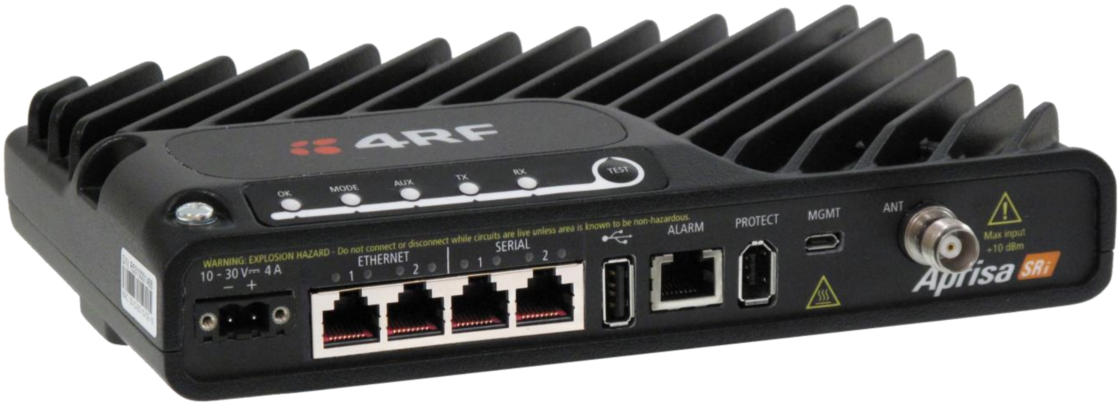
4RF

Aprisa SRi



User Manual

Manufacturer:

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RoHS and WEEE Compliance

The Aprisa SRi is fully compliant with the European Commission's RoHS (Restriction of Certain Hazardous Substances in Electrical and Electronic Equipment) and WEEE (Waste Electrical and Electronic Equipment) environmental directives.

Restriction of hazardous substances (RoHS)

The RoHS Directive prohibits the sale in the European Union of electronic equipment containing these hazardous substances: lead, cadmium, mercury, hexavalent chromium, polybrominated biphenyls (PBBs), and polybrominated diphenyl ethers (PBDEs).

4RF has worked with its component suppliers to ensure compliance with the RoHS Directive which came into effect on the 1st July 2006.

End-of-life recycling programme (WEEE)

The WEEE Directive concerns the recovery, reuse, and recycling of electronic and electrical equipment. Under the Directive, used equipment must be marked, collected separately, and disposed of properly.

4RF has instigated a programme to manage the reuse, recycling, and recovery of waste in an environmentally safe manner using processes that comply with the WEEE Directive (EU Waste Electrical and Electronic Equipment 2002/96/EC).

4RF invites questions from customers and partners on its environmental programmes and compliance with the European Commission's Directives (sales@4RF.com).

Compliance General

The Aprisa SRi radio predominantly operates within frequency bands that are covered under a class license or general user license which is a license is issued to ‘every person’.

Changes or modifications not approved by the party responsible for compliance could void the user’s authority to operate the equipment.

Equipment authorizations sought by 4RF are based on the Aprisa SRi radio equipment being installed at a fixed restricted access location and operated in point-to-multipoint or point-to-point mode within the environmental profile defined by EN 300 019, Class 3.4. Operation outside these criteria may invalidate the authorizations and / or license conditions.

The term ‘Radio’ with reference to the Aprisa SRi User Manual, is a generic term for one end station of a point-to-multipoint Aprisa SRi network and does not confer any rights to connect to any public network or to operate the equipment within any territory.

Compliance United States of America FCC

The Aprisa SRi radio is designed to comply with the USA Federal Communications Commission (FCC) specifications as follows:

Radio	47CFR Part 15.247
EMC	47CFR Part 15 Subpart C Radio Frequency Devices
Environmental	EN 300 019, Class 3.4 Ingress Protection IP51
Safety	EN 60950-1:2006 Class 1 division 2 for hazardous locations

Frequency Band	**Channel size**	**Voltage input**	**Authorization**	**FCC ID**
902-928 MHz	50 kHz	10-30 VDC	Part 15.247	UIPSI902M160

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Compliance Canada ISED

The Aprisa SRi radio is designed to comply with Innovation, Science and Economic Development (ISED) specifications as follows:

Radio	RSS-247
EMC	This Class A digital apparatus complies with Canadian standard RSS-Gen.
Environmental	EN 300 019, Class 3.4 Ingress Protection IP51
Safety	EN 60950-1:2006 Class 1 division 2 for hazardous locations

Frequency Band	Channel size	Voltage input	Authorization	ISED
902-928 MHz	50 kHz	10-30 VDC	RSS-247	6772A-SI902M160

This device complies with Part 15 of the FCC Rules and ISED's licence exempt RSSs. Operation is subject to the following two conditions: (1) This device may not cause interference; and (2) This device must accept any interference, including interference that may cause undesired operation of the device.

Ce dispositif est conforme à la partie 15 des règles de la Federal Communications Commission (FCC) des États Unis et d'Innovation, Sciences et Développement économique Canada (ISED) exempts de licence RSS norme(s). Son fonctionnement est assujetti aux deux conditions suivantes: (1) Ce dispositive nedoit pas provoquer de brouillage préjudiciable, et (2) il doit accepter tout brouillagereçu, y compris le brouillage pouvant entraîner unmauvais fonctionnement.

Compliance Australia ACMA

The Aprisa SRi radio is designed to comply with Australia ACMA specifications as follows:

Radio	Radio Communications (Short Range Devices) Standard 2004
EMC	AS/NZS 4268
Environmental	EN 300 019, Class 3.4 Ingress Protection IP51
Safety	EN 60950-1:2006 Class 1 division 2 for hazardous locations

Frequency Band	**Channel size**	**Voltage input**	**Authorization**	**ACMA**
915-928 MHz	50 kHz	10-30 VDC		Complete

Compliance New Zealand RSM

The Aprisa SRi radio is designed to comply with New Zealand RSM specifications as follows:

Radio / EMC	AS/NZS 4268
Environmental	EN 300 019, Class 3.4 Ingress Protection IP51
Safety	EN 60950-1:2006 Class 1 division 2 for hazardous locations

Frequency Band	**Channel size**	**Power input**	**Authorization**	**RSM**
915-928 MHz	50 kHz	10-30 VDC	Licence 266324	Complete

Compliance Brazil ANATEL

The Aprisa SRi radio is designed to comply with Brazil ANATEL specifications as follows:

Radio / EMC	Resolution No. 680
Environmental	EN 300 019, Class 3.4 Ingress Protection IP51
Safety	EN 60950-1:2006 Class 1 division 2 for hazardous locations

Frequency Band	**Channel size**	**Voltage input**	**Authorization**	**ANATEL**
902-907.5 and 915-928 MHz	50 kHz	10-30 VDC		Pending

Compliance Mexico IFETEL

The Aprisa SRi radio is designed to comply with the Mexico IFETEL specifications as follows:

Radio / EMC	NOM-208-SCFI-2016
Environmental	EN 300 019, Class 3.4 Ingress Protection IP51
Safety	EN 60950-1:2006 Class 1 division 2 for hazardous locations

Frequency Band	Channel size	Voltage input	Authorization	ID
902-928 MHz	50 kHz	10-30 VDC		Pending

Compliance Peru

The Aprisa SRi is designed to comply with Ministry of Transport and Communication (MTC Peru) regulations El uso y operatividad está sujeto a las restricciones y disposiciones del D.S. Nº 006-2013-MTC.

Asimismo para comercializar este equipo deberá cumplir con adherir, grabar o imprimir en el aparato o equipo una “Etiqueta de Cumplimiento” de forma visible, conforme lo dispuesto es R.M. Nº 199-2013-MTC/03 que modifica la R.M. Nº777-2005-MTC/03 y el PNAF aprobado mediante R.M. Nº 187-2005-MTC/03:

Radio / EMC	NOM-208-SCFI-2016
Environmental	EN 300 019, Class 3.4 Ingress Protection IP51
Safety	EN 60950-1:2006 Class 1 division 2 for hazardous locations

Frequency Band	Channel size	Voltage input	Authorization	ID
915-928 MHz	50 kHz	10-30 VDC	pending	

Compliance Hazardous Locations Notice

This product is suitable for use in Class 1, Division 2, Groups A - D hazardous locations or non-hazardous locations. A Nationally Recognized Testing Laboratory (NRTL) listed power supply is required to power the equipment.

The following text is printed on the Aprisa SRi fascia:

WARNING: EXPLOSION HAZARD - Do not connect or disconnect while circuits are live unless area is known to be non-hazardous.

The following text is printed on the Aprisa SRi where the end user is in Canada:

AVERTISSEMENT: RISQUE D'EXPLOSION - Ne pas brancher ou débrancher tant que le circuit est sous tension, à moins qu'il ne s'agisse d'un emplacement non dangereux.

The USB service ports, and lock switch are not to be used unless the area is known to be non-hazardous.

Les ports de service USB et le commutateur de verrouillage ne doivent pas être utilisés, à moins qu'il ne s'agisse d'un emplacement non dangereux.

RF Exposure Warning

WARNING:

The installer and / or user of Aprisa SRi radios shall ensure that a separation distance as given in the following table is maintained between the main axis of the terminal's antenna and the body of the user or nearby persons.

Minimum separation distances given are based on the maximum values of the following methodologies:

1. Maximum Permissible Exposure non-occupational limit (B or general public) of 47 CFR 1.1310 and the methodology of FCC's OST/OET Bulletin number 65.
2. Reference levels as given in Annex III, European Directive on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz) (1999/519/EC). These distances will ensure indirect compliance with the requirements of EN 50385:2002.

Frequency (MHz)	Maximum Power (dBm) Note 1	Maximum Antenna Gain (dBi)	Minimum Separation Distance (m)
915	+ 26	10 dBi	0.3

Note 1: The Peak Envelope Power (PEP) at maximum set power level is 1.0 W ,+30 dBm.

Contents

1. Getting Started

This section is an overview of the steps required to commission an Aprisa SRi radio network in the field:

Phase 1:	Pre-installation	
1.	Confirm path planning.	Page 68
2.	Ensure that the site preparation is complete: • Power requirements • Tower requirements • Environmental considerations, for example, temperature control • Mounting space	Page 71

Phase 2:	Installing the radios	
1.	Mount the radio.	Page 74
2.	Connect earthing to the radio.	Page 73
3.	Confirm that the: • Antenna is mounted and visually aligned • Feeder cable is connected to the antenna • Feeder connections are tightened to recommended level • Tower earthing is complete	
4.	Install lightning protection.	Page 73
5.	Connect the coaxial jumper cable between the lightning protection and the radio antenna port.	Page 78
6.	Connect the power to the radio.	Page 79

Phase 3:	**Establishing the link**	
1.	If radio's IP address is not the default IP address (169.254.50.10 with a subnet mask of 255.255.0.0) and you don't know the radio's IP address see 'Command Line Interface' on page 361.	Page 361
2.	Connect the Ethernet cable between the radio's Ethernet port and the PC.	
3.	Confirm that the PC IP settings are correct for the Ethernet connection: • IP address • Subnet mask • Gateway IP address	Page 84
4.	Open a web browser and login to the radio.	Page 85
5.	Set or confirm the RF characteristics: • TX / RX frequency • TX output power • Zone / channel selection	Page 125
6.	Compare the actual RSSI to the expected RSSI value (from your path planning).	Page 289
7.	Align the antennas.	Page 371
8.	Confirm that the radio is operating correctly; the OK, MODE and AUX LEDs are green.	

2. Introduction

About This Manual

What It Covers

This user manual describes how to install and configure an Aprisa SRi point-to-multipoint digital radio network.

It specifically documents an Aprisa SRi radio running system software version 1.4.0 .

It is recommended that you read the relevant sections of this manual before installing or operating the radios.

Who Should Read It

This manual has been written for professional field technicians and engineers who have an appropriate level of training and experience.

Contact Us

If you experience any difficulty installing or using the Aprisa SRi radio after reading this manual, please contact Customer Support or your local 4RF representative.

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Telephone	+1 866 232-5647

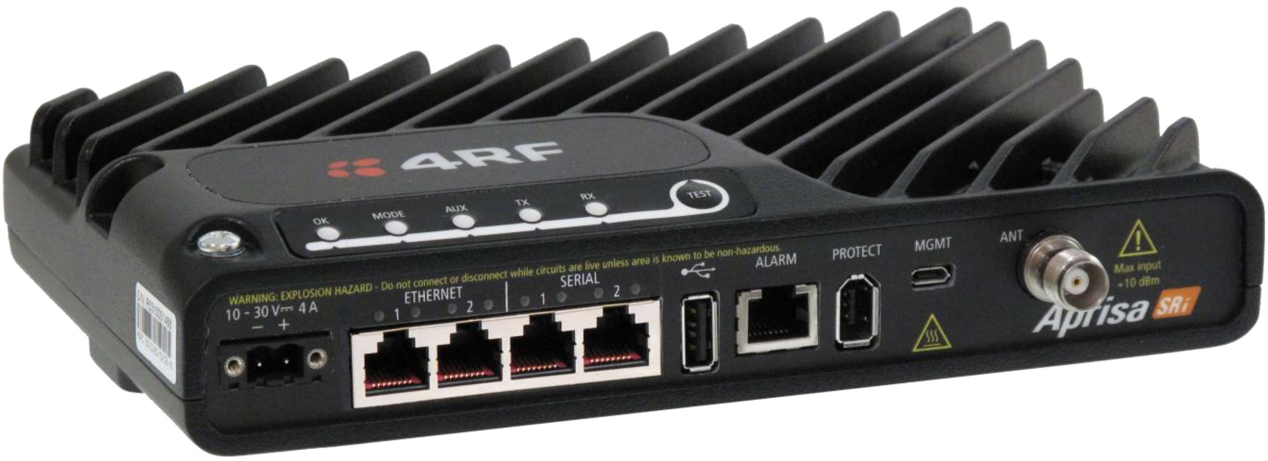
3. About the Radio

The 4RF Aprisa SRi Radio

The 4RF Aprisa SRi is a Point-To-Multipoint (PMP) digital radio providing 915 MHz Industrial Licence Free Spread Spectrum communications.

The radios carry a combination of serial data and Ethernet data between the base station and remote radios.

A single Aprisa SRi is configurable as a Point-To-Multipoint base station or remote radio.



Product Features

Functions

- Point-to-Multipoint (PMP) operation
- Unlicensed frequency bands in the frequency range of 902-928 MHz as permitted by the local regulator
- Channel size of 50 kHz
- Half duplex RF Point-To-Multipoint operation
- Multi-Hop Repeater Stations
- Jam resistant frequency hopping spread spectrum technology operating where other licence free radios have difficulty in break through
- Full band and reduced non-overlapping zone options allow a tailored approach to interference management for maximum range
- Ethernet data interface and RS-232 / RS-485 asynchronous
- Data encryption and authentication using 128,192 and 256-bit AES and CCM security standards
- Terminal server operation for transporting RS-232 / RS-485 traffic over IP or Ethernet and converting IP packets to a local physical serial port
- Mirrored Bits ® and SLIP support for RS-232
- IEEE 802.1Q VLAN support with single and double VLAN tagged and add/remove VLAN manipulation to adapt to the appropriate RTU / PLCs
- QoS supports using IEEE 802.1p VLAN priority bits to prioritize and handle the VLAN / traffic types
- QoS per port (Ethernet, serial, management)
- L2 / L3 / L4 filtering for security and avoiding narrow band radio network overload
- L3 Gateway Router mode with standard static IP route for simple routing network integration
- L3 Router mode with per Ethernet interface IP address and subnet
- L2 Bridge mode with VLAN aware for standard Industrial LAN integration
- Ethernet and serial payload compression to increase the narrow band radio capacity
- SuperVisor web management support for element and sub-network management
- SuperVisor Extended Network Management (EXM) extending SuperVisor management beyond the single radio network providing configuration and monitoring to other Aprisa SR family products
- SNMPv1/2/3 & encryption MIB supports for 4RF SNMP manager or third-party SNMP agent network management
- SNMP context addressing for compressed SNMP access to remote radios
- SNTP for accurate wide radio network time and date
- Transparent to all common SCADA protocols; e.g. Modbus, IEC 60870-5-101/104, DNP3 or similar
- Complies with international standards, including FCC, EMC, safety and environmental standards

Security

The Aprisa SRi provides security features to implement the key recommendations for industrial control systems. The security provided builds upon the best in class from multiple standards bodies, including:

- IEC/TR 62443 (TC65) 'Industrial Communications Networks – Network and System Security'
- IEC/TS 62351 (TC57) 'Power System Control and Associated Communications – Data and Communication Security'
- FIPS PUB 197, NIST SP 800-38C, IETF RFC3394, RFC3610 and IEEE P1711/P1689/P1685
- FIPS 140-2: Security Requirements for Cryptographic Modules

The security features implemented are:

- Data encryption

  Counter Mode Encryption (CTR) using Advanced Encryption Standard (AES) 128, 192, 256 bit, based on FIPS PUB 197 AES encryption (using Rijndael version 3.0)

- Data authentication

  NIST SP 800-38C Cipher Block Chaining Message Authentication Code (CBC-MAC) based on RFC 3610 using Advanced Encryption Standard (AES)

- Data payload security

  CCM Counter with CBC-MAC integrity (NIST special publication 800-38C)

- Secured management interface protects configuration
- L2 / L3 / L4 Address filtering enables traffic source authorization
- Proprietary physical layer protocol and modified MAC layer protocol based on standardized IEEE 802.15.4
- SNMPv3 with Encryption for NMS secure access
- Secure USB software upgrade
- Key Encryption Key (KEK) based on RFC 3394, for secure Over The Air Re-keying (OTAR) of encryption keys
- User privilege allows the accessibility control of the different radio network users and the user permissions
- RADIUS security for remote user authorization, authentication, and accounting
- Secure management access using HTTPS and SNMPv3
- HTTPS certificate uses ECC 256
- Secure remote software upgrade via HTTPS

Performance

- Typical deployment of 30 remote radios from one base station with a practical limit of a few hundred remote radios
- Low noise receiver
- Forward Error Correction
- Frequency Hopping using non-overlapping zones and channels over the frequency band
- Frequency lock < 100 us not impacting FHSS throughput
- Thermal management for high power over a wide temperature range

Usability

- Configuration / diagnostics via front panel Management Port USB interface, Ethernet interface
- Built-in webserver SuperVisor with full configuration, diagnostics and monitoring functionality, including remote radio configuration / diagnostics over the radio link
- LED display for on-site diagnostics
- Dedicated alarm port
- Software upgrade and diagnostic reporting via the host port USB flash drive
- Over-the-air software distribution and upgrades
- Simple installation with integrated mounting holes for wall, DIN rail and rack shelf mounting

Product Overview

Network Coverage and Capacity

The Aprisa SRi has a typical link range of up to 50 km / 30 miles, however, geographic features, such as hills, mountains, trees and foliage, or other path obstructions, such as buildings, will limit radio coverage. Additionally, geography may reduce network capacity at the edge of the network where errors may occur and require retransmission. However, the Aprisa SRi uses 1 W (+30 dBm) peak output power and Forward Error Correction (FEC) which greatly improves the sensitivity and system gain performance of the radio resulting in less retries and minimal reduction in capacity.

Ultimately, the overall performance of any specific network will be defined by a range of factors including the RF output power, the modulation used and its related receiver sensitivity, interference from other unlicensed radios, the geographic location, the number of remote radios in the base station coverage area and the traffic profile across the network. Effective network design will distribute the total number of remote radios across the available base stations to ensure optimal geographic coverage and network capacity.

One base station can register and operate with up to 500 remote radios.

The practical limit of remote radios that can operate with one base station is determined by a range of factors including the number of services, the packet sizes, the protocols used, the message types and network timeouts.

Automatic Registration

On start-up, the remote radio listens for the base station and tries to sync with base station frequency hopping before attempting registration. It then transmits a registration message to the base station which responds with a registration response. The base station records the details of all the remote radios active in the network.

If a remote radio cannot register with the base station after multiple attempts within 10 minutes, it will automatically reboot. If remote is not able to register with base station in 5 attempts, then a ‘Network Configuration Warning’ alarm event will be raised indicating that a remote is not registered with the base station.

If a remote radio has registered with the base station but then loses communication, it will automatically reboot within 2 minutes.

Remote Messaging

There are two message types in the Aprisa SRi network, broadcast messages and unicast messages. Broadcast messages are transmitted by the base station to the remote radios and unicast messages are transmitted by the remote radio to the base station. These messages are commonly referred to as uplink (unicast remote to base) and downlink (broadcast base to remote).

All remotes within the coverage area will receive broadcast messages and pass them on to either the Ethernet or serial interface. The RTU determines if the message is intended for it and will accept it or discard it.

Architecture

The Aprisa SRi Architecture is based around a layered TCP/IP protocol stack:

- Physical
  Proprietary wireless
  RS-232 and Ethernet interfaces

- Link
  Proprietary wireless (channel access, ARQ, segmentation)
  VLAN aware Ethernet bridge

- Network
  Standard IP
  Proprietary automatic radio routing table population algorithm

- Transport
  TCP, UDP

- Application
  HTTPS web management access through base station with proprietary management application software including management of remote radios over the radio link
  SNMPv1/2/3 for network management application software

Product Operation

There are three components to the wireless interface: the Physical Layer (PHY), the Data Link Layer (DLL) and the Network Layer. These three layers are required to transport data across the wireless channel in the Point-to-Multipoint (PMP) configuration. The Aprisa SRi DLL is largely based on the 802.15.4 Media Access Control (MAC) layer using a proprietary implementation.

Physical Layer

The Aprisa SRi PHY uses a one frequency half duplex transmission mode which eliminates the need for a duplexer.

Remote nodes are predominantly in receive mode with only sporadic bursts of transmit data. This reduces power consumption.

The Aprisa SRi is a packet-based radio. Data is sent over the wireless channel in discrete packets / frames, separated in time. The PHY demodulates data within these packets with coherent detection.

The Aprisa SRi PHY provides carrier, symbol, and frame synchronization predominantly through the use of preambles. This preamble prefixes all packets sent over the wireless channel which enables fast Synchronization.

Data Link Layer / MAC layer

The Aprisa SRi PHY enables multiple users to be able to share a single wireless channel; however a DLL is required to manage data transport. The two key components to the DLL are channel access and hop by hop transmission.

Channel Access

The Aprisa SRi radio uses frequency hopping in conjunction with a channel access of Access Request (AR) MAC to maximize the data throughput and performance. With a channel access scheme, the base station controls the communication on the channel. Remotes ask for access to the channel, and the base station grants access if the channel is not occupied.

Access Request

This scheme is particularly suited to digital SCADA systems where all data flows through the base station. In this case it is important that the base station has contention-free access as it is involved in every transaction. The channel access scheme assigns the base station as the channel access arbitrator and therefore inherently it has contention-free access to the channel. This means that there is no possibility of contention on data originating from the base station. As all data flows to or from the base station, this significantly improves the robustness of the system.

All data messages are controlled via the AG (access grant) control message and therefore there is no possibility of contention on the actual end user data. If a remote radio accesses the channel, the only contention risk is on the AR (access request) control message. These control messages are designed to be as short as possible and therefore the risk of collision of these control messages is significantly reduced. Should collisions occur these are resolved using a random back off and retry mechanism.

As the base station controls all data transactions multiple applications can be effectively handled, including a mixture of polling and report by exception.

Hop by Hop Transmission

Hop by Hop Transmission is realized in the Aprisa SRi by adding a MAC address header to the packet. For 802.15.4, there are 2 addresses, the source and destination addresses.

