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Radio-over-IP Product Family



- **RG Series RoIP/VoIP Network Devices**
- **SoftRadio Series Operator Interfaces and Applications**
- **Options, Specials and Accessories**
 - » Further your two-way radio network - to your needs, budgets and schedule
 - » Maximise availability, utilisation and access across your network
 - » Respond quickly and decisively to unforeseen needs and situations
 - » Simplify administration and maintenance
 - » Safeguard investment and extend use of existing assets and infrastructure
 - » Be prepared for new applications

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1. Introduction

Radio-over-IP (RoIP) allows us to connect radios and transport two-way radio communications over an IP-network. RoIP is essentially Voice over IP (VoIP) with Push-To-Talk (PTT), but with the ability to provide much more than simple two-way speech. With RoIP, users no longer need a physical radio to communicate via a radio network. An IP-enabled radio can be accessed from anywhere with access to an IP-network, be it from within an organisation's own intranet or via the internet. RoIP is by nature interoperable as radios are simply nodes on an IP-network, regardless of standard, frequency and RF-interface.

Radio over Internet Protocol sends analogue and digital 'radio payload' via IP-packets across a LAN or WAN. The sending node converts the payload into digital, organises the data into packets and sends these packets to the receiving node - much like goods in a shipping container. At the receiving end packets are reassembled into a constant flow of user data and as needed reproduced into an analogue signal. In a RoIP network, at least one node of a network is an IP-enabled radio: A radio in combination with an RoIP Interface Unit (RIU). The IP-Radio is the interface between IP-network (Internet) and the RF environment. The other nodes are typically an operator PC with a RoIP/VoIP based speech and control console, but can be basically any IP-capable device.

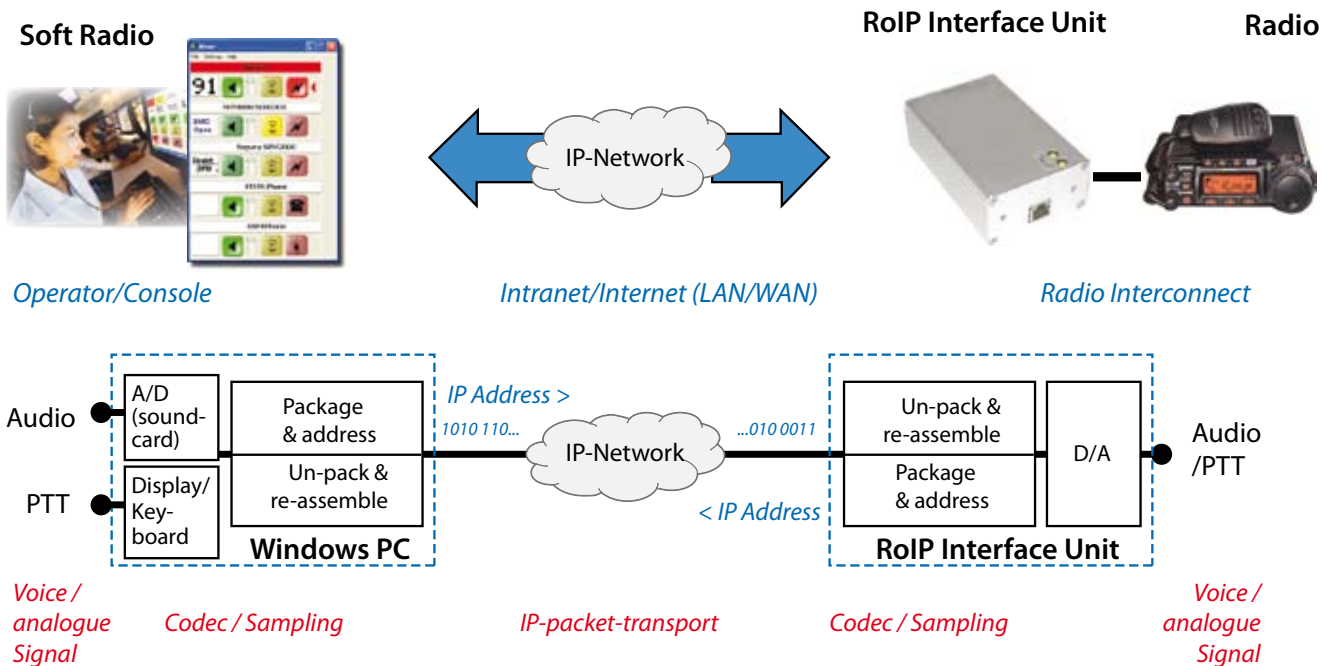


Figure 1. Basic Radio-over-IP Channel

The RoIP channel connects the operator to a remote radio via an IP-network and in turn via the radio to a mobile radio user. At the operator end SoftRadio, a Windows based RoIP/VoIP application provides the console and the interface between operator-PC and RoIP-network. On the remote or radio side a dedicated RoIP/Radio Interface Unit (RIU) connects the radio to the IP-network.

To send from the operator, the SoftRadio on the PC converts the audio, PTT and any control signals to IP-compatible data and sends these to the IP-address of the remote RIU/Radio. This can include any applicable digital payload for the radio. The RIU then converts these back to the analogue and digital signals and formats required by the radio. Sending from the RIU to the operator is the same, simply in reverse. At the SoftRadio, the IP-packets are converted back into the payload and control content and displayed respectively reproduced into audio using the PC's sound card.

The key to building an efficient and effective RoIP Radio Network is the RoIP (Radio) Interface Unit, or Network Interface and its seamless integration with the operator-side applications.

2. RG-Series RoIP Interface Unit

The RG-Series RIU adapts many different types of radios, analogue and digital and their inherent radio capabilities for use over an IP-Network. A generic RIU provides the basic IP-Network interface for basically any type of radio: Audio and PTT. Radio-specific RIU's allow operators to access additional radio-features over the RoIP network.

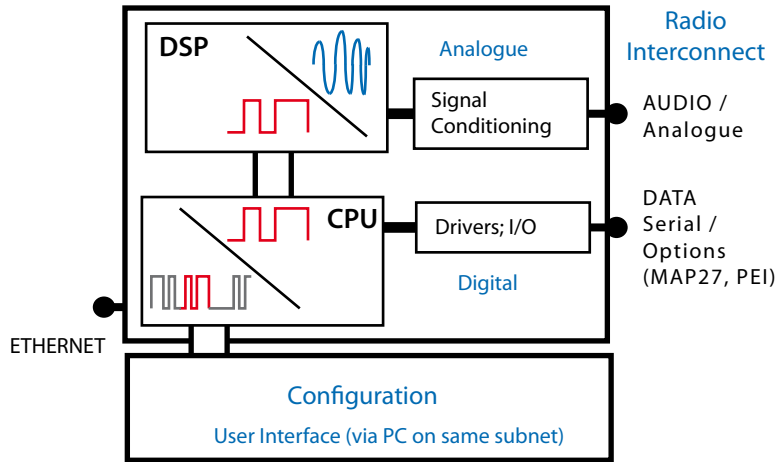


Figure 2. Principle block-diagram of the RoIP Interface Unit

The RIU is an IP-interface for a two-way radio. The interconnect between RIU and radio carries the basic audio ('speaker'/'microphone'), PTT and Squelch. Depending on the type of radio and RIU, it can further carry Alarms, Off-hook, Control-Data, Data-Messages and general purpose data I/O. The network connection is a standard 10/100 base-T Ethernet connection. In a local sub-net, up to 99 operators can access the RIU/Radio in parallel and via a UDP transport. Over a WAN network, one operator can connect at a time using TCP transport. A typical audio channel (transport) requires approximately 80kbyte/s when is active. When there is no audio, only a "keep alive" status burst is sent out every second to identify each RIU to the network.

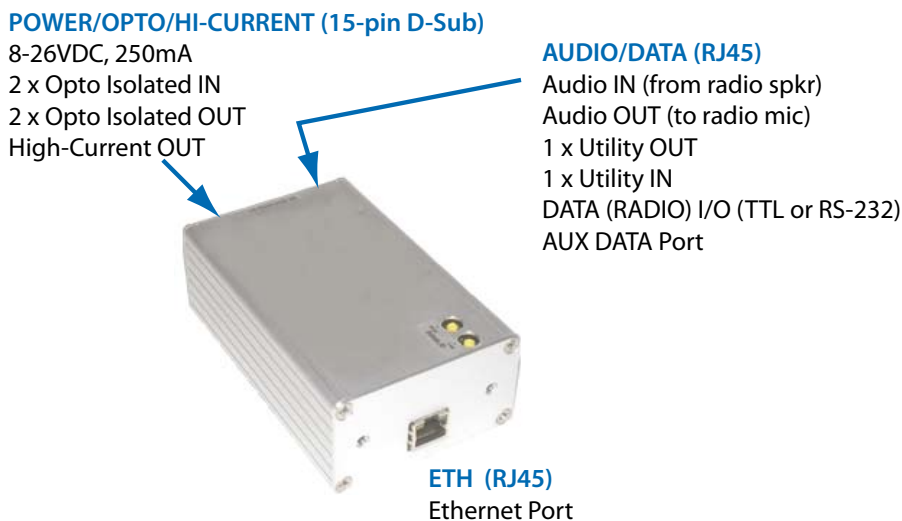


Figure 3. Interfaces/Interconnects on the RoIP Interface Unit

The RIU's design is structured and flexible, allowing the unit to be configured and customised to fit almost any radio including mobile radios and base stations. RG-Series RIU's can be provided pre-configured and -adjusted for use with specific radios. These RIU's allow operators to remotely access radio functions that are normally accessed manually via a control head. The RIU 'delivers' these features and functions via the RoIP channel to an operator's SoftRadio console. Special RIU applications provide further functionality such as Phone Connect and Intercom. All these functions and features are provided within the same user-interface.

3. SoftRadio Operator Console & interface

SoftRadio enables an operator to connect from a standard PC to multiple two-way radios via an IP-network. SoftRadio is a structured and expandable, yet easy-to-use and robust family of software applications. Soft Radio is specifically designed for two-way radio networks and operations. The application runs on a standard Windows PC and utilizes the computers processor and sound-card to provide the RoIP channel and functions. The sound-card is used to convert audio from analogue to digital and back, allowing a simple and effective voice-communication with the remote user. The remainder of the RoIP processing is done via the software and the computer's resources. This eliminates the need for a second RoIP Interface Unit on the operator side and more importantly, opens up a range of possibilities to add functionality and enhance/extend usage of the RoIP based radio-network.



