruptible Frequencies' settings. A red box highlights the 'Admit Criteria' and 'In Call Criteria' dropdown menus. 'Admit Criteria' is set to 'Color Code Free' and 'In Call Criteria' is set to 'Follow Admit Criteria'. Below these, the 'RSSI Threshold (dBm)' is set to -124.

Figure 23 Admit Criteria / In Call Criteria

Write the configuration to the radio.

Programming of the GPS control radio

Read the radio code plug and make the needed changes in the following CPS windows:

General Settings

Set the *Radio ID* field with the same value as the ARS control radio – this ID will be used by the subscriber radios to send GPS data on the GPS revert channel.

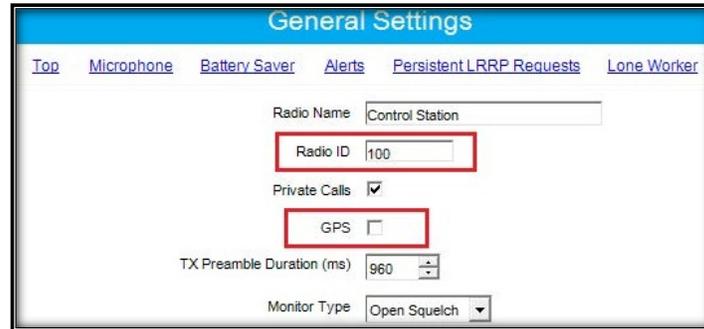


Figure 24 GPS Control Radio Radio ID

The above figure shows a *Radio ID* of 100, however, this can be any number that you choose. As this is a base radio (that will never send GPS data) the *GPS* field should be left unchecked.

⚠ THE ARS CONTROL RADIO AND GPS CONTROL RADIO MUST HAVE THE SAME ID OTHERWISE THE GPS DATA WILL BE LOST.

Network Settings

The network settings of the GPS control radio should be configured as follows:

The GPS control radio must have a *Radio IP* address – this is used for the USB connection between this radio and the PC. To avoid any potential IP address conflicts while keeping an easy to manage value we recommend to use a value similar to the one used for the ARS control radio by changing the second byte value – for example, if the ARS control radio IP address is set to 192.168.10.60, then use for the GPS control radio the value 192.168.20.60.

Check the *Forward to PC* field – in this way all GPS messages this radio receives are passed to the connected PC.

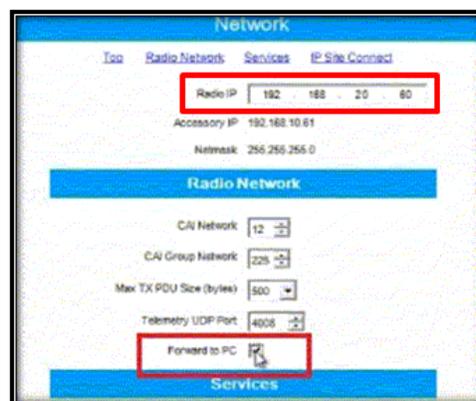


Figure 25 GPS Control Radio Network Settings

Channel Settings

The GPS control radio must have only one channel, using the settings indicated below:



Figure 26 GPS Control Radio Channel Settings

The ARS field should be set to *Disabled* as this radio will never register. Set the frequencies for RX (receive) and TX (transmit). Set the *Repeater/Time Slot* to 2.

We also recommend to check the *Compressed UDP Data Header* field – using this feature will reduce the duration of all data messages.

⚠ ALL THE RADIOS IN THE SYSTEM SHOULD BE PROGRAMMED WITH THE SAME VALUE FOR THIS FIELD.

Program the radio not to transmit over a busy channel when starting a call or during a call.

DO NOT check the *Data Call Confirmed* field (DCC is not used on Enhanced GPS revert channels).

⚠ NOTE: As the only task for the GPS control radio is to receive the GPS messages, this radio will never transmit. You can even check the *RX Only* field to prevent any accidental transmission but this is not mandatory (you can keep its TX capability for RF testing).

Write the configuration to the radio.

Programming of the subscriber radios

Read the radio code plug and make the needed changes in the following CPS windows:

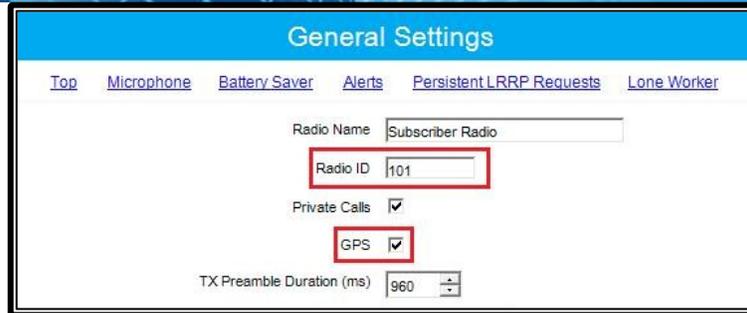
General Settings

A subscriber radio must have a *Radio ID*.

Fig.27 shows a *Radio ID* of 101, however, this can be any number that you choose.

⚠ ALL SUBSCRIBER RADIOS MUST HAVE A UNIQUE RADIO ID.

The *GPS* field **MUST** be checked. The Subscriber radio must have GPS enabled in order to transmit location data.



General Settings

[Top](#) [Microphone](#) [Battery Saver](#) [Alerts](#) [Persistent LRRP Requests](#) [Lone Worker](#)

Radio Name: Subscriber Radio

Radio ID: 101

Private Calls:

GPS:

TX Preamble Duration (ms): 960

Figure 27 Subscriber Radios General Settings

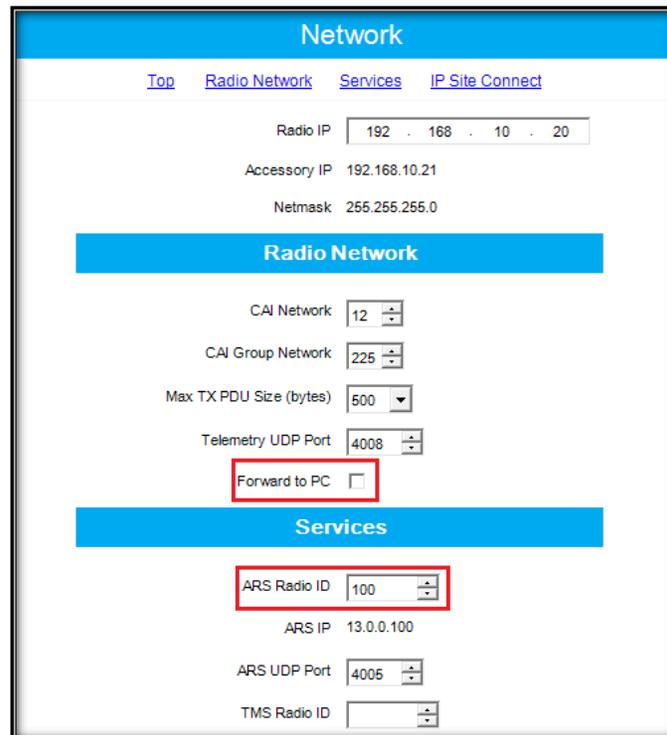
Network Settings

The network settings of the subscriber radios should be configured as follows:

The *Radio IP* field can be left unmodified. The *Forward to PC* field should be set to *Disabled* as these radios do not connect to a PC.

In the *ARS Radio ID* field MUST be entered the ID of the ARS control radio.

⚠ FAILING TO ENTER THE PROPER CONTROL RADIO ID WILL RESULT IN REPEATED UNSUCCESSFUL REGISTRATION ATTEMPTS.



Network

[Top](#) [Radio Network](#) [Services](#) [IP Site Connect](#)

Radio IP: 192 . 168 . 10 . 20

Accessory IP: 192.168.10.21

Netmask: 255.255.255.0

Radio Network

CAI Network: 12

CAI Group Network: 225

Max TX PDU Size (bytes): 500

Telemetry UDP Port: 4008

Forward to PC:

Services

ARS Radio ID: 100

ARS IP: 13.0.0.100

ARS UDP Port: 4005

TMS Radio ID:

Figure 28 Subscriber Radios Network Settings

Channel Settings

Program at least two digital channels in the radio (one for voice and one for GPS revert). The voice channel should be present in *Zone 1* while the GPS revert channel must be added to the *Channel Pool*(so that the user cannot select it).

For the voice channel:

- The subscriber radios **MUST** have ARS enabled on the voice channels. This is responsible for transmitting presence notification to the MOTOTRBO Gateway Application.

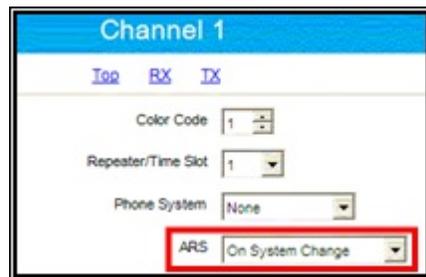


Figure 29 ARS On System Change

- Set the same RX and TX frequencies, timeslot, TX admit criteria and in call criteria as for the ARS control radio. Select for the *GPS Revert* field the GPS revert channel to allow GPS updates transmitted on that channel.

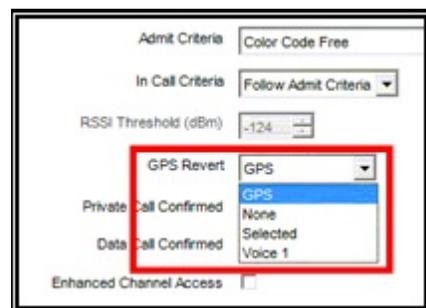


Figure 30 GPS Revert

- Check the *Data Call Confirmed* field (to be sure that the radio will register). We also recommend to check the *Compressed UDP Data Header* field – using this feature will reduce the duration of all data messages.

⚠ ALL THE RADIOS IN THE SYSTEM SHOULD BE PROGRAMMED WITH THE SAME SETTINGS FOR THESE TWO FIELDS.

For the GPS revert channel:

- Set the *ARS* field to *Disabled*.
- Check the *Enhanced GPS* field and set the *Window Size* to 7.



Figure 31 GPS Revert Channel Settings

- Program the GPS revert channel with the same frequencies as the voice channel (you can use copy/paste) but use Timeslot 2.
- Set the same TX admit criteria and in call criteria as on the voice channel
- Check the *Compressed UDP Data Header* field – using this feature will reduce the duration of the GPS data messages, allowing to use the *Window Size* of 7.

⚠ **ALL THE RADIOS IN THE SYSTEM SHOULD BE PROGRAMMED WITH THE SAME SETTING FOR THIS FIELD.**

Write the configuration to the radio.

Programming of the repeater

Read the repeater code plug and make the needed changes in the following CPS windows:

General Settings

In this case you can ignore the *Radio ID* (it is not used). We recommend to change the *Group Call Hang Time*, the *Private Call Hang Time* and the *Emergency Call Hang Time* fields to lower values (1-2 seconds) to minimize the voice calls duration, allowing more time for voice, registration and GPS traffic.

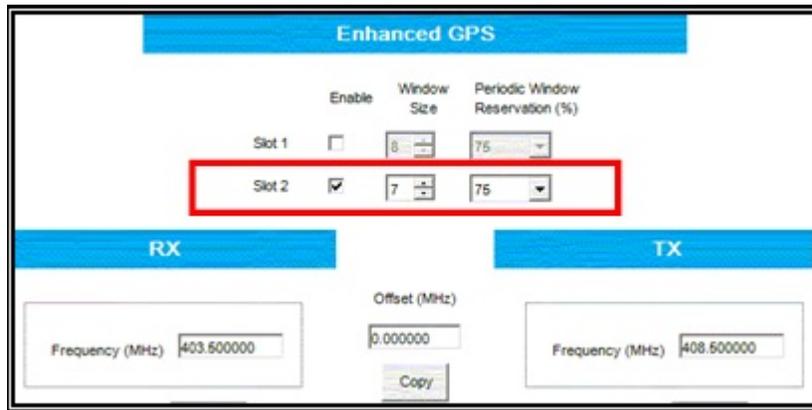


Figure 32 Repeater General Settings

Channel Settings

Program the repeater with only one digital channel, having the following settings:

- In the *Enhanced GPS* section check the *Enable* field for *Slot 2* and set the *Window Size* to 7.
- Change (only if needed) the *Periodic Window Reservation (%)* field to the desired value (the default value is 75%).
- Set the TX and RX frequencies (according to the frequency license).