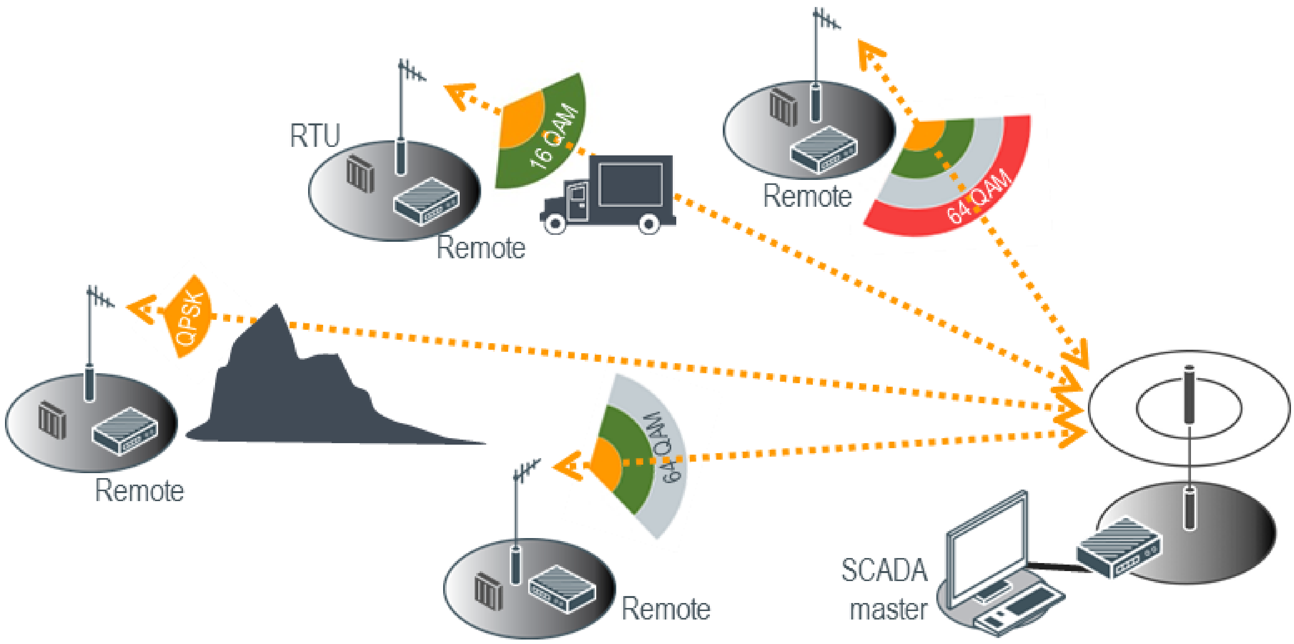
Adaptive Coding and Modulation

The Aprisa SRi provides Adaptive Coding and Modulation (ACM) which maximizes the use of the RF path to provide the highest radio capacity available.

ACM automatically adjusts the modulation coding and FEC code rate in both directions of transmission over the defined modulation range based on the signal quality for each individual remote radio.

When the RF path is healthy (no fading), modulation coding is increased and the FEC code rate is decreased to maximize the data capacity.

If the RF path quality degrades, modulation coding is decreased and the FEC code rate is increased for maximum robustness to maintain path connectivity.



System Gain vs Modulation

This table defines the modulation order based on gross capacity:

Modulation	Capacity
QPSK (Low Gain)	Minimum
16QAM (Low Gain)	↓
64QAM (Low Gain)	Maximum

This table defines the modulation order based on receiver sensitivity:

Modulation	Coverage
QPSK (Low Gain)	Maximum
16QAM (Low Gain)	↑
64QAM (Low Gain)	Minimum

Zones and Channels

The Aprisa SRi supports:

Compliance	Number Of Channels per hop zone	Number Of Standard Hop Zones (non-overlapping)	Full Band Single Zone Option
FCC / ISED	50	8	400
ACMA / RSM	25	8	200
ANATEL	35	8	280
PERU	25	8	200

All zones are enabled by default, but the user can deactivate / active each zone / channel separately. There are exceptions e.g. FCC region, where the minimum active channels must be at least 50. This is enforced by the radio management.

FCC / ISED

	Frequencies	Channels	Guard Band
Channel Spacings	62.5		
Zone 1	902.5313		0.5
	905.5938	50	
Zone 2	905.6563		
	908.7188	50	
Zone 3	908.7813		
	911.8438	50	
Zone 4	911.9063		
	914.9688	50	
Zone 5	915.0313		
	918.0938	50	
Zone 6	918.1563		
	921.2188	50	
Zone 7	921.2813		
	924.3438	50	
Zone 8	924.4063		
	927.4688	50	0.5
Total		400	
Zone BW	3.125		

ACMA / RSM

	Frequencies	Channels	Guard Band
Channel Spacings	62.5		
Zone 1	915.2813		0.25
	916.7813	25	
Zone 2	916.8438		
	918.3438	25	
Zone 3	918.4063		
	919.9063	25	
Zone 4	919.9688		
	921.4688	25	
Zone 5	921.5313		
	923.0313	25	
Zone 6	923.0938		
	924.5938	25	
Zone 7	924.6563		
	926.1563	25	
Zone 8	926.2188		
	927.7188	25	0.25
Total		200	
Zone BW	1.5625		

ANATEL

	Frequencies	Channels	Guard Band
Channel Spacings	56.25		
Zone 1	902.625		0.596875
	904.5375	35	
Zone 2	904.5938		
	906.5063	35	0.965625
Zone 3	915.6188		0.590625
	917.5313	35	
Zone 4	917.5875		
	919.5	35	
Zone 5	919.5563		
	921.4688	35	
Zone 6	921.525		
	923.4375	35	
Zone 7	923.4938		
	925.4063	35	
Zone 8	925.4625		
	927.375	35	0.596875
Total		280	
Zone BW	1.9125		

PERU

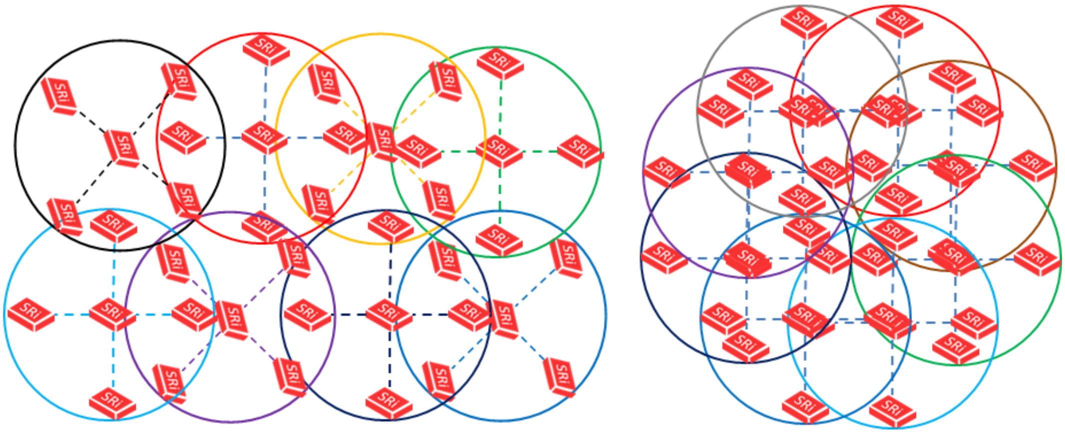
	Frequencies	Channels	Guard Band
Channel Spacings	62.5		
Zone 1	915.2813		0.25
	916.7813	25	
Zone 2	916.8438		
	918.3438	25	
Zone 3	918.4063		
	919.9063	25	
Zone 4	919.9688		
	921.4688	25	
Zone 5	921.5313		
	923.0313	25	
Zone 6	923.0938		
	924.5938	25	
Zone 7	924.6563		
	926.1563	25	
Zone 8	926.2188		
	927.7188	25	0.25
Total		200	
Zone BW	1.5625		

Frequency Hopping Synchronization

The base and remote have a pre-arranged pseudo-random channel sequence to follow where pseudo-random channels and sequence pattern are determined per base station ID parameter settings. Up to 32 base stations with overlapping coverage are allowed with minimal interference (see figure below).

For better channel synchronization and performance, remotes inherit zones and black-list channels settings from the base station during registration or when user updates blacklist channels settings on the base station. The radio frequency hopping is done on all active channels (across all zones).

A remote will override its configured channels once it registers and gets updates from base station or when base station changes its channels configuration. At power-on, the Aprisa SRi base station immediately starts hopping and sending packets, ACKs and beacon control packets. When a remote is powered-on or has lost sync with the base station, it picks a random channel from its hop channel set and listens for a beacon with a default of up to 180 seconds (a good link sync on average will be < 10 sec), covering 400 channels. A remote doesn't try to register before it is synchronized with the base station. On idle, a beacon is sent by base station per hop set to keep sync and channel sequence. To avoid miss-synchronization, remote radios are constantly checking for whitelist channel mismatch and in case of a mismatch, the remote will correct the mismatch accordingly.



Interference Avoidance / Immunity

Aprisa SRi is designed to avoid interference, mainly from other unlicensed radios and deploys a few mechanisms for better interference immunity, to increase performance and maintain robust communication.

Using frequency hopping with 8 zones and a narrower radio channel results in better power density and reduces the chance the channel will be hit with interference.

The noise floor and statistics of each zone and hop set channel is being logged and can be used to find frequencies that have constant interference mainly from other DTS radios. Using this information, the user can navigate in SuperVisor to Radio > Channels and deactivate the noisy zone / channels.

If a beacon isn't received due to frequency interference or being occupied, remotes will automatically move to the next frequency hop before sending an access request (AR). This prevents occupied channels being used with no major impact on throughput.

For reliable link in a noisy environment, remotes will buffer transmitted packets, and perform retries using ARQ mechanism. ARQ (Automatic Repeat reQuest) is a well-known data integrity mechanism used in the Aprisa SRi as it adds a layer of interference recovery on top of the powerful Aprisa FEC (Forward Error Correction). When ARQ is enabled, the radio sending a packet will immediately resend a packet if the receiver does not send an acknowledgement.

Some frequencies may be subject to more interference than others so if packet retries are enabled in the Aprisa SRi and interference on a specific frequency overwhelms the FEC, then any missing packets are automatically retransmitted on another frequency. Packet retries for uplink and downlink direction will work as follows;

<u>In uplink direction:</u>

Packet retries will continue until the packets TTL time expires, or packet has been re sent per 'Remote to Base Packet' parameter settings retry times (if 0 no retries will be made). Remote radios will check the next downlink ack flag in the beacon or data packet to determine if retransmission is required (if the remote 'unicast packet' is set to auto, the retries parameter is received by the remote from base during registration).

<u>In downlink direction:</u>

Downlink packet retries are used for unicast packets. Retries will continue until the packets TTL time expires, or packet has been re sent 'Unicast Packet' parameter settings retries times (if 0 no retries will be made). The base radio will check the next uplink ack flag from the remote radio to determine if retransmission is required.

To ensure the integrity of some broadcast packets (e.g. OTA firmware upgrade), they would automatically be sent per 'Broadcast Packet' parameter settings times.

Two Base Stations Using the Same Antenna

Two Aprisa SRi base stations can be used with the same antenna (overlapping coverage). This can be done with the G5 tuned duplexer (see 'Duplexer Kits' on page 385).

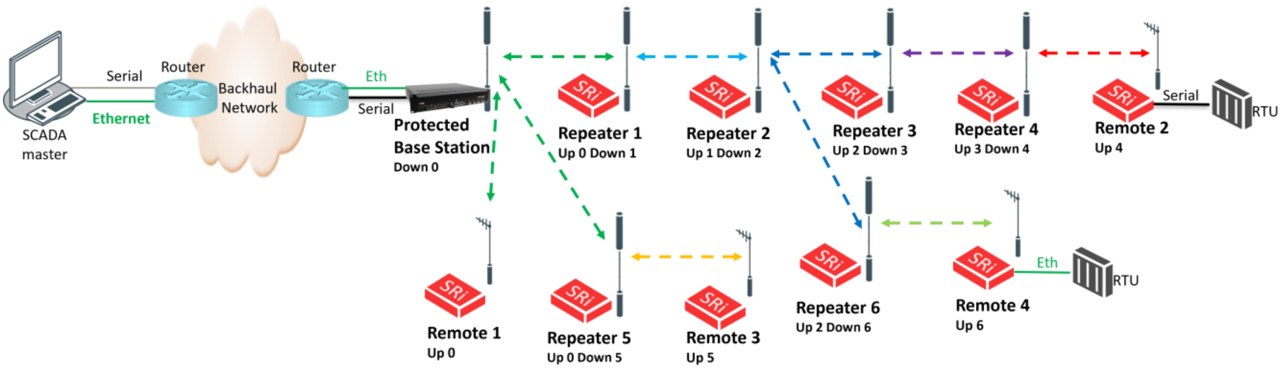
The antenna will be connected to the two base stations via the duplexer. Base station 1 is configured to zones 1 and 2 and base station 2 is configured to zones 7 and 8. Remotes will be configured as per the base station they are associated with.

Note: this cannot be used with ACMA / RSM radios.

Multi-Hop Repeater Stations

User can create a multi-hop repeater network with up to 31 repeaters in the network. A repeater network can support multiple repeaters at any depth and at any repeater tree structure.

The multi-hop repeater diagram below is just one example of multi-hop repeater chain and tree structure network topology. Configuration and network typology is determined by setting the Upstream and Downstream IDs as shown in the example diagram below.



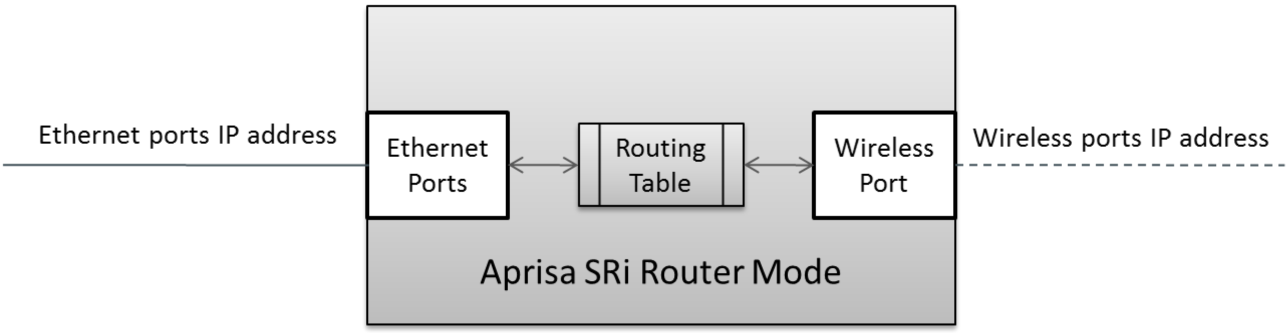
Network Layer

Packet Routing

Aprisa SRi is a standard static IP router which routes and forwards IP packet-based on standard IP address and routing table decisions.

Aprisa SRi router mode (see figure below) enables the routing of IP packets within the Aprisa SRi wireless network and in and out to the external router / IP RTUs devices connected to the Aprisa SRi wired Ethernet ports.

Within the Aprisa SRi Router mode, each incoming Ethernet packet on the Ethernet port is stripped from its Ethernet header to reveal the IP packet and to route the IP packet based on its routing table. If the destination IP address is one of the RTUs, the packet is then forwarded to the wireless ports and broadcasted as a PMP wireless packet to all the remote radios. The appropriate remote then routes the IP packet and forwards it based on its routing table to the appropriate Ethernet port, encapsulating the appropriate next hop MAC header and forwarding it to the RTU. The RTU can then interpret and process the IP data and communication is established between the RTU and the initiating communication device.



Static IP Router

The Aprisa SRi works in the point-to-multipoint (PMP) network as a standard static IP router with the Ethernet and wireless / radio as interfaces and serial ports using terminal server as a virtual interface.

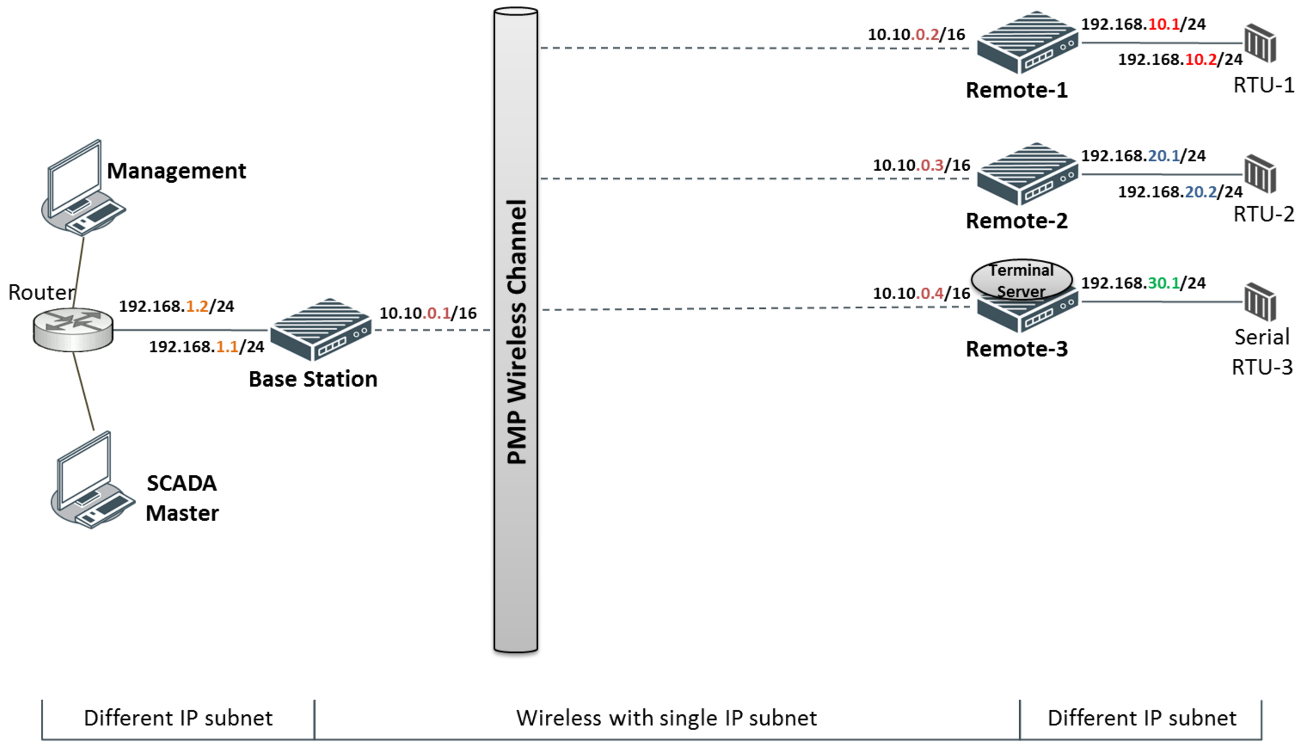
The Aprisa SRi static router is semi-automated operation, where the routing table is automatically created in the base station and populated with routes to all remote radios in the network during the registration process and vice versa, where the routing table is automatically created in remote radios and populated with routes to base station during the registration process. Updates occur when a remote radio is disconnected from network for any reason, with the routing table updated in a controlled fashion.

Also, in decommission operation, the base station routing tables are completely flushed allowing an automatic rebuild. This avoids the user manually inserting / removing of multiple static routes to build / change the routes in the network which might be tedious and introduce significant human error. The Aprisa SRi works as a static IP router without using any routing protocol and therefore does not have the overhead of a routing protocol for better utilization of the narrow bandwidth network.

In addition to the semi-automated routes, the user can manually add / remove routes in the routing table for the radio interface, Ethernet Interface and for routers which are connected to the radio network.

The Aprisa SRi base station is used as a gateway to other networks. Thus, a configurable IP address default gateway can be set using a static route in the routing table with a destination IP address of the destination network address. It is recommended to use a real network IP address (actual device IP) for the gateway and not 0.0.0.0.

The Aprisa SRi sub-netting rules distinguish between the wireless interface and the remote Ethernet interface where RTUs are connected. The entire wireless network is set on a single IP subnet, while each Aprisa SRi remote's Ethernet interface is set to a different subnet network. In this way, the user can easily distinguish between the remote radio's subnet IP addresses.



The Radio Network as a Gateway Router

The Aprisa SRi point-to-multipoint radio network can be considered as a gateway router where the 'network Ethernet interface' on each radio in the network is the 'router port'.

The routing table for all directly attached devices to the Aprisa SRi network, at the Base or the Remote radios is automatically built, and no static routes are required to be entered for those device routes.

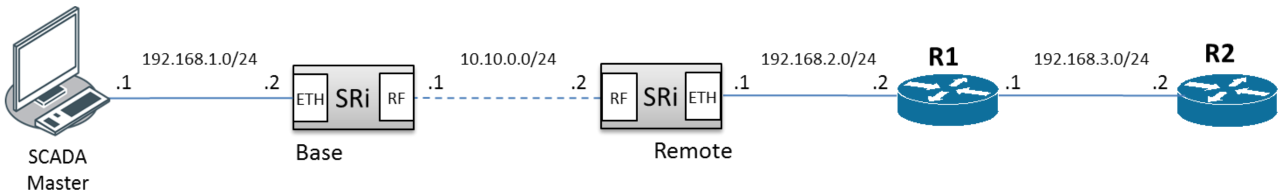
The 'Radio interface IP address' is used internally for the radio network and automatic routes. It is not used when setting static routes or default gateways.

Static route IP addresses or the default gateway should use the 'network Ethernet interface' IP address.

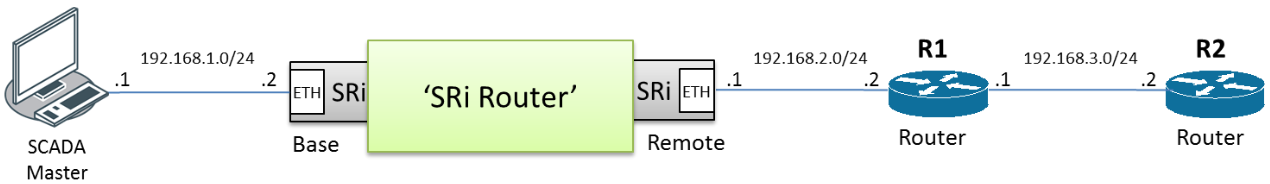
External network routers should be set with a high metric for the SRi path, to prevent route updates being sent over the radio network.

The Radio Network as a Router – Example

The purpose of this example is to determine the static route setting for router R2 in the base station and remote radio in the following network.



Since the Aprisa SRi network should be considered as a router where the network Ethernet interface is the 'router port', the network configuration for setting the static routes or the default gateway IP addresses is described in the follow figure:



Thus, the static route setting for router R2 at the Aprisa SRi base station and remote radio will be:

Destination Address	Destination Mask	Gateway Address	Static Route Setting at ?
192.168.3.0	255.255.255.0	192.168.2.1	Base station
192.168.3.0	255.255.255.0	192.168.2.2	Remote radio

Note: The radio network (base station and remote radios) will automatically build routes to the attached device e.g. SCADA Master station or attached router e.g. router R1 so static routes are not required for these devices.

Advanced Gateway Router Mode (AGRM) and Advanced Router Mode (ARM)

The Advanced Gateway Router Mode (AGRM) or Advanced Router Mode (ARM) are enabled when either Router or Gateway Router modes are selected, and the Advanced checkbox is ticked (see 'Terminal > Operating Mode' on page 107).

Advanced Gateway Router mode (AGRM) or Advanced Router mode (ARM) act like a true router between the Ethernet ports and the RF interface port where the next hop is either an Ethernet port or an RF port (in the non-advanced option the next hop is the Ethernet interface of the next hop radio, and the RF interface are for internal use). This means that the RF Interface of the radio also becomes a public interface, so the user should be able to use this interface just like any other Ethernet interface.