Figure 4. Basic SoftRadio Operator Interface with active Virtual Control Heads

- The operator can control up to 8 radios from one SoftRadio station
- In development: SoftRadio for 30 radios
- The operator can monitor all his/her radios at the same time
- Audio from the other radios is received and monitored even when transmitting
- SoftRadio is easily expandable via add-on functions and applications
- SoftRadio can extend and integrate with dispatch and command & control applications
- SoftRadio supports radio Virtual Control Heads (with the appropriate RIU)

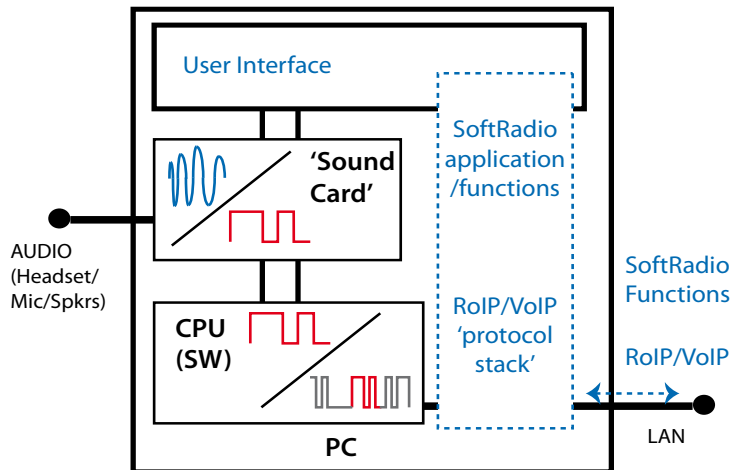


Figure 5. Principle block-diagram of SoftRadio

4. A basic RoIP Radio Network

A basic two-way radio network consists of multiple mobile radio users connected via one or more radio base-stations to one or more operators or dispatchers. In a RoIP based two-way radio network, base-stations and radio-sites are connected to an IP-network via RoIP Interface Units (RIU). Radio and RIU create an IP-enabled radio, or IP-Radio, identified via the IP-Address assigned to the RIU. The RIU provides a RoIP-Channel between operator and radio. In a LAN, RoIP transport is via UDP and in a WAN, via TCP. The SoftRadio connects an operator to an IP-Radios via that RoIP channel. SoftRadio can administer and access up to 8 RoIP channels, be it radios or other RoIP applications such as a phone-connect.

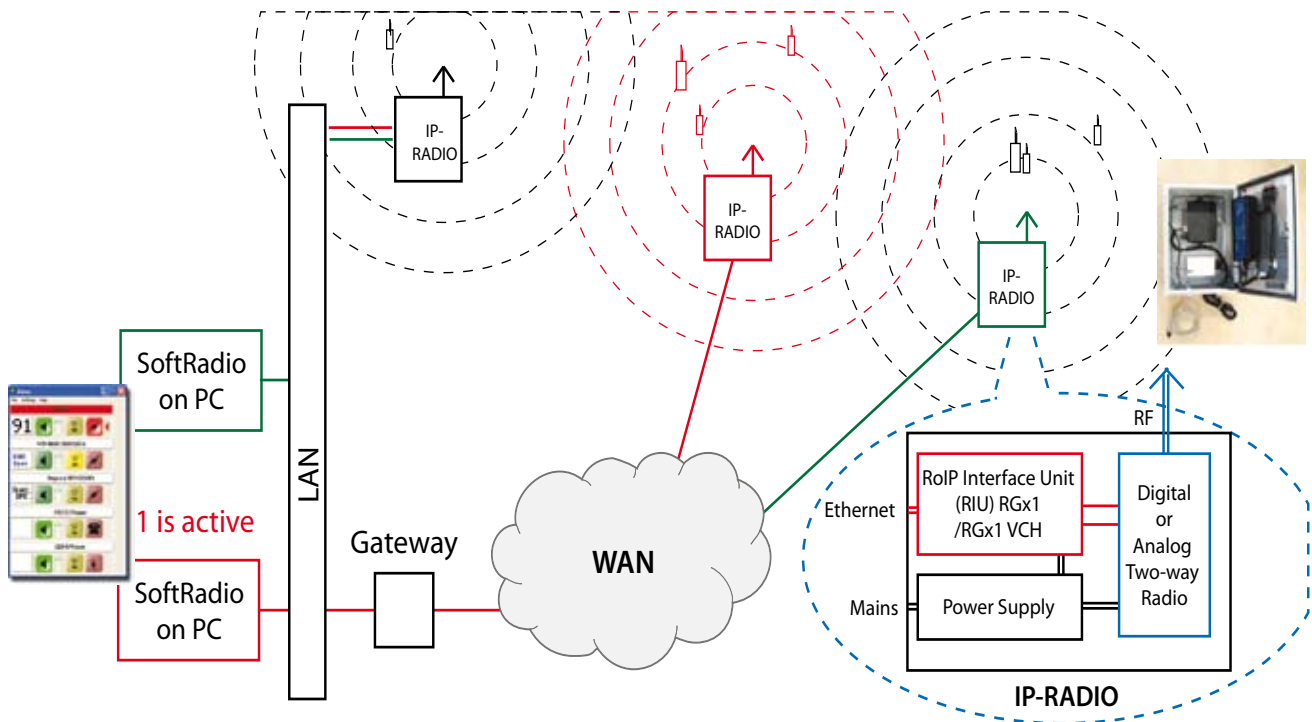


Figure 6. Basic RoIP Network with mixed UDP/TCP RoIP channels

There are two basic RoIP channels. In smaller RoIP networks, the operators access radios via the same local sub-net (LAN). Here UDP is used and the RIU can support up to 99 SoftRadios accessing its radio. Access is granted in order of PTT. The first PTT occupies the RIU. The the radio is 'released' when PTT ends.

In larger and more distributed two-way radio networks, operators and radios connect via the Internet or a larger Intranet (WAN). Here TCP transport is used and the RIU supports a 1-to-1 connection to a SoftRadio console. In essence, the RoIP channel is 'make-break-make', the connection with one SoftRadio needs to be completely released before another operator can access the RIU and radio. The RoIP channel is static rather than dynamic. On the operator end, SoftRadio maintains connections with up to 8 (available) RIU's. It monitors the incoming traffic on all channels while transmitting on one.

5. Deploying the RG-Series RIU

Deploying the RoIP Interface Unit consists of two distinct set-ups: The radio interconnect and the network configuration. The RIU is deployed at the radio site and connected to the radio using the audio ports and the PTT-signal. For specific radio-types, the control bus between for the radio's control head is also connected to the RIU, enabling Virtual Control Head and radio-specific functions to be accessed via the RoIP channel. The signals from the radio are digitised, structured and 'packaged' and then sent over the network via UDP or TCP. The RIU is connected to the network via the Ethernet port. Prior to deploying the unit, the RIU must be configured via a PC connected over the same sub network as the network interface.

5.1 Connecting the RIU to a two-way radio

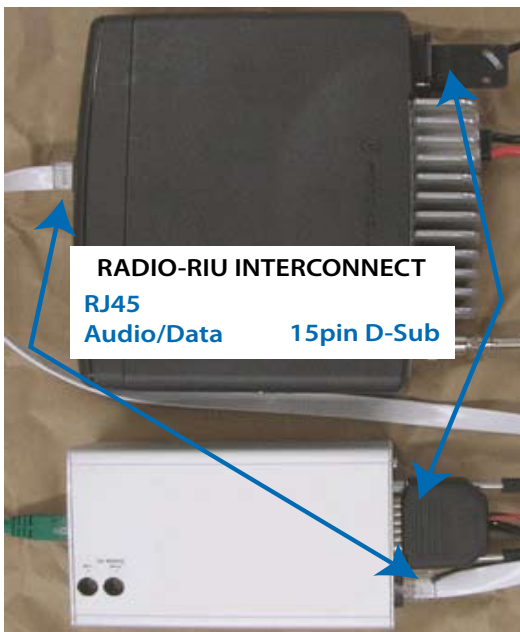
The RoIP Interface Unit provides two levels on connectivity with the radio:

- **Generic** interconnect provides the RoIP channel for basic Voice and PTT functions for any type of radio
- **Advanced** interconnect adds radio-specific functionality to the RoIP channel and transport

The generic interconnect accesses audio via the radio's speaker and microphone access and PTT is connected to the appropriate I/O on the radio. Ready made cable kits are available for the generic interconnect.

The advanced interconnect allows the operator remotely access a radio's specific features, e.g. channel-control, selective calling and enhanced display. Advanced interconnect uses special capabilities built in to the RoIP Interface Unit that allow it to access and connect with the control bus between radio and control head. This enables SoftRadio to provide a remote Virtual Control Head (VCH) for the radio. VCH enables a local operator to access functions and features of the remote radio beyond audio and PTT, e.g. including key presses and display. The advanced interconnect requires a type-specific cable kit to access the radio's control bus between the radio and the standard control head. These kits include the generic interconnect to the radio's speaker, microphone and PTT and for some radio types also to the external alarm output of the radio.

We can provide a range of integration and customisation for Radio and RIU builds and installations.



The currently available VCH versions are:

- Generic Interface (RJ45 Audio/PTT only)
- Advanced Interface (RJ45 & 15 D Sub):
 - Motorola MotoTrbo, DM3600/DM3601
 - Motorola GM360/GM380/GM1280
 - Motorola MTM700/MTM800
 - Ericsson Aurora / Niros TRX300
 - ICOM IC-F1610/2610
 - Sepura SRM2000 / SRM3500 / SRG3500

(Current as of 04/10)

New versions are continually being added.
Please contact us with your requirements.

Figure 7. Radio<->RIU Interconnect (Example Motorola GM380 with remote control head kit)

5.2 Connecting the RIU to the IP-Network

The RIU is connected to a network via a standard 10/100 Base-T Ethernet port. The Interface Unit can be connected to various networks, such as an existing LAN, a dedicated LAN just for RoIP/Radio operations and directly to an Internet connection using e.g. ADSL, WiFi or other types. Each RIU in the network requires a unique ID-number and IP-address.

5.2.1 RG-Series Set-Up

The RIU Set-Up Menu is accessed from a PC that is connected to the same sub network as the RIU.