Enhanced GPS			
	Enable	Window Size	Periodic Window Reservation (%)
Slot 1	<input type="checkbox"/>	8	75
Slot 2	<input checked="" type="checkbox"/>	7	75

RX		TX	
Frequency (MHz)	408.500000	Frequency (MHz)	408.500000
Offset (MHz)		Offset (MHz)	
0.000000		0.000000	
Copy			

Figure 33 Repeater Channel Settings

Write the configuration to the repeater.

Programming of IP Site Connect Systems

An IP Site Connect (IPSC) system offers a much wider communication area as compared to a single-site repeater system. Generally, it offers the possibility to use any of the 2 repeater timeslots either in local mode or in wide-area mode. It also allows to separate the voice and GPS traffic by using each of them on different timeslots, using the GPS revert feature of the radios. Here we will consider only the case when both timeslots are used in wide-area mode – for any local use you can read and program (for each site) according to the single-site repeater case. SafeDispatch will need in this case 2 control radios (one used on the timeslot for voice and ARS and one used on the timeslot for GPS data). As voice and GPS data are on different channels the capacity can be limited by either of the two types of traffic – the recommended limits per timeslot are the same as for the single-site repeater case:

- 51 radios with Low Voice profile
- 18 radios with High Voice profile
- 20 GPS updates per minute

As a result, an IPSC system can use up to 18 High Voice & High GPS radios or up to 51 Low Voice & Low GPS radios (in this case the GPS interval can be in fact lowered to 153 sec. (2.55 min.) per radio).

However, if High GPS profile is needed, you should either limit the number of radios to 20 or use more repeaters (for Low Voice & High GPS you should use 2 systems with up to 51 radios – one timeslot for voice and 3 timeslots for GPS – a costly and low efficiency solution). The real solution is to use the “Enhanced GPS” feature (for Low Voice & High GPS this will allow to use only one system, with 45% reserved windows on the Enhanced GPS timeslot).

Programming of the ARS control radio

Read the radio code plug and make the needed changes in the following CPS windows:

General Settings

A control radio must have a *Radio ID* – this ID will be used by the subscriber radios to register to the system and to send GPS data and will also be used to make private voice calls to the dispatcher – for this last reason we recommend to use an easy to remember value.

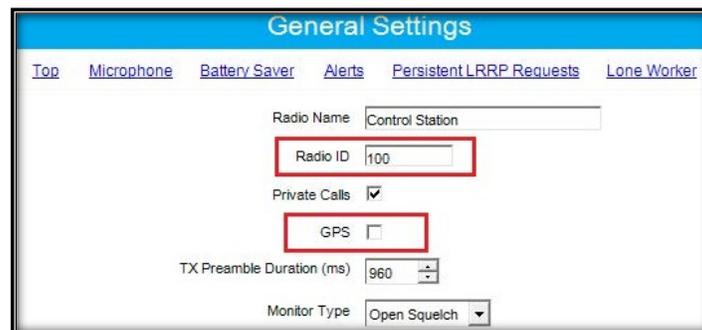


Figure 34 ARS Control Radio ID

The above figure shows a *Radio ID* of 100, however, this can be any number that you choose. As this is a base radio (that will never send GPS data) the *GPS* field should be left unchecked.

Network Settings

The network settings of the ARS control radio should be configured as follows:

The control radio must have a *Radio IP* address – this is used for the USB connection between this radio and the PC. The below figure shows an IP address of 192.168.10.60, however this may be different, depending on your IT network settings.

Check the *Forward to PC* field – in this way all text messages this radio receives are passed to the connected PC.

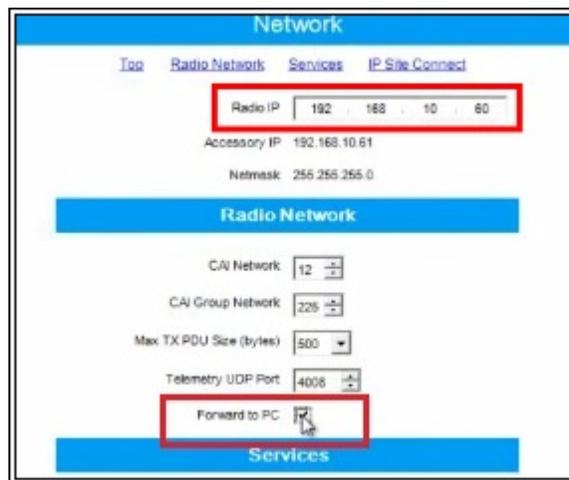


Figure 35 ARS Control Radio Network Settings

Channel Settings

Normally the control radio can have only one channel but if the dispatcher has to talk to different groups that use the same RF channel the radio can use more channel positions – but all should use the same settings (except the *Contact Name* field), as indicated below:

The *ARS* field should be set to *Disabled* as this radio will never register.



Figure 36 ARS Control Radio Channel Settings

Set the frequencies for RX (receive) and TX (transmit) corresponding to the local repeater. Set the *Repeater/Time Slot* to 1.

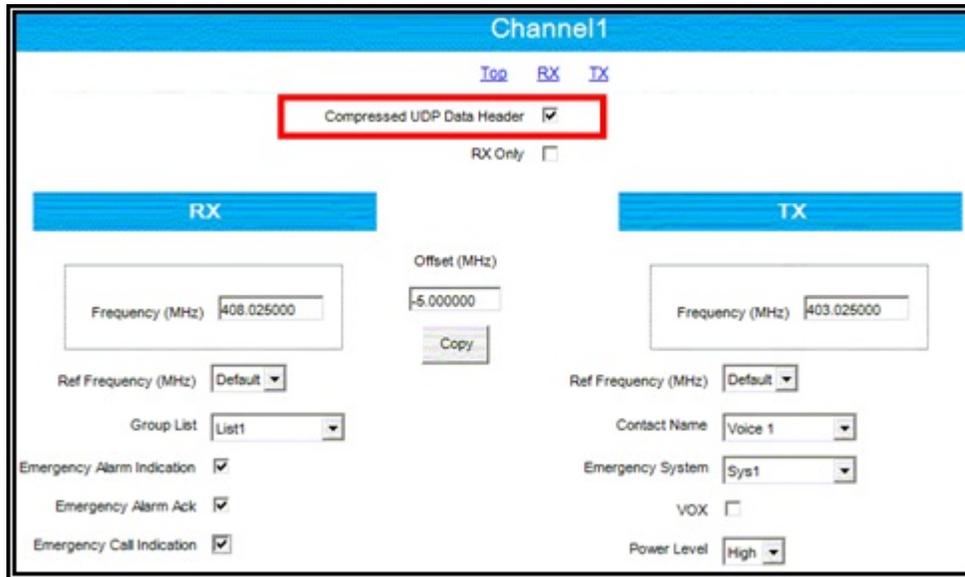


Figure 37 Set the RX and TX frequencies

Check the *Data Call Confirmed* field (to be sure that the subscriber radios will register). We also recommend to check the *Compressed UDP Data Header* field – using this feature will reduce the duration of all data messages.

⚠ ALL THE RADIOS IN THE SYSTEM SHOULD BE PROGRAMMED WITH THE SAME SETTINGS FOR THESE TWO FIELDS.

Program the radio not to transmit over a busy channel when starting a call or during a call.



Figure 38 Admit Criteria / In Call Criteria

Write the configuration to the radio.

Programming of the GPS control radio

Read the radio code plug and make the needed changes in the following CPS windows:

General Settings

Set the *Radio ID* field with the same value as the ARS control radio – this ID will be used by the subscriber radios to send GPS data on the GPS revert channel.



Figure 39 GPS Control Radio ID

The above figure shows a *Radio ID* of 100, however, this can be any number that you choose. As this is a base radio (that will never send GPS data) the *GPS* field should be left unchecked.

⚠ THE ARS CONTROL RADIO AND GPS CONTROL RADIO MUST HAVE THE SAME ID OTHERWISE THE GPS DATA WILL BE LOST.

Network Settings

The network settings of the GPS control radio should be configured as follows:

The GPS control radio must have a *Radio IP* address – this is used for the USB connection between this radio and the PC. To avoid any potential IP address conflicts while keeping an easy to manage value we recommend to use a value similar to the one used for the ARS control radio by changing the second byte value – for example, if the ARS control radio IP address is set to 192.168.10.60, then use for the GPS control radio the value 192.168.20.60.

Check the *Forward to PC* field – in this way all GPS messages this radio receives are passed to the connected PC.

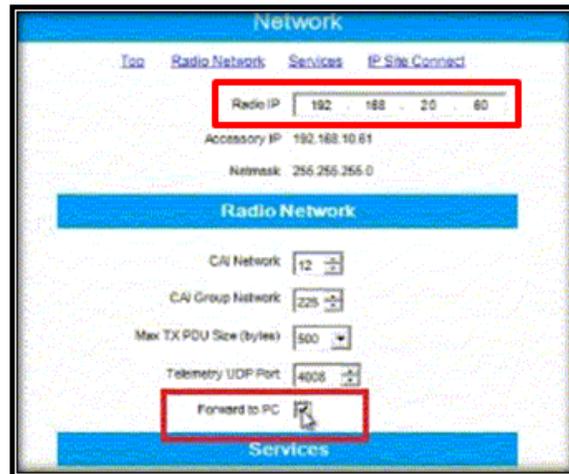


Figure 40 GPS Control Radio Network Settings

Channel Settings

The GPS control radio must have only one channel, using the settings indicated below:



Figure 41 GPS Control Radio Channel Settings

The ARS field should be set to *Disabled* as this radio will never register. Set the frequencies for RX (receive) and TX (transmit) corresponding to the local repeater. Set the *Repeater/Time Slot* to 2.

Check the *Compressed UDP Data Header* field – using this feature will reduce the duration of the GPS data messages.

⚠ ALL THE RADIOS IN THE SYSTEM SHOULD BE PROGRAMMED WITH THE SAME VALUE FOR THIS FIELD ON THE GPSREVERT CHANNEL.

Program the radio not to transmit over a busy channel when starting a call or during a call.

DO NOT check the *Data Call Confirmed* field (DCC is not used on Enhanced GPS revert channels).

⚠ NOTE: As the only task for the GPS control radio is to receive the GPS messages, this radio will never transmit. You can even check the *RX Only* field to prevent any accidental transmission but this is not mandatory (you can keep its TX capability for RF testing).

Write the configuration to the radio.

Programming of the subscriber radios

Read the radio code plug and make the needed changes in the following CPS windows:

General Settings

A subscriber radio must have a *Radio ID*.

Fig.42 shows a *Radio ID* of 101, however, this can be any number that you choose.

⚠ ALL SUBSCRIBER RADIOS MUST HAVE A UNIQUE RADIO ID.

The *GPS* field **MUST** be checked. The Subscriber radio must have GPS enabled in order to transmit location data.

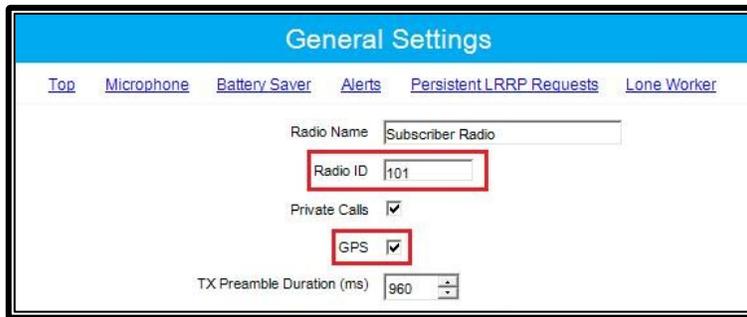


Figure 42 Subscriber Radios General Settings

Network Settings

The network settings of the subscriber radios should be configured as follows:

The *Radio IP* field can be left unmodified. The *Forward to PC* field should be set to *Disabled* as these radios do not connect to a PC.

In the *ARS Radio ID* field **MUST** be entered the ID of the ARS control radio.

⚠ FAILING TO ENTER THE PROPER CONTROL RADIO ID WILL RESULT IN REPEATED UNSUCCESSFUL REGISTRATION ATTEMPTS.