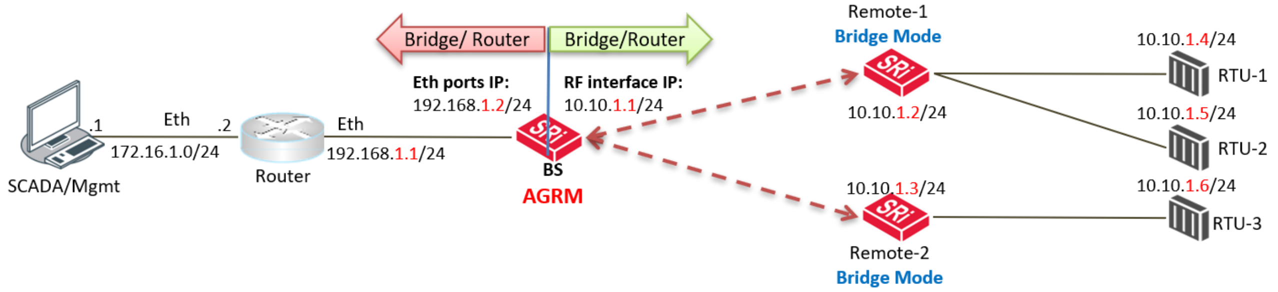
In AGRM, all Ethernet ports have the same IP address and subnet and in ARM, each Ethernet interface has a different IP address and subnet. In addition, the advanced option supports a new mix between AGRM / ARM and Bridge Mode in a radio network. The following mix of [Base Station] - [Remote] networks are supported:

- **AGRM / ARM - Bridge network** i.e. base station AGRM / ARM and remote radios in Bridge mode.
- **Bridge - AGRM / ARM network** i.e. base station in Bridge mode and remote radios are in AGRM / ARM, where each node in the network can act as independent router without depending on other nodes in the network.
- **Bridge - Mix [AGRM / ARM and Bridge] network** i.e. base station in Bridge mode and remotes are a mix of Bridge and AGRM / ARM.
- **AGRM / ARM - Mix [AGRM / ARM and Bridge] network** i.e. base station in AGRM / ARM and remotes are a mix of Bridge and AGRM / ARM.
- **AGRM / ARM - AGRM / ARM network** i.e. base station in AGRM / ARM and remote radios are also in AGRM / ARM.

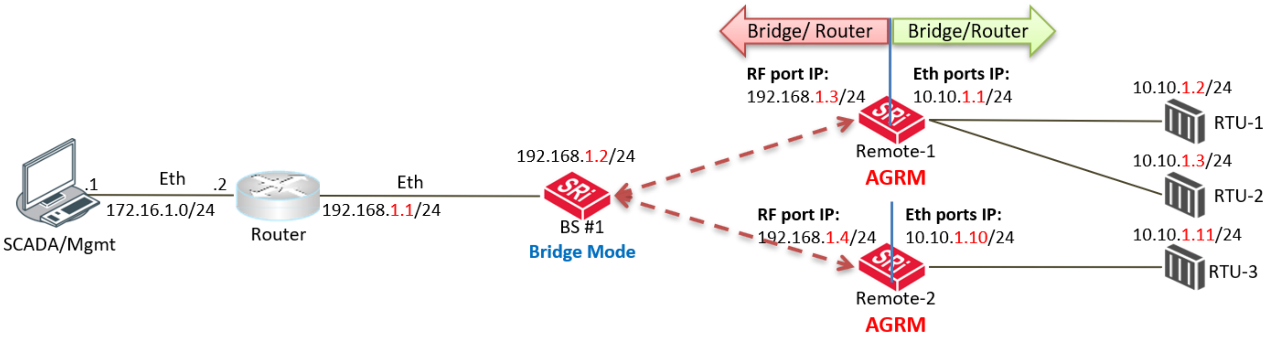
The last option is a fully routed network where it is recommended to use the standard router modes to benefit from the radio port auto IP assignment and auto static route build for all associated devices connected to the radio network.

Note: A mix between advanced router modes and standard router modes in the network is prohibited and will raise a 'network configuration warning' alarm. If a user wants to build a full routed network, use the standard router modes for the base station, remote radios.

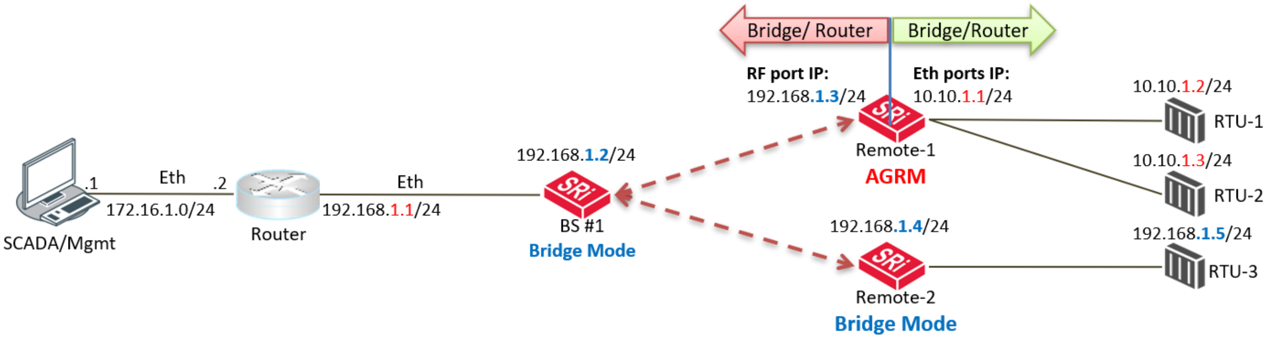
The following figures are examples of the currently supported networks as described above.



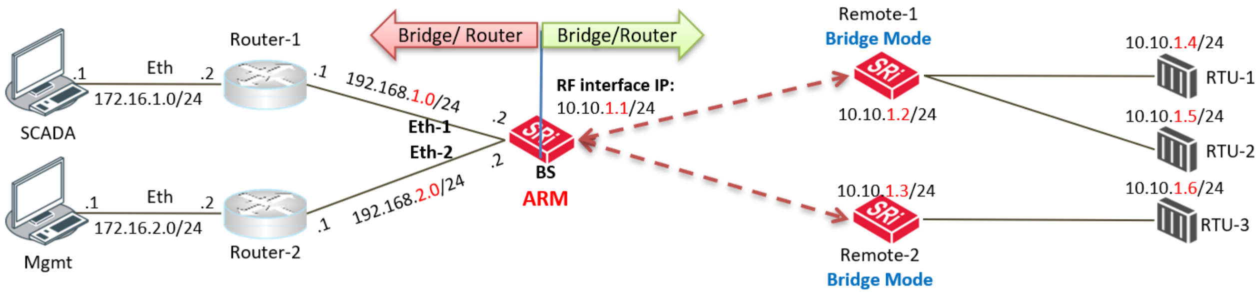
The above figure describes a mixed radio mode network (AGRM-Bridge) where base station is in Advanced Gateway Router Mode (AGRM) and the remote radios are in bridge mode (where the base station is AGRM / ARM, and all remotes must be in the same bridge mode). RTUs must set their default gateway to 10.10.1.1 which is RF IP Address of base station to reach the SCADA master.



The above figure describes a mixed radio mode network (Bridge-AGRM) where the base station is in Bridge Mode and remote radios are in AGRM. To reach RTU-3 (10.10.1.11), the external router must use a next hop gateway of 192.168.1.4 which is RF Interface address of Remote-2.



The above figure describes a mixed radio mode network (Bridge-Mix [AGRM and Bridge]) where the base station is in Bridge Mode and remote radios are a mix of AGRM and Bridge mode. To reach RTU-2 (10.10.1.3), the external router must use a next hop gateway of 192.168.1.3 which is RF Interface address of Remote-1. To reach RTU-3 (192.168.1.5), the external router can send the traffic directly on the bridge subnet 192.168.1.x/24 network.



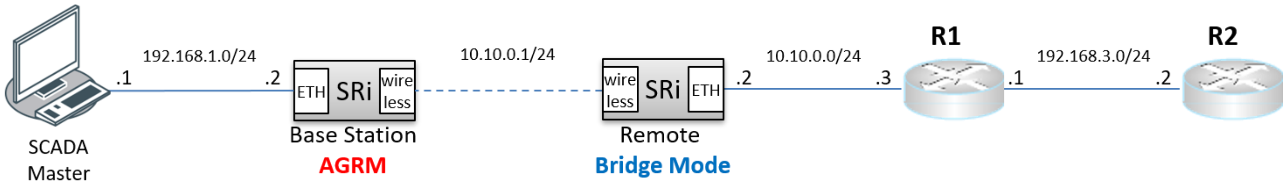
The above figure describes a mixed radio mode network (ARM-Bridge) where base station is in Advanced Router Mode (ARM) and remote radios are in bridge mode. It’s the same case as the AGRM-Bridge network above, but each Ethernet interface has a different IP address and subnet at the ARM base station.

The following functions supported in AGRM / ARM is the differences between Advanced Router Mode options (AGRM / ARM) and standard Router Mode options Gateway Router Mode (GRM) / Router Mode (RM), such as AGRM vs GRM and/or ARM vs RM:

- The radio interface IP Address (RF IP Address) is associated with Ethernet MAC Address so it can be addressed like any other Ethernet Interface. The radio interface IP address will ARP respond to ARP request with his MAC address.
- The radio interface IP address can be used for radio management functions such as SNMP, ICMP and SNTP.
- External routers can use radio interface IP address as next hop / default gateway.
- The radio Interface IP address can be used as the ‘Local IP Address’ in terminal server.
- Auto assignment of radio interface IP address is done in a routed network of Router Mode (RM) and Gateway Router Mode (GRM) but not in AGRM / ARM. In AGRM / ARM the radio interface IP address is manually configured.
- Changes to the radio Interface IP address will be included in the remote registration or re-registration with base station, respectively.
- AGRM / ARM allows a mix with Bridge mode, so a AGRM / ARM-Bridge or Bridge-AGRM / ARM or a Bridge-Mix [AGRM / ARM and Bridge] network can be created. A network configuration warning alarm will be raised on base station if this condition is not met.
- The ARP table will report a radio interface IP address if any address is learned on this interface.

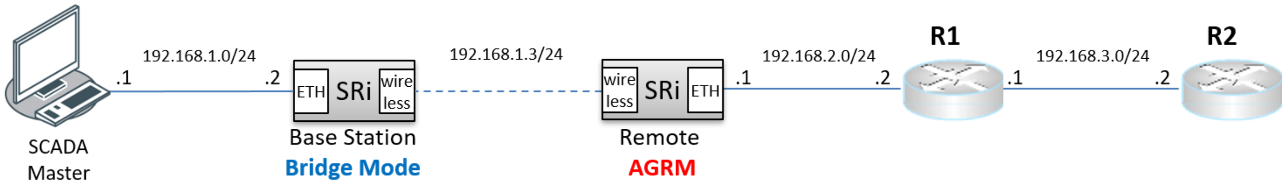
Advanced Gateway Router (AGRM) or Advanced Router Mode (ARM) Static Route - Example

The purpose of this example is to determine the static route setting for router R2 in the base station and remote radio in the following AGRM-Bridge, Bridge-AGRM networks.



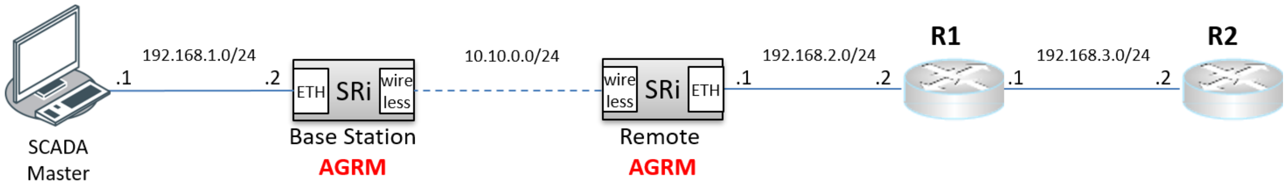
In the above figure, the static route setting for router R2 at the base radio AGRM will be:

Destination Address	Destination Mask	Gateway Address
192.168.3.0	255.255.255.0	10.10.0.3



In the above figure, the static route setting for router R2 at the remote radio AGRM will be:

Destination Address	Destination Mask	Gateway Address
192.168.3.0	255.255.255.0	192.168.2.2



In the above figure, the static route setting for router R2 at the Base Station AGRM will be:

Destination Address	Destination Mask	Gateway Address
192.168.3.0	255.255.255.0	10.10.0.2

Note: In AGRM / ARM - AGRM / ARM network scenario, automatic route build of the radio network is currently not supported. Auto route build for the associated devices to the radio network (i.e. next hop devices) is only supported in the standard router modes where the base station, and remote radios are all in standard router modes.

Static IP Router – Human Error Free

To ensure correct operation, the Aprisa SRi router base station alerts when one (or more) of the devices is not configured for router mode or a duplicated IP is detected when manually added.

When the user changes the base station IP address / subnet, the base station sends an ARP unsolicited announcement message and the remote radios auto-update their routing table accordingly. This also allows the router that is connected to the base station to update its next hop IP address and its routing table.

When the user changes the remote radio IP address / subnet, a re-registration process in the base station then auto-updates its routing table accordingly.

Terminal Server - Transition to Converged Ethernet / IP Network

Customers that are transitioning their SCADA network to an Ethernet / IP SCADA network, can simultaneously operate their legacy serial RTUs, not as a separate serial network to the new Ethernet / IP network, but as part of the Ethernet / IP network, by using the terminal server feature.

The Aprisa SRi terminal server is an application running in the radio that encapsulates serial traffic into Ethernet / IP traffic. For SCADA networks, this enables the use of both serial and Ethernet / IP RTUs within an Ethernet / IP based SCADA network.

Network Address Translation (NAT) Router

The NAT functions are only available in Advanced Gateway Router Mode (AGRM) or Advanced Router Mode (ARM). Configuring NAT on the standard router modes will raise a 'configuration not supported' alarm.

The current implementation of One-to-One NAT and Port Forwarding NAPT supports network configurations of AGRM / ARM mode, such as AGRM / ARM – Bridge (or mix of Bridge and AGRM / ARM), Bridge - AGRM / ARM, Bridge - Mix [AGRM / ARM and Bridge] and AGRM / ARM – AGRM / ARM networks (where in AGRM / ARM – AGRM /ARM network, either base station or remote radios can be NAT enabled, not both). It is recommended to read the section about AGRM / ARM above before reading this section. The NAT is enabled in IP > NAT' on page 171.

Network Address Translation (NAT) is a method of remapping external (public) IP addresses into other local/internal (private) IP addresses and vice versa; providing transparent routing to end users/hosts via the AGRM / ARM router.

In One-to-One NAT, IP addresses in the IP address space are mapped (translated) from external / public interface IP address into other local / private interface IP address space (and vice-versa) via the AGRM / ARM router, where One-to-One IP addresses are translated (including recalculating affected fields of the header, like IP header checksum or higher-level checksum).

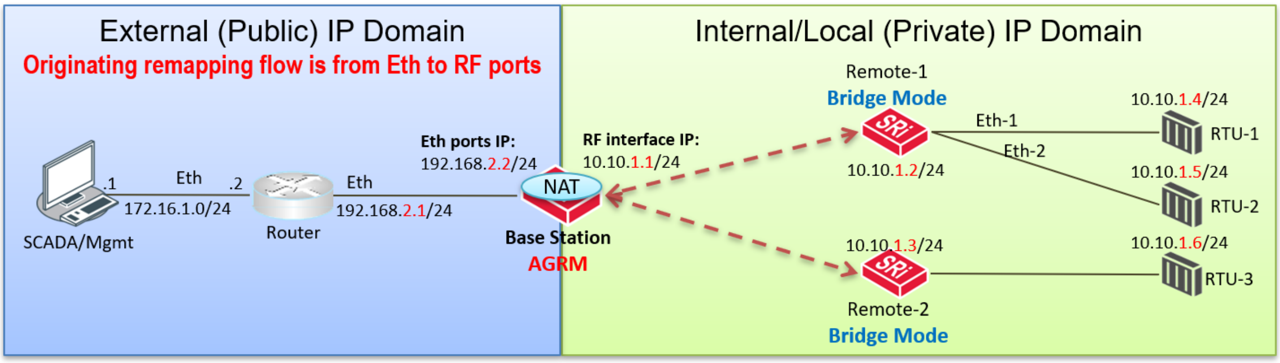
The advantage of NAT is to allow preservation of the multiple local (private) IP addresses, even if the external (public) IP addresses change. Another advantage is the security function of NAT where private / internal IP addresses are 'hidden' from the external / public IP domain behind the NAT. Also, private / internal IP addresses can be reused in different NAT routers in the radio network.

To easily explain the NAT function, the following terminology is used:

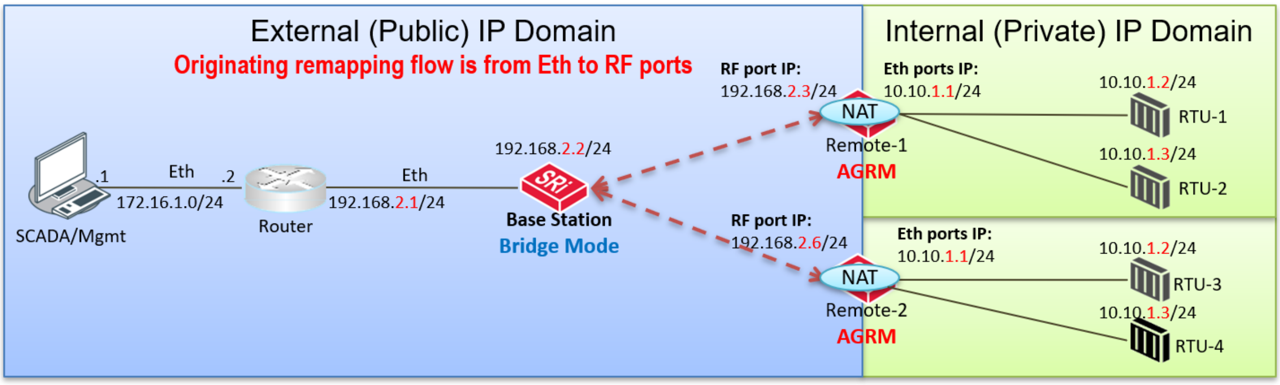
- **Session** – an IP / TCP / UDP service (identified by IP address and/or TCP / UDP port (or ICMP query ID))
- **Public (external) / Private (internal / local) IP domain** – the public / external and private / local IP network domains is used to define the NAT gating function and the inbound and outbound session NAT translation process based on NAT Address Map Table (AMP). The external / local notations used for IP address and TCP / UDP ports are as follow:
    - **Eth: eIP:ePort** – represents the external domain Ethernet port, IP address and TCP/UDP port.
    - **Eth: iIP:iPort** – represents the internal/local domain Ethernet port, IP address and TCP/UDP port.
- **Inbound / Outbound** – session originating from external to local network domain will be considered as inbound session. Session originating from internal / local to external network domain will be considered as outbound traffic. Outbound session only may for example represent report by exception. Inbound and Outbound session may for example represent poll / response.

Public (External) and Private (Internal/Local) IP Domains

The following figure describes the Public (external) and Private (internal/local) IP domains in AGRM / ARM-Bridge network. The NAT IP domains splits at the NAT function enabled device, the AGRM base station.



The following figure describes the Public (external) / Private (internal) IP domains in Bridge-AGRM / ARM network. The NAT IP domains splits at the NAT function enabled device, the AGRM remote radios.



One-to-One NAT Description

One-to-One NAT method is based on the remapping of external / public IP address space (e.g. radio IP space) into another internal / private IP space (e.g. RTUs IP space) and vice versa, by modifying the IP address. UDP / TCP ports will preserve their source / destination port numbers. NAT IP address translation function is performed before routing for inbound packets and after routing for outbound packets. NAT can translate and handle TCP, UDP, ICMP query, IP fragments and FTP packet types.

One-to-One NAT is translating inbound session packets per public interface and based on NAT Address Map Table (Address Map Table), supporting max 20 entries. Outbound session packets are translated based on the reverse table of Address Map Table. The user can configure the public port and Address Map Table in 'IP > NAT' page. NAT is translating inbound packets (IP address) originating in public network domain and destined for devices in private network domain. Outbound NAT translation refers to packets originated in private network and destined for devices in public network. Inbound or outbound packets will be dropped if it does not match any translation criteria defined for the appropriate public interface and Address Map Table configuration.

Monitoring the NAT translation sessions is available in 'Monitoring > NAT' with max 250 entries in NAT session table. Entries with a max idle time will be aged in favor of a new entry if the limit is reached. Entries are automatically removed after a period of inactivity as configured at 'IP > NAT > Settings TAB' in 'Session Idle Timeout'. NAT packet statistics of inbound and outbound sessions are also reported in the NAT session table per session basis.

NAT alarms are supported for any invalid configuration settings, including improper translation entries, invalid timeout, along with any incompatibilities with other feature settings will cause a ‘configuration not supported’ alarm.

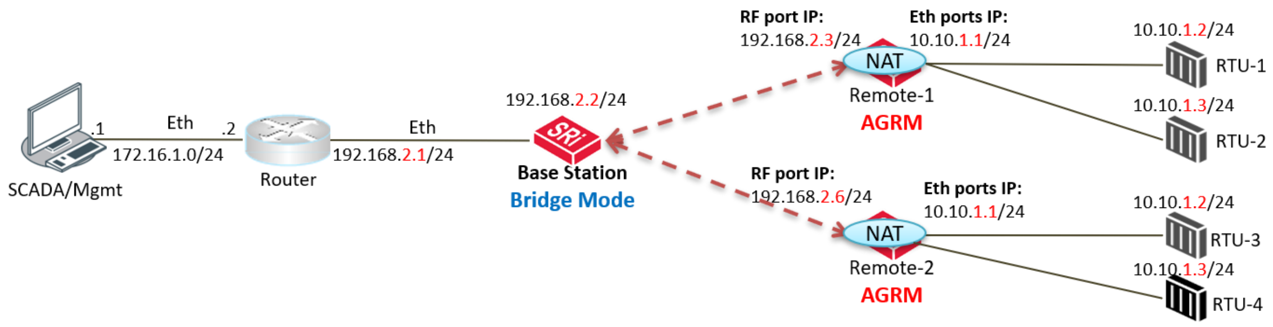
As shown in the figure of Bridge-AGRM network above, IP addresses used in one NAT internal domain can be reused by any other NAT internal domain. In the example figure above, RTUs connected to AGRM remote-1 and remote-2 reusing the same IP addresses space i.e. in this case all RTUs can have the same IP addresses space per remote radio.

NAT router radio will respond to inbound ARP requests for IP addresses in public range as defined in the Address Map Table with the MAC address of the public interface. Outbound ARP request for private IP range will ARP respond with MAC address of the NAT radio private/local interface.

In a protected station, all NAT configurations are shared between both the active and standby radios. The standby radio will not perform any NAT translation and routing. After a protection switchover, NAT session table will be aged. For smooth protection switching and continuous traffic flow, the protected station automatically supports MAC address cloning for both active and standby radios NAT public interface (the cloned MAC address is presented in ‘RF Mac Address’ field (see ‘Maintenance > Advanced’ on page 247).

One-to-One NAT Operation

The following figure describes an example of a radio network with One-to-One NAT configured at remotes in AGRM mode including the user configuration of NAT Address Map Table and expected session table (a detailed in / outbound session is shown for clarity of explanation, where NAT session table in SuperVisor will show a session in one line which will include inbound / outbound transactions, session duration, statistics, etc).



NAT Address Map Table - [Remote-1, Public Interface: RF Port]					
Order	Match To…			Translate To…	Active
	Public Dest IP Address Start	Public Dest IP Address End	Protocol	Private Dest IP Address Start	
1	192.168.2.4	192.168.2.5	Any	10.10.1.2	✓

NAT Address Map Table - [Remote-2, Public Interface: RF Port]					
Order	Match To…			Translate To…	Active
	Public Dest IP Address Start	Public Dest IP Address End	Protocol	Private Dest IP Address Start	
1	192.168.2.7	192.168.2.8	Any	10.10.1.2	✓

NAT Session Table - [Remote-1]							
ID	In/Out bound	Public IP Src Addr	Public IP Dest Addr	Protocol	Private IP Src Addr	Private IP Dest Addr	Comments
1	In	172.16.1.1	192.168.2.3	Any	N/A	N/A	Management > Remote1
2	In	172.16.1.1	192.168.2.4	Any	172.16.1.1	10.10.1.2	SCADA Master > RTU-1
3	Out	192.168.2.4	172.16.1.1	Any	10.10.1.2	172.16.1.1	RTU-1 > SCADA Master
4	In	172.16.1.1	192.168.2.5	Any	172.16.1.1	10.10.1.3	SCADA Master > RTU-2
5	Out	192.168.2.5	172.16.1.1	Any	10.10.1.3	172.16.1.1	RTU-2 > SCADA Master

The configured NAT Address Map Table of remote-1 shows that NAT will translate public interface RF port IP address range 192.168.2.4 - 5 to private IP address range 10.10.1.2 – 3. NAT Address Map Table of remote-2 shows reuse of the same private IP address range where NAT will translate public IP address range 192.168.2.7 - 8 to private IP address range 10.10.1.2 – 3.