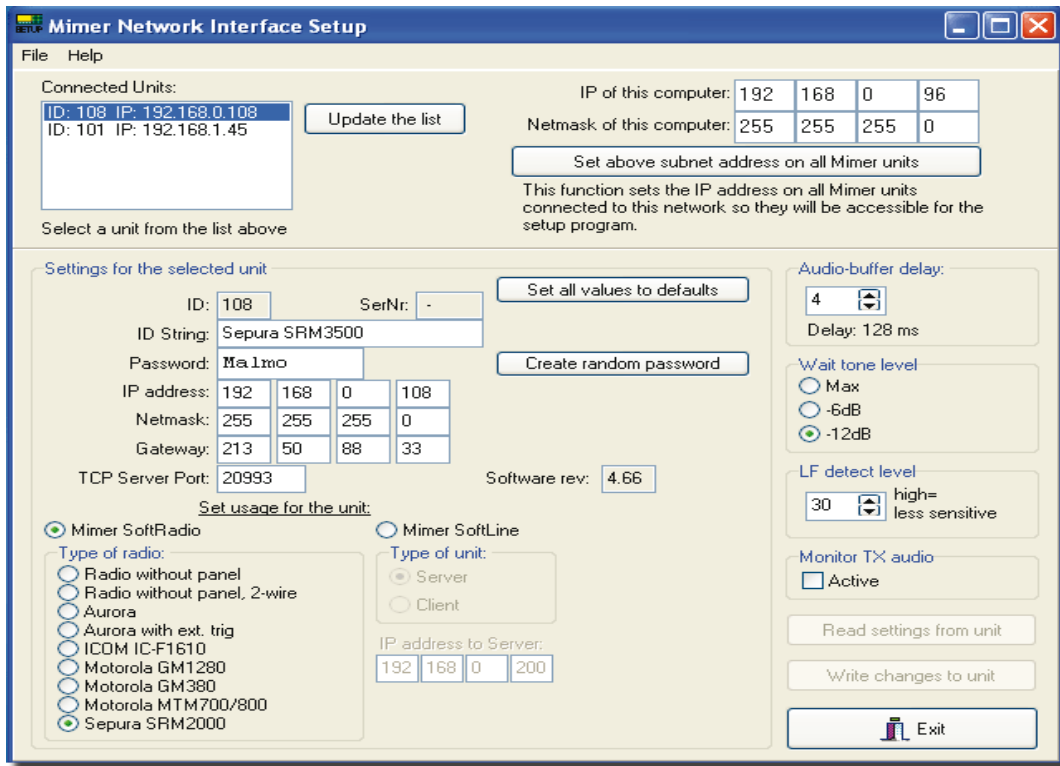


Figure 8. RoIP Interface Unit Set-Up

Connected Units: RoIP Interface Units found on the network. Select one to bring forward it's settings

Settings:

- **ID:** The value set by the rotary selectors on the interface unit
- **SerNr:** The unit's serial number
- **ID String:** The name displayed in SoftRadio
- **Password:** Required when using TCP over the Internet
- **IP-Address, Netmask, Gateway - Settings** for the IP-network (the interface requires a fixed IP address)
- **TCP Server Port:** Used to provide access to the unit in networks with a firewall
- **SoftRadio:** Sets the type of radio - *should only be changed by trained technicians*
- **SoftLine:** For use as SoftLine - *should only be changed by trained technicians*
- **Audio Buffer Delay:** Used to improve the quality of the received audio
- **Wait Tone Level:** Sets the level of the wait-tone sent to mobile users
- **LF Detect Level:** Sets the threshold at which audio is detected (the radio's squelch-signal is not used)
- **Monitor Tx Audio:** When 'Active' the outgoing audio of each operator is broadcast to all operator consoles (used for operators at different locations, not when they are in the same control-room, can cause feedback)

Ensure "Write changes to unit" is executed to save changes.

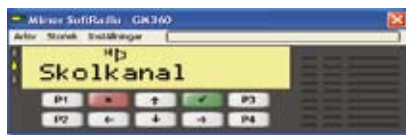
5.2.2 RG-Series Virtual Control Head

The Virtual Control Head allows the operator to remotely control a radio using the functions and interface of the radio's standard control head. The SoftRadio VCH panel replicate the radio's standard control head. Buttons can be pushed via the mouse, via a touch screen or via the computers keyboard. Operators can use a remote just as if he/she is sitting in front of the radio. As with the standard SoftRadio interface, multiple dispatchers can operate and share the same radio. Hence they need to bear in mind that changes made to the radio-setting by one operator will affect all users since they share the same radio.

The key to the Virtual Control Head (VCH) is the extra functionality built into the RoIP Interface Unit that allows the RIU to connect to the radio's control bus between radio and control head. The RIU interfaces with the control bus and sends respectively receives the control-data as part of the RoIP data-transport to the operator's SoftRadio console. On the console, a type-specific VCH-interface (application) creates the display and reproduces the radio's state, e.g. channel selection and operating mode. In turn, the VCH-interface takes the operator's control-input from mouse, touch-screen and/or keyboard and sends the control-input via the RoIP-Channel to the remote RIU and radio.



Ericsson Aurora / Niros TRX3001
(Standard control head will work in parallel)



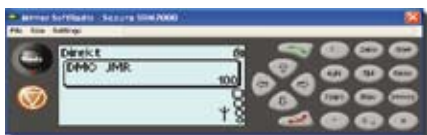
Motorola GM360
(Should also work with GM660, CDM1550, GM338 and GM160 - yet not factory-tested)



Icom IC-F1610 / F2610
(Standard control head will work in parallel)



Motorola GM380 (also works with GM398)



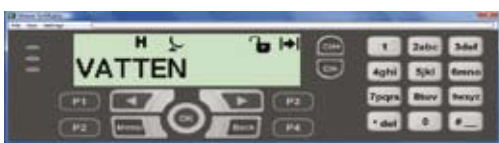
Sepura SRM2000 / SRM3500 / SRG3500
(Standard control head will work in parallel)



Motorola GM1280



Motorola MTM700 / MTM800
(Motorcycle Control Head)



Motorola MotoTrbo, DM3600/DM3601

Figure 9. Radio specific Virtual Control Heads

6. Deploying SoftRadio Operator Console & Interface

SoftRadio is installed as any other PC-software.

6.1 SoftRadio Connections Set-Up

Before SoftRadio can be used on the network, the system-administrator needs to run the SoftRadio/RIU connections utility. In Connections Set-Up, the system-administrator first must set the required IP-addresses, passwords and configure how SoftRadio connects to RoIP Interface Units (devices) that are located on the network.

Devices are typically RIU's connected to radios, but can also be an RIU interfacing to a PSTN or Cellular Network, a Voice or Status Log, or a pure RIU-to-RIU Channel (SoftLine). The Connections SetUp menu allows the administrator to configure more than the eight devices than normally each SoftRadio can handle. This allows the administrator to pre-configure a system-wide list of devices for all consoles (super-set of devices). This significantly simplifies administration as each operator can then simply choose from the super-set which eight devices are used on the specific console and eliminates the need to set-up every SoftRadio individually. Set-up files can also be copied from one computer to another, as long as each SoftRadio console (PC) has its own Operator ID.

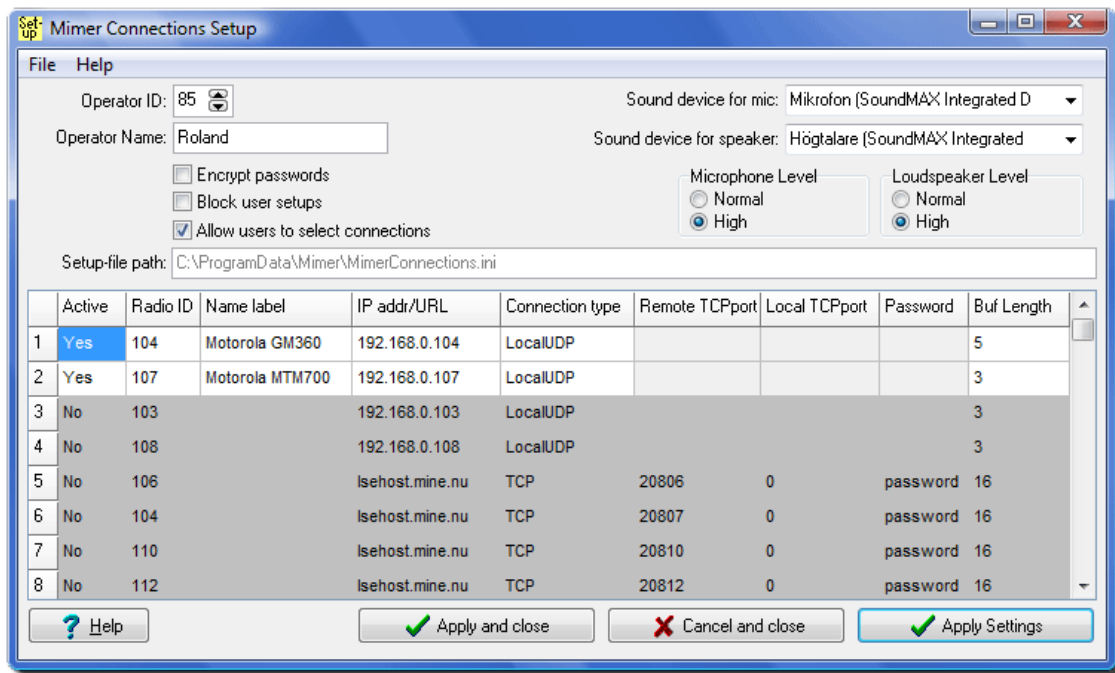


Figure 10. SoftRadio Connections Set-up screen

Common Settings:

- **Operator ID:** Needs to be unique for every PC
- **Operator name:** Used in systems with a Radio Server
- **Sound device:** Sets the Audio Device used (e.g. Headset), can be different than the default set for the PC
- **Encrypt Passwords:** Secure Passwords
- **Block user setups:** Disables changing Settings by users in SoftRadio. Tip: Install the Connection Setup utility under the PC-user "Administrator" to limit access to the System Administrator
- **Allow users to select connections:** Activates **Name Label** function
- **Levels:** Basic Audio-Levels (Detailed settings are done via the PC's Control Panel/Audio Devices)
- **Set-up file path:** Name and file-location of the setup-file

Device/Network Settings:

- **Active:** Activates this device in the console
- **Radio ID:** Corresponds to the rotary switches on the RoIP Interface Unit
- **Name Label:** Descriptive name for a device, requires "Allow users to select connections" to be selected
- **IP address/URL:** Sets the network-address/path to the Network Interface
- **Connection Type:** UDP for local networks (LAN, intranet), TCP for large intranets or via Internet/WAN
- **TCP-ports:** Required to pass through firewalls
- **Password:** Secures connection over the Internet, the corresponding password is set in the RIU
- **Buffer length:** Helps compensate poor audio due to a degraded connection (increase buffer)

General:

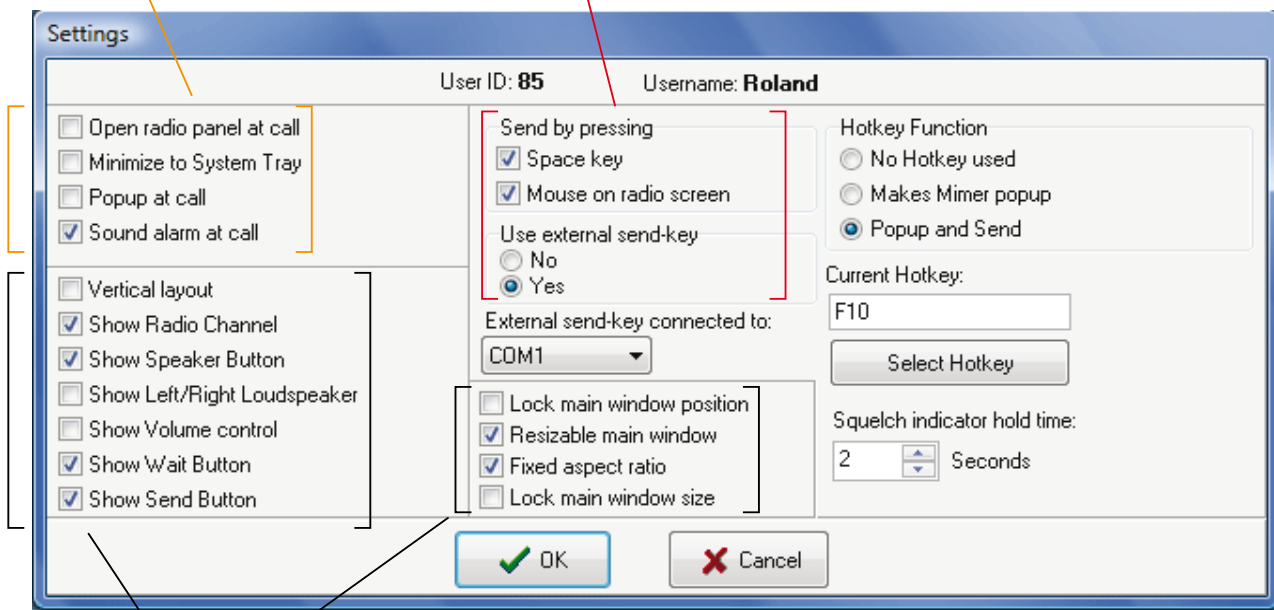
- **Apply and close:** Will write the new settings and then close the application window
- **Cancel and close:** Will **not** write the settings, but will close the application window
- **Apply Settings:** Will write the new settings and keep the application window open

6.2 SoftRadio User Settings

Settings is accessed from the Menu Bar in SoftRadio. Access to Settings can be blocked in Connection Set-Up, allowing only the system administrator to make changes (see above).

SoftRadio Actions when
a radio in the list receives a selective call

PTT



SoftRadio interface (display)

Figure 11. SoftRadio User Settings screen

Settings:

- **PTT:** Sets which device/action executes a PTT. Selecting no option deactivates PTT, the user can only monitor the radio-communications. External PTT connects to the PC-COM port (Close pin 7 & 8)
- **Hot key:** Sets a keyboard 'hot key' action, useful for operators running SoftRadio in a minimised window
- **Squelch Indicator Hold Time:** Sets the time Squelch is held to indicate after the squelch (Tx) goes inactive. 1-2s is recommended to allow operators to better differentiate between radio-communications

6.3 SoftRadio & RoIP Interface - Tips for Set-Up

This chapter provides some useful information and tips on how to make your RoIP system work most efficiently and effectively.

Monitor Tx Audio - RIU, allows operators to hear outgoing audio from other operators

The default setting is 'deactivated'. Operators can not hear the audio sent from other operators. This setting is preferable where several operators are in the same room as audio from the consoles can lead to feedback in the system. To allow operators in separate locations to hear both the audio from the radio(s) and from other operators (i.e. both sides of the conversation), set "Monitor Tx Audio" to "Active" in the RIU settings panel. The RIU then broadcasts the transmitted audio to all SoftRadio consoles using that RIU/radio combination.

It is possible to configure a mix of both settings: Set the appropriate RIU's to Active for "Monitor Tx Audio" **and in addition** exclude select operators by making the appropriate **expert setting** in their SoftRadio's 'ini-file'.

Ring tone when using headsets - SoftRadio Connections Set-Up

Where SoftRadio is configured for use with a head-set, all audio including ring- or alarm-tones is sent to the head-set on the console (PC). To avoid missing a ring-tone or alarm to be missed, e.g. when no operator is wearing a head-set, ring-tones and alarms can be routed to a second audio card in the PC by making the appropriate **expert setting** in the SoftRadio 'ini-file'. (Note: This requires a second audio card with the necessary speakers to be installed on the PC).

Multiple dispatchers - audible delay in audio broadcast

In some operations, consoles are configured so that multiple dispatchers can monitor the same radios via speakers. This is typically not an issue, but where different PC's and sound-cards are used, deviations in their performance can result in the audio being broadcast with slight differences in timing, even though the audio comes from the same radio and RoIP channel. Although only fractions of a second, this overlap of the audio is perceptible and hence annoying. It is recommended to use PC's and sound-cards of the same type and performance and further to check if other applications are loading the PC.

Poor audio and feedback when using phones

The phone (**PhoneConnect**) add-on function to SoftRadio is designed for use with headsets. An automatic and self-adjusting echo cancellation on the PSTN interface is included. If issues with the audio occur in the PC we recommend to turn off the microphone feedback in the audio card (PC - Control Panel, Volume Control) and use a head-set. If a head-set is not possible, adjust to the speaker volume as low as feasible and keep an adequate distance between speakers and microphone.

Expert settings - System Administrator only

There are a number of settings that can be configured within the SoftRadio's 'ini-file'. **We strongly recommend that this is only performed by an adequately trained system administrator.** An excerpt of possible settings:

- Prevent SoftRadio from being shut down
- Configure a second audio card for ring signal
- Block the Icon from the task-bar
- Block the blinking in the task-bar when transmitting
- Change the symbols/text on the buttons
- Turn off audio from other operators when enabled at RIU

Please contact us if you need to change any of the above functions and **before** you make alterations to the ini-file. (At the very least, first make a copy of the original ini-file...)

7. Operating SoftRadio - Standard Functions

The SoftRadio user interface is straightforward and easy to use. It provides an efficient and effective overview of the key status and functions of the connected radios. More detailed views can be accessed by either selecting a function or via the appropriate menus from the menu-bar. The SoftRadio interface can be configured to the user's preferences, e.g. either as a minimal window or as a maximum sized window in the forefront of the user's screen.

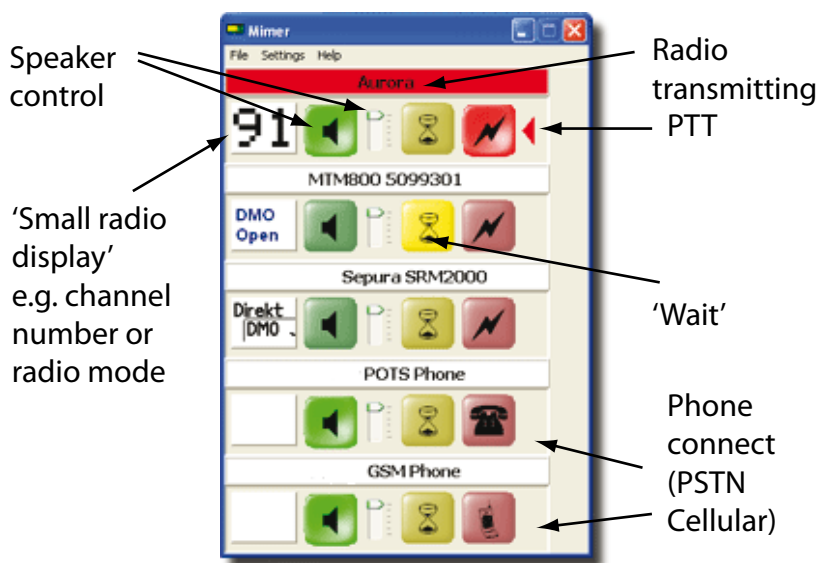


Figure 12. Configuration basic SoftRadio screen

SoftRadio automatically configures the rows (display bars, panels) according to the number and type of devices connected. Each device (Radio, PhoneConnect, StatusLog/VoiceLog, SoftLine et al) has its own area with the appropriate buttons and display. The layout and type of buttons can be configured for different purposes and users (SoftRadio User Settings). The SoftRadio screen supports both touch-screen and conventional PC displays with keyboard/mouse input.



Speaker buttons: ON/OFF toggle, can be expanded with two additional buttons for on/off right/left. When using a stereo-headset/speakers, an operator can configure one device for the left channel, one for the right to more easily select who is speaking. Separate volume controls are available for each speaker button. When the buttons are deactivated, audio remains ON.



PTT (send) buttons: Transmits the operator audio on the remote radio. The small red arrow on the right-edge of the panel indicates which radio is selected for external PTT. The red arrow when lit is used to indicate the radio last used by the operator. PTT can be deactivated for users that only monitor channels. The VCH display can be configured to execute PTT pressing the VCH display, providing operators on touch-screens ergonomically efficient operation.



Wait button: Sends out a tone message on the radio channel to acknowledge users that they have been heard, but the operator is busy at the moment. The wait button will remain lit at all operators using that radio as a reminder that a user is "on hold". Pressing the wait button again or when an operator presses PTT for that radio turns wait off.



Phone button / GSM Phone button: Opens a phone line and brings forward the dial-pad. A speed dial list is available. Symbols are used according to the type of phone connected.