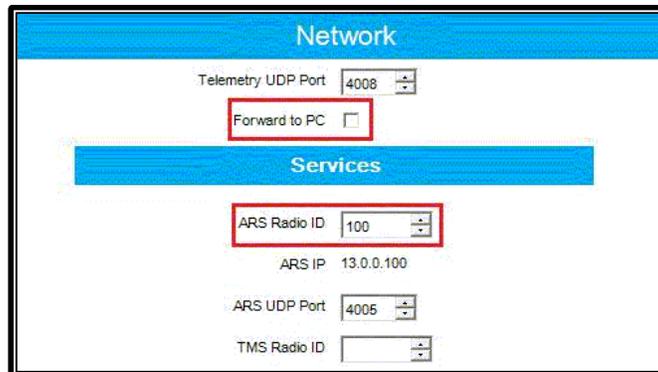


Figure 43 Subscriber Radios Network Settings

Channel Settings

Program at least two digital channels in the radio (one for voice and one for GPS revert) for each repeater site. The voice channels should be present in *Zone 1* while the GPS revert channels must be added to the *Channel Pool*(so that the user cannot select them).

For the voice channels:

- The subscriber radios MUST have *ARS* enabled on the voice channels. This is responsible for transmitting presence notification to the MOTOTRBO Gateway Application.

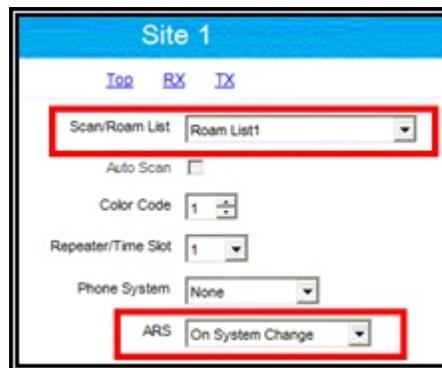


Figure 44 ARS and Roam List

- Check the *IP Site Connect* field and set the *Scan/Roam List* field to *Roam List 1*.
- Set the RX and TX frequencies corresponding to each repeater site, using Timeslot 1.

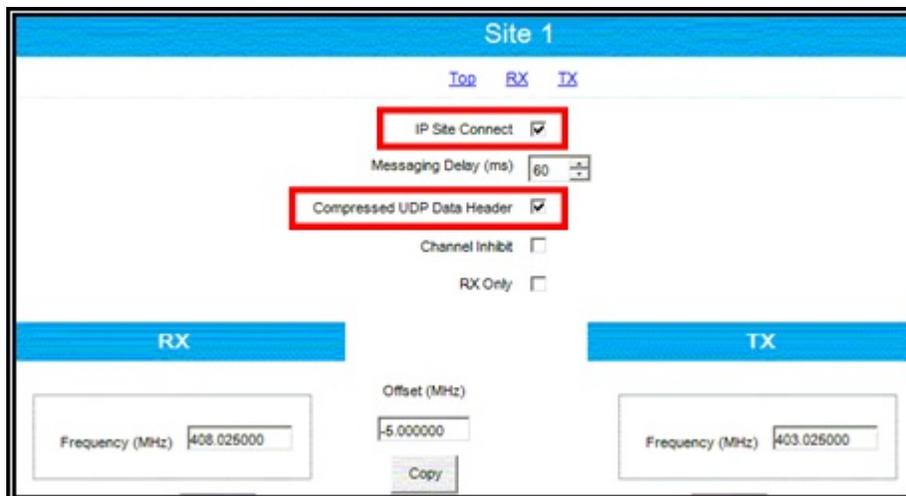


Figure 45 IP Site Connect Channel

- Set the same TX admit criteria and in call criteria as for the ARS control radio.

- Select for each voice channel (in the *GPS Revert* field) the corresponding GPS revert channel to allow GPS updates transmitted on that channel.

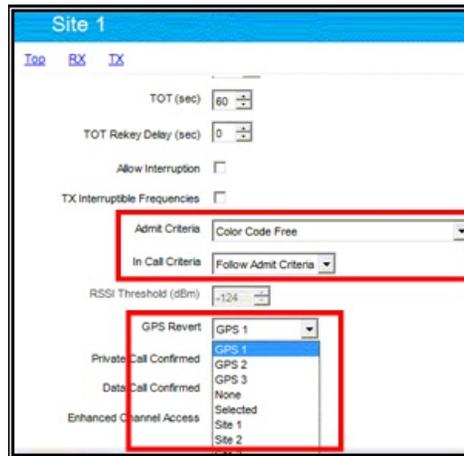


Figure 46 GPS Revert Selection

Check the *Data Call Confirmed* field (to be sure that the radio will register). We also recommend to check the *Compressed UDP Data Header* field – using this feature will reduce the duration of all data messages.

⚠ ALL THE RADIOS IN THE SYSTEM SHOULD BE PROGRAMMED WITH THE SAME SETTINGS FOR THESE TWO FIELDS.

For the GPS revert channels:

- Set the *ARS* field to *Disabled*.
- Check the *Enhanced GPS* field and set the *Window Size* to 7.



Figure 47 GPS Revert Channel Settings - 1

- Do not check the *IP Site Connect* field
- Program each GPS revert channel with the same frequencies as the corresponding voice channel (you can use copy/paste) but use Timeslot 2.
- Set the same TX admit criteria and in call criteria as on the voice channels

- Check the *Compressed UDP Data Header* field – using this feature will reduce the duration of the GPS data messages, allowing to use the *Window Size* of 7.

⚠ ALL THE RADIOS IN THE SYSTEM SHOULD BE PROGRAMMED WITH THE SAME SETTING FOR THIS FIELD.



Figure 48 GPS Revert Channel Settings - 2

Roam Settings

The set of corresponding voice channels (one for each site) uses a Roam List (if there are more channel sets (using for example another *Contact Name* in the TX section) each will use a separate list). The list is defined by selecting (with the mouse) a channel in the *Available* table and clicking on the *Add>>* button – the channel will move to the *Members* table.



Figure 49 Roam List

Write the configuration to the radio.

Programming of the repeaters

Read the repeater code plug and make the needed changes in the following CPS windows:

General Settings

⚠ IN THIS CASE THE RADIO ID IS USED IN THE REPEATER IP NETWORK TO IDENTIFY EACH REPEATER, SO EACH REPEATER MUST HAVE A DIFFERENT ID.



General Settings	
Radio Name	Motorola
Radio ID	1
SIT (ms)	6000
Group Call Hang Time (ms)	3000
Private Call Hang Time (ms)	4000
Emergency Call Hang Time (ms)	4000
Call Hang Time (sec)	3

Figure 50 IPSC Repeaters General Settings

We recommend to change the *Group Call Hang Time*, the *Private Call Hang Time* and the *Emergency Call Hang Time* fields to lower values (1-2 seconds) to minimize the voice calls duration, allowing more time for voice, registration and GPS traffic.

Network Settings

In an IPSC system all repeaters are connected together via Ethernet connections. As each repeater is in a different site, the most common case is the general Internet connection type via an Internet Service Provider (ISP) – other cases like a customer WAN are also possible but less probable. To allow maximum flexibility (towards the ISP) the system doesn't use multicast data packets – each repeater will send in turn the data packets (that can correspond to voice or data radio transmissions) to each of the other repeaters present in the system. While this leads to a limit in the maximum number of repeaters (currently 15) it avoids the problem of the multicast data packets that most ISP are blocking. But it also means that each repeater must know the IP address of all the other repeaters in the system. To provide flexibility in the system topology (capability to add new repeaters or to adapt to the change of the IP address of the repeaters) without the need to reprogram the repeaters for every change Motorola has implemented the following mechanism: one repeater will be programmed to be a "Master" while the others will be programmed to be "Peers". The "Master" is the only repeater that must have a fixed IP address (provided by the ISP) while the "Peers" can have a variable IP address (using DHCP). The "Peers" are programmed with the "Master"'s IP address and

(when switched on) they will register to the “Master” with their IP address – the “Master” keeps a

table of existing repeaters and for each change (new registration) will update the table and resend it to all the other repeaters (“Peers”).

⚠ Note that the DHCP mechanism will create anyhow short communication interruptions when a “Peer”’s IP address is changed, so we recommend to avoid (if possible) the use of DHCP and to set all repeaters to fixed IP addresses – or to discuss with the ISP the possibility to perform the IP address changes during a low traffic moment of time (like during night).

To secure the repeater IP communication an authentication key is used (it is an up to 40 digits hex number value) – for more security you can use VPN connections between repeaters (with additional hardware).

For the “Master” repeater use the following network settings in the *Link Establishment* section:

- Select for the *Link Type* field the value *Master*.
- Enter an *Authentication Key* value (the same value must be used for all repeaters – keep it also saved in a separate secure place as you cannot see it in a read or opened code plug)
- Enter the *Ethernet IP* value (the fixed address provided by the ISP)
- Enter the *Gateway IP* and the *Gateway Netmask* values (also provided by the ISP)

For the “Peer” repeaters use the following network settings in the *Link Establishment* section:

- Select for the *Link Type* field the value *Peer*.
- Enter the *Authentication Key* value (the same value as used for the “Master”)
- Enter the Master IP value (the fixed address provided for the “Master” by the ISP)
- Check the *DHCP* box (if DHCP is used for the “Peers”) or (if DHCP is not used) Enter the *Ethernet IP* value (the fixed address provided by the ISP for this repeater)
- Enter (if DHCP is not used) the *Gateway IP* and the *Gateway Netmask* values (also provided by the ISP)

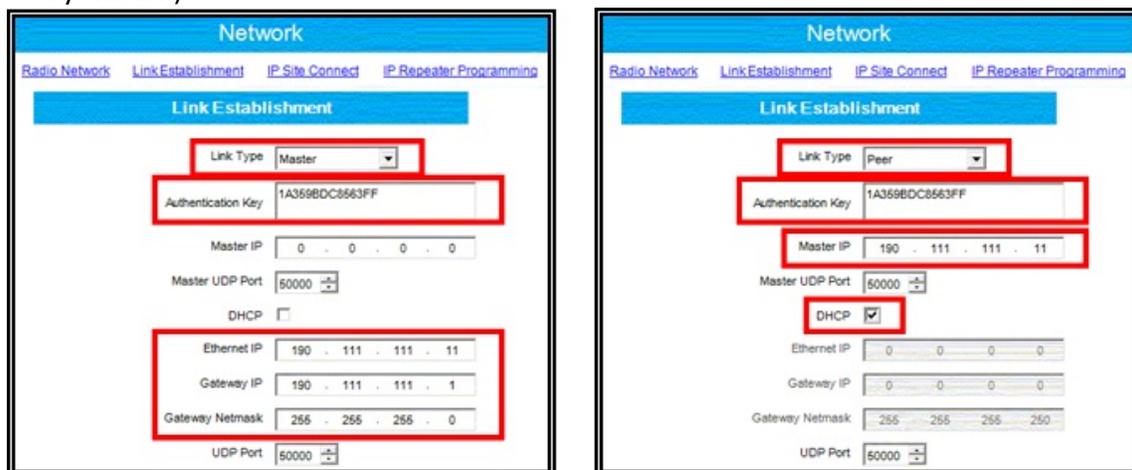


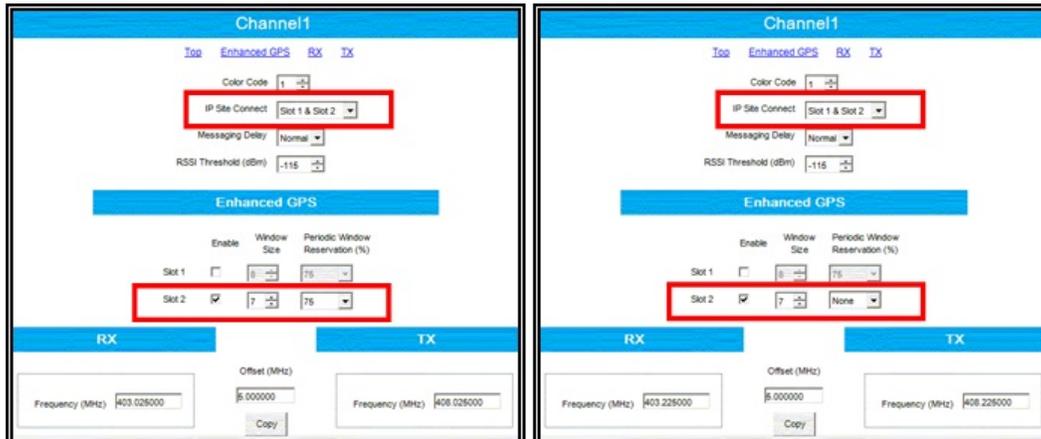
Figure 51 IPSC Repeaters Network Settings

Master

Peer

Channel Settings

Program the repeaters with only one digital channel, having the following settings:



The figure shows two side-by-side screenshots of the 'Channel1' configuration interface. Both screens have a blue header with 'Channel1' and navigation tabs for 'Top', 'Enhanced GPS', 'RX', and 'TX'.
 - **Master Repeater (Left):** The 'IP Site Connect' dropdown is set to 'Slot 1 & Slot 2'. In the 'Enhanced GPS' section, 'Slot 2' is checked, 'Window Size' is 7, and 'Periodic Window Reservation (%)' is 75. RX and TX frequencies are both 403.025000.
 - **Peer Repeater (Right):** The 'IP Site Connect' dropdown is set to 'Slot 1 & Slot 2'. In the 'Enhanced GPS' section, 'Slot 2' is checked, 'Window Size' is 7, and 'Periodic Window Reservation (%)' is 'None'. RX and TX frequencies are both 403.225000.