The NAT session table of remote-1 session ID #1 shows that the public interface RF port address can't be used in the NAT function or in NAT Address Map Table configuration as it is reserved for the radio access (e.g. management access, etc). This line is just for explanation purposes as in SuperVisor it will not be shown in NAT session table since no NAT translation is made as it's not part of the Address Map Table configuration table.

Session ID #2 and #3 shows the inbound and outbound session translation when the SCADA master accesses RTU-1 and vice versa. From the SCADA master perspective, RTU-1 public address is 192.168.2.4 (as it doesn't know the real address 10.10.1.2 of RTU-1 which is 'hidden' behind the NAT). As explained above, SuperVisor will not show session ID #2 and #3 in one line as these inbound / outbound transactions are considered as one session.

NAT translates the inbound session public RF port destination IP 192.168.2.4 to 10.10.1.2 on Eth port, the real private IP destination of RTU-1. The source address of SCADA master 172.16.1.1 remains unchanged during the inbound NAT translation as shown in session ID#2.

Outbound session #3 shows the response of RTU-1 to SCADA master and NAT translation of Eth port private source address 10.10.1.2 to 192.168.2.4 on RF port public source address. The destination address of the SCADA master 172.16.1.1 remains unchanged during the outbound NAT translation.

Port Forwarding NAT (NAPT) Description

Port Forwarding NAT method is based on the remapping (translating) of an external / public TCP/UDP port of a single public IP addresses (e.g. BS radio Eth port-1 IP address) into multiple internal / private IP space (e.g. remote and RTUs IP address space) and vice versa, by translating public TCP/UDP ports space to the private IP space. The NAT translation function is performed before routing for inbound packets and after routing for outbound packets. NAT can translate and handle TCP, UDP, ICMP query, IP fragments and FTP packet types.

Port Forwarding NAT translates inbound session packets per public interface based on the NAT Address Map Table supporting max 20 entries. Outbound session packets are translated based on the reverse of the Address Map Table based on dynamic table entries created whenever a session is not configured in the Address Map Table (no dynamic session is allowed on inbound session). The user can configure the public port and Address Map Table in 'IP > NAT' page. NAT translates inbound packets (IP address) originating in public network domain and destined for devices in private network domain. Outbound NAT translation refers to packets originating in a private network and destined for devices in a public network. Inbound packets will be dropped if they don't match any translation criteria defined for the appropriate public interface and Address Map Table configuration.

Monitoring the NAT translation sessions is available in 'Monitoring > NAT' with max 250 entries in NAT session table. Entries with a max idle time will be aged in favour of a new entry if the limit is reached. Entries are automatically removed after a period of inactivity as configured at 'IP > NAT > Settings TAB' in 'Session Idle Timeout'. NAT packet statistics of inbound and outbound sessions are also reported in the NAT session table on a per session basis.

NAT alarms are supported for any invalid configuration settings, including improper translation entries, invalid timeout, along with any incompatibilities with other feature settings which will cause a 'configuration not supported' alarm.

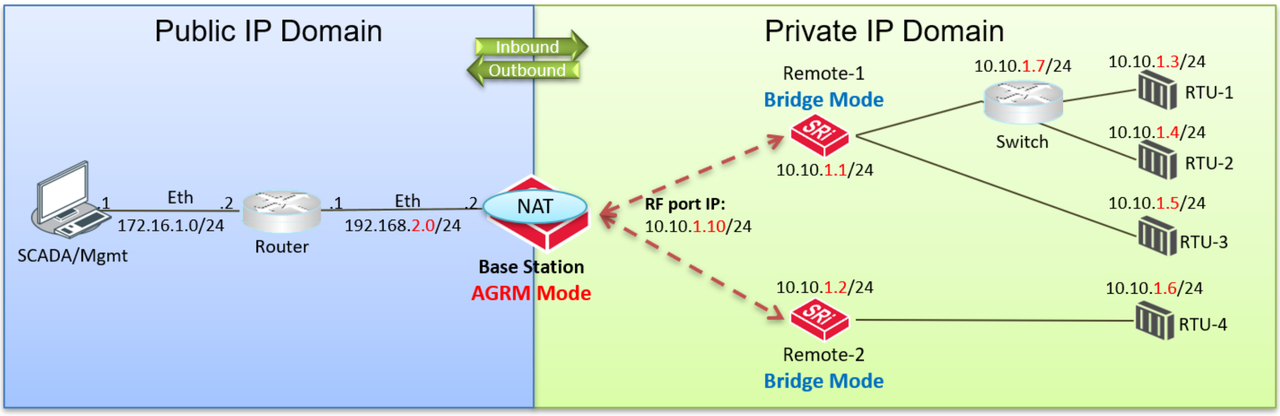
IP addresses used in one NAT internal domain can be reused by any other NAT internal domain.

A NAT router radio will respond to inbound ARP requests for IP addresses in public range as defined in the Address Map Table with the MAC address of the public interface. An outbound ARP request for a private IP range will respond with the MAC address of the NAT radio private/local interface.

In a protected station, all NAT configurations are shared between both the active and standby radios. The standby radio will not perform any NAT translation and routing. After a protection switchover, the NAT session table will be aged. For smooth protection switching and continuous traffic flow, the public interface MAC address will be used.

Port Forwarding NAT (NAPT) Operation

The following figure describes an example of Port Forwarding used for security, hiding the private IP address from the public interface network and it can be used to preserve private IP address even if public IP network subnet might change, reducing operational risk and expense. In this example, Port Forwarding NAT is configured at the Base Station in AGRM mode including the user configuration of NAT Address Map Table and expected session table (a detailed in / outbound session is shown for clarity of explanation, where NAT session table in SuperVisor will show a session in one line which will include inbound / outbound transactions, session duration, statistics, etc).



NAT Address Map Table - [Base Station, Public Interface: Eth-1]							
Order ID	Match To…				Translate To…		Active
	Public Dest IP Address Start	Public Dest Port Start	Public Dest Port End	Protocol	Private Dest IP Address Start	Private Dest Port	
1	192.168.2.2	8081	8087	Any	10.10.1.1	80	✓
2	192.168.2.2	10003	10006	Any	10.10.1.3	502	✓
3	192.168.2.2	101	107	ICMP	10.10.1.1	200	✓

NAT Session Table - [Base Station, Eth-1]											
ID	In Out bound	Public IP Src Addr	Public IP Dest Addr	Public Src Port	Public Dst Port	Protocol	Private IP Src Addr	Private IP Dest Addr	Private Src Port	Private Dst Port	Comments
1	In	172.16.1.1	192.168.2.2	PPP	80	Any	N/A	N/A	N/A	N/A	Management > Base
2	In	172.16.1.1	192.168.2.2	XYZ	8081	Any	172.16.1.1	10.10.1.1	XYZ	80	Management > Remote-1
3	Out	192.168.2.2	172.16.1.1	8081	XYZ	Any	10.10.1.1	172.16.1.1	80	XYZ	Remote-1 > Management
4	In	172.16.1.1	192.168.2.2	XXX	10003	Any	172.16.1.1	10.10.1.3	XXX	502	SCADA > RTU-1 (Modbus)
5	Out	192.168.2.2	172.16.1.1	10003	XXX	Any	10.10.1.3	172.16.1.1	502	XXX	RTU-1 (Modbus) > SCADA
6	In	172.16.1.1	192.168.2.2	FFF	20000	Any	N/A	N/A	N/A	N/A	To Base CPU (and drop)
7	Out	192.168.2.2	172.16.1.1	10003	RRR	Any	10.10.1.3	172.16.1.1	502	RRR	RBE RTU-1 > SCADA
8	Out	192.168.2.2	172.16.1.1	NNN	23	Any	10.10.1.3	172.16.1.1	ZZZ	23	RTU-1 (Telnet) > SCADA
9	In	172.16.1.1	192.168.2.2	23	NNN	Any	172.16.1.1	10.10.1.3	23	ZZZ	To Base CPU (and drop)
10	In	172.16.1.1	192.168.2.2	N/A	102	ICMP	172.16.1.1	10.10.1.1	N/A	200	Ping (Req.) > Remote-2
11	Out	192.168.2.2	172.16.1.1	102	N/A	ICMP	10.10.1.1	172.16.1.1	200	N/A	Remote-2 > Ping (Resp.)

The configured NAT Address Map Table of the Base Station shows that Port Forwarding NAT will translate;

NAT Address Map Table Line 1 configuration will translate public interface Eth-1 IP address 192.168.2.2 port range 8081 - 8087 to private IP address range 10.10.1.1 – 7 and port 80.

NAT Address Map Table Line 2 configuration will translate public IP address 192.168.2.2 port range 10,003 – 10,006 to private IP address range 10.10.1.3 – 6 and port 502 (Modbus).

NAT Address Map Table Line 3 configuration will translate ping messages public IP address 192.168.2.2 ping query ID 101 – 107 to private IP address range 10.10.1.1 – 7 and ping query ID 200.

The NAT session table of Base Station session ID #1 shows that the public interface Eth-1 IP address and TCP/UDP port 80 can't be used in the NAT function or in NAT Address Map Table configuration as it is reserved for the radio access (e.g. management access, etc). This line is just for explanation purposes as in SuperVisor it will not be shown in NAT session table since no NAT translation is made and it's not part of the Address Map Table configuration table.

Session ID #2 and #3 shows the inbound and outbound session translation when the Management accesses remote-1 using HTTP (port 80) and vice versa. From the Management perspective, remote-1 public address is 192.168.2.2 and port 8081 (as it doesn't know the real address 10.10.1.1 which is 'hidden' behind the NAT). As explained above, SuperVisor will not show session ID #2 and #3 in separate lines as these inbound / outbound transactions are considered as one session.

Session ID #4 and #5, are the same as sessions ID #2 and #3 and supported by NAT Address Map Table configuration ID #2.

Session ID #6 shows that an inbound session will drop packets if the session configuration is not supported in the NAT Address Map Table, or there is no outbound session initiated that can support a response of an inbound session (even if not in Address Map Table).

Session ID #7 and #8 are session initiated outbound sessions like RTU-1 RBE (Report by Exception) and Telnet session initiated from RTU-1, respectively. Initiated outbound sessions will be either translated per reverse Address Map Table configuration and if no configuration rule exists, then it will be built dynamically by the NAT function to later support a response from inbound session. Inbound session ID #9 is an example of a response to initiated outbound session ID #8, which is a dynamically created NAT translation table/session.

Session ID #10 and #11, are the same as sessions ID #2 and #3 and supported by NAT Address Map Table configuration ID #3, but this rule is set for ICMP ping. Instead of TCP/UDP port, NAT uses the ping query ID for translation. To run a ping across port forwarding NAT, user can use the hrPing.exe utility (run as admin) that can control the ping query ID value. Standard Windows ping command doesn't have the capability to control the ping query ID value.

Bridge Mode with VLAN Aware

Ethernet VLAN Bridge / Switch Overview

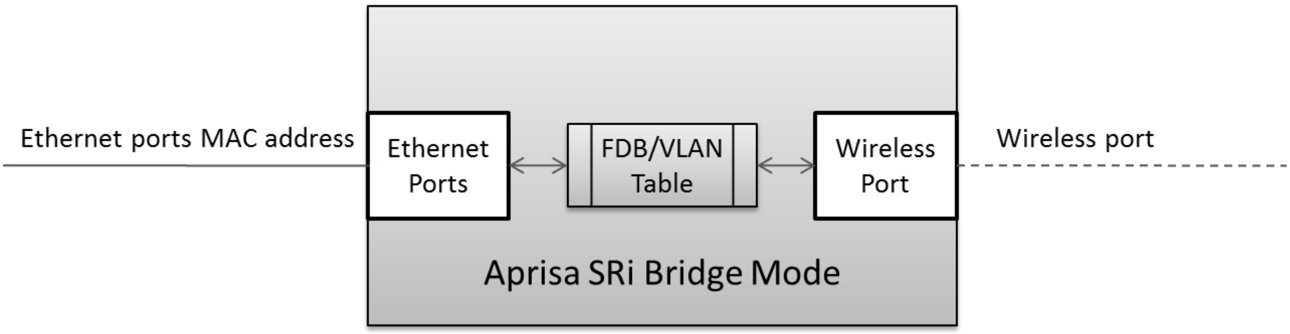
The Aprisa SRi in Bridge mode of operation is a standard Ethernet Bridge based on IEEE 802.1d or VLAN Bridge based on IEEE 802.1q/p which forward / switch Ethernet packet based on standard MAC addresses and VLANs using FDB (forwarding database) table decisions. VLAN is short for Virtual LAN and is a virtual separate network, within its own broadcast domain, but across the same physical network.

VLANs offer several important benefits such as improved network performance, increased security and simplified network management.

The Aprisa SRi Bridge mode (see figure below) is the default mode of operation, and it enables the switching / bridging of Ethernet VLAN tagged or untagged packets within the Aprisa SRi wireless network and in and out to the external Industrial LAN network and RTUs devices connected to the Aprisa SRi wired Ethernet ports or serial ports through the terminal server function.

Within the Aprisa SRi Bridge mode, each incoming Ethernet packet is inspected for the destination MAC address (and VLAN) and looks up its FDB table for information on where to send the specific Ethernet frame. If the FDB table doesn't contain the specific MAC address, it will flood the Ethernet frame out to all ports in the broadcast domain and when using VLAN, the broadcast domain is narrowed to the specific VLAN used in the packet (i.e. broadcast will be done only to the ports which configured with that specific VLAN).

The FDB table is used to store the MAC addresses that have been learnt and the ports associated with that MAC address. If the destination MAC address is one of the RTUs, the packet is then forwarded to the wireless ports and broadcast as a PMP wireless packet to all the remote radios. The appropriate remote then switches the Ethernet packet and forwards it based on its FDB table (based on the MAC or VLAN & MAC) to the appropriate Ethernet port to the RTU. The RTU can then interpret and process the Ethernet / IP data and communication is established between the RTU and the initiating communication device.



VLAN Bridge Mode Description

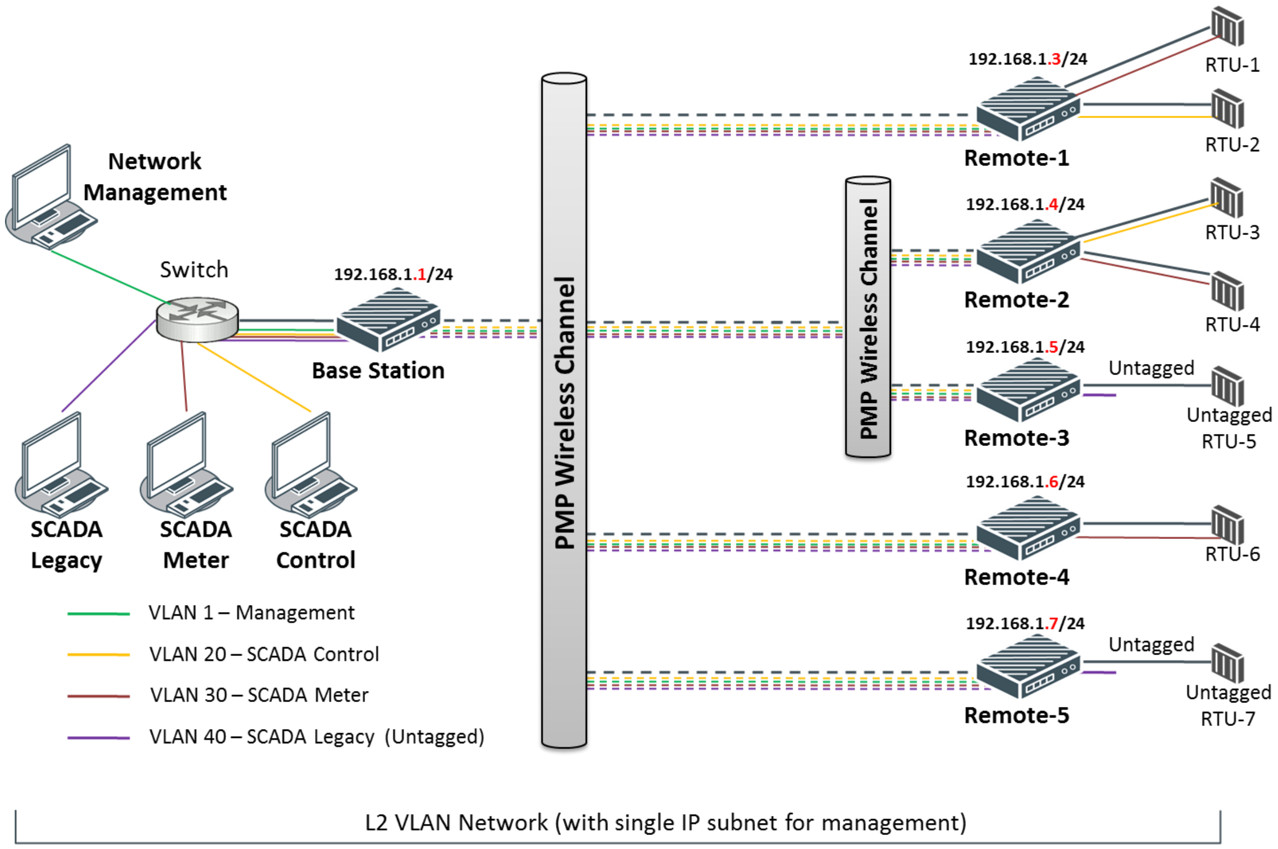
General – Aprisa SRi VLAN Bridge

The Aprisa SRi works in a point-to-multipoint (PMP) network as a standard VLAN bridge with the Ethernet and wireless / radio as interfaces and serial ports using terminal server as a virtual interface.

The Aprisa SRi is a standard IEEE 802.1q VLAN bridge, where the FDB table is created by the bridge learning / aging process. New MACs are learnt and the FDB table updated. Unused MACs are aged out and flushed automatically after aging period.

VLANs are statically configured by the user on the ports where a Virtual LAN is required across the radio network. An example of VLAN isolation of traffic type is shown in the figure below, where RTUs #1, 4 and 6 together with SCADA meter master form a Virtual LAN which is isolated from the other devices, even though they are on the same physical network. VLAN management can be used to manage with external NMS all the Aprisa SRi devices on the radio network and is automatically created with a VLAN ID = 1 default value. The VLAN ID can be changed by the user later.

Each device in the Aprisa SRi bridge is identified by its own IP address, as shown in the figure.



VLANs – Single, Double and Trunk VLAN ports

The Aprisa SRi supports single VLAN (CVLAN), double VLAN (SVLAN) and trunk VLAN.

A single VLAN can be used to segregate traffic type.

A double VLAN can be used to distinguish between Aprisa SRi sub-networks (remotes), where the outer SVLAN is used to identify the sub-network and the CVLAN is used to identify the traffic type. In this case, a double tagged VLAN will be forwarded across the Industrial LAN network and switched based on the SVLAN to the appropriate Aprisa SRi sub-network. When packet enters the Aprisa SRi network, the SVLAN will be stripped off (removed) and the forwarding will be done based on the CVLAN, so only a single VLAN will pass through over the radio network and double VLAN will be valid on the borders of the radio network.

Trunk VLAN is also supported by the Aprisa SRi where the user can configure multiple VLANs on a specific Ethernet port, creating a trunk VLAN port. For example, in the above figure, a single trunk VLAN port is created between the switch and the Aprisa SRi base station, carrying VLAN ID #1, 20, 30 and 40.

VLAN Manipulation – Add / Remove VLAN Tags

In order to support double VLAN and different device types connected to the Aprisa SRi e.g. switches, RTUs, etc, which can be VLAN tagged or untagged / plain Ethernet devices, add / remove VLAN manipulation is required.

In an Aprisa SRi VLAN tagged network, a remote Aprisa SRi connected to a plain RTU without VLAN support, will remove (strip-off) the VLAN tag from the packet before sending it to the RTU. On the other direction, when the RTU is sending an untagged packet, the Aprisa SRi will add (append) an appropriate user pre-configure VLAN tag before sending it over the air to the base station. This is shown in the above figure on untagged RTU #5 and 7.

QoS using VLAN

VLANs carry 3 priority bits (PCP field) in the VLAN tag allowing prioritization of VLAN tagged traffic types with 8 levels of priority (where 7 is the highest priority and 0 is the lowest priority). The Aprisa SRi supports QoS (Quality of Service) where the priority bits in the VLAN tagged frame are evaluated and mapped to four priority levels and four queues supported by the Aprisa SRi radio. Packets in the queues are then scheduled out in a strict priority fashion for transmission over-the-air as per the priority level from high to low.

Avoiding Narrow Band Radio Traffic Overloading

The Aprisa SRi supports mechanisms to prevent narrowband radio network overload:

1. L3/L4 Filtering

The L3 filtering can be used to block undesired traffic from being transferred on the narrow band channel, occupying the channel and risking the SCADA critical traffic. L3/4 filtering has the ability to block a known IP address and applications using TCP/IP or UDP/IP protocols with multiple filtering rules. The L3 (/L4) filter can block/forward (discard/process) a specific IP address and a range of IP addresses. Each IP addressing filtering rule set can also be set to filter a L4 TCP or UDP port/s which in most cases relates to specific applications as per IANA official and unofficial well-known ports. For example, filter and block E-mail SMTP or TFTP protocol as undesired traffic over the SCADA network. The user can block a specific or range of IP port addresses, examples SMTP (Simple Mail Transfer Protocol) TCP port 25 or TFTP (Simple Trivial File Transfer Protocol) UDP port 69.

2. L2 Address Filtering

L2 Filtering (Bridge Mode) provides the ability to filter radio link traffic based on specified Layer 2 MAC addresses. Destination MAC (DA) addresses and a Source MAC (SA) addresses and protocol type (ARP, VLAN, IPv4, IPv6 or Any type) that meet the filtering criteria will be transmitted over the radio link. Traffic that does not meet the filtering criteria will not be transmitted over the radio link.

3. L2 Port VLANs Ingress Filtering and QoS

Double VLAN (Bridge Mode)

Double VLAN is used to distinguish/segregate between different radio sub-networks (remotes). Traffic with double VLANs which are not destined to a specific sub-network will be discarded on the ingress of the radio sub-network, avoiding the overload of the radio sub-network.

Single VLAN (Bridge Mode)

Single VLAN is used to distinguish/segregate between different traffic types assigned by the user in its industrial corporate LAN. In order to avoid the overload of the radio network, traffic with single VLANs which are not destined to a specific radio network will be discarded on the Ethernet ingress port of the radio network. All single VLANs which set and are eligible will be transmitted over the radio link.

QoS using 802.1p priority bits (Bridge Mode)

The priority bits can be used in the VLAN tagged frames to prioritize critical mission SCADA traffic and ensure SCADA traffic transmission relative to any other unimportant traffic. In this case, traffic based on VLAN priority (priority 0 to 7) enters one of the four priority queues of the Aprisa SRi (Very High, High, Medium and Low). Traffic leaves the queues (to the radio network) from highest priority to lowest in a strict priority fashion.

4. Ethernet port QoS

The Aprisa SRi supports ‘Ethernet Per Port Prioritization’. Each Ethernet port can be assigned a priority and traffic shall be prioritized accordingly. This is quite useful in networks where customers do not use VLANs or cannot use 802.1p prioritization.