Small radio display button: Displays a part of the radio's physical display. The content of the small radio display can be configured (depends on the type of radio). Pressing the small radio display button toggles (brings forward or closes) that radio's Virtual Control Panel.

GM1280 - MPT

Radio Name Bar: The radio name displayed is defined in **RoIP Interface Unit Set-Up ('ID String')**. Pressing the Radio Name Bar will bring forward, or close that radio's Virtual Control Panel. The Radio Name Bar changes colour according to the status of the radio:

- Grey - Not connected to the Network Interface
- White - Stand By
- Yellow - Incoming audio
- Red - I am transmitting
- Orange - Another PC is transmitting
- Blinking Green - Selective call has been received
- Light Blue - Phone call on-hold



Virtual Radio Control Panel: This panel is automatically selected based on the type of radio the RIU is configured for. The size of the radio control panel can be chosen in increments, (3 - 4, depends on model). All keys on the Radio Control Panel are replicated on the PC keyboard, making input for channel selection and selective calls easy, e.g. on a Motorola GM380, the green button corresponds to the Enter button on the keyboard and the red button to Esc.

8. Enhancing and 'growing' the Radio Network

Two-way radio is about connecting users in a way that suits their needs and environment: Direct communication between mobiles, group-talk, broadcast, or as is often the case, connecting to mobile users from a central dispatch centre. Operating a network obviously requires more than just voice communication. The network needs to be configured, controlled and maintained. Radio stations at remote sites need to be administered. Usage, configuration and payload needs to be optimised. Applications need to be updated and integrated. Interoperability is an increasingly important requirement. Staff and indeed organisations need to respond quickly and decisively to new and often unforeseeable situations. While radio networks are built on common technologies and standards, the organisations that use them have their own unique practices and structures. It is essential that any 'solutions' retain and further that competence. Only then can the variety of challenges, day-to-day, mid- and long-term be met efficiently and effectively.

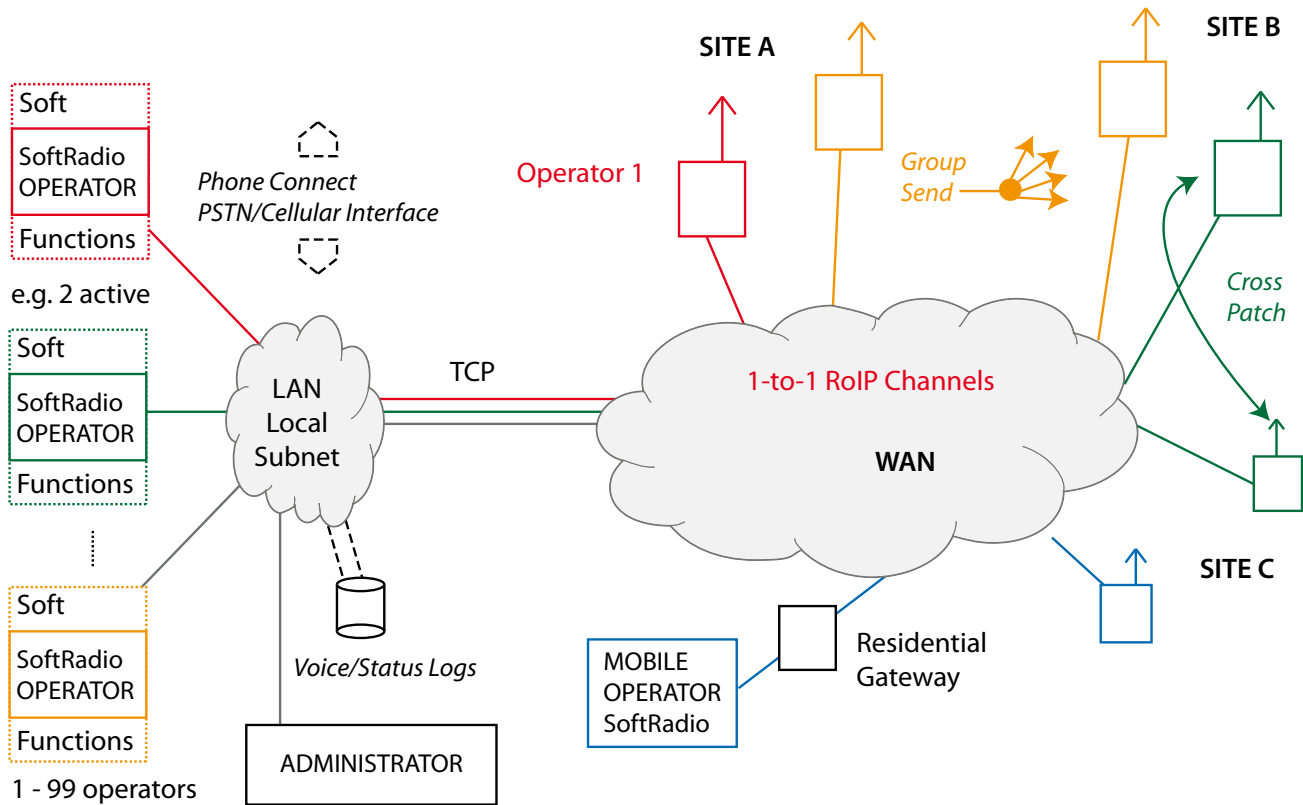


Figure 13. Enhanced RoIP Two-Way Radio network

All this is realised with a structured and flexible operations 'platform' that utilises the variety of existing resources and technologies efficiently while adding and enabling the addition of capabilities - without the need for expansive 're-design'. A platform that comprises the elements and interworkings that can grow with the operation's needs, rather than an expensive and proprietary 'closed' system. A modular, structured and open platform with distributed resources:

- Capabilities are embedded, flexible and expendable
- System-architecture supports the 'evolution' of new capabilities
- The platform is 'upward' compatible and supports lateral integration

On the operator side, SoftRadio makes the most of the inherent flexibility in a PC based application and infrastructure. The RIU itself is built on a structured and flexible platform, enabling new applications with a minimum of development. A smart network significantly simplifies administration and integration. Elements are simply nodes on a network. Operators can readily add and extend functionality, without necessarily changing the physical network-elements. SW-Applications can be readily added to consoles and control-centres, simply by installing compatible application building-blocks: The 'soft-functions'. This structured approach is not new. What is new is the means to do this efficiently; 'smart' RoIP network elements such as RIU and SoftRadio. It simply makes sense to take full advantage of their inherent capabilities.

9. Enhancing the Operator Console - SoftRadio Add-On Functions

SoftRadio is more than a PC-based operator-console. It is a platform. Designed from the beginning to grow and expand, SoftRadio provides a simple, cost-effective and efficient base from which to grow network-capability, when and where it is needed.

9.1 SoftRadio - CrossPatch

The SoftRadio CrossPatch add-on allows operators to very simply and dynamically cross-connect two or more radios. In essence, CrossPatch routes the RF-payload from one radio via the RoIP channel to the RF-interface of the radio(s). CrossPatch allows operators to cross-connect users on different radio channels, in different frequency bands or even on different radio-types, e.g. from an analogue channel to a digital talk group. CrossPatch provides network operators and organisations a highly cost-effective tool for migrating from old to new radio-technology and formats. Using CrossPatch means networks can retain essentially the same coverage and migrate to a new technology or radio-type and upgrade radio-sites successively with the upgrade of mobiles. CrossPatch is also highly efficient in dynamic situations where coverage and configuration of the network needs to be set-up quickly and tailored to the unique situation. For example personnel on a rescue site may use one simplex channel on-site and another for calling back to base. Both channels can be used more effectively by using a CrossPatch, improving coverage and capacity of the ad hoc network.

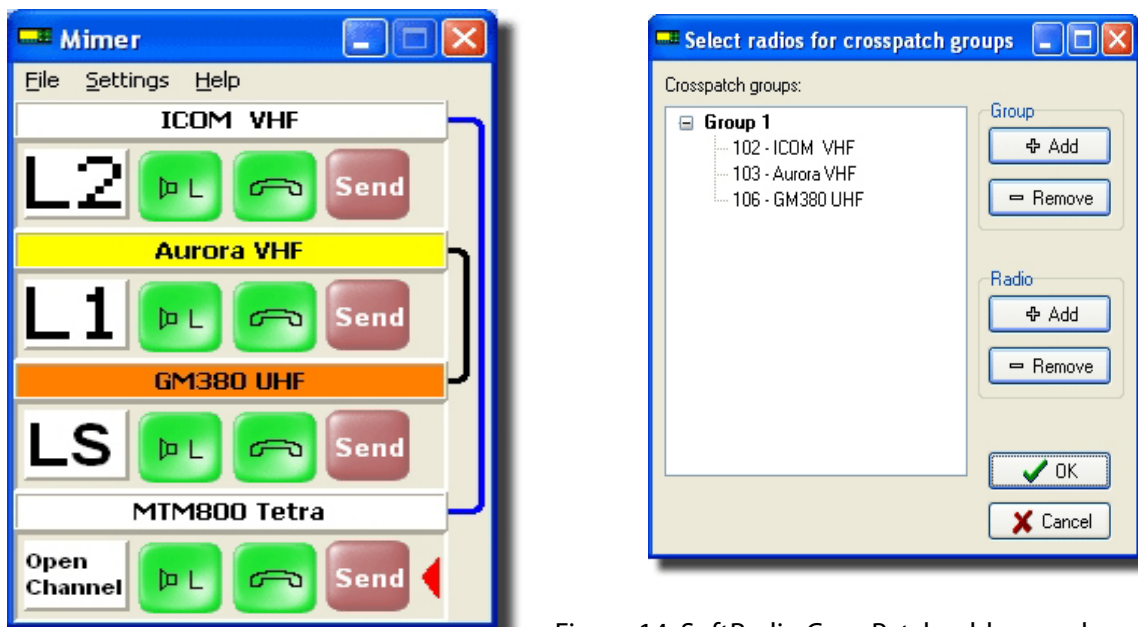


Figure 14. SoftRadio CrossPatch add-on and configuration

Up to eight radios can be in the same patch. Each operator can make up to four patches at the same time. A radio that is in a patch set-up by an operator can still be used by all other operators. (It can not be placed into a new patch while in an active 'patch') The operator that made the patch controls it and is the only one allowed to release the patch. CrossPatch works between any RIU device, including between radio and telephone.

Typical applications

Area extension: Cross-connect radio-stations to other radio-stations in other area

Linear-extension: 'Chain-connect' radio-stations, e.g. in tunnels

Migration: Mix 'old and new' technology, extending the usage of existing assets while migrating to new radios

Cross Band: Cross-connect a radio in VHF to a radio in UHF.