Figure 52 IPSC Repeaters Channel Settings

Master

Peer

- For the *IP Site Connect* field select the value *Slot 1 & Slot 2* (this sets both timeslots to be used in wide-area mode).
- In the *Enhanced GPS* section check the *Enable* field for *Slot 2* and set the *Window Size* to 7.
- For the “Master” repeater change (only if needed) the *Periodic Window Reservation (%)* field to the desired value (the default value is 75%).
- For the “Peer” repeaters change the *Periodic Window Reservation (%)* field to *None*.
- Set the TX and RX frequencies (according to the frequency license for each repeater).

Write the configuration to the repeater.

Programming of Capacity Plus Systems

A Capacity Plus system is a single-site trunking system that offers a much greater communication capacity as compared to a single repeater system. Generally, it consists in a number of voice/data repeaters (maximum 6) that work in trunking mode and a number of data revert repeaters (maximum 12) that work in conventional mode – both timeslots of either type of repeater are of the same type. Although the GPS data can also be sent on the trunking channels we do not recommend this (unless only a limited number of Low GPS profile radios are used) –the normal way of sending the GPS data is on a data revert repeater timeslot, using the GPS revert feature of the radios.

In Capacity Plus (unless there are no data revert repeaters) the radios register on the data revert channels (and not on the trunking channels) – even if they are Enhanced GPS ones. SafeDispatch will need in this case more control radios – one used in trunking mode(only for data information sent to the subscriber radios and also for dispatcher’s voice communication) and at least two (or multiple of two) used in conventional mode (one on eachGPS data revert time slot).

If the GPS data is sent on the trunking channels (no data revert repeaters) the trunking control radio must also be used for registrations. This creates an additional problem: while it is used by the dispatcher for voice calls no radios can register – the only solution is to use two separate radios (one used for ARS, GPS data and data sent to the subscriber radios and one used for dispatcher’s voice communication). In this case the following limits in the number of radios per system apply:

Number of trunking repeaters / (channels)	Maximum no. of High Voice/Low GPS radios	Maximum no/ of Low Voice/Low GPS radios
1 / (2)	10	30
2 / (4)	30	50
3 / (6)	100	230
4 / (8)	210	470
5 / (10)	330	740
6 / (12)	460	1020

Note that to handle the GPS traffic a separate trunking control radio will be needed for every 200-250 Low GPS radios.

If the GPS data is sent on the data revert channels the following limits in the number of radios per system apply:

- For the trunking channels:

Number of trunking repeaters / (channels)	Maximum number of High Voice radios	Maximum number of Low Voice radios
1 / (2)	25	75
2 / (4)	120	360
3 / (6)	245	735
4 / (8)	390	1170
5 / (10)	545	1635
6 / (12)	710	2130

You can compare the above two tables and notice the impact of even Low GPS data sending on trunking channels.

- For the GPS data revert channels (because they work in conventional mode) the same number of 20 updates per minute per timeslot is supported as in the conventional repeater systems:

Number of data revert repeaters / (channels)	Maximum number of High GPS radios	Maximum number of Low GPS radios
1 / (2)	40	400
2 / (4)	80	800
3 / (6)	120	1200
4 / (8)	160	1600
5 / (10)	200	2000
6 / (12)	240	2400
⋮	⋮	⋮
12 / (24)	480	4800

It's easy to see that if using High GPS radios more data revert repeaters are needed than voice repeaters, even if the radios are also High Voice profile ones – a costly and low efficiency solution. The real solution is to use the “Enhanced GPS” feature – this will allow to use the following number of High GPS radios per system (for Low GPS radios multiply the below values by 10):

Number of “Enhanced GPS” data revert repeaters / (channels)	Maximum number of High GPS radios – 75% reserved windows	Maximum number of High GPS radios – 60% reserved windows	Maximum number of High GPS radios – 45% reserved windows
1 / (2)	214	172	128
2 / (4)	428	344	256
3 / (6)	642	516	384
4 / (8)	856	688	512
5 / (10)	1070	860	640
6 / (12)	1284	1032	768
⋮	⋮	⋮	⋮
12 / (24)	2568	2064	1536

Programming of the trunking control radio

Read the radio code plug and make the needed changes in the following CPS windows:

General Settings

A control radio must have a *Radio ID* – this ID will be used by the subscriber radios to register to the system and to send GPS data:



Figure 53 Trunking Control Radio/D

The above figure shows a *Radio ID* of 100, however, this can be any number that you choose. As this is a base radio (that will never send GPS data) the *GPS* field should be left unchecked.

Network Settings

The network settings of the trunking control radios should be configured as follows:

The control radio must have a *Radio IP* address – this is used for the USB connection between this radio and the PC. The below figure shows an IP address of 192.168.10.60, however this may be different, depending on your IT network settings.

Check the *Forward to PC* field – in this way all text messages this radio receives are passed to the connected PC.



Figure 54 Trunking Control Radio Network Settings

Personality / Channel Settings

The trunking control radio will have only one Capacity Plus personality, using the settings indicated below:

- The ARS field should be set to *Disabled* as this radio will never register.



Figure 55 Trunking Control Radio ARS Setting

- Select for the *Voice List* field the *List 1* value (it contains the RF trunking channels from the *Channel Pool* – see below).

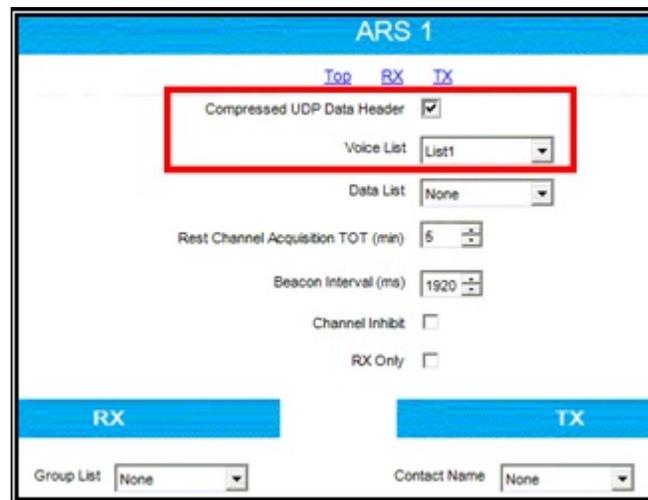


Figure 56 Trunking Control Radio Personality Settings

- Check the *Data Call Confirmed* field (to be sure that no data messages are lost). We also recommend to check the *Compressed UDP Data Header* field – using this feature will reduce the duration of all data messages.

⚠ ALL THE RADIOS IN THE SYSTEM SHOULD BE PROGRAMMED WITH THE SAME SETTINGS FOR THESE TWO FIELDS.

- Program the radio not to transmit over a busy channel when starting a call or during a call.



Figure 57 Admit Criteria / In Call Criteria

Add in the *Channel Pool* the number of *Capacity Plus Voice Channels* that corresponds to the number of voice (trunking) repeaters in the system. For each voice channel set the frequencies for RX (receive) and TX (transmit) corresponding to each repeater.

Voice List Settings

The set of corresponding voice channels determines a *Voice List* – this list is used by the radio for all trunking communication. The list is defined by selecting (with the mouse) a channel in the “*Available*” table and clicking on the “*Add>>*” button – the channel will move to the “*Members*” table.

Go to *Voice List 1* and add all the corresponding voice channels from the *Channel Pool* – take care to use the same order in the list as the numbering order used in the repeater programming (see below).

⚠ A WRONG ORDER IN THE LIST WILL DETERMINE THE RADIO NOT TO WORK WITH SOME OR ALL OF THE REPEATERS.

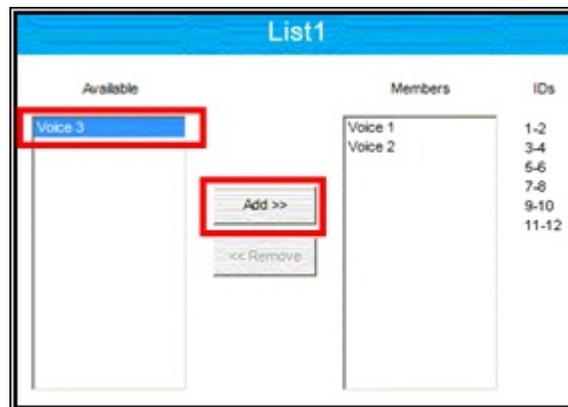


Figure 58 Capacity Plus Voice List

Write the configuration to the radio.

Programming of the GPS control radios

Read the radio code plug and make the needed changes in the following CPS windows:

General Settings

Set the *Radio ID* field with the same value as the trunking control radio – this ID will be used by the subscriber radios to send GPS data on the GPS revert channels.

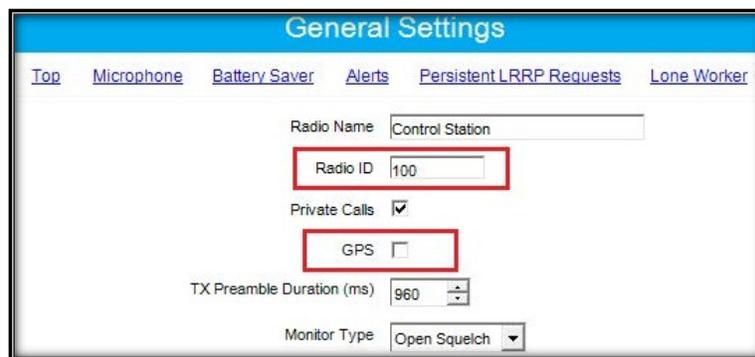


Figure 59 GPS Control Radios Radio ID

The above figure shows a *Radio ID* of 100, however, this can be any number that you choose. As this is a base radio (that will never send GPS data) the *GPS* field should be left unchecked.

⚠ THE TRUNKING CONTROL RADIO AND THE GPS CONTROL RADIOS MUST HAVE THE SAME ID OTHERWISE THE GPS DATA WILL BE LOST.

Network Settings

The network settings of the GPS control radios should be configured as follows:

The GPS control radio must have a *Radio IP* address – this is used for the USB connection between this radio and the PC. To avoid any potential IP address conflicts while keeping an easy to manage value we recommend to use a value similar to the one used for the ARS control radio by changing the third byte value – for example, if the ARS control radio IP address is 192.168.10.60, then use for the first GPS control radio the value 192.168.20.60, for the second one 192.168.30.60 and so on.

Check the *Forward to PC* field – in this way all GPS messages this radio receives are passed to the connected PC.