5. Ethernet Data and Management Priority and Background Bulk Data Transfer Rate

Alternatively, to VLAN priority, users can control the Ethernet traffic priority (vs serial), management priority and rate in order to control the traffic load of the radio network, where important and high priority data (SCADA) will pass-through first assuring SCADA network operation. The user can set the use of the Ethernet Data Priority, which controls the priority of the Ethernet customer traffic relative to the serial customer traffic and can be set to one of the four queues. The Ethernet Management Priority controls the priority of the Ethernet management traffic relative to Ethernet customer traffic and can be set to one of the four queues. The Background Bulk Data Transfer Rate sets the data transfer rate (high, medium, low) for large amounts of management data.

6. Ethernet Packet Time to Live

Another aspect of avoiding overload radio network is the Ethernet packet TTL, which is used to prevent old, redundant packets being transmitted through the radio network. This sets the time an Ethernet packet is allowed to live in the system before being dropped if it cannot be transmitted over the air.

7. Payload Compression

Aprisa SRi supports payload compression. A Lempel–Ziv (LZ) algorithm is used to efficiently compress up to 50% traffic with high percentage of repetitive strings. Both serial and Ethernet / IP payload traffic are compressed.

Interfaces

Antenna Interface

- 1 x TNC, 50 ohm, female connector

Ethernet Interface

- 2 ports 10/100 base-T Ethernet layer 2 switch using RJ45

  Used for Ethernet user traffic and radio sub-network management.

RS-232 / RS-485 Interface

- 2 ports RS-232 asynchronous ports using RJ45 connectors
- Optional 1x RS-232 or RS-485 asynchronous port using USB host port with USB to RS-232 or USB to RS-485 converters

USB Interfaces

- 1 x Management port using USB micro type B connector

  Used for product configuration with the Command Line Interface (CLI).

- 1 x Host port using USB standard type A connector

  Used for software upgrade, diagnostic reporting and configuration save / restore.

Protect Interface

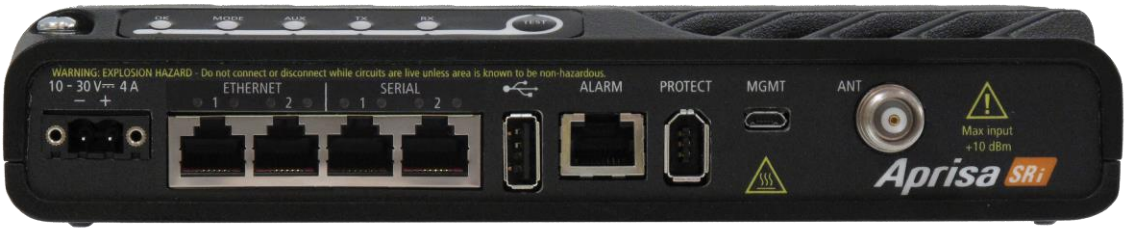
- 1x Protect interface port

  Not applicable for the Aprisa SRi radio.

Alarms Interface

- 1x Alarm port using RJ45 connector
  Used to provide 2 x hardware alarm inputs and 2 x hardware alarm outputs

Front Panel Connections



All connections to the radio are made on the front panel. The functions of the connectors are (from left to right):

Designator	**Description**
10 - 30 VDC; 3A	+10 to +30 VDC (negative ground) DC power input using Molex 2 pin male screw fitting connector. AC/DC and DC/DC power supplies are available as accessories. See ‘External Power Supplies’ on page 79.
ETHERNET 1 & 2	Integrated 10Base-T/100Base-TX layer-3 Ethernet switch using RJ45 connectors. Used for Ethernet user traffic and product management. See ‘Ethernet > Port Setup’ on page 149.
SERIAL 1	One port of RS-232 serial using RJ45 connector. Used for RS-232 asynchronous user traffic. See ‘Serial > Port Setup’ on page 132.
	Host Port using a USB standard type A connector. Used for software upgrade and diagnostic reporting and optional: 1x RS-232 asynchronous port with USB to RS-232 converter. See ‘Software Upgrade’ on page 393 and ‘Maintenance > General’ on page 235.
ALARM	Alarm Port using a RJ45 connector. Used for two alarm inputs and two alarm outputs. See ‘Hardware Alarms Interface’ on page 419.
MGMT	Management Port using a USB micro type B connector. Used to access the radio Command Line Interface (CLI). See ‘ Connecting to the CLI via the Management Port’ on page 362
PROTECT	Protect port. Not used for the SRi.
ANT	TNC, 50 ohm, female connector for connection of antenna feeder cable for half duplex RF operation. See ‘Coaxial Feeder Cables’ on page 71.

LED Display Panel

The Aprisa SRi has an LED Display panel which provides on-site alarms / diagnostics without the need for PC.

The LEDs indicate the following conditions:

	OK	MODE	AUX	TX	RX
Flashing Red		*Radio has not registered*			
Solid Red	*Alarm present with severity Critical, Major and Minor*			*TX path fail*	*RX path fail*
Flashing Orange		*Diagnostics Function Active* *OTA software distribution*	*Management traffic on the USB MGMT port*		
Solid Orange	*Alarm present with Warning Severity*		*Device detect on the USB host port (momentary)*		
Flashing Green	*Software Upgrade Successful*		*Tx / Rx Data on the USB host port*	*RF path TX is active*	*RF path RX is active*
Solid Green	*Power on and functions OK and no alarms*	*Processor Block is OK*	*USB interface OK*	*Tx path OK*	*Rx path OK*

LED Colour	Severity
Green	No alarm - information only
Orange	Warning alarm
Red	Critical, major or minor alarm

Single Radio Software Upgrade

During a radio software upgrade, the LEDs indicate the following conditions:

- Software upgrade started - the OK LED flashes orange
- Software upgrade progress indicated by running AUX to MODE LEDs
- Software upgrade completed successfully - the OK LED flashes green
- Software upgrade failed - any LED flashing red during the upgrade

Network Software Upgrade

During a network software upgrade, the MODE LED flashes orange on the base station and all remote radios.

Test Mode

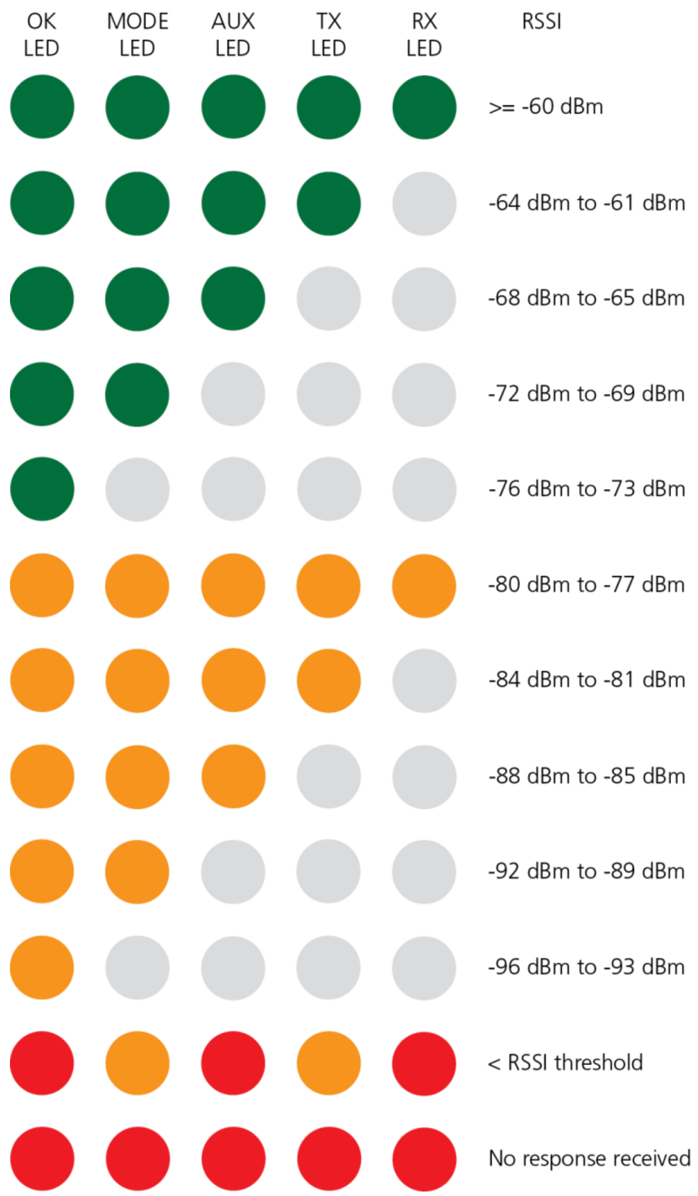
Remote radios have a Test Mode which presents a real time visual display of the RSSI on the LED Display panel. This can be used to adjust the antenna for optimum signal strength.

To enter Test Mode, press and hold the TEST button on the radio LED panel until all the LEDs flash green (about 3 - 5 seconds). The response time is variable and can be up to 5 seconds.

To exit Test Mode, press and hold the TEST button until all the LEDs flash red (about 3 – 5 seconds).

Note: Test Mode traffic has a low priority but could affect customer traffic depending on the relative priorities setup.

The RSSI result is displayed on the LED Display panel as a combination of LED states:



Network Management

The Aprisa SRi contains an embedded web server application (SuperVisor) to enable element management with any major web browser. The currently supported Browsers are:

- Mozilla Firefox
- Microsoft Edge
- Google Chrome

SuperVisor enables operators to configure and manage the Aprisa SRi base station radio and remote radios over the radio link.

The key features of SuperVisor are:

- Full element management, configuration and diagnostics
- Manage the entire network from the Base Station (remote management of elements)
- Managed network software distribution and upgrades
- Performance and alarm monitoring of the entire network, including RSSI, alarm states, time-stamped events, etc.
- View and set standard radio configuration parameters including frequencies, transmit power, channel access, serial, Ethernet port settings
- Set and view security parameters
- User management
- Operates over a secure HTTPS session on the access connection to the base station

SuperVisor, when connected to the base station radio allows management of all radios in the network. The Network Table displays a list of all the registered remote radios for the base station and provides management access to each of the remote radios (see ‘Network Status > Network Table’ on page 303).

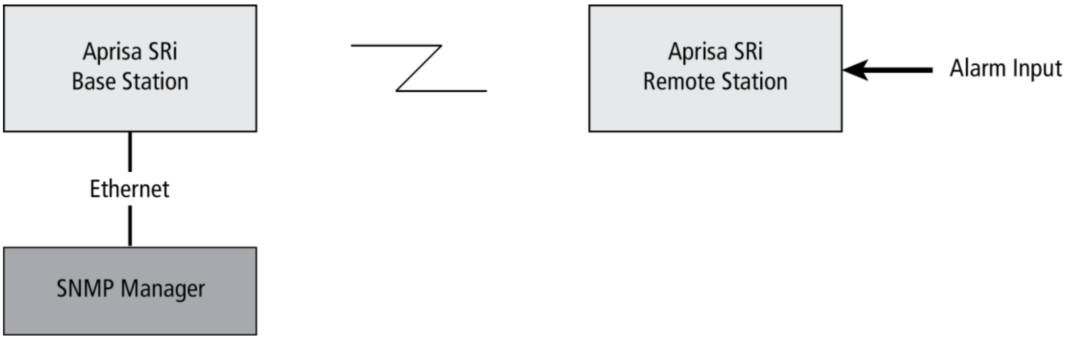
Hardware Alarm Inputs / Outputs

The Aprisa SRi provides two hardware alarm inputs to generate alarm events in the network and two hardware alarm outputs to receive alarm events from the network.

The hardware alarm inputs and outputs are part of the event system. All alarm events can be viewed in SuperVisor event history log (see 'Events > Event History' on page 250). These include the alarm events generated by the hardware alarm inputs.

Alarm Input to SNMP Trap

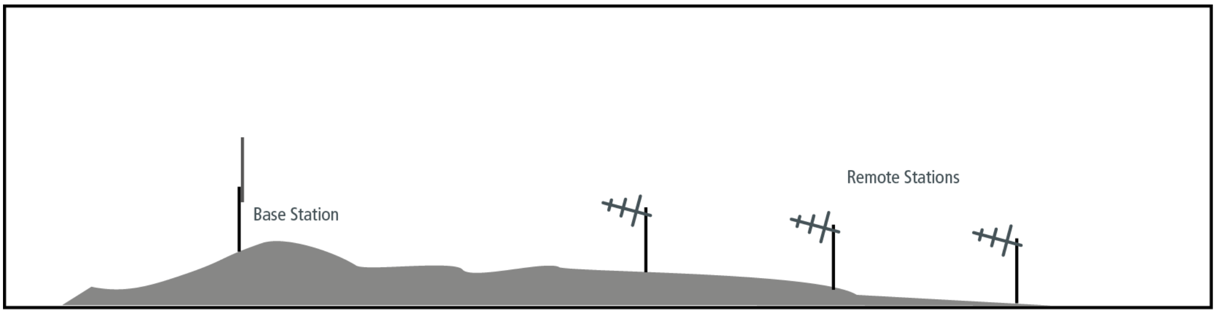
An alarm event from an Aprisa SRi hardware alarm input can be sent over the air to any SNMP Manager using SNMP traps.



4. Implementing the Network

Network Topologies

Point-to-Multipoint Network



Initial Network Deployment

Install the Base Station

To install the base station in your network:

1. Install the base station radio (see ‘Installing the Radio’ on page 74).
2. Set the radio Network ID to a unique ID in your entire network (see ‘Terminal > Device’ on page 100).
3. Set the radio operating mode to ‘base station’ (see ‘Terminal > Operating Mode’ on page 107).
4. Set the radio IP address (see ‘IP > IP Setup > Bridge / Gateway Router Modes’ on page 161).
5. Set the radio zones / channels.
6. Set the radio security settings (see ‘Security > Setup’ on page 204).

Installing the Remote radios

To install the remote radios in your network:

1. Install the remote radio (see ‘Installing the Radio’ on page 74).
2. Set the radio Network ID to the same ID as the other stations in the network (see ‘Terminal > Device’ on page 100).
3. Set the radio operating mode to ‘remote radio’ (see ‘Terminal > Operating Mode’ on page 107).
4. Set the radio IP address (see ‘IP > IP Setup > Bridge / Gateway Router Modes’ on page 161).
5. Set the radio zones / channels to be compatible with the base station.
6. Set the radio security settings to the same as the base station (see ‘Security > Setup’ on page 204).

The base station will automatically allocate a node address to the new remote radio.

Network Changes

Adding a Remote radio

To add a remote radio to your network:

1. Install the remote radio (see 'Installing the Radio' on page 74).
2. Set the radio Network ID to the same ID as the other stations in the network (see 'Terminal > Device' on page 100).
3. Set the radio IP address (see 'IP > IP Setup > Bridge / Gateway Router Modes' on page 161).).
4. Set the radio zones / channels to be compatible with the base station.
5. Set the radio operating mode to 'remote radio' (see 'Terminal > Operating Mode' on page 107).

The base station will automatically allocate a node address to the new remote radio.

To remove a remote radio from your network:

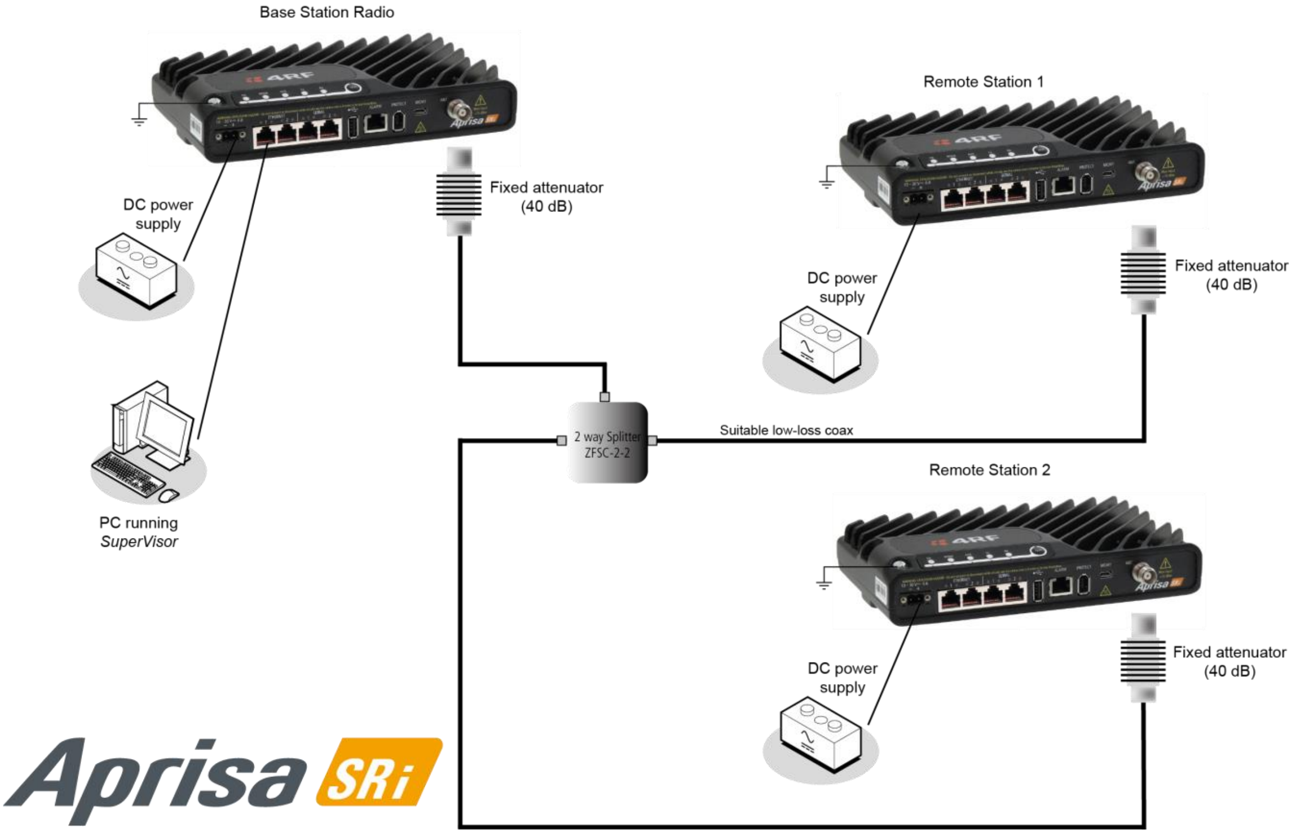
1. Turn the power off on the remote radio you wish to remove. This is the only action that is required.

Note: The remote radio will continue to show in the Network Table list.

5. Preparation

Bench Setup

Before installing the links in the field, it is recommended that you bench-test the links. A suggested setup for basic bench testing is shown below:



When setting up the equipment for bench testing, note the following:

Earthing

Each radio should be earthed at all times. The radio earth point should be connected to a protection earth.

Attenuators

In a bench setup, there should be 60 - 80 dB at up to 1 GHz of 50 ohm coaxial attenuation, capable of handling the transmit power of +26 dBm (0.4 W) between the radios' antenna connectors.

Splitter

If more than two radios are required in your bench setup, a multi-way splitter is required. The diagram shows a two way splitter. This splitter should be 50 ohm coaxial up to 1 GHz and capable of handling the transmit power of +26 dBm (0.4 W).

Cables

Use double-screened coaxial cable that is suitable for use up to 1 GHz at ≈ 1 metre.

CAUTION: Do not apply signals greater than +10 dBm to the antenna connection as they can damage the receiver.

Compliance Considerations

The Aprisa SRi is a professional radio product and as such must be installed by a suitably trained and qualified installer who is aware of the local regulatory requirements existing at the time of installation and is capable of ensuring that the regulations are adhered to.

The maximum Equivalent Isotropic Radiated Power (EIRP) permitted from the Aprisa SRi is regulated and must not exceed the limits provided in the following table. To meet this regulatory requirement; knowledge of the antenna gain and feeder cable loss must be known before setting the transmitter output power.

Regulatory Requirement	Frequency Range	Maximum EIRP[1]	SRi Equivalent Maximum Average Power (R_{dBm})
USA, FCC Part 15.247	902 MHz to 928 MHz	+36 dBm PEP	+32 dBm
Canada, ISED RSS-247	902 MHz to 928 MHz	+36 dBm PEP	+32 dBm
Australia, ACMA AS/NZS 4268	915 MHz to 928 MHz	+30 dBm	+30 dBm
New Zealand, General User Radio Licence for Short Range Devices	915 MHz to 928 MHz	+30 dBm	+30 dBm
New Zealand, General User Radio Licence for Short Range Devices	920 MHz to 928 MHz	+36 dBm	+36 dBm
Brazil, Act No. 14.448, of December 4, 2017	902 MHz to 907.5 MHz & 915 MHz to 928 MHz	+36 dBm PEP	+30 dBm
Mexico, NOM-208-SCFI-2016	902 MHz to 928 MHz	+36 dBm PEP	+30 dBm
Peru	915 MHz to 928 MHz	+30 dBm	+30 dBm

[1] These are correct at the time of printing. The installer must ensure that the installation complies with the regulatory requirements at the time of installation.

The Aprisa SRi has a maximum mean output power of +26 dBm into a 50 ohm antenna which equates to a maximum peak power of +30 dBm PEP. To determine the maximum power to be set on the Aprisa SRi, the following installation parameters must be known:

1. Aprisa SRi equivalent average power for maximum permitted EIRP (specified in dBm) R_{dBm}
2. Antenna isotropic gain (specified in dBi) G_{dBi}
3. Feeder coax loss between Aprisa SRi and antenna (specified in dB/m) $L_{dB/m}$
4. Length of feeder coax between Aprisa SRi and antenna (specified in metres) d_m

From these the above information, the power setting of the Aprisa SRi (P_{dBm}) can be calculated to ensure operation within the regulatory requirements using the formula:

$$P_{dBm} = R_{dBm} + \left(d_m \times L_{dB/m}\right) - G_{dBi}$$

Antenna gain information can be obtained from the Antenna manufacturer and is either expressed in terms of dBi, referenced to an isotropic radiator, or dBd, referenced to a dipole.

If the gain is expressed in dBd, it can be converted to dBi by adding 2.15 dB to the gain value.

The following is an example of transmitter power calculations:

Antenna Type and Gain	Feeder Coax Length and Loss	Regulatory Limit	Maximum SRi Power Setting
Yagi, 11 dBi	10 m of ½” Heliax @ 0.11 dB/m gives 1.1 dB loss	+36 dBm PEP	22 dBm
Panel, 12 dBi	33 m of RG214 @ 0.22 dB/m gives 7.3 dB loss	+30 dBm	25 dBm
Dipole, 3.5 dBi	3 m of RG214 @ 0.22 dB/m gives 0.66 dB loss	+30 dBm	26 dBm
Grid, 18 dBi	15 m of ½” Heliax @ 0.11 dB/m gives 1.65 dB loss	+30 dBm	13 dBm

Canada

This radio transmitter Aprisa SRi ISED: 6772A-SI902M160 has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Mexico

La operación de este equipo está sujeta a las siguientes dos condiciones:

(1) es posible que este equipo o dispositivo no cause interferencia perjudicial y

(2) este equipo o dispositivo debe aceptar cualquier interferencia, incluyendo la que pueda causar su operación no deseada.

Este equipo ha sido diseñado para operar con las antenas que enseguida se enlistan y para una ganancia máxima de antena de 6 dBi.

El uso con este equipo de antenas no incluidas en esta lista o que tengan una ganancia mayor que 6 dBi quedan prohibidas. La impedancia requerida de la antena es de 50 ohms.

Path Planning

The following factors should be considered to achieve optimum path planning:

- Antenna Selection and Siting
- Coaxial Cable Selection
- Linking System Plan

Antenna Selection and Siting

Selecting and siting antennas are important considerations in your system design. The antenna choice for the site is determined primarily by the frequency of operation and the gain required to establish reliable links.

Base Station

The predominant antenna for a base station is an omni-directional collinear gain antenna.