Cross System: Cross-connect an analogue channel to a digital talk group, connect a radio to a phone.

Disaster-Response: Dynamically configure users and groups across radio and response systems. E.g. firemen on Tetra hand-held's with plant-workers on analogue hand-held's with an emergency coordinator at a PABX

Phone-patch: Route phone calls to users in the field via the two-way radio system, thereby overcoming overloaded or unavailable networks, e.g. when an emergency overloads the cellular network's capacity

9.2 SoftRadio - GroupSend

The SoftRadio GroupSend add-on allows operators to very simply configure outgoing transmissions to be sent on up to 8 remote radios simultaneously. From the operator's point of view, GroupSend adds a simple 'tick-box' option to the radio-display bar and a common GroupSend button to the SoftRadio user-interface. The operator selects the GroupSend 'tick-box' on the radios to be used in the GroupSend transmission. To transmit a GroupSend, the operator simply uses the GroupSend button analogous to the radios' PTT buttons.



Figure 15. SoftRadio GroupSend add-on and configuration (SoftRadio with four radios, two configured for GroupSend)



Typical applications:

System-Messages: Broadcast system-messages to all mobile users (on up to 8 radio-sites), e.g. to notify of maintenance

Emergency Messages: Broadcast urgent messages to all mobile users (on up to 8 radio-sites), e.g. to evacuate a site

Notify User: GroupSend a notification across an area to notify a mobile user whose location is unknown

Call-Back Notification: GroupSend a notification to request a call-back, e.g. for security guards on patrol

Cross-System Notification: GroupSend a message via different radio-systems to notify users e.g. in an ad hoc and mixed radio-network set-up for an emergency situation

9.3 SoftRadio - PhoneConnect

The SoftRadio PhoneConnect add-on allows operators to very simply connect from SoftRadio to PSTN and Cellular phones. From the operator's point of view, PhoneConnect simply changes the one or more of the eight radio panels to a phone access panel. Instead of pushing "send", the operator selects the handset symbol.



Doing so opens a number pad (1). Selecting it again opens a speed dial pop-up window (2). PhoneConnect allows an operator to use the same SoftRadio console and audio set-up used for two-way radio to make a call via a land-line or cellular telephone, greatly improving the efficiency of operations.

Each operator can have his/her own phone line or share one or more lines with other operators. Calls can be made, received and put on hold for other operators to take over. With both PhoneConnect and GroupSend together on a SoftRadio console, operators can patch both radio communications and phone-calls across the network, e.g. forwarding phone-calls to two-way radio users and vice versa.

Figure 16. SoftRadio PhoneConnect add-on with dial-pad and speed-dial pop-up windows

Possible Connections

Analogue (PSTN, conventional) Phone: The physical connection to the phone-line (PSTN) is made via the RoIP Interface Unit. The RIU connects to a standard two wire, DTMF phone line. A fixed cellular phone with PSTN access/interface, a GSM-modem and even a satellite phone with a PSTN interface can be connected.

Digital Phone (VoIP Phone): The connection to a VoIP-Phone or VoIP switch (SIP) is made via LAN with a Network Repeater as a gateway. (A RIU is not required when connecting via a Network Repeater)

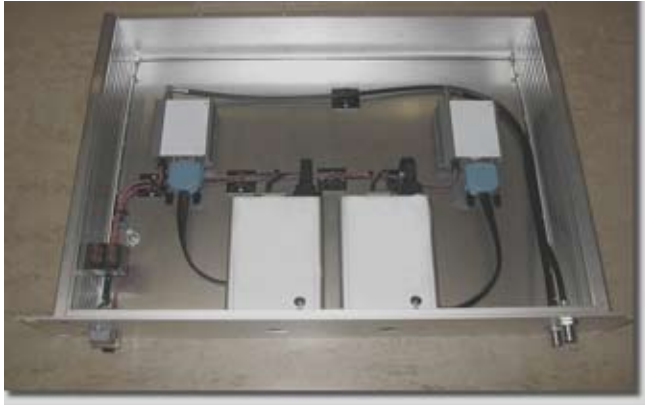


Figure 17. Two GSM modules combined with RoIP Interface Units to create a interconnect from a two-way radio network to a GSM cellular network (provides two independent phone channels) This example is used in a command and control vehicle.

9.4 SoftRadio - VoiceLog

The SoftRadio VoiceLog add-on allows operations to easily record and recall all audio communications to a server. From the operator's point of view, VoiceLog simply adds a VoiceLog display-bar to the SoftRadio user-interface. (Note: The VoiceLog display-bar takes up one display-slot of the maximum eight display-bars the standard SoftRadio console supports).



Figure 18. SoftRadio VoiceLog add-on VoiceLog playback window

VoiceLog records all audio for each SoftRadio console (operator) and each radio channel to a common server. All recordings are in standard WAV-format and named with date, time and audio path. VoiceLog runs on most Windows computers or Servers. Recordings are made with the appropriate ID and time-stamp(s) allowing users to recover and assess communications quickly and effectively. Two time-lines of recordings are displayed for each device (radio, phone), one for outgoing and one for incoming audio. Each duration of active audio is represented by a burst on the time line. The operator simply sets the marker on a burst to play back the recording. Each operator can recall his/her conversations for a preset time, (e.g. an hour or a day). In many situations and organisations it may be required to investigate past communications, e.g. after an incident. A supervisor or investigator can listen to all recordings on the server. How much is recorded and available depends on traffic load, the size of the storage medium (hard drive) and what back-up schemes are used. (20 hours of constant recording require approximately 1GB of storage)

9.4 SoftRadio - StatusLog and ObjectLog

The SoftRadio StatusLog and ObjectLog (option) add-on allows operations to record and recall all incoming status calls and voice requests from the field.

The optional ObjectLog enables operators assign objects and duties to mobile radios, e.g. for patrol schedules. Every console in the network displays the same information in real time.

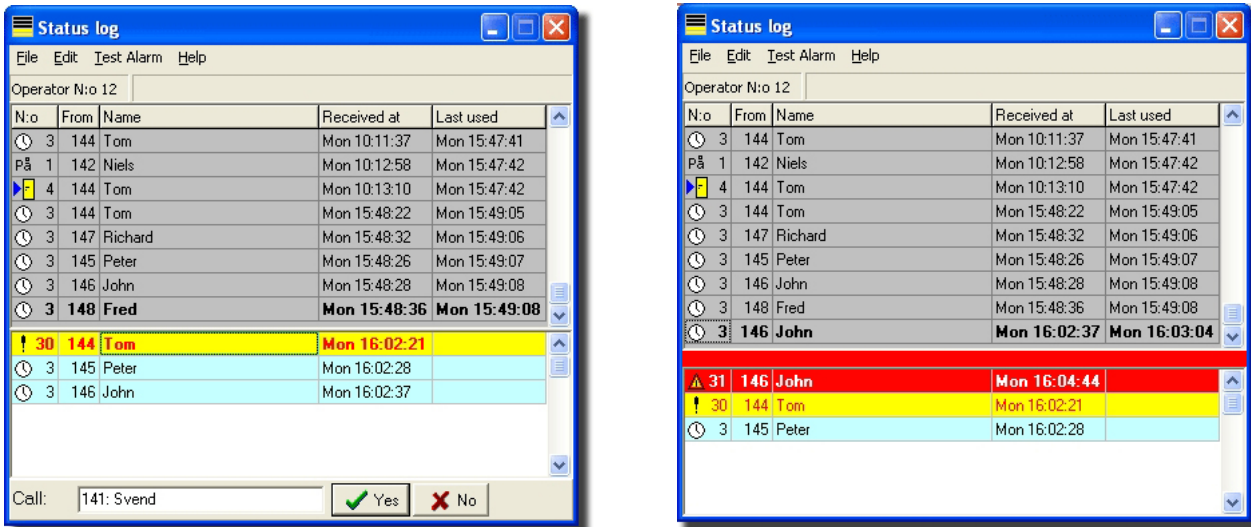


Figure 19. SoftRadio StatusLog showing calls and status with a call in progress (left) and with an incoming emergency call (right)

Status

Every incoming status is logged with a time stamp, e.g. “log-in”, “lunch”, “maintenance” etc. Status messages can be exported to other systems. StatusLog can be configured to log and display status on the consoles or only log to the server.

Voice Call Requests

StatusLog can log voice call requests from users in the field. In this set-up, all calls to all operators are logged to one radio number and placed in a common queue, regardless of how many operators are active on the system. The operators handle the calls according to the queue and which radio they are assigned to.

Time Stamping

Every call is time stamped when it is received, when it is first answered and when it is last handled. Priority and emergency calls are given a higher status and can be assigned an external alarm signal to alert the operators.

Emergency

An emergency call will trigger a red square across all screens and an alarm tone from the computer until a dispatcher clears the alarm. The emergency call is placed at the top of the queue for voice calls.

Optional ObjectLog

ObjectLog allows to pre-program (pre-set) ‘objects’ and ‘mobiles’ with specific ‘conditions’. For example at a manufacturing plant (object), a security guard (mobile) arrives at 07.00 and does his rounds at 10.15 for 20 minutes (conditions). In this example, ObjectLog will keep track of when the guard:

- Logs in at the plant
- Starts the rounds
- Calls in the routine status-update
- Returns from rounds
- Logs out from plant

Different parameters can be assigned to every object (plant) and every mobile (guard, radio-number). Object conditions (round-duration) and mobile parameters (guard, radio-number) can be changed dynamically. If any one of the conditions set is not fulfilled in its allotted time, a warning is sent to the mobile. If the appropriate response is not received, an alarm is raised at the dispatch console/control centre. ObjectLog can be used for many types of applications that are required to send in a status and receive an corresponding time-stamp, e.g. at an airport or logistic centre. StatusLog/ObjectLog can be customised. It is currently available for MPT-systems and for 5-tone systems with a Tetra system in development. StatusLog is Windows software that runs on most Windows computers or Servers.

9.5 SoftRadio Tailored Options - ongoing developments

SoftRadio is continually enhanced and extended. Quite often, these developments start off as very specific customer requirements. Often these needs are actually quite common and more users and customers can benefit from them. Here is a list of such developments that have been added to our product family. Please feel free to contact us at any time to discuss your specific needs.