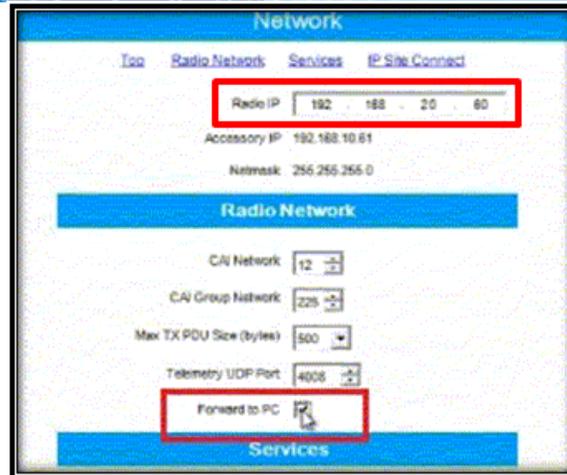


Figure 60GPSControl Radios Network Settings

Channel Settings

The GPS control radio must have only one digital conventional channel, using the settings indicated below:

- The ARS field should be set to *Disabled* as this radio will never register. Set the frequencies for RX (receive) and TX (transmit) corresponding to the proper data revert repeater. Set the *Repeater/Time Slot* to 1 for the first control radio using that repeater and to 2 for the second one.
 - Check the *Compressed UDP Data Header* field – using this feature will reduce the duration of the GPS data messages.
- ⚠ ALL THE RADIOS IN THE SYSTEM SHOULD BE PROGRAMMED WITH THE SAME VALUE FOR THIS FIELD ON THE GPSREVERT CHANNEL.**

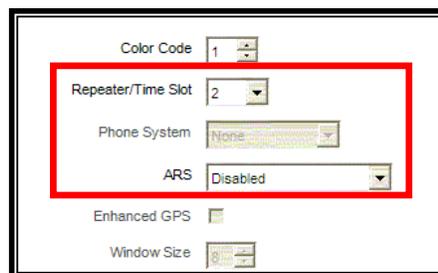


Figure 61GPS Control Radios Channel Settings

- Program the radio not to transmit over a busy channel when starting a call or during a call.
- DO NOT check the *Data Call Confirmed* field (DCC is not used on Enhanced GPS channels).

Write the configuration to the radio.

Programming of the subscriber radios

Read the radio code plug and make the needed changes in the following CPS windows:

General Settings

A subscriber radio must have a *Radio ID*.

Fig.62 shows a *Radio ID* of 101, however, this can be any number that you choose.

⚠ ALL SUBSCRIBER RADIOS MUST HAVE A UNIQUE RADIO ID.

The *GPS* field **MUST** be checked. The Subscriber radio must have GPS enabled in order to transmit location data.

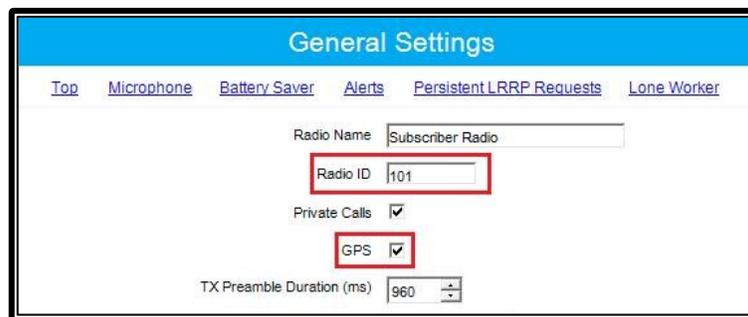


Figure 59 Subscriber Radios General Settings

Network Settings

The network settings of the subscriber radios should be configured as follows:

The *Radio IP* field can be left unmodified. The *Forward to PC* field should be set to *Disabled* as these radios do not connect to a PC.

In the *ARS Radio ID* field **MUST** be entered the ID of the ARS control radio.

⚠ FAILING TO ENTER THE PROPER CONTROL RADIO ID WILL RESULT IN REPEATED UNSUCCESSFUL REGISTRATION ATTEMPTS.

If more ARS control radios are used (for systems with many registrations), as each must have a different *Radio ID*, the subscriber radios must also be equally “allocated” to each of them, using the corresponding ID (for example, for two ARS control radios half of the subscriber radios will use the ID of the first ARS control radio and half will use the ID of the second one).

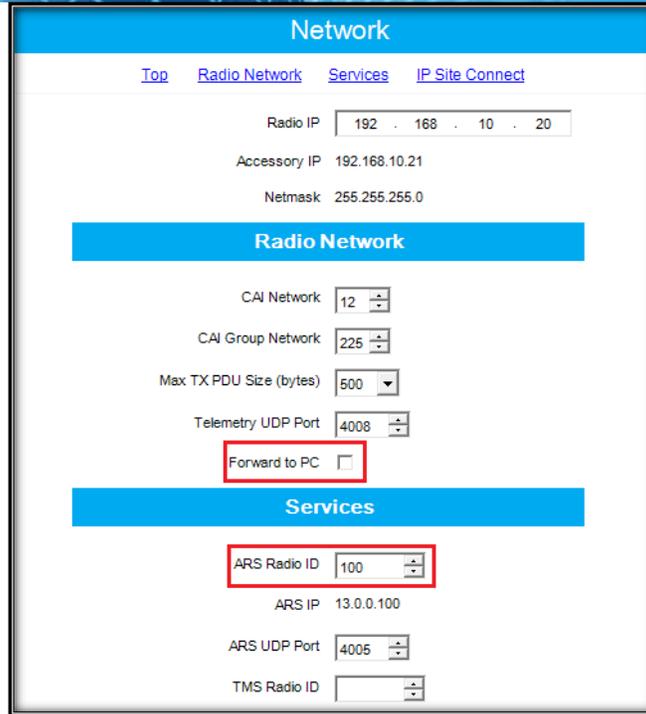


Figure 60 Subscriber Radios Network Settings

Personality / Channel Settings

Program in the radio at least one Capacity Plus personality using the following settings:

- The subscriber radios MUST have ARS enabled. This is responsible for transmitting presence notification to the MOTOTRBO Gateway Application.

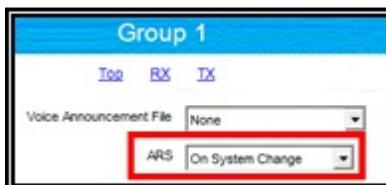


Figure 61 Subscriber Radios ARS Setting

- Check the *Data Call Confirmed* field (to be sure that the radio will register). We also recommend to check the *Compressed UDP Data Header* field – using this feature will reduce the duration of all data messages.

⚠ ALL THE RADIOS IN THE SYSTEM SHOULD BE PROGRAMMED WITH THE SAME SETTINGS FOR THESE TWO FIELDS.

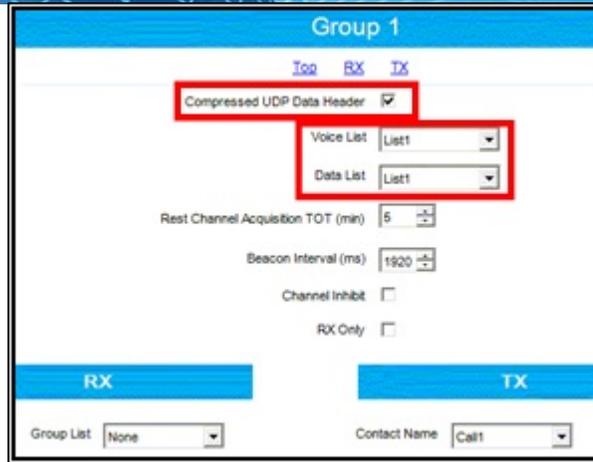


Figure 62 Subscriber Radios Personality Settings

- Select for the *Voice List* field the *List 1* value (it contains the RF trunking channels from the *Channel Pool* – see below) and for the *Data List* field the *List 1* value (it contains the GPS revert channel from the *Channel Pool* – see also below).
- Set the same TX admit criteria and in call criteria as for the ARS control radio.



Figure 63 Admit Criteria / In Call Criteria

Add in the *Channel Pool* the number of *Capacity Plus Voice Channels* that corresponds to the number of voice (trunking) repeaters in the system. For each voice channel set the frequencies for RX (receive) and TX (transmit) corresponding to each repeater.

The GPS revert channel must be also added (as a conventional digital channel) to the *Channel Pool*(so that the user cannot select it).

For the GPS revert channel use the following settings:

- Set the *ARS* field to *Disabled*.
- Check the *Enhanced GPS* field and set the *Window Size* to 7.



Figure 64 GPS Revert Channel Settings - 1

- Program the GPS revert channel with the frequencies and the timeslot corresponding to the used repeater channel (the subscriber radios should be equally “allocated” to the existing data revert channels)
- Set the same TX admit criteria and in call criteria as on the trunking personality
- Check the *Compressed UDP Data Header* field – using this feature will reduce the duration of the GPS data messages, allowing to use the *Window Size* of 7.

⚠ ALL THE RADIOS IN THE SYSTEM SHOULD BE PROGRAMMED WITH THE SAME VALUE FOR THIS FIELD.

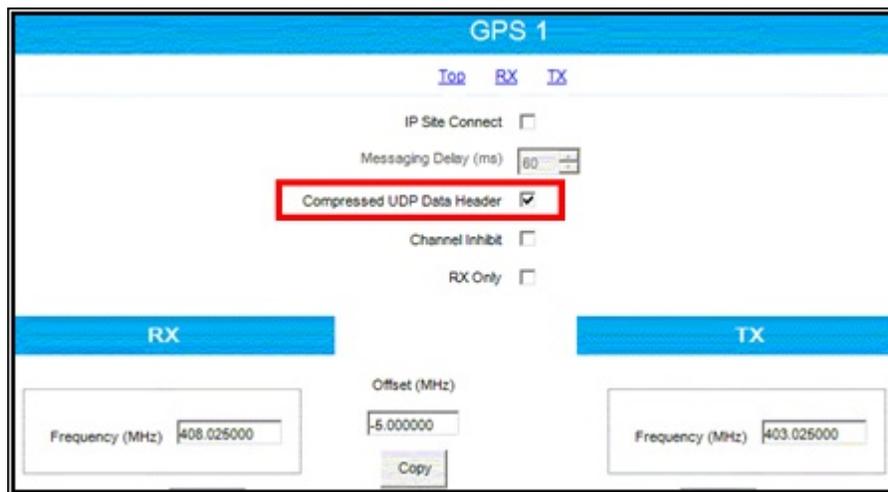


Figure 65 GPS Revert Channel Settings – 2

Voice and Data Lists Settings

The set of corresponding voice channels determines a *Voice List* – this list is used by the radio for all trunking communication. The list is defined by selecting (with the mouse) a channel in the “Available”

table and clicking on the “Add>>” button – the channel will move to the “Members” table.

Go to *Voice List 1* and add all the corresponding voice channels from the *Channel Pool* – take care to use the same order in the list as the numbering order used in the repeater programming (see below).

⚠ A WRONG ORDER IN THE LIST WILL DETERMINE THE RADIO NOT TO WORK WITH SOME OR ALL OF THE REPEATERS.



Figure 66 Voice List

Go to the *Data List 1* and add (using the same procedure as above) the GPS revert channel from the *Channel Pool*.

Write the configuration to the radio.

Programming of the repeaters

Read the repeater code plug and make the needed changes in the following CPS windows:

General Settings

⚠ IN THIS CASE THE RADIO ID IS USED IN THE REPEATER IP NETWORK TO IDENTIFY EACH REPEATER, SO EACH REPEATER MUST HAVE A DIFFERENT ID.



Figure 67 Capacity Plus Repeaters General Settings

For the voice repeaters we recommend to change the *Group Call Hang Time*, the *Private Call Hang Time* and the *Emergency Call Hang Time* to lower values (1-2 seconds) to minimize the voice calls

duration, allowing a more efficient voice traffic.

Network Settings

In a Capacity Plus system all repeaters are connected together via an Ethernet switch. As for the IPSC systems one repeater will be programmed to be a “Master” while the others will be programmed to be “Peers”. Although the “Master” is the only repeater that must have a fixed IP address while the “Peers” can have a variable IP address (using DHCP), in this case (because all repeaters are in the same LAN) the “Peers” should also be programmed with fixed IP addresses. The “Peers” are programmed with the “Master’s IP address and (when switched on) they will register to the “Master” with their IP address – the “Master” keeps a table of existing repeaters and for each change (new registration) will update the table and resend it to all the other repeaters (“Peers”).

⚠ Note that the DHCP mechanism will create anyhow short communication interruptions when a “Peer’s IP address is changed, so we recommend to set all repeaters to fixed IP addresses. Even more, the LAN of the repeaters should not include any other device – if an external RDAC is used, a router should isolate the LAN from the external environment.

To secure the repeater IP communication an authentication key is used – it is an up to 40 digits hex number value that is programmed in all repeaters.