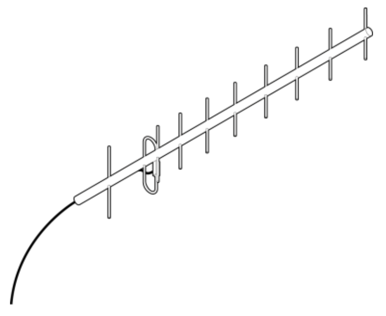
Omni Directional Collinear Antennas

	**Factor**	**Explanation**
	Gain	Varies with size (5 dBi to 11 dBi typical)
	Wind loading	Minimal
	Tower aperture required	Minimal
	Size	Range from 2 m to 3 m length
	Polarization	Vertical

Remote radio

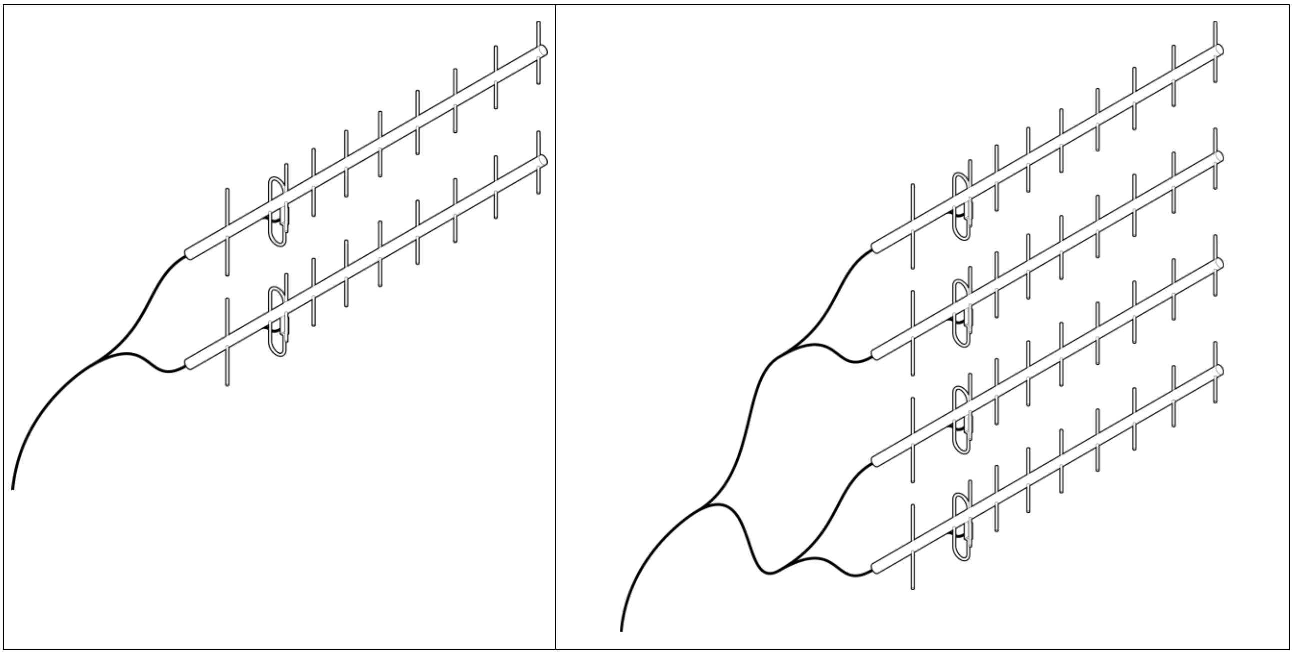
There are two main types of directional antenna that are commonly used for remote radios, Yagi and corner reflector antennas.

Yagi Antennas



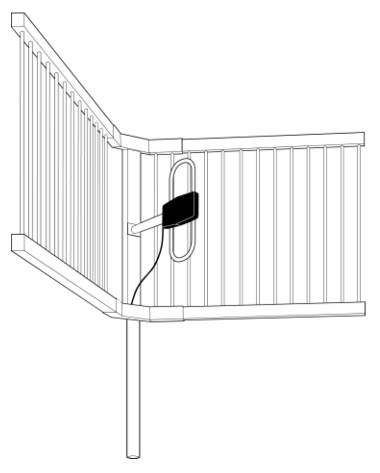
Factor	Explanation
Gain	Varies with size (typically 11 dBi to 16 dBi)
Stackable gain increase	2 Yagi antennas (+ 2.8 dB) 4 Yagi antennas (+ 5.6 dB)
Size	Range from 0.6 m to 3 m in length
Front to back ratio	Low (typically 18 to 20 dB)

It is possible to increase the gain of a Yagi antenna installation by placing two or more of them in a stack. The relative position of the antennas is critical.



Example of stacked antennas

Corner Reflector Antennas

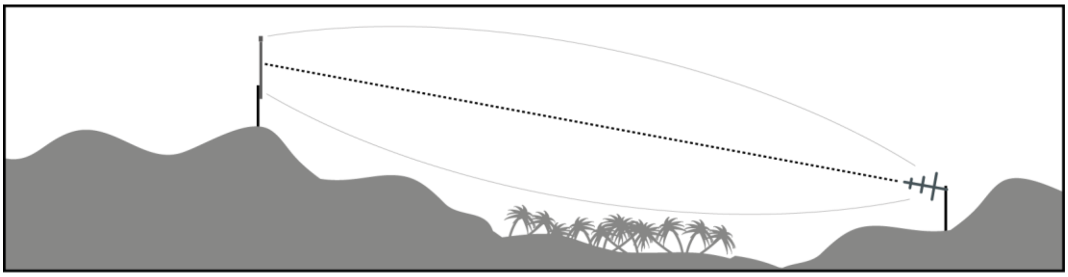


Factor	Explanation
Gain	Typically 12 dBi
Size	Range from 0.36 m to 0.75 m in length
Front to back ratio	High (typically 30 dB)
Beamwidth	Broad (up to 60°)

Antenna Siting

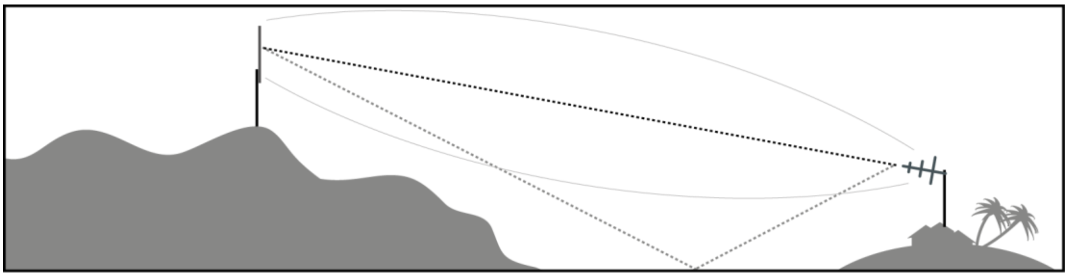
When siting antennas, consider the following points:

A site with a clear line of sight to the remote radio is recommended. Pay particular attention to trees, buildings, and other obstructions close to the antenna site.



Example of a clear line-of-sight path

Any large flat areas that reflect RF energy along the link path, for instance, water, could cause multipath fading. If the link path crosses a feature that is likely to cause RF reflections, shield the antenna from the reflected signals by positioning it on the far side of the roof of the equipment shelter or other structure.



Example of a mid-path reflection path

The antenna site should be as far as possible from other potential sources of RF interference such as electrical equipment, power lines and roads. The antenna site should be as close as possible to the equipment shelter.

Wide angle and zoom photographs taken at the proposed antenna location (looking down the proposed path), can be useful when considering the best mounting positions.

Coaxial Feeder Cables

To ensure maximum performance, it is recommended that you use good quality low-loss coaxial cable for all feeder runs. When selecting a coaxial cable consider the following:

Factor	Effect
Attenuation	Short cables and larger diameter cables have less attenuation
Cost	Smaller diameter cables are cheaper
Ease of installation	Easier with smaller diameter cables or short cables

For installations requiring long feeder cable runs, use the RFI AVA5 50, RFI LDF4 50A or RFI CNT-400 feeder cable or equivalent:

Part Number	Part Description	Specification
RFI AVA5 50	Feeder Cable, 7/8", HELIAX, Low loss	7/8" foam dielectric. Standard Jacket Outer conductor corrugated copper, inner conductor copper-clad aluminum Bending radius of 250 mm min Attenuation of 3.7 dB / 100m @ 900 MHz
RFI LDF4 50A	Feeder cable, 1/2", HELIAX, Low Loss	1/2" foam dielectric. Standard Jacket Outer conductor corrugated copper, inner conductor copper-clad aluminum Bending radius of 125 mm min Attenuation of 7.0 dB / 100m @ 900 MHz
RFI CNT 400	Feeder, CNT-400, 10.8mm, Double Shielded Solid Polyethylene	Low loss 0.4' (10.8 mm) feeder cable UV protected black Polyethylene, bonded AL tape outer conductor Bending radius of 30 mm min Attenuation of 12.8 dB / 100m @ 900 MHz

For installations requiring short feeder cable runs, use the RFI 8223 feeder cable or equivalent:

Part Number	Part Description	Specification
RFI 8223	Feeder, RG 223 5.4mm d, Double Shielded Solid Polyethylene	Bending radius of 20 mm min Attenuation of 45.6 dB / 100m @ 900 MHz

When running cables:

Run coaxial feeder cable from the installation to the antenna, ensuring you leave enough extra cable at each end to allow drip loops to be formed.

Terminate and ground the feeder cables in accordance with the manufacturers' instructions. Bond the outer conductor of the coaxial feeder cables to the base of the tower mast.

Linking System Plan

All of the above factors combine in any proposed installation to create a Linking System Plan. The Linking System Plan predicts how well the radios will perform after it is installed.

Use the outputs of the Linking System Plan during commissioning to confirm the radios have been installed correctly and that it will provide reliable service.

Site Requirements

Power Supply

Ensure a suitable power supply is available for powering the radio.

The nominal input voltage for a radio is +13.8 VDC (negative earth) with an input voltage range of +10 to +30 VDC. The maximum power input is 25 W.

WARNING:

Before connecting power to the radio, ensure that the radio is grounded via the negative terminal of the DC power connection.

Equipment Cooling

If the Aprisa SRi is operated in an environment where the ambient temperature exceeds 50°C, the Aprisa SRi convection air flow over the heat sinks must be considered.

The environmental operating conditions are as follows:

Operating temperature	-40 to +70° C (-40 to +158° F)
Storage temperature	-40 to +85° C (-40 to +185° F)
Humidity	Maximum 95% non-condensing

WARNING:

If the Aprisa SRi is operated in an environment where the ambient temperature exceeds 50°C, the Aprisa SRi must be installed within a restricted access location to prevent human contact with the enclosure heat sink.

WARNING:

The Aprisa SRi can be operated in an environment where the ambient temperature exceeds 50°C. The heat sink will be a hot surface - do not touch.

Earthing and Lightning Protection

WARNING:

Lightning can easily damage electronic equipment.

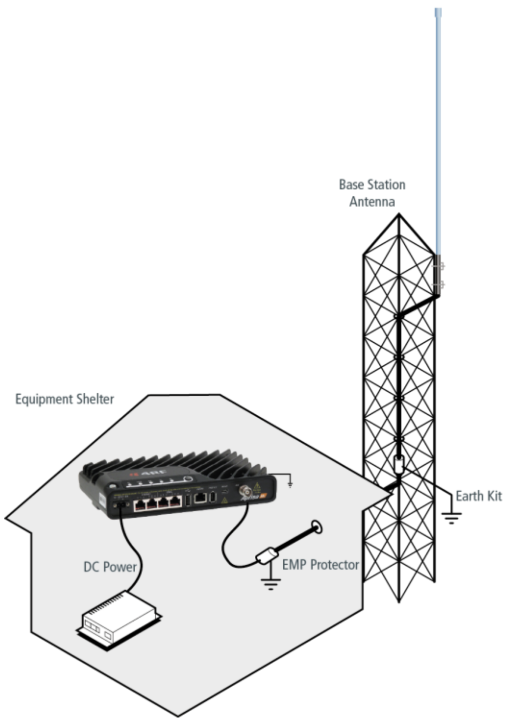
To avoid this risk, install primary lightning protection devices on any interfaces that are reticulated in the local cable network.

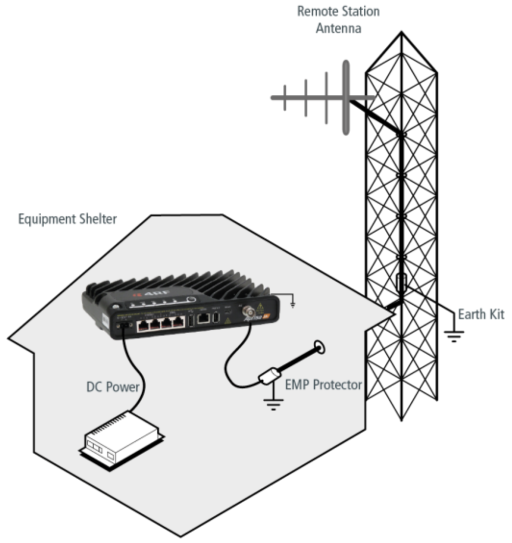
You should also install a coaxial surge suppressor on the radio antenna port.

Feeder Earthing

Earth the antenna tower, feeders and lightning protection devices in accordance with the appropriate local and national standards. The diagram below shows the minimum requirements.

Use grounding kits as specified or supplied by the coaxial cable manufacturer to properly ground or bond the cable outer.





Radio Earthing

The Aprisa SRi has an earth connection point on the top left of the enclosure. M4 8mm pan pozi machine screws and M4 lock washers are supplied fitted to the radio. These screws can be used to earth the enclosure to a protection earth.

6. Installing the Radio

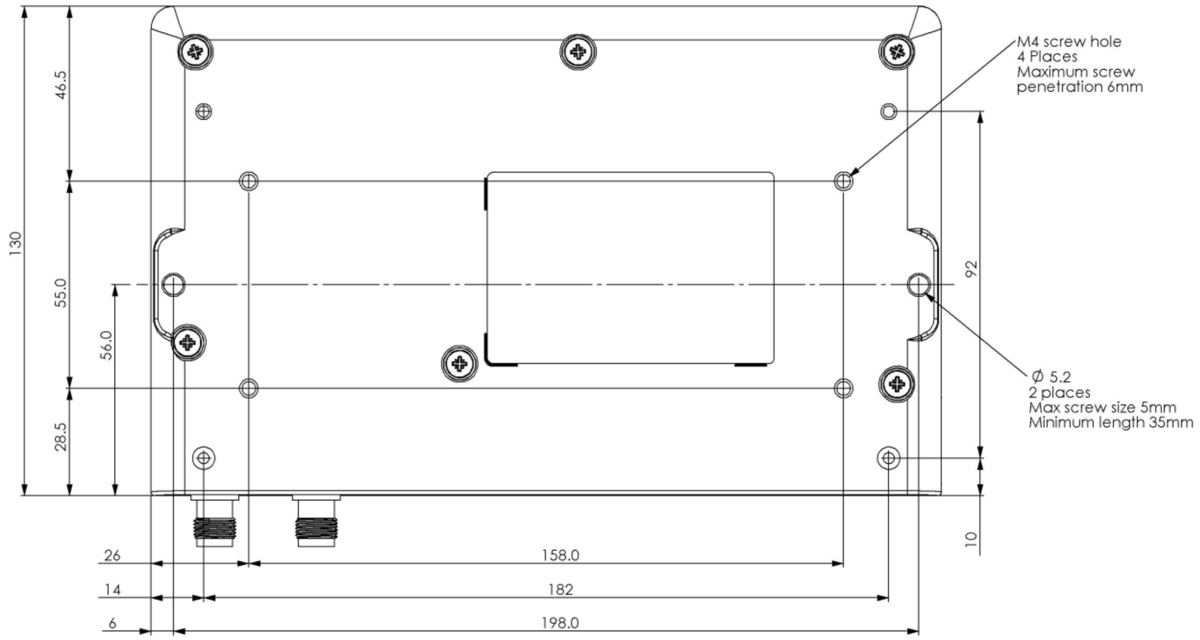
CAUTION:

You must comply with the safety precautions in this manual or on the product itself.

4RF does not assume any liability for failure to comply with these precautions.

Mounting

The Aprisa SRi has four threaded holes (M4) in the enclosure base and two holes (5.2 mm) through the enclosure for mounting.



Mounting options include:

- DIN rail mounting with the DIN Rail Mounting Bracket
- Rack shelf mounting
- Wall mounting
- Outdoor enclosure mounting

WARNING:

If the Aprisa SRi is operated in an environment where the ambient temperature exceeds 50°C, the Aprisa SRi must be installed within a restricted access location to prevent human contact with the enclosure heatsink.

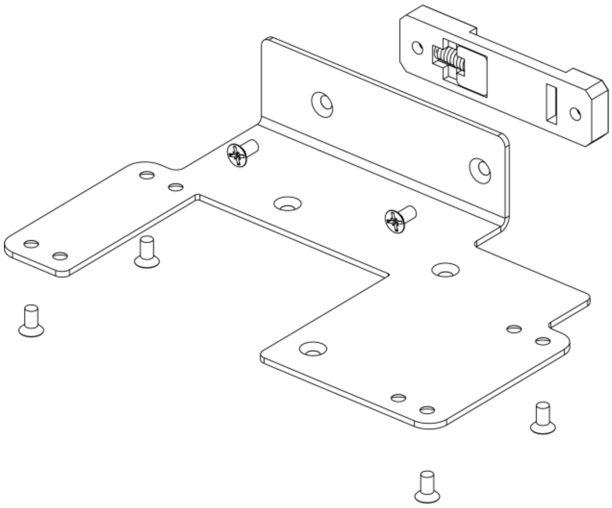
Required Tools

No special tools are needed to install the radio.

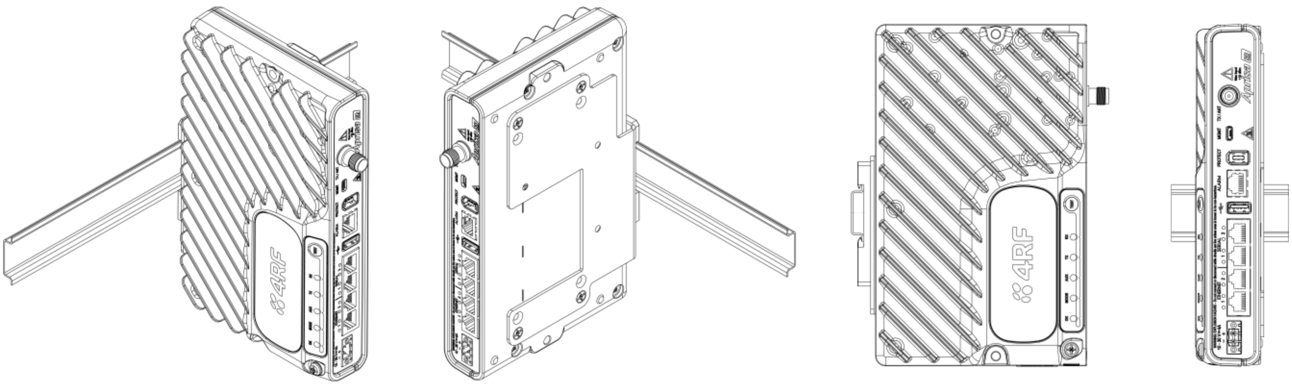
DIN Rail Mounting

The Aprisa SRi has an optional accessory part to enable the mounting on a standard DIN rail:

Part Number	Part Description
APGA-MBRK-DIN	4RF Acc, Mounting, Bracket, DIN Rail



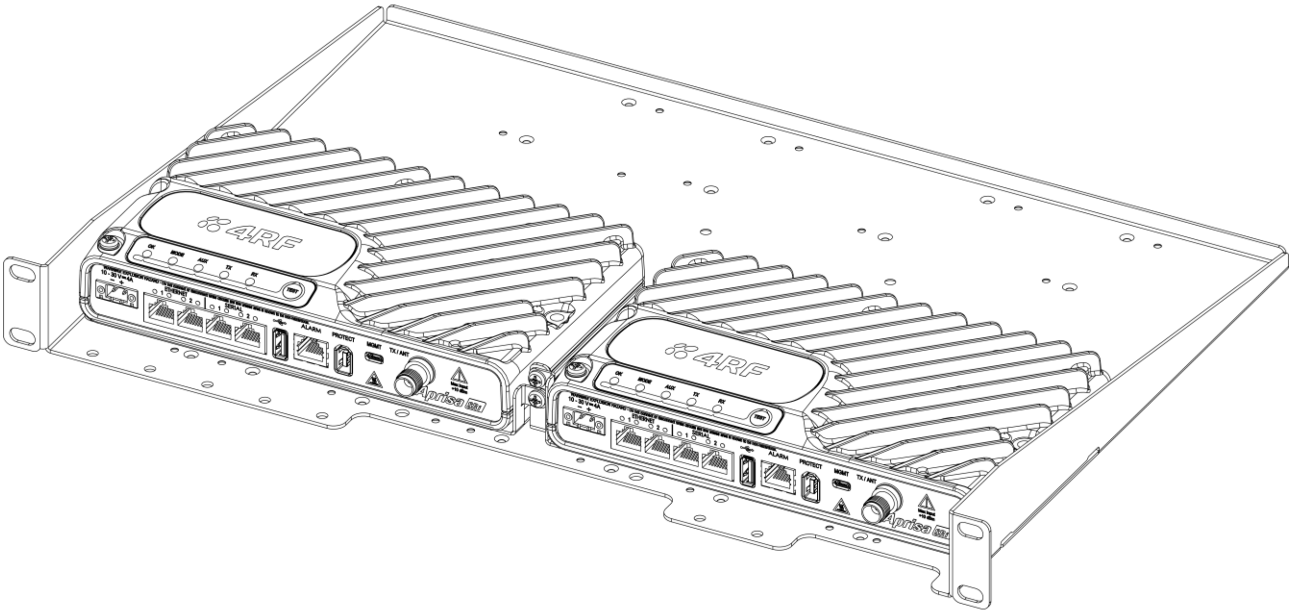
The Aprisa SRi is mounted into the DIN rail mounting bracket using the four M4 threaded holes in the Aprisa SRi enclosure base. Four 8 mm M4 pan pozi machine screws are supplied with the bracket.



Rack Shelf Mounting

The Aprisa SRi can be mounted on a rack mount shelf using the four M4 threaded holes in the Aprisa SRi enclosure base. The following picture shows Aprisa SRi mounted on a 1 RU rack mounted shelf.

Part Number	Part Description
APGA-MR19-X1U	4RF Acc, Mounting, 19" Rack Mount Shelf, 1 Rack Unit

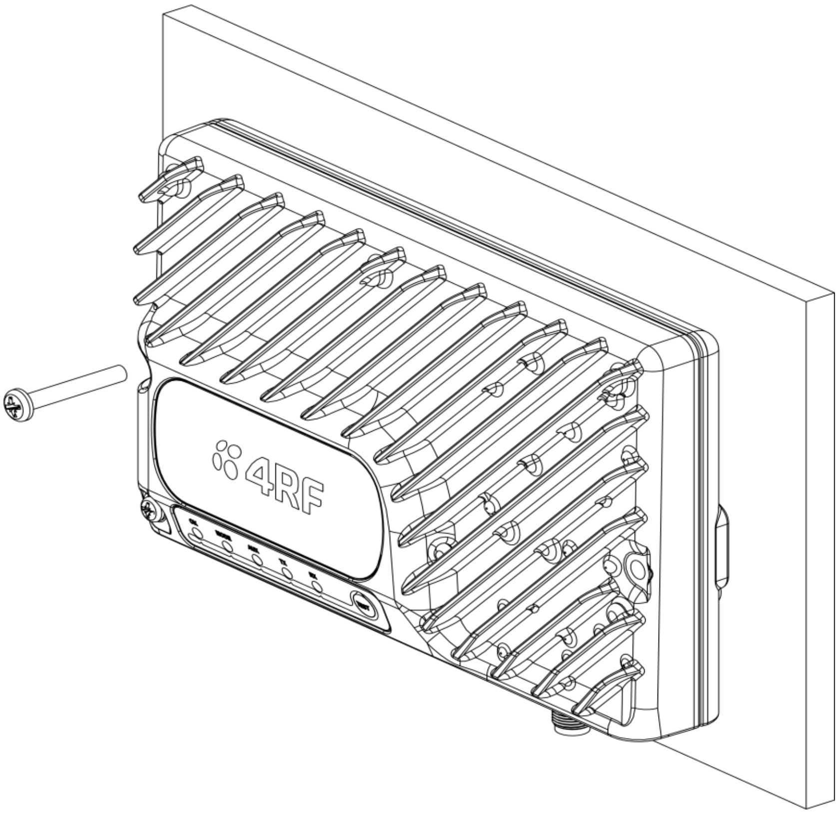


WARNING:

If the Aprisa SRi is operated in an environment where the ambient temperature exceeds 50°C, the Aprisa SRi convection air flow over the heat sinks must be considered.