MPT1327 Speed Dial List

This special speed dial list simplifies selective calling and text messaging using a SoftRadio console, much easier than using the radio's virtual control panel. The Speed Dial List is configured on an individual SoftRadio console, but can be copied between the PC's. Speed Dial List is currently available for MPT-Systems.

Selective call routing with Ericsson Aurora

The Ericsson Aurora radio, (Niros TRX3001), has in-built seven-tone capability. Radio, RIU and SoftRadio can be configured to route the seven possible selective calls to multiple SoftRadio consoles. On the console, the operator determines which calls (1 to all 7) his/her SoftRadio console will react to.

Selective call routing with Tone Decoder

A tone en-/decoder in the RoIP Interface Unit encodes the analogue signalling-tones as data messages and sends these to the SoftRadio console(s). SoftRadio is pre-set to react/respond to the different codes.

Text Export

Text Export allows information displayed in the radio control panel on Motorola radios to be exported to other systems. This can e.g. be useful to export an incoming SDS (Short Data Service - TETRA) message received by the TETRA-radio to a different (non-TETRA) two-way radio system or network.

No Shut Down

SoftRadio can be set up to start automatically and can not be shut down by the operator.

Hook Switch

Operators with handsets can use the hook switch to control the loudspeaker on/off, not only on their own computer but also on the other operators computers. This is done via a data message over the network.

Base station Tone PTT/ Base station DC-Keying

In some systems base-stations are connected via a 2- or 4-wire telephone line (land-line). Here the RoIP Interface Unit can provide PTT over the land-line by sending a single tone (Tone PTT) or a DC-Current (DC-Keying) over the line to initiate transmission.

External Alarm

External Alarm provides a logic output on the SoftRadio's PC COM-port when a radio receives a selective call.

10. Extending the RoIP Network and Access

As discussed in section 4, there are two basic network configurations: WAN and LAN. In smaller RoIP networks, the operators access radios that are connected via RoIP Interface Units that are on the same local sub-net (LAN) as the operator's PC. Here the RIU supports up to 99 SoftRadios accessing its radio via UDP. In larger networks, operators and radios connect via the Internet (WAN). Here TCP transport is used. The difference is that TCP (WAN) allows only a 1-to-1 connection between one SoftRadio console and one RIU (radio).

In figure 13 we introduced an expanded RoIP radio-network. This network was 'grown' by adding more RoIP Interface Units and more SoftRadio consoles. It is not always possible or sensible to create more capacity by adding more individual nodes. It is often more efficient and effective to improve and extend access to the already installed assets and infrastructure, thereby increasing utilisation. This can be done in two ways, or stages. The first stage is to allow multiple operators dynamic access to multiple radios at one radio-site.

10.1 Radio-Server extension for a Radio-Site

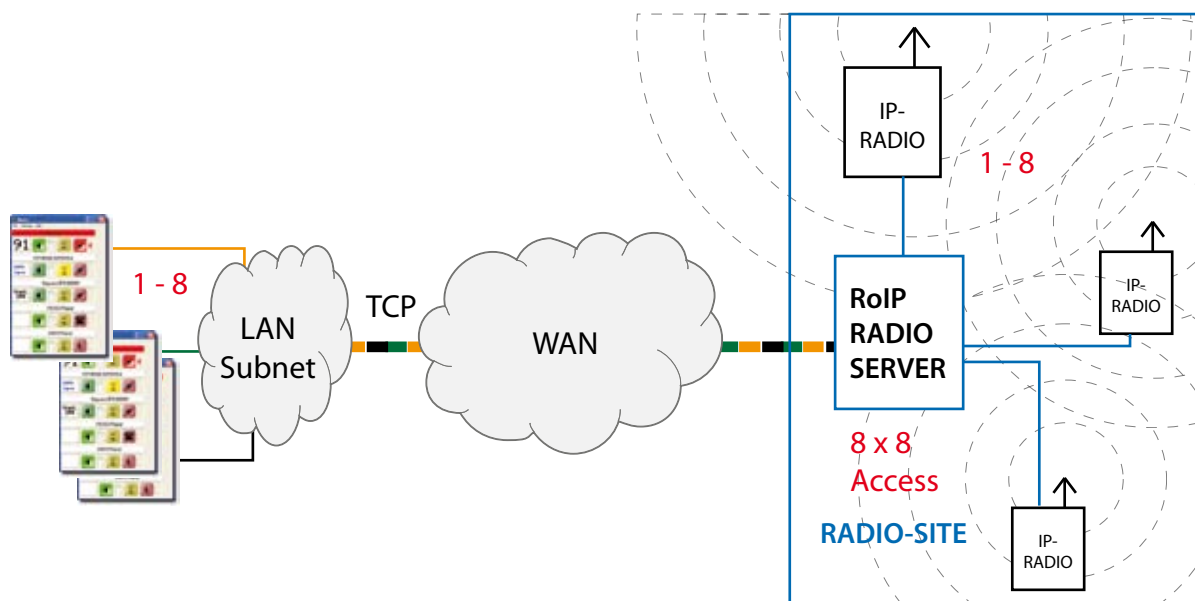


Figure 20. Basic RoIP Radio Server function

Example:

A network has 3 distributed radio-sites, each with 4 IP-radios (RIU & two-way radio) and 3 operators at the control site. One radio-site is situated in an urban environment and has a heavy traffic-load with many frequent calls, but only at peak times. The other two radio-sites are in suburban and rural areas with fewer calls, but with a wider coverage area using directional antennas.

The network operator needs to improve capacity and usage for the site with heavy traffic. We can safely assume that the radio-site provides sufficient radio-capacity. The bottleneck is at the dispatch centre: The network was originally set-up with one operator responsible for one radio-site. Each operator has a SoftRadio console which allows him/her to access the radios on his/her site. The operator on the urban site though can become overwhelmed with calls at peak times.

The solution is quite simple: Provide all operators access to the urban site so that they can assist the main operator in peak times. This is easy to implement, all that is required is to install a radio-server at that site. The SoftRadios of all operators can then access all radios at that site through the radio-server. The set-up is also expandable. In this case described here, up to 4 more RIU/radio pairs can be added, doubling the radio-capacity. Up to 5 more SoftRadio consoles can access all 4 (8) radios on that specific site as well.

10.2 RG 8x8 RoIP Radio Server

The RG 8x8 RoIP Radio Server extends operator access to the IP-Radios (RIU/Radio) installed at one site. The radio-server manages the dynamic access to the RIU's and radios. The RG 8x8 RoIP Radio Server enables up to 8 radio/RIU pairs to be shared between 8 SoftRadio consoles. The RoIP Radio Server can also be installed at a dispatcher central to allow users dynamic access to radio resources from anywhere on a WAN (Internet). This is ideal for operations that need to change or shift dispatch and operation, e.g. a taxi company with local operators during the day and remote operators at night. An enhanced version with 64 configurable ports is in development. Here ports can be assigned as needed to RIU's/radios and SoftRadio consoles: E.g. 50 operators can access 14 IP-Radios, or 32 operators can access 32 radios, and so on.

The RoIP Radio Server is a self-contained Linux PC operating on 5VDC. It can be installed with a power-supply back-up. The unit auto-starts after a power failure. It has low power consumption and is easy to install

10.3 RG nxn RoIP Network Repeater extension for WAN's

As discussed, RIU's using TCP (WAN) allows only a 1-to-1 connection to a console, while on a LAN up to 99 different consoles can access one RIU. The RoIP Network Repeater essentially 'interprets' a Wide Area Network as a LAN (local) network. The SoftRadio consoles access the Network Repeater using UDP rather than the WAN using TCP which in turn allows each remote RIU's to support access of up to 99 SoftRadio consoles.

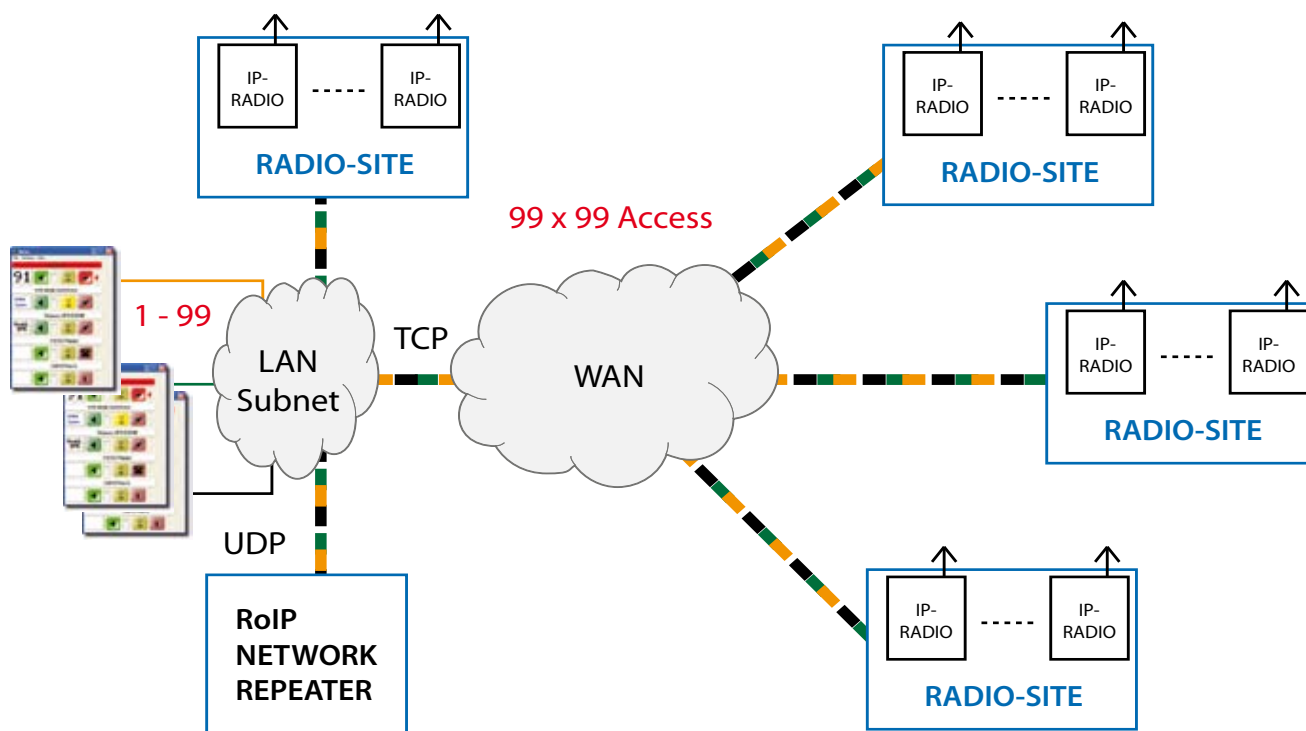


Figure 21. Basic RoIP Network Repeater function

Simply put, the Network Repeater makes all the remote IP-Radios (RIU's + radio) look like nodes on a local network. A very desirable 'side-effect' of using a Network Repeater is the substantial reduction in network traffic. Since all SoftRadios and RIU's are connected via a virtual local network, they no longer need to each establish a dedicated RoIP-Channel across the WAN. Further, using a Network Repeater eliminates the need to install RoIP Radio Servers at the radio-sites. Hence it is prudent to consider the configuration and growth of the radio-network when choosing between Radio Server Network Repeater. When in doubt, it is best to select a Network Repeater. Network Repeater operates on most Windows computers or Servers.