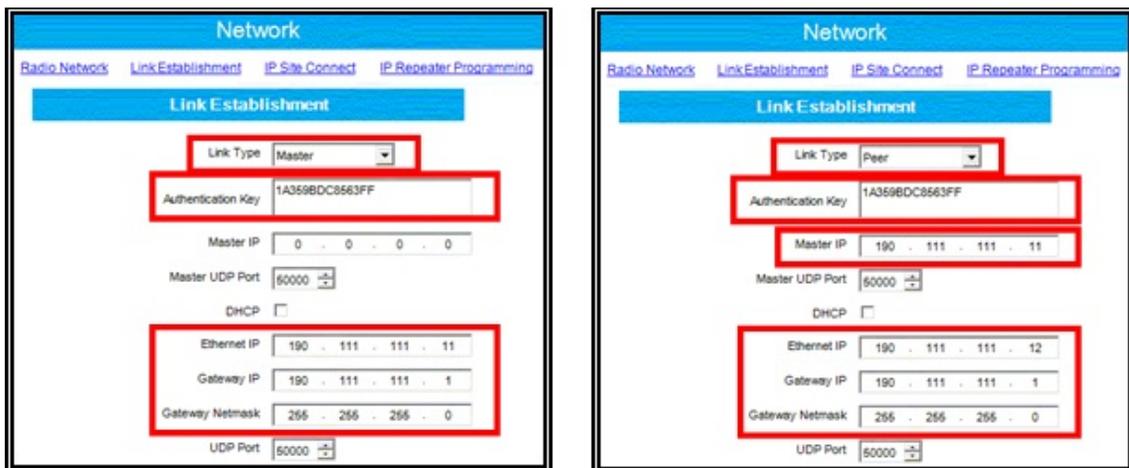


Figure 68 Capacity Plus Repeaters Network Settings

Master

Peer

For the “Master” repeater use the following network settings in the *Link Establishment* section:

- Select for the *Link Type* field the value *Master*.
- Enter an *Authentication Key* value (the same value must be used for all repeaters – keep it also saved in a separate secure place as you cannot see it in a read or opened code plug)
- Enter the *Ethernet IP* value (the fixed address used in the repeater LAN)
- Enter the *Gateway IP* and the *Gateway Netmask* values (if a router is used)

For the “Peer” repeaters use the following network settings in the *Link Establishment* section:

- Select for the *Link Type* field the value *Peer*.
- Enter the *Authentication Key* value (the same value as used for the “Master”)
- Enter the Master IP value (the fixed address provided for the “Master”)
- Do not check the *DHCP* field and enter the *Ethernet IP* value (the fixed address provided for this repeater in the LAN)
- Enter the *Gateway IP* and the *Gateway Netmask* values (if a router is used)

For all the repeaters use the following network settings in the *Capacity Plus* section:

- Enter the *Rest Channel/Site IP* value – an address inside the site’s LAN range

Channel Settings

Program the voice (trunking) repeaters with only one *Capacity Plus Voice Channel*, having the following settings:

- For the *Slot 1 Channel ID* field select the value corresponding for each repeater – so that it matches the trunking channels order in the radios’ *Voice List*.

⚠ A WRONG SELECTION WILL DETERMINE THE RADIOS NOT TO WORK WITH SOME OR ALL OF THE REPEATERS.

- Set the TX and RX frequencies (according to the frequency license for each repeater).

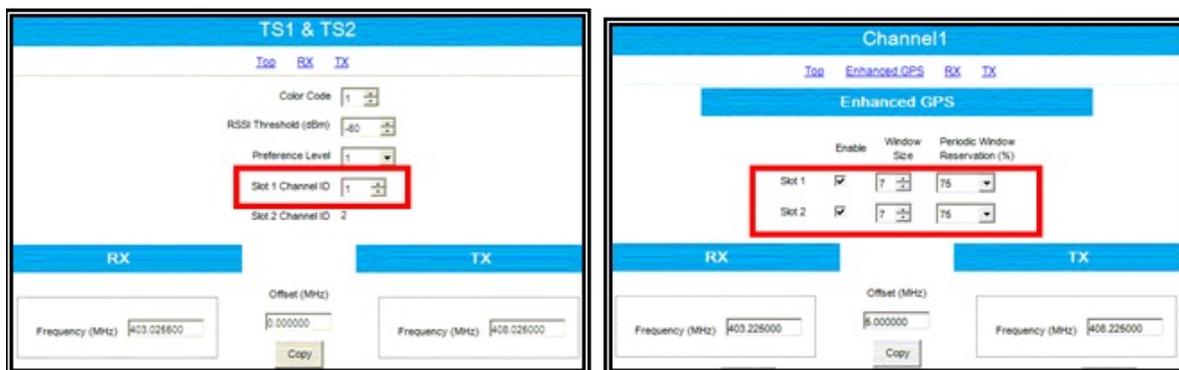


Figure 69 Capacity Plus Repeaters Channel Settings

Voice Repeater

Data Revert Repeater

Program the data revert repeaters with only one *Capacity Plus Data Channel*, having the following settings:

- In the *Enhanced GPS* section check the *Enable* fields for both slots and set the *Window Size* to 7.
- Change (only if needed) the *Periodic Window Reservation (%)* field to the desired value (the default value is 75%).
- Set the TX and RX frequencies (according to the frequency license for each repeater).

Write the configuration to the repeater.

Programming of Linked Capacity Plus Systems

A Linked Capacity Plus system is a multi-site trunking system that combines the greater communication capacity of trunking with the greater coverage of multi-site. Generally, it consists in a number of voice/data repeaters (maximum 6 per site) that work in trunking mode and a number of data revert repeaters (maximum 3 per site) that work in conventional mode – both timeslots of either type of repeater are of the same type. Although the GPS data can also be sent on the trunking channels we do not recommend this (unless only a limited number of Low GPS profile radios are used) – the normal way of sending the GPS data is on a data revert repeater timeslot, using the GPS revert feature of the radios.

In Linked Capacity Plus (unless there are no data revert repeaters) the radios register on the data revert channels (and not on the trunking channels) – even if they are Enhanced GPS ones. SafeDispatch will need in this case more control radios – one used in trunking mode (only for data information sent to the subscriber radios and also for dispatcher’s voice communication) and at least two (or multiple of two) used in conventional mode (one on each GPS data revert time slot).

If the GPS data is sent on the trunking channels (no data revert repeaters) the trunking control radio must also be used for registrations. This creates an additional problem: while it is used by the dispatcher for voice calls no radios can register – the only solution is to use two separate radios (one used for ARS, GPS data and data sent to the subscriber radios and one used for dispatcher’s voice communication).

Estimating the LCP capacity is difficult because it is a multi-site system and its flexibility in allocating the groups to different sites will give specific values for each case. But (when not using data revert repeaters) the dispatcher site is a critical one because all GPS traffic (from all sites) will load this site. So, while other sites can handle additional traffic, there are the following limits in the number of radios that use this site (for voice and/or GPS):

Number of trunking repeaters / (channels)	Maximum no. of High Voice/Low GPS radios	Maximum no/ of Low Voice/Low GPS radios
1 / (2)	10	30
2 / (4)	30	50
3 / (6)	100	230
4 / (8)	210	470
5 / (10)	330	740
6 / (12)	460	1020

Note that to handle the ARS and GPS traffic a separate trunking control radio will be needed for every 200-250 Low GPS radios.

If the GPS data is sent on data revert channels the following limits in the number of radios per system apply for the GPS data revert channels (because they work in conventional mode the same number of 20 updates per minute per timeslot is supported as in the conventional repeater systems):

Number of data revert repeaters / (channels)	Maximum number of High GPS radios	Maximum number of Low GPS radios
1 / (2)	40	400
2 / (4)	80	800
3 / (6)	120	1200

It's easy to see that the data revert repeaters can handle only a very limited number of High GPS radios. The solution to use more High GPS radios is to use the "Enhanced GPS" feature. The below table summarizes the capacity of "Enhanced GPS" data revert channels for High GPS profile radios (for Low GPS radios multiply the below values by 10):

Number of Enhanced GPS data revert repeaters / (channels)	Maximum number of High GPS radios for 75% reservation	Maximum number of High GPS radios for 60% reservation	Maximum number of High GPS radios for 45% reservation
1 / (2)	214	172	128
2 / (4)	428	344	256
3 / (6)	642	516	384

Programming of the trunking control radio

Read the radio code plug and make the needed changes in the following CPS windows:

General Settings

A control radio must have a *Radio ID* – this ID will be used by the subscriber radios to register to the system and to send GPS data:



Figure 70 Trunking Control Radio ID

The above figure shows a *Radio ID* of 100, however, this can be any number that you choose. As this is a base radio (that will never send GPS data) the *GPS* field should be left unchecked.

Network Settings

The network settings of the trunking control radio should be configured as follows:



Figure 71 Trunking Control Radio Network Settings

The control radio must have a *Radio IP* address – this is used for the USB connection between this radio and the PC. The below figure shows an IP address of 192.168.10.60, however this may be different, depending on your IT network settings.

Check the *Forward to PC* field – in this way all text messages this radio receives are passed to the connected PC.

Personality / Channel Settings

The trunking control radio will have only one LCP personality using the settings indicated below:

- The *ARS* field should be set to *Disabled* as this radio will never register.



Figure 72 Trunking Control Radio ARS Setting

- Select for the *Site List* field the *List 1* value (it contains the RF trunking channels from the *Channel Pool* – see below).
- Check the *Data Call Confirmed* field (to be sure that no data messages are lost). We also recommend to check the *Compressed UDP Data Header* field – using this feature will reduce the duration of all data messages.

⚠ ALL THE RADIOS IN THE SYSTEM SHOULD BE PROGRAMMED WITH THE SAME SETTINGS FOR THESE TWO FIELDS.



Figure 73 Trunking Control Radio Personality Settings

- Program the radio not to transmit over a busy channel when starting a call or during a call.



Figure 74 Admit Criteria / In Call Criteria

Add in the *Channel Pool* the number of *Capacity Plus Voice Channels* that corresponds to the number of voice (trunking) repeaters in the used site. For each voice channel set the frequencies for RX (receive) and TX (transmit) corresponding to each repeater.

Voice List Settings

The set of corresponding voice channels determines a *Voice List* – this list is used by the radio for all trunking communication. The list is defined by selecting (with the mouse) a channel in the “*Available*” table and clicking on the “*Add>>*” button – the channel will move to the “*Members*” table.

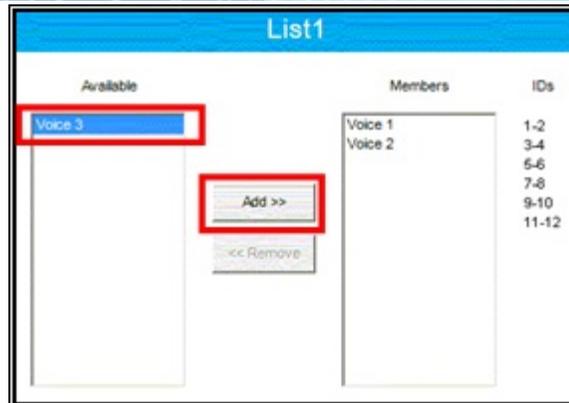


Figure 75 (Linked) Capacity Plus Voice List

Go to *Voice List 1* and add all the corresponding voice channels from the *Channel Pool* – take care to use the same order in the list as the numbering order used in the repeater programming (see below).

⚠ A WRONG ORDER IN THE LIST WILL DETERMINE THE RADIO NOT TO WORK WITH SOME OR ALL OF THE REPEATERS.

Site List Settings

In LCP the set of corresponding sites determines a *Site List* – this list is used by a radio for all multi-site trunking communication. The list is defined by adding the corresponding number of sites and selecting each site’s voice list and data list. In our case (the trunking control radio is a fixed one) the list will contain only one site.

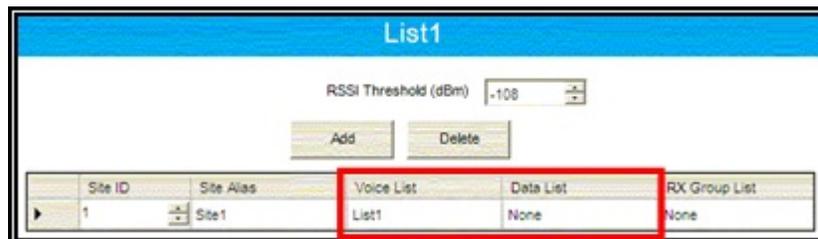


Figure 76 LinkedCapacity Plus Site List

Select *Voice List 1* and no data list (this radio is used only on trunking channels).

Write the configuration to the radio.

Programming of the GPS control radios

Read the radio code plug and make the needed changes in the following CPS windows:

General Settings

Set the *RadioID* field with the same value as the trunking control radio – this ID will be used by the subscriber radios to send GPS data on the GPS revert channels.