Wall Mounting

The Aprisa SRi can be mounted on a wall using the two holes through the enclosure (5.2 mm diameter). Typically, M5 screws longer than 35 mm would be used.



Installing the Antenna and Feeder Cable

Carefully mount the antenna following the antenna manufacturers' instructions. Run feeder cable from the antenna to the radio location.

Lightning protection must be incorporated into the antenna system (see 'Earthing and Lightning Protection' on page 73).

WARNING:

When the link is operating, there is RF energy radiated from the antenna.
Do not stand in front of the antenna while the radio is operating (see the 'RF Exposure Warning' on page 3).

Fit the appropriate male or female connector (usually N-type) to the antenna feeder at the antenna end. Carefully follow the connector manufacturers' instructions.

Securely attach the feeder cable to the mast and cable trays using cable ties or cable hangers. Follow the cable manufacturer's recommendations about the use of feeder clips, and their recommended spacing.

Connect the antenna and feeder cable. Weatherproof the connection with a boot, tape or other approved method.

The Aprisa SRi antenna connection is a TNC female connector so the feeder / jumper must be fitted with a TNC male connector.

If a jumper is used between the feeder and the radio, connect a coaxial surge suppressor or similar lightning protector between the feeder and jumper cables (or at the point where the cable enters the equipment shelter). Connect the feeder cable to the antenna port on the radio.

Earth the case of the lightning protector to the site Lightning Protection Earth.

The Aprisa SRi has an earth connection point on the top left of the enclosure. M4 8mm pan pozi machine screws and M4 lock washers are supplied fitted to the radio. These screws can be used to earth the enclosure to a protection earth.

Connecting the Power Supply

The nominal input voltage for a radio is +13.8 VDC (negative earth) with an input voltage range of +10 to +30 VDC. The maximum power input is 25 W.

The power connector required is a Molex 2 pin female screw fitting part. This connector is supplied fitted to the radio.

The negative supply of the Aprisa SRi power connection is internally connected to the Aprisa SRi enclosure. Power must be supplied from a Negative Earthed power supply.

Wire your power source to power connector and plug the connector into the radio. The connector screws can be fastened to secure the connector.

Spare Molex 2 pin female power connectors can be ordered from 4RF:

Part Number	**Part Description**
APGS-CML2-FEM-01	4RF Spare, Connector, Molex 2 pin, Female, 1 item

Turn your power source on:

- All the radio LEDs will flash orange for one second and then the OK, MODE and AUX LEDs will light green, the TX and RX LEDs will flash red.
- The Aprisa SRi radio is ready to operate.
- The TX and RX LEDs will be green (steady or flashing) when the radio is registered with the network.

If the LEDs fail to light, carefully check the supply polarity. If the power supply connections have been accidentally reversed, internal fuses will have blown to protect the unit.

Spare fuses are contained within the radio, see ‘Spare Fuses’ on page 389 for instructions on how to locate and replace the fuses.

External Power Supplies

The following external power supplies are available from 4RF as accessories:

Part Number	**Part Description**
APSB-P230-030-24-TS	4RF Acc, PSU, 230 VAC, 30W, 24 VDC, -10 to +60C
APSB-P230-048-24-TE	4RF Acc, PSU, 230 VAC, 48W, 24 VDC, -20 to +75C
APSB-P230-060-24-TS	4RF Acc, PSU, 230 VAC, 60W, 24 VDC, -10 to +60C
APSB-P48D-050-24-TA	4RF Acc, PSU, 48 VDC, 50W, 24 VDC, 0 to +50C

7. Managing the Radio

SuperVisor

The Aprisa SRi contains an embedded web server application (SuperVisor) to enable element management with any major web browser. The currently supported Browsers are:

- Mozilla Firefox
- Microsoft Edge
- Google Chrome

SuperVisor enables operators to configure and manage the Aprisa SRi base station radio and remote radios over the radio link.

The key features of SuperVisor are:

- Full element management, configuration and diagnostics
- Manage the entire network from the Base Station (remote management of elements)
- Managed network software distribution and upgrades
- Performance and alarm monitoring of the entire network, including alarm states, time-stamped events, etc.
- View and set standard radio configuration parameters including frequencies, transmit power, channel access, serial, Ethernet port settings
- Set and view security parameters
- User management
- Operates over a secure HTTPS session on the access connection to the base station

Connecting to SuperVisor

The predominant management connection to the Aprisa SRi radio is with an Ethernet interface using standard IP networking. There should be only one Ethernet connection from the base station to the management network.

The Aprisa SRi has a factory default IP address of 169.254.50.10 with a subnet mask of 255.255.0.0. This is an IPv4 Link Local (RFC3927) address which simplifies the connection to a PC.

Each radio in the network must be set up with a unique IP address on the same subnet.

The Aprisa SRi Protected Station radio A (left radio) has a factory default IP address of 169.254.50.10 and radio B (right radio) has a factory default IP address of 169.254.50.20, both with a subnet mask of 255.255.0.0.

To change the Aprisa SRi IP address:

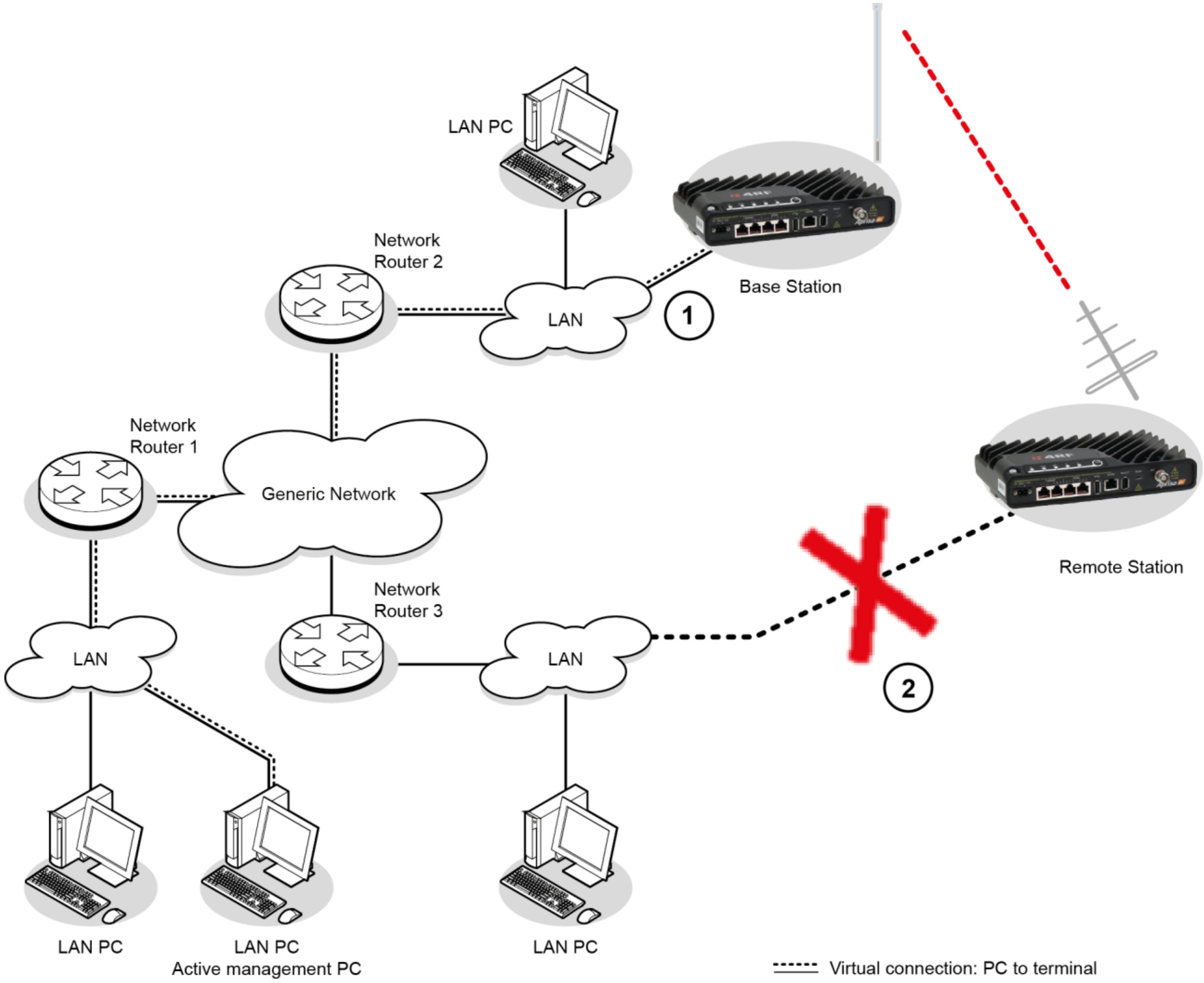
1. Set up your PC for a compatible IP address e.g. 169.254.50.1 with a subnet mask of 255.255.0.0.
2. Connect your PC network port to one of the Aprisa SRi Ethernet ports.
3. Open a browser and enter http://169.254.50.10.
4. Login to the radio with the default Username ‘admin’ and Password ‘admin’.
5. Change the IP address to conform to the network plan in use.

Note 1: When the radio Ethernet Operating Mode is Router Mode or Advanced Router Modes, users must connect to SuperVisor via Ethernet Port 1 to have full management functionality when performing remote management to the other radios on the network.

Note 2: Remote management functionality requires that on networks with mixed versions of software, the base station must be running the latest version of software that is used on the network.

Management PC Connection

The active management PC must only have one connection to the network as shown by path ①. There should not be any alternate path that the active management PC can use via an alternate router or alternate LAN that would allow the management traffic to be looped as shown by path ②.



When logging into a network, it is important to understand the relationship between the Local Radio and the Remote Radios.

The Local Radio is the radio that your IP network is physically connected to.

If the Local Radio is a base station, SuperVisor manages the base station and all the remote radios in the network.

If the Local Radio is a remote radio, SuperVisor only manages the remote radio logged into.

If the user is at the remote radio and connects SuperVisor directly to the remote radio via their computer, all relevant features are still available. This includes the ability to monitor the 'Last received packet RSSI. If ICMP is enabled on the base station, the user will also be able to ping the base station to confirm the connectivity.

PC Settings for SuperVisor

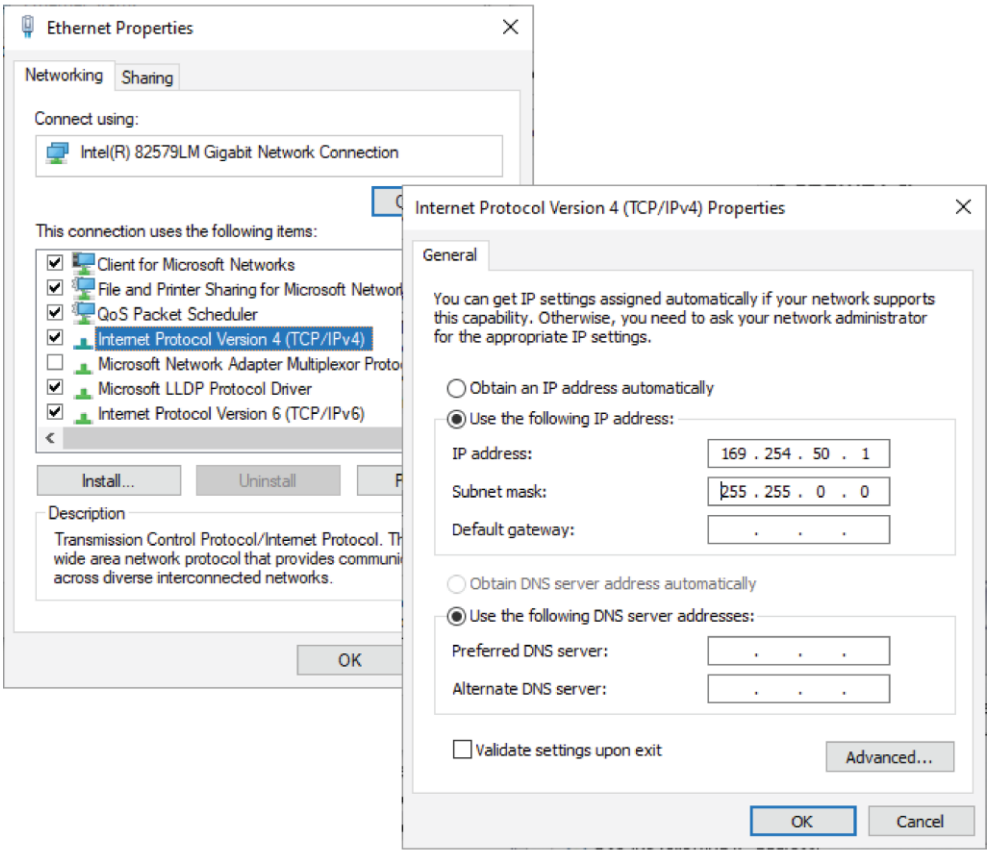
To change the PC IP address:

If your PC has previously been used for other applications, you may need to change the IP address and the subnet mask settings. You will require Administrator rights on your PC to change these.

Windows Example:

1. Open the ‘Control Panel’.
2. Open the ‘Network and Sharing Center’, click on the ‘Change Adapter Settings’ and select the network.
3. On the Ethernet Status window, click ‘Properties’.
4. Click on the ‘Networking’ tab.
5. Click on ‘Internet Protocol Version 4 (TCP/IPv4)’ and click on properties.
6. Enter the IP address and the subnet mask (example as shown).
7. Click ‘OK’ then close the Control Panel.

If the radio is on a different subnet from the network the PC is on, set the PC default gateway address to the network gateway address which is the address of the router used to connect the subnets (for details, consult your network administrator).



Login to SuperVisor

The maximum number of concurrent users that can be logged into a radio is 6.

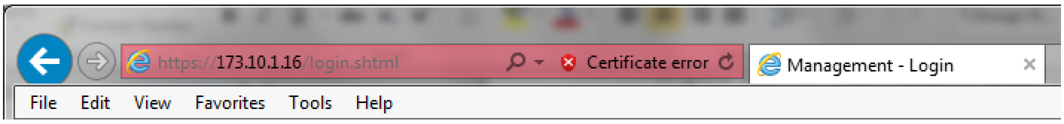
If SuperVisor is inactive for a period defined by the Inactivity Timeout option (see 'Maintenance > General' on page 235), the radio will automatically logout the user.

To login to SuperVisor:

1. Open your web browser and enter the IP address of the radio.

If you haven't assigned an IP address to the radio, use the factory default IP address of 169.254.50.10 with a subnet mask of 255.255.0.0.

If you don't know the IP address of the radio, you can determine it using the Command Line Interface (see 'Command Line Interface' on page 361).



Note: The Aprisa SRi has a randomly generated unique self-signed ECC256 security certificate which may cause the browser to prompt a certificate warning. It is safe to ignore the warning and continue. The valid certificate is 'Issued By: 4RF-APRISA' which can be viewed in the browser.

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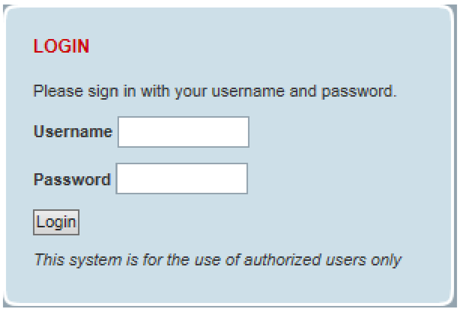
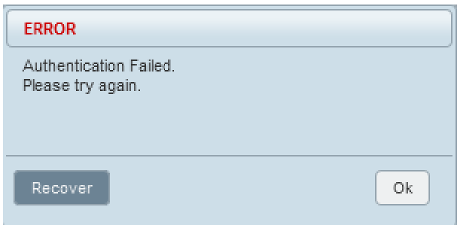
2. Login with the Username and Password assigned to you.

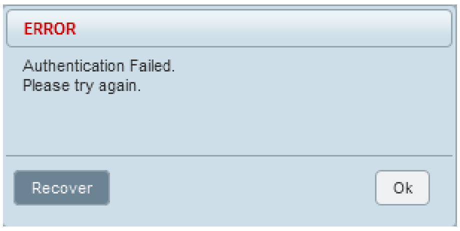
If unique usernames and passwords have not yet been configured, use the default username 'admin' and password 'admin'.



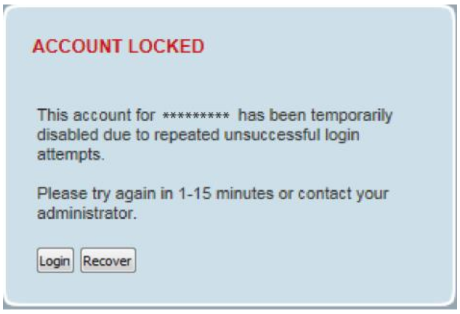
If the login fails, the pop-up will be displayed.



SuperVisor will display a warning popup upon multiple consecutive failed login attempts on the same account.

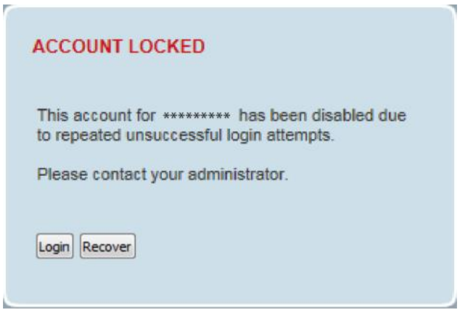


SuperVisor has login protection options which provide protection against unsuccessful login retries (see Security > Users 'Login Protection Mode' on page 214). If login protection is active and a login attempt failed due to temporary lockout of the account (Level 1 or Level 2 lockout), SuperVisor will display an 'Account Locked' message.



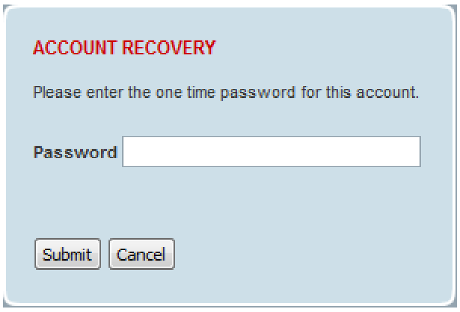
Login

If a login attempt failed due to permanent lockout of the account (continued failed login attempts even after levels 1 and 2 lockout periods), SuperVisor will display an 'Account Locked' message.

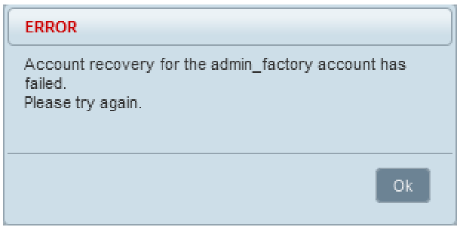


Recover

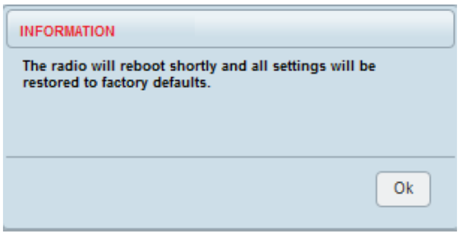
If a login attempt failed due to permanent lockout of the account or the Admin password is unknown, click the ‘Recover’ button to start the recovery process.



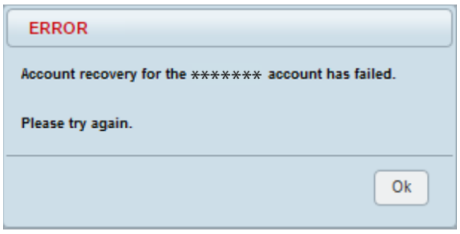
If the user account is not an ADMIN account, or if the account does not have an associated ‘Standard OPT’ password entered (see ‘One-time Password Recovery’ on page 220), SuperVisor will display an error message.



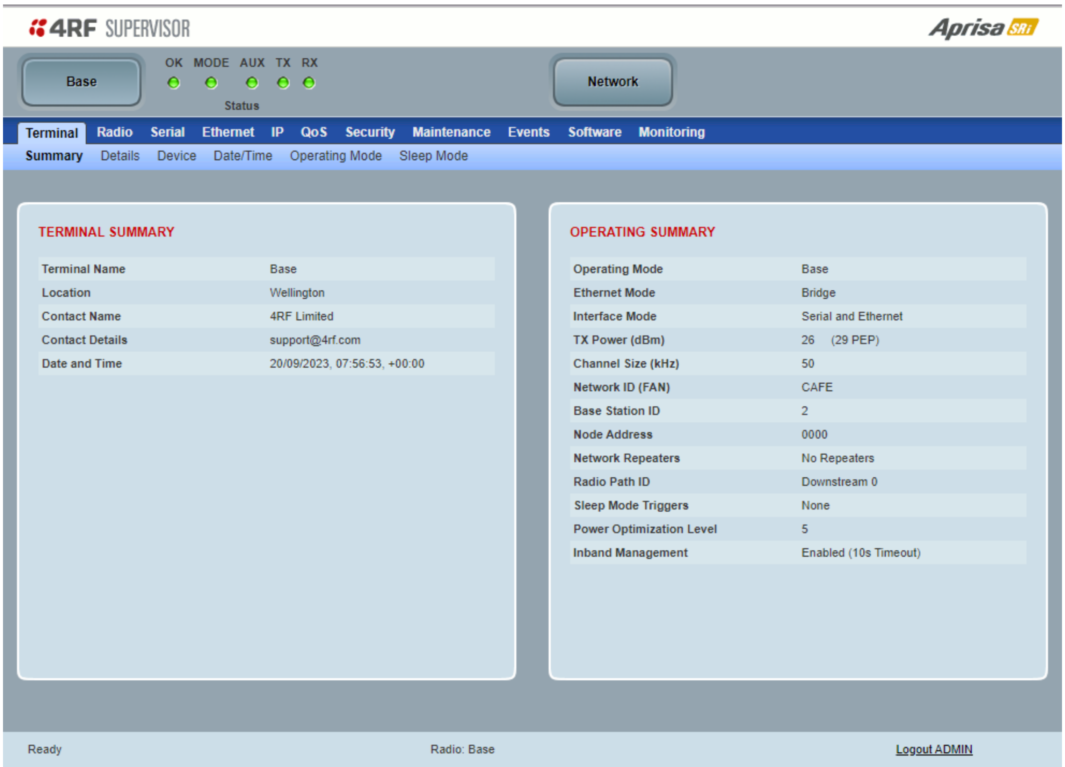
If a factory password was verified successfully during the account recover process, SuperVisor will display a message indicating that the radio will be reset to factory defaults and rebooted.



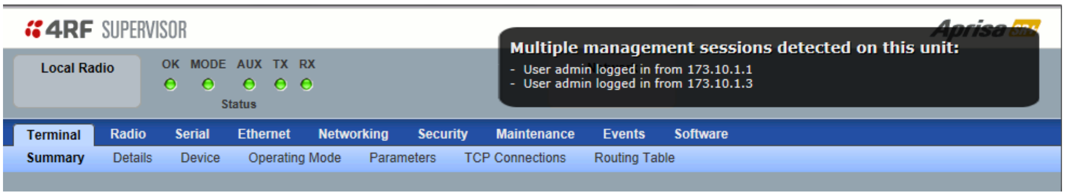
If the submitted password for the account recovery process was invalid, SuperVisor will display a message indicating that the recovery process has failed.



If the login is successful, the opening Terminal > Summary page will be displayed.