The Network Repeater can also be used to connect the two-way radios to an IP-phone system with SIP-protocol. A further option uses the Network Repeater to 'intercom' between operators. (Please refer to InterCom)

11. Special Applications of the RoIP Interface Unit

The RG-Series RoIP Interface Units are quite purposely based on a structured and flexible design and platform. The units are indeed 'smart' RoIP Network Interfaces and it only makes sense to take advantage of their capabilities for applications beyond pure two-way radio over IP.

11.1 RG InterCom

It is not always possible to communicate via an RF-Interface. Some situations prohibit the use of radio-transmissions, e.g. in RF-sensitive areas e.g. in emergencies involving gasses, or where security concerns forbid any 'over-the-air' exchange of information. In other cases, RF simply doesn't work well enough, e.g. in tunnels, or in areas of severe interference. The RG InterCom is a specialised version of the RG-series RIU. The unit allows operators to connect external wire-line intercom devices (portable 'Intercom Boxes') to the RoIP Network and communicate with operators and radios. Several intercom boxes can be connected to the same wire line.



Figure 22. InterCom devices and cable-kit

InterCom adds a display-bar (panel) to the SoftRadio display including SEND, volume control et al. To transmit to an external intercom device, the operator simply uses send as with any other device. InterCom functions as a talk-group for operators and external intercom users. The audio from an intercom transmission is broadcast to all users and SoftRadio operators. CrossPatch allows intercom calls to be routed to a two-way radio and/or phone line, effectively extending radio coverage and the PSTN/Cellular network. InterCom is ideally suited to command & control vehicles, both as a central InterCom and to connect C&C vehicles.

11.2 RG SoftLine

Networks, operations and special applications at times require to send audio and/or data via wire-line and over long distances. This can be because of the history of the installed systems, the nature of the operation, or for security purposes. Sending audio, data or control (logic I/O) via leased lines or similar infrastructure can be expensive and inefficient, especially compared to the ubiquitous IP-Networks. RG SoftLine is a specialised version of the RG-series RIU. It allows operations to replace dedicated transport methods with IP-transport by using two RG SoftLine units. The SoftLine interfaces create a channel that replicates a two- or four-wire wire-line connection. The 'virtual wire line' provides an audio line, a RS232 connection and a number of generic I/O-ports.

- 1 virtual 2 -or 4-wire line for audio
- 1 RS232 transparent data connection
- 2 optical I/O's

SoftLine is ideal to connect older type base stations or dispatchers to radio switches. It can also be used for alarms and especially client-specific applications and connections.

SoftLine can also be used to install a remote radio's standard control head locally and connect to the remote radio via an IP-Network. The SoftLine in essence extends the radio's control-bus indefinitely by transforming the control signals for an IP-based transport. This is ideal for applications where a single radio is at a remote site and the users key requirement is to use the radio via its standard control-head. No PC or other SW infrastructure is required, only access to an IP-Network. The radio and the control head can be separated by a standard CAT5 cable of up to 150m. Using a standard LAN or even WAN allows operators to extend further.

11.3 Motorola SoftLine - Motorola GM-series analogue radios



A Motorola GM-series radio connected via SoftLine to the standard control head.

At the control head side, the standard speaker and microphone can be used.

The RG SoftLine Interface has a built in speaker amplifier allowing to adjust for the correct audio level.

Figure 23. Motorola SoftLine

11.3 Sepura SoftLine - Sepura TETRA radios



A Sepura TETRA radio connected via SoftLine to the standard control head.

At the control head side, the standard speaker and microphone can be used.

The RG SoftLine Interface has a built in speaker amplifier allowing to adjust for the correct audio level.

Figure 24. Sepura SoftLine

12. Dispatcher Terminals and Accessories

It is crucial that operators and users can utilize the system and network in a way that suits their needs and capabilities - only then can a system be truly efficient and effective. We offer a variety of solutions and continually work on providing the 'look & feel' users need and expect. Please feel free to contact us with your ideas and requirements.

12.1 Dispatcher Terminals

The most common method is to use SoftRadio on a standard office PC. Yet this is not always possible or appropriate. Tailored or special dispatch consoles are the best solution for safety systems, industrial control rooms, outdoor applications, land-vehicles and ships.



Touch screen PC, all in one

Perfect for industrial control rooms that use a separate PC for the radio dispatch console (SoftRadio). The PC uses XP Embedded from a flash memory card and has no hard drive. It comes with built in LAN/WLAN.

Figure 25. SoftRadio console on touch screen PC

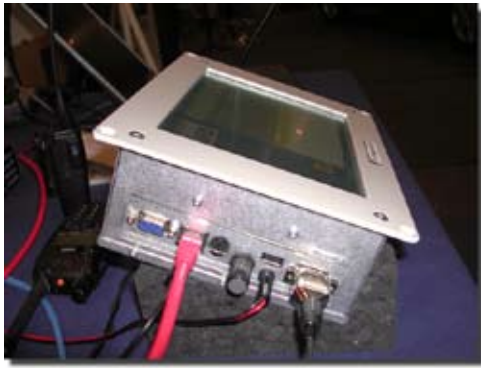


Figure 26. SoftRadio on touch screen PC for installation in a control panel (used in Command & Control vehicles)



Waterproof Touch Screen

Design of a water proof touch screen. The knob adjusts the light from very bright to nearly dark so that it can be used at sea. The red button is a PTT and the hand rest is used when the boat is rocking so that you still can find your way on the touch screen. (Note: Screen only, requires PC)

Figure 27. Design of Waterproof SoftRadio console

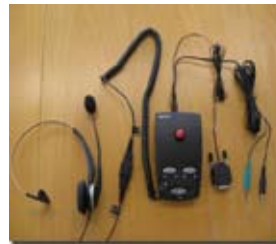
12.2 Dispatcher Accessories

SoftRadio consoles run on Windows PC and operators can select from a wide range of readily available accessories and components. We can certainly assist in the selection and delivery and equally provide a full, turn-key configuration for your operations.



Stereo-Headset

We recommend to use stereo-headsets in most central dispatch environments. This allows the operator to configure SoftRadio so that one radio (or other device) is on the 'left' and one on the 'right' audio channel.



Audio-Kit

For operators that need to switch their headset between the ordinary office phone and their SoftRadio console.



Desk-top PTT (left)

Foot-switch PTT (right)



Example Desk-top goose-neck PC-microphone



These are a few examples of components that have been used and which we can recommend.

13. Key Specifications - RGx1/ RGx1 VCH Series RoIP Interface Units

Specifications

General			
Voltage / Current / Consumption	+8 to +26Vdc; nominal 12V/ 250mA		
Operating temperature	-10°C to + 50°C		
Connectors	RJ45 (ETHERNET; AUDIO, DATA & UTILITY) 15-PIN D-SUB (female) PWR, OPTO I/O, HI-CURRENT OUT		
Dimensions	78mm (W) x 44mm (H) x 120mm (D) plus connectors		
Audio IN			
Input impedance	600Ω nom. DC coupled to GND, can be customised via alt. components		
Input voltage (max. signal level)	0.7V-13Vpp (0.25-4.5Vrms) (adjustable) extendable via alt. components		
Frequency range	300-3000Hz		
Audio OUT			
Output impedance	600ohm transformer coupled, can be customised via alt. components		
Output voltage (max. signal level)	0-1.1Vpp (adjustable) extendable via alt. components		
Frequency range	300-3000Hz		
Optical INPUT (opto-isolated)			
Input Voltage Range ON	3.0-30V	Input Voltage Range OFF	0-1.2V
Input current	> 0.15mA for active input, 8.2kohm in series with Opto coupler input		
Reference options	Internal references to ground or +5V		
External references	LOW: typically external GND	HIGH: typ. ext. , e.g. +12V or +24V	
Active Level (optocoupler setting) active state draws current	Active HIGH: + to IN; - to low ref (current drain when IN high)	Active LOW: + high ref; - to IN (current drain when IN low)	
Optical OUTPUT (opto-isolated)			
Voltage	max. 30V	Current (protected via 100Ω in series, configurable)	max. 30mA
Reference options	Internal references to ground or +5V		
External references	LOW: typically external GND	HIGH: typ. ext. , e.g. +12V or +24V	
Active Level (optocoupler setting)	Active HIGH: + to OUT; - to low ref	Active LOW: + high ref; - to OUT	
High Current Output			
Voltage (Limited by Zener diode protection)	max. 16V	Current	Max 500mA
Active level:	Sinks current to ground when active. Intended for operating relays etc.		
Utility Input (Active High)			
Voltage	3-30V	Impedance	5.6kΩ pull-up to +5V; 47kΩ to trans. input, configurable
Utility Output (Sinks to ground when active. Collector output via 330 ohm series resistor)			
Voltage	max. 30V	Current	Max 10mA
Data I/O for radio			
TTL or RS232 compatible in/outputs. (Output positive only, but works well with RS232 input if cable is <2m)			
Baud rate adapts to each particular radio type. For general purpose use 2400-19200 Baud is available.			
AUX DATA Port (Use of this port requires custom software. Contact the manufacturer)			
Typical use is for MAP27 or PEI protocols in trunked or digital radio systems			
TTL or RS232 compatible in/outputs. (Output positive only, but works well with RS232 input if cable is <2m)			
Baud rate 2400-19200Baud			
ETHERNET			
10/100 base-T Ethernet			
TCP and UDP network protocols are available			

Specifications are subject to change without notice

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