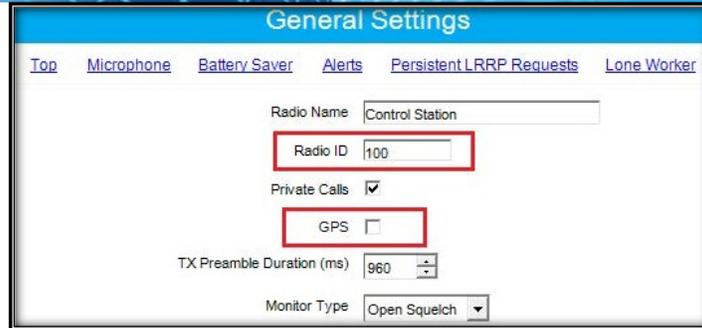


Figure 77 GPS Control Radios Radio ID

The above figure shows a *Radio ID* of 100, however, this can be any number that you choose. As this is a base radio (that will never send GPS data) the *GPS* field should be left unchecked.

⚠ THE TRUNKING CONTROL RADIO AND THE GPS CONTROL RADIOS MUST HAVE THE SAME ID OTHERWISE THE GPS DATA WILL BE LOST.

Network Settings

The network settings of the GPS control radios should be configured as follows:

The GPS control radio must have a *Radio IP* address – this is used for the USB connection between this radio and the PC. To avoid any potential IP address conflicts while keeping an easy to manage value we recommend to use a value similar to the one used for the ARS control radio by changing the second byte value – for example, if the ARS control radio IP address is 192.168.10.60, then use for the first GPS control radio the value 192.168.20.60, for the second one 192.168.30.60 and so on.

Check the *Forward to PC* field – in this way all GPS messages this radio receives are passed to the connected PC.

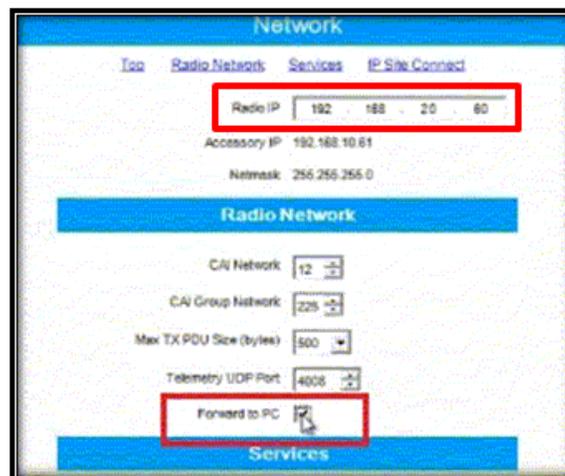


Figure 78 GPS Control Radios Network Settings

Channel Settings

The GPS control radio must have only one digital conventional channel, using the settings indicated below:

- The ARS field should be set to *Disabled* as this radio will never register. Set the frequencies for RX and TX corresponding to the proper data revert repeater. Set the *Repeater/Time Slot* to 1 for the first control radio using that repeater and to 2 for the second one.



Figure 79 GPS Control Radios Channel Settings

- Check the *Compressed UDP Data Header* field – using this feature will reduce the duration of the GPS data messages.
- ⚠ **ALL THE RADIOS IN THE SYSTEM SHOULD BE PROGRAMMED WITH THE SAME VALUE FOR THIS FIELD ON THE GPSREVERT CHANNEL.**
- Program the radio not to transmit over a busy channel when starting a call or during a call.
- **DO NOT** check the *Data Call Confirmed* field (DCC is not used on Enhanced GPS channels).

Write the configuration to the radio.

Programming of the subscriber radios

Read the radio code plug and make the needed changes in the following CPS windows:

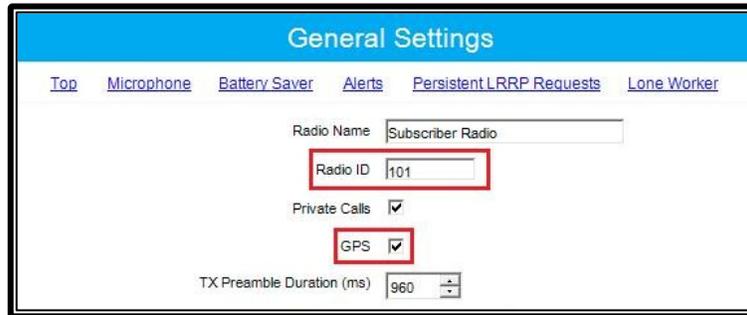
General Settings

A subscriber radio must have a *Radio ID*.

Fig.83 shows a *RadioID* of 101, however, this can be any number that you choose.

- ⚠ **ALL SUBSCRIBER RADIOS MUST HAVE A UNIQUE RADIO ID.**

The *GPS* field **MUST** be checked. The Subscriber radio must have GPS enabled in order to transmit location data.



The screenshot shows the 'General Settings' interface for a subscriber radio. At the top, there are navigation links: Top, Microphone, Battery Saver, Alerts, Persistent LRRP Requests, and Lone Worker. The main settings include:

- Radio Name: Subscriber Radio
- Radio ID: 101 (highlighted with a red box)
- Private Calls:
- GPS: (highlighted with a red box)
- TX Preamble Duration (ms): 960

Figure 80 Subscriber Radios General Settings

Network Settings

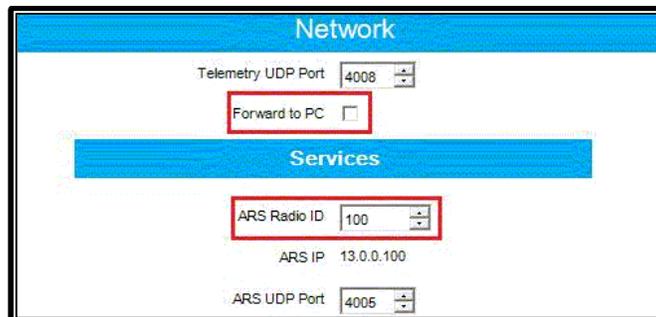
The network settings of the subscriber radios should be configured as follows:

The *Radio IP* field can be left unmodified. The *Forward to PC* field should be set to *Disabled* as these radios do not connect to a PC.

In the *ARS Radio ID* field MUST be entered the ID of the ARS control radio.

⚠ FAILING TO ENTER THE PROPER CONTROL RADIO ID WILL RESULT IN REPEATED UNSUCCESSFUL REGISTRATION ATTEMPTS.

If more ARS control radios are used (for systems with many registrations), as each must have a different *Radio ID*, the subscriber radios must also be equally “allocated” to each of them, using the corresponding ID (for example, for two ARS control radios half of the subscriber radios will use the ID of the first ARS control radio and half will use the ID of the second one).



The screenshot shows the 'Network' settings interface. It includes:

- Telemetry UDP Port: 4008
- Forward to PC: (highlighted with a red box)
- A blue header for the 'Services' section.
- ARS Radio ID: 100 (highlighted with a red box)
- ARS IP: 13.0.0.100
- ARS UDP Port: 4006

Figure 81 Subscriber Radios Network Settings

Personality / Channel Settings

Program in the radio at least one Linked Capacity Plus personality using the following settings:

- The subscriber radios MUST have ARS enabled. This is responsible for transmitting presence notification to the MOTOTRBO Gateway Application.

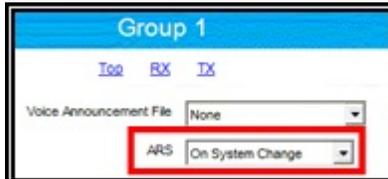


Figure 82 Subscriber Radios ARS Setting

- Select for the *Site List* field the *List 1* value (it contains the LCP sites – see below).
- Check the *Auto Roam* field (to be sure that the radio will roam between sites).
- Check the *Data Call Confirmed* field (to be sure that the radio will register). We also recommend to check the *Compressed UDP Data Header* field – using this feature will reduce the duration of all data messages.

⚠ ALL THE RADIOS IN THE SYSTEM SHOULD BE PROGRAMMED WITH THE SAME SETTINGS FOR THESE TWO FIELDS.

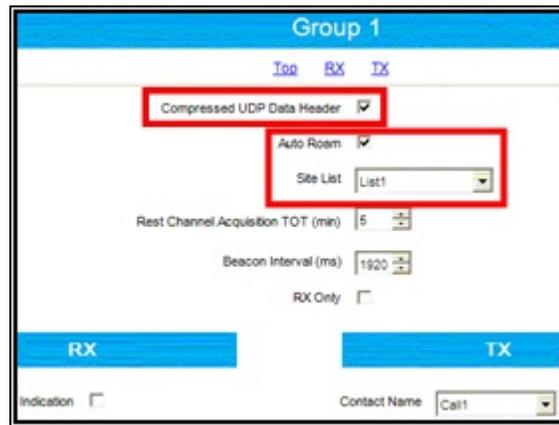


Figure 83 Subscriber Radios Personality Settings

- Set the same TX admit criteria and in call criteria as for the ARS control radio.



Figure 84 Admit Criteria / In Call Criteria

Add in the *Channel Pool* the number of *Capacity Plus Voice Channels* that corresponds to the number of voice (trunking) repeaters in the system. For each voice channel set the frequencies for RX (receive) and TX (transmit) corresponding to each repeater.

The GPS revert channels must be also added (as conventional digital channels) to the *Channel Pool*(so that the user cannot select them).

For the GPS revert channels use the following settings:

- Set the *ARS* field to *Disabled*.
- Check the *Enhanced GPS* field and set the *Window Size* to 7.



Figure 85 GPS Revert Channel Settings – 1

- Program the GPS revert channels with the frequencies and the timeslot corresponding to the used repeater channels in each site (the subscriber radios should be equally “allocated” to the existing revert channels)
- Set the same TX admit criteria and in call criteria as on the trunking personality
- Check the *Compressed UDP Data Header* field – using this feature will reduce the duration of the GPS data messages, allowing to use the *Window Size* of 7.

⚠ ALL THE RADIOS IN THE SYSTEM SHOULD BE PROGRAMMED WITH THE SAME VALUE FOR THIS FIELD.



Figure 86 GPS Revert Channel Settings - 2

Voice and Data Lists Settings

The set of corresponding voice channels of a site determines a *Voice List* – this list is used by the radio for all trunking communication in that site. The list is defined by selecting (with the mouse) a channel in the “Available” table and clicking on the “Add>>” button – the channel will move to the “Members” table.

For Site 1 go to *Voice List 1* and add all the corresponding voice channels from the *Channel Pool* – take care to use the same order in the list as the numbering order used in the repeater programming (see below).

⚠ A WRONG ORDER IN THE LIST WILL DETERMINE THE RADIO NOT TO WORK WITH SOME OR ALL OF THE REPEATERS.

Go to the *Data List 1* and add (using the same procedure as above) the corresponding GPS revert channel from the *Channel Pool*.



Figure 87 Voice List

Add a new voice list and data list for each LCP site and repeat the above procedure for all the other sites.

Site List Settings

In LCP the set of corresponding sites determines a *Site List* – this list is used by a radio for all multi-site trunking communication. The list is defined by adding the corresponding number of sites and selecting each site’s voice list and data list. For the mobile/portable subscriber radios the list will contain all LCP sites.

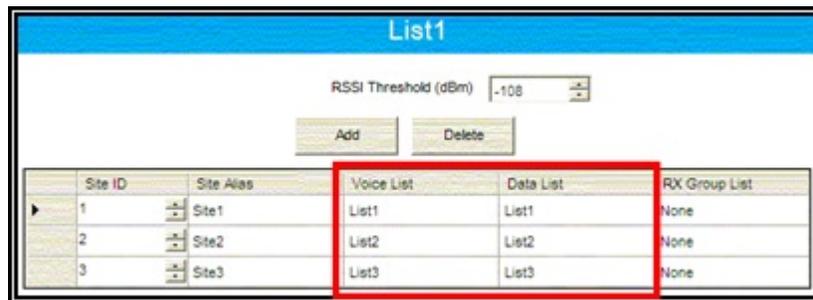


Figure 88 Linked Capacity Plus Site List

Select for each site the corresponding voice and data lists.

⚠ A WRONG SETTING IN THE SITE LIST WILL DETERMINE THE RADIO NOT TO WORK WITH SOME OR ALL OF THE SITES.

Write the configuration to the radio.