If there is more than one user logged into the same radio, the Multiple Management Sessions popup will show the usernames and IP addresses of the users. This popup message will display until 5 seconds after the cursor is moved. The event log will also record the users logged into the radio or logged out the radio.



Logout of SuperVisor

As the maximum number of concurrent users that can be logged into a radio is 6, not logging out correctly can restrict access to the radio until after the timeout period (30 minutes).

Logging out from a radio will logout all users logged in with the same username.

If the SuperVisor window is closed without logging out, the radio will automatically log the user out after a timeout period of 3 minutes.

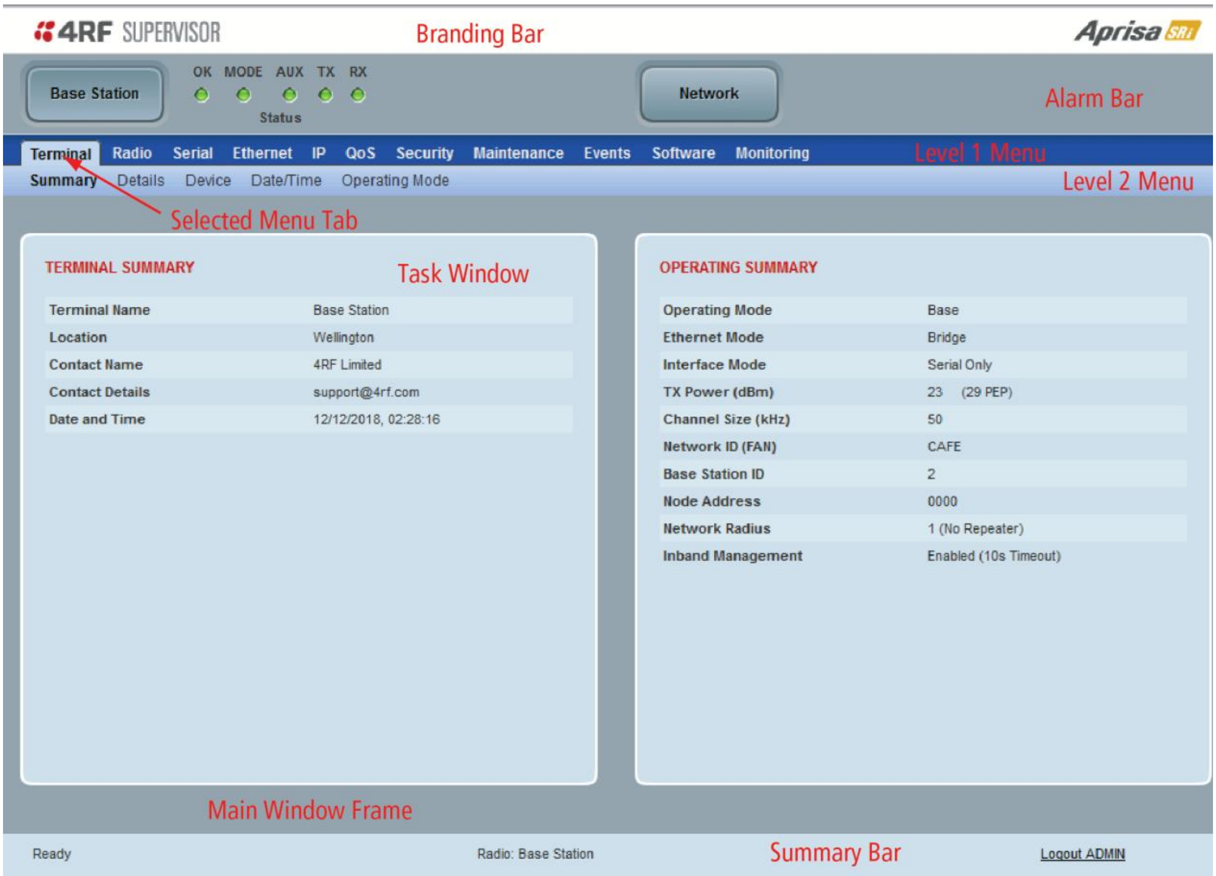
To logout of SuperVisor:

Click on the ‘Logout’ button on the Summary Bar.

SuperVisor Page Layout

Standard Radio

The following shows the components of the SuperVisor page layout for a standard radio:



SuperVisor Branding Bar

The branding bar at the top of the SuperVisor frame shows the branding of SuperVisor on the left and the product branding on the right.

SuperVisor Alarm Bar

The alarm bar shows the name of the radio terminal that SuperVisor is logged into (the local radio) on the left.

If the local radio is a base station, the page shows the name of the current remote radio (the remote radio) on the right. SuperVisor will manage all the remote radios in the network.

If the local radio is a remote radio, the page shows the name of the remote radio on the left. The right side of the Alarm Bar will be blank.

The LED alarm indicators reflect the status of the front panel LEDs on the radio.

SuperVisor Summary Bar

The summary bar at the bottom of the page shows:

Position	Function
Left	Busy - SuperVisor is busy retrieving data from the radio that SuperVisor is logged into. Ready - SuperVisor is ready to manage the radio.
Middle	Displays the name of the radio terminal that SuperVisor is currently managing.
Right	The access level logged into SuperVisor. This label also doubles as the SuperVisor logout button.

SuperVisor Extended Network Management (EXM)

Extended Network Management (EXM) extends SuperVisor management beyond the single radio network providing configuration and monitoring to other Aprisa SR family products down the RF path from the radio logged into. All radios that are then managed from one login become part of the extended network radio list.

A typical use of this new feature is where an Aprisa SRi radio network is connected to the 'tail end' of an Aprisa SR+ radio network where the Aprisa SRi base station is cable connected to the Ethernet port of an Aprisa SR+ remote radio. The connection between the Network Operations Centre (NOC) to the Aprisa SRi base station would be via the Over-The-Air path of the Aprisa SR+ base station's network.

Benefits Of EXM

Some of the benefits that will be seen from this enhancement include:

- Ability to use SuperVisor to manage any 4RF compatible radio units via the 'closest radio station'.
- A user can now simply establish a local connection with the closest radio and navigate to manage another radio down the RF path from the radio logged into.
- Ability to use SuperVisor to perform 'inverse remote management' – i.e. to manage the base station from any of its remote radios.
- When on site at a remote location, the user can now login to the remote radio and navigate to manage its base station.
- A user can now add any IP connectable radio to a SuperVisor session and utilize the Network Status monitoring feature to monitor radios network wide.
- SuperVisor can be left running long term on the 'Network Status > Summary' page to have a summarized status view of the whole monitored network.

The EXM feature will not be suitable for customers who use Port forwarding NAT configuration or One to One NAT in their existing setup.

Extended Network Management (EXM) Setup

1. Enable Network Extension Mode on all radios required in the extended network radio list including the radio logged into, the remote radio being used to extend management, the destination base station and any remote radios off that base station requiring management. See 'Security > Setup' on page 204 for the Network Extension Mode setting.

2. Ensure that the Network ID is the same on all radios in the extended network radio list (see 'Network ID' on page 102).

3. Ensure that the Key Encryption Key Type, Key Encryption Key Size and the Key Encryption Key are the same on all radios in the extended network radio list (see 'Security > Setup' on page 204).

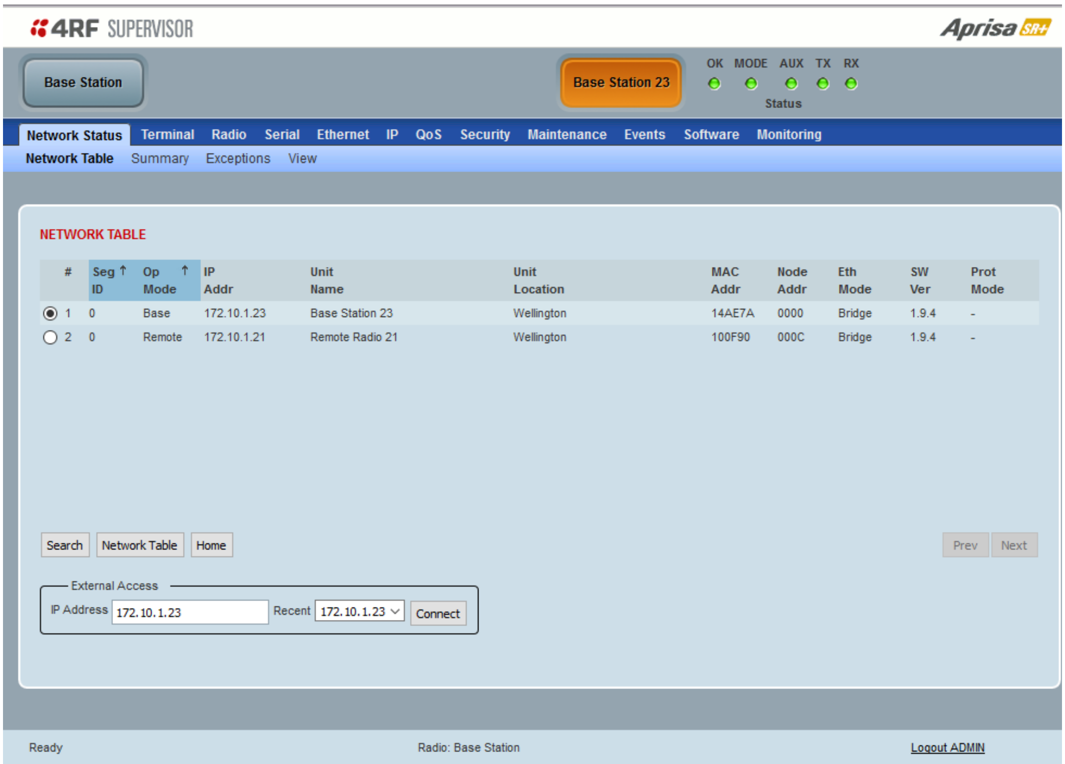
4. Click on the Network button on SuperVisor Alarm Bar (see 'Network Status > Network Table' on page 303).

5. In the External Access box, enter the IP address of the external radio and click the Connect button.

If this connection is successful:

- The Network Button will show the name of the radio connected to
- The LEDs next to the Network button will display the status of the radio connected to
- Clicking any top-level menu after the connection is established will open the page for the radio connected to

The Network Table shows the radio connected to. To see the complete Network Table of the radio connected to, click the Network Table button.



SuperVisor Menu

The SuperVisor menu has varying access levels dependent on the login User Privileges.

The following is a list of all possible SuperVisor menu items versus user privileges:

Terminal Settings Menu Items

Menu Item	View	Technician	Engineer	Admin
Terminal > Summary	Read-Only	Read-Only	Read-Only	Read-Only
Terminal > Details	Read-Only	Read-Only	Read-Only	Read-Only
Terminal > Device	No Access	Read-Write	Read-Write	Read-Write
Terminal > Date / Time	Read-Only	Read-Only	Read-Only	Read-Only
Terminal > Operating Mode	No Access	Read-Write	Read-Write	Read-Write
Terminal > Sleep Mode	No Access	Read-Write	Read-Write	Read-Write
Radio > Radio Summary	Read-Only	Read-Only	Read-Only	Read-Only
Radio > Channel Summary	Read-Only	Read-Only	Read-Only	Read-Only
Radio > Zone Summary	Read-Only	Read-Only	Read-Only	Read-Only
Radio > Radio Setup	No Access	Read-Write	Read-Write	Read-Write
Radio > Channel Setup	No Access	Read-Write	Read-Write	Read-Write
Radio > Zone Setup	No Access	Read-Write	Read-Write	Read-Write
Radio > Advanced Setup	No Access	Read-Write	Read-Write	Read-Write
Serial > Summary	Read-Only	Read-Only	Read-Only	Read-Only
Serial > Port Setup	No Access	Read-Write	Read-Write	Read-Write
Ethernet > Summary	Read-Only	Read-Only	Read-Only	Read-Only
Ethernet > Port Setup	No Access	Read-Write	Read-Write	Read-Write
Ethernet > L2 Filtering	No Access	No Access	Read-Write	Read-Write
Ethernet > VLAN	No Access	No Access	Read-Write	Read-Write
IP > IP Summary	Read-Only	Read-Only	Read-Only	Read-Only
IP > Terminal Server Summary	Read-Only	Read-Only	Read-Only	Read-Only
IP > IP Setup	No Access	Read-Write	Read-Write	Read-Write
IP > Terminal Server Setup	No Access	Read-Write	Read-Write	Read-Write
IP > L3 Filtering	No Access	No Access	Read-Write	Read-Write
IP > IP Routes	No Access	No Access	Read-Write	Read-Write
IP > NAT	No Access	No Access	Read-Write	Read-Write
QoS > Summary	Read-Only	Read-Only	Read-Only	Read-Only
QoS > Traffic Priority	No Access	No Access	Read-Write	Read-Write
QoS > Traffic Classification	No Access	No Access	Read-Write	Read-Write
Security > Summary	Read-Only	Read-Only	Read-Only	Read-Only
Security > Setup	No Access	No Access	Read-Write	Read-Write
Security > Users	No Access	No Access	No Access	Read-Write
Security > RADIUS	No Access	No Access	No Access	Read-Write
Security > SNMP	No Access	No Access	No Access	Read-Write
Security > Manager	No Access	No Access	Read-Write	Read-Write

Menu Item	View	Technician	Engineer	Admin
Security > Distribution	No Access	No Access	Read-Write	Read-Write
Maintenance > Summary	Read-Only	Read-Only	Read-Only	Read-Only
Maintenance > General	No Access	Read-Write	Read-Write	Read-Write
Maintenance > Modem	No Access	Read-Write	Read-Write	Read-Write
Maintenance > Defaults	No Access	No Access	No Access	Read-Write
Maintenance > Licence	No Access	No Access	Read-Write	Read-Write
Maintenance > Files	No Access	No Access	Read-Write	Read-Write
Maintenance > Advanced	No Access	No Access	Read-Write	Read-Write
Events > Alarm Summary	Read-Only	Read-Only	Read-Only	Read-Only
Events > Event History	Read-Only	Read-Only	Read-Only	Read-Only
Events > Event Primary History	Read-Only	Read-Only	Read-Only	Read-Only
Events > Event Secondary History	Read-Only	Read-Only	Read-Only	Read-Only
Events > Events Setup	No Access	No Access	Read-Write	Read-Write
Events > Traps Setup	No Access	No Access	Read-Write	Read-Write
Events > Alarm I/O Setup	Read-Only	Read-Only	Read-Write	Read-Write
Events > Event Action Setup	No Access	No Access	Read-Write	Read-Write
Events > Syslog	No Access	No Access	Read-Write	Read-Write
Events > Defaults	No Access	No Access	Read-Write	Read-Write
Software > Summary	Read-Only	Read-Only	Read-Only	Read-Only
Software > Setup	No Access	No Access	Read-Write	Read-Write
Software > File Transfer	No Access	No Access	Read-Write	Read-Write
Software > File Primary Transfer	No Access	No Access	Read-Write	Read-Write
Software > File Secondary Transfer	No Access	No Access	Read-Write	Read-Write
Software > Manager	No Access	No Access	Read-Write	Read-Write
Software > Remote Distribution	No Access	No Access	Read-Write	Read-Write
Software > Remote Activation	No Access	No Access	Read-Write	Read-Write
Monitoring > Terminal	Read-Only	Read-Only	Read-Only	Read-Only
Monitoring > Serial	Read-Only	Read-Only	Read-Only	Read-Only
Monitoring > Ethernet	Read-Only	Read-Only	Read-Only	Read-Only
Monitoring > Radio	Read-Only	Read-Only	Read-Only	Read-Only
Monitoring > Interface	Read-Only	Read-Only	Read-Only	Read-Only
Monitoring > User Selected	Read-Only	Read-Only	Read-Only	Read-Only
Monitoring > TCP Connections	Read-Only	Read-Only	Read-Only	Read-Only
Monitoring > Routing Table	Read-Only	Read-Only	Read-Only	Read-Only
Monitoring > Address Tables	Read-Only	Read-Only	Read-Only	Read-Only
Monitoring > NAT	Read-Only	Read-Only	Read-Only	Read-Only

Network Settings Menu Items

Menu Item	View	Technician	Engineer	Admin
Network Table	Read-Only	Read-Only	Read-Only	Read-Only
Summary	Read-Only	Read-Only	Read-Only	Read-Only
Exceptions	Read-Only	Read-Only	Read-Only	Read-Only
View	Read-Only	Read-Only	Read-Only	Read-Only

SuperVisor Menu Items

As SuperVisor screens are dependent on the Aprisa SRi configuration deployed, the following section is split into two sections:

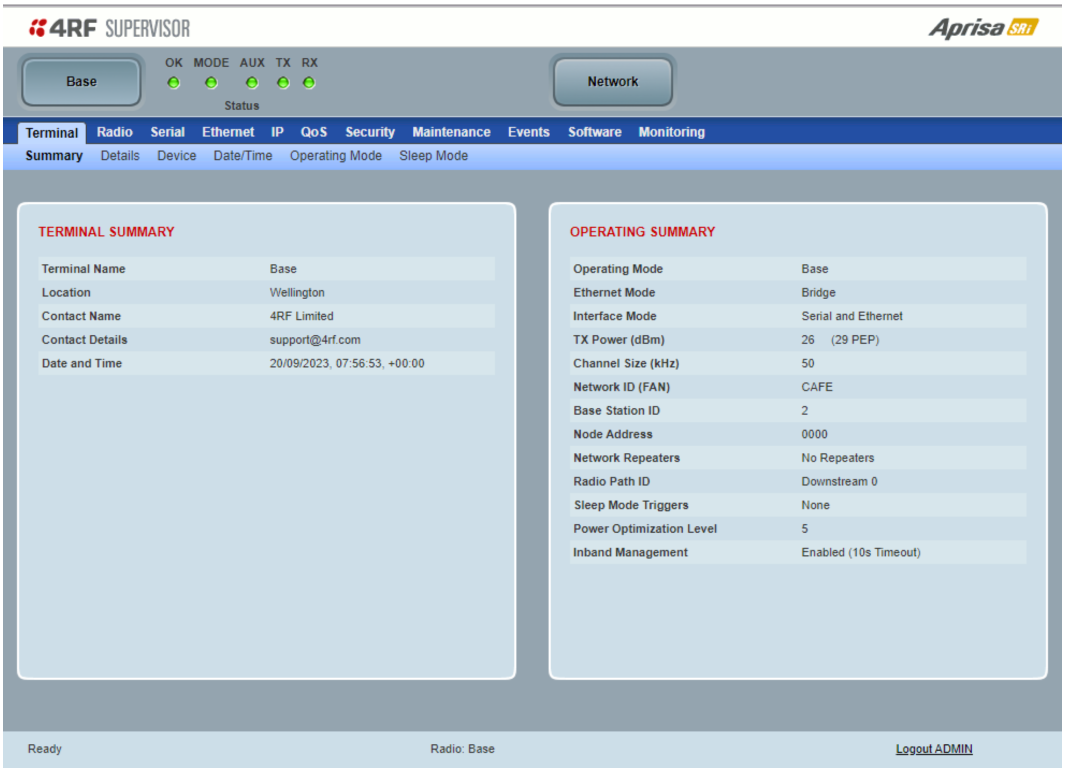
- Standard Radio
- Protected Station

All SuperVisor menu item descriptions assume full access 'Admin' user privileges:

Standard Radio

Terminal

Terminal > Summary



TERMINAL SUMMARY

This page displays the current settings for the Terminal parameters. See 'Terminal > Details' on page 98, 'Terminal > Device' on page 100 and 'Terminal > Operating Mode' on page 107 for setting details.

OPERATING SUMMARY

Operating Mode

This parameter displays the current Operating Mode i.e. if the radio is operating as a base station or remote radio and the network operating mode of Bridge Mode or Router Mode.

Interface Mode

This parameter displays the Interfaces available for traffic on the radio such as Ethernet and Serial. For Ethernet availability on the radio see 'Maintenance > Licence' on page 241.

TX Power (dBm)

This parameter displays the current Transmit Power in dBm.

Channel Size (kHz)

This parameter displays the current Channel Size in kHz.

Network ID

This parameter is the network ID of this base station node and its remote radios in the network. The entry is four hex chars (not case sensitive).

Base Station ID

This parameter identifies the base station. All radios operating to the base station in the same network must use the same Base Station ID setting.

It is especially important to set different values for each network when two or more networks using the same frequencies are operating with some overlapping coverage. The entry is an integer from 1 to 32.

Node Address

The Node Address of the base station is 0000.

If the Node Address shown is FFFE, this radio is a remote radio but has not been registered with the base station.

The base station will automatically allocate a Node Address to all its registered remote radios. This address can be between 000B to 01FE.

Network Repeaters

This parameter displays the repeaters in the network.

Radio Path ID

This parameter displays either the Radio Path Downstream ID (Base Station and Repeaters) or the Radio Path Upstream ID (Remote Radios and Repeaters).

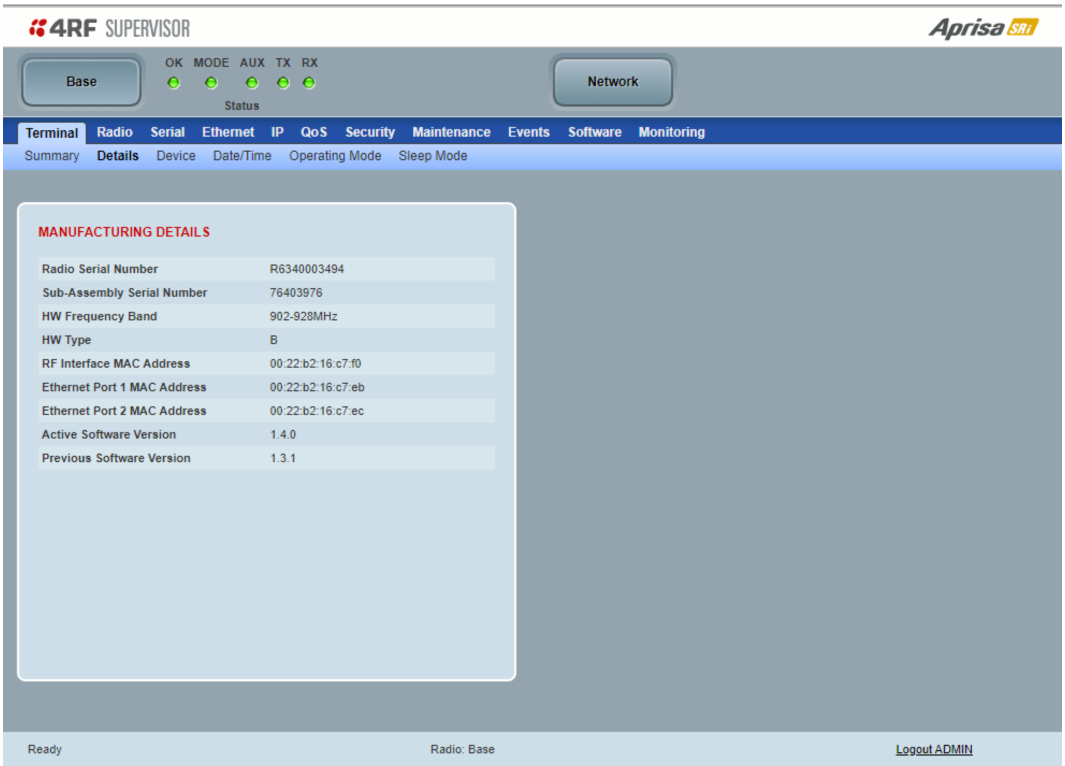
Inband Management

This parameter displays the status of the Inband Management option.

Inband Management Timeout (sec)

This parameter displays the number of seconds that the base station waits for a response from a remote radio before aborting the Inband Management request.

Terminal > Details



MANUFACTURING DETAILS

Radio Serial Number

This parameter displays the Serial Number of the radio (shown on the enclosure label).

Sub-Assembly Serial Number

This parameter displays the Serial Number of the printed circuit board assembly (shown on the PCB label).

HW Frequency Band

This parameter displays the hardware radio frequency operating range.

HW Type

This parameter displays the hardware board assembly type.

Radio MAC