Programming of the repeaters

Read the repeater code plug and make the needed changes in the following CPS windows:

General Settings

⚠ IN THIS CASE THE RADIO ID IS USED IN THE REPEATER IP NETWORK TO IDENTIFY EACH REPEATER, SO EACH REPEATER MUST HAVE A DIFFERENT ID.



Figure 89 LCP Repeaters General Settings

For the voice repeaters we recommend to change the *Group Call Hang Time*, the *Private Call Hang Time* and the *Emergency Call Hang Time* to lower values (1-2 seconds) to minimize the voice calls duration, allowing a more efficient voice traffic.

Network Settings

In a Linked Capacity Plus system all repeaters of a site are connected together in a LAN via an Ethernet switch and a router is added to connect to the other sites – this LAN should not include any other device.

For inter site connections the most common case is the general Internet connection type via an Internet Service Provider (ISP) – other cases like a customer WAN are also possible but less probable. To allow maximum flexibility (towards the ISP) the system doesn't use multicast data packets – during a call, each repeater will send in turn the data packets (that can correspond to voice or data radio transmissions) to the corresponding repeaters present in the other sites of the system. While this leads to a limit in the maximum number of sites (currently 15) it avoids the problem of the multicast data packets that most ISP are blocking. But it also means that each repeater must know the IP address of all the other repeaters in the system. To provide flexibility in the system topology (capability to add new repeaters or to adapt to the change of the IP address of the repeaters) without the need to reprogram the repeaters for every change Motorola has implemented the following mechanism: one repeater will be programmed to be a "Master" while the others will be programmed to be "Peers". The "Master" is the only repeater that must have a fixed IP address (provided by the ISP) while the "Peers" can have a variable IP address (using DHCP). Also, in LCP each repeater must use a different UDP port.

The "Peers" are programmed with the "Master's IP address / UDP port and (when switched on) they will register to the "Master" with their IP address and UDP port – the "Master" keeps a table of existing repeaters and for each change (new registration) will update the table and resend it to all the other repeaters ("Peers"). Note that what has to be programmed in the "Peer" repeaters as the "Master" IP address is in fact the WAN IP address of the router (of the site containing the "Master").

⚠ Note the DHCP mechanism will create anyhow short communication interruptions when a "Peer's IP address is changed, so we recommend to set all repeaters to fixed IP addresses inside each site's LAN. We also recommend (if possible) to set fixed IP addresses for all sites (routers) to avoid the above described interruptions when a router IP address changes – or to discuss with the ISP the possibility to perform the IP address changes during a low traffic moment of time (like during night).

To secure the repeater IP communication an authentication key is used – it is an up to 40 digits hexa number value that is programmed in all repeaters.



Figure 90 Linked Capacity Plus Repeaters Network Settings

Master

Peer (from another site)

For the “Master” repeater use the following network settings in the *Link Establishment* section:

- Select for the *Link Type* field the value *Master*.
- Enter an *Authentication Key* value (the same value must be used for all repeaters – keep it also saved in a separate secure place as you cannot see it in a read or opened code plug)
- Enter the *Ethernet IP* value (the fixed address used in the repeater LAN)
- Enter the *Gateway IP*(the LAN IP address of the router) and the *Gateway Netmask* values
- Enter the *UDP Port* value (different for each repeater in the LCP system)

For the “Peer” repeaters use the following network settings in the *Link Establishment* section:

- Select for the *Link Type* field the value *Peer*.
- Enter the *Authentication Key* value (the same value as used for the “Master”)
- Enter the *Master IP* value (the fixed address provided by the ISP for the “Master’s router)
- Enter the *Master UDP Port* value (the same value as used for the “Master”’s *UDP Port*)
- Do not check the *DHCP* field and enter the *Ethernet IP* value (the fixed address provided for this repeater in the LAN)
- Enter the *Gateway IP*(the LAN address of the site’s router) and the *Gateway Netmask* values
- Enter the *UDP Port* value (different for each repeater in the LCP system)

For all the repeaters use the following network settings in the *Capacity Plus* section:

- Enter the *Rest Channel/Site IP* value – an address inside the site’s LAN (different for each site)
- Enter the *Rest Channel/Site UDP port* value – a separate port value (different for each site)

Channel Settings

Program the voice (trunking) repeaters with only one *Capacity Plus Voice Channel (Linked)*, having the following settings:

- For the *Slot 1 Channel ID* field select the value corresponding for each repeater from that site – so that it matches the trunking channels order in the radios' *Voice List* for that site.

⚠ A WRONG SELECTION WILL DETERMINE THE RADIOS NOT TO WORK WITH SOME OR ALL OF THE REPEATERS.

- Set the TX and RX frequencies (according to the frequency license for each repeater).

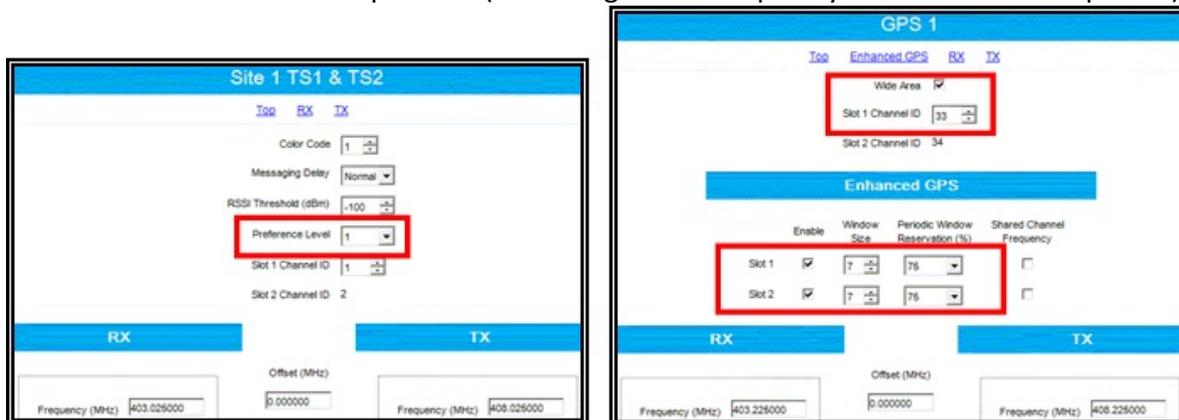


Figure 91 Linked Capacity Plus Repeaters Channel Settings

Voice Repeater

Data Revert Repeater

Program the data revert repeaters with only one *Capacity Plus Data Channel (Linked)*, having the following settings:

- Check the *Wide Area* box – this will allow the GPS data sent from any site to arrive to the GPS control radios
- Select the *Slot 1 Channel ID* value – for the first data revert repeater in each site choose the value 33, for the second set of repeaters (if used) choose the value 35 and so on
- In the *Enhanced GPS* section check the *Enable* fields for both slots and set the *Window Size* to 7.
- For one of the Data Revert repeaters change (only if needed) the *Periodic Window Reservation (%)* field to the desired value (the default value is 75%).
- For all the other Data Revert repeaters change the *Periodic Window Reservation (%)* field to *None*.
- Set the TX and RX frequencies (according to the frequency license for each repeater).

Write the configuration to the repeater.

SafeMobile Support

Email Support

Please email your technical support questions to support@safemobile.com.

SafeMobile Technical Support Online Forum

Please visit our SafeMobile Technical Support Online Forum for all your SafeMobile and Motorola questions at www.safemobile.com/forum.

Sales and Installation Support

Please contact your SafeMobile Channel Account Manager directly for assistance.

Figure 1 System Diagram 6

Figure 2 Communication diagram in a LAN 7

Figure 3 Communication diagram for virtual LAN via multicast VPN 7

Figure 4 Data Storage 8

Figure 5 Run PrechecksSetup 12

Figure 6 Subscriber Radios General Settings 33

Figure 7 Subscriber Radios Network Settings 34

Figure 8 ARS On System Change 34

Figure 9 GPS Revert–Selected 35

Figure 10 Control Radios Radio ID 36

Figure 11 Control Radios Network Settings 37

Figure 12 Control Radios Channel Settings 38

Figure 13 Set the RX and TX frequency 39

Figure 14 Admit Criteria / In Call Criteria 39

Figure 15 Subscriber Radios General Settings 40

Figure 16 Subscriber Radios Network Settings 41

Figure 17 ARS On System Change 41

Figure 18 GPS Revert – Selected 42

Figure 19 ARS Control Radio ID 43

Figure 20 ARS Control Radio Network Settings 44

Figure 21 ARS Control Radio Channel Settings 44

Figure 22 Set the RX and TX frequencies 45

Figure 23 Admit Criteria / In Call Criteria 45

Figure 24 GPS Control Radio Radio ID 46

Figure 25 GPS Control Radio Network Settings 46

Figure 26 GPS Control Radio Channel Settings 47

Figure 27 Subscriber Radios General Settings 48

Figure 28 Subscriber Radios Network Settings 48

Figure 29 ARS On System Change 49

Figure 30 GPS Revert 49

Figure 31 GPS Revert Channel Settings 50

Figure 32 Repeater General Settings 50

Figure 33 Repeater Channel Settings 51

Figure 34 ARS Control Radio ID 52

Figure 35 ARS Control Radio Network Settings 53

Figure 36 ARS Control Radio Channel Settings 53

Figure 37 Set the RX and TX frequencies 54

Figure 38 Admit Criteria / In Call Criteria 54

Figure 39 GPS Control Radio ID 55

Figure 40 GPS Control Radio Network Settings 56

Figure 41 GPS Control Radio Channel Settings 56

Figure 42 Subscriber Radios General Settings 57

Figure 43 Subscriber Radios Network Settings..... 57

Figure 44 ARS and Roam List..... 58

Figure 45 IP Site Connect Channel..... 58

Figure 46 GPS Revert Selection 59

Figure 47 GPS Revert Channel Settings - 1 59

Figure 48 GPS Revert Channel Settings - 2 60

Figure 49 Roam List..... 60

Figure 50 IPSC Repeaters General Settings..... 61

Figure 51 IPSC Repeaters Network Settings..... 62

Figure 52 IPSC Repeaters Channel Settings..... 63

Figure 53 Trunking Control RadioID..... 66

Figure 54 Trunking Control Radio Network Settings..... 66

Figure 55 Trunking Control Radio ARS Setting 67

Figure 56 Trunking Control Radio Personality Settings..... 67

Figure 57 Admit Criteria / In Call Criteria 68

Figure 58 Capacity Plus Voice List 68

Figure 59 Subscriber RadiosGeneral Settings..... 71

Figure 60 Subscriber Radios Network Settings..... 72

Figure 61 Subscriber Radios ARS Setting..... 72

Figure 62 Subscriber Radios Personality Settings..... 73

Figure 63 Admit Criteria / In Call Criteria 73

Figure 64 GPS Revert Channel Settings - 1 74

Figure 65 GPS Revert Channel Settings – 2 74

Figure 66 Voice List 75

Figure 67 Capacity Plus Repeaters General Settings..... 75

Figure 68 Capacity Plus Repeaters Network Settings..... 76

Figure 69 Capacity Plus Repeaters Channel Settings 77

Figure 70 Trunking Control Radio ID 79

Figure 71 Trunking Control Radio Network Settings..... 80

Figure 72 Trunking Control Radio ARS Setting 80

Figure 73 Trunking Control Radio Personality Settings..... 81

Figure 74 Admit Criteria / In Call Criteria 81

Figure 75 (Linked) Capacity Plus Voice List 82

Figure 76 LinkedCapacity Plus Site List..... 82

Figure 77 GPS Control Radios Radio ID 83

Figure 78 GPS Control Radios Network Settings 83

Figure 79 GPS Control Radios Channel Settings..... 84

Figure 80 Subscriber Radios General Settings..... 85

Figure 81 Subscriber Radios Network Settings..... 85

Figure 82 Subscriber Radios ARS Setting..... 86

Figure 83 Subscriber Radios Personality Settings..... 86

Figure 84 Admit Criteria / In Call Criteria 86

Figure 85 GPS Revert Channel Settings – 1 87



<i>Figure 86 GPS Revert Channel Settings - 2</i>	88
<i>Figure 87 Voice List</i>	88
<i>Figure 88 Linked Capacity Plus Site List</i>	89
<i>Figure 89 LCP Repeaters General Settings</i>	89
<i>Figure 90 Linked Capacity Plus Repeaters Network Settings</i>	91
<i>Figure 91 Linked Capacity Plus Repeaters Channel Settings</i>	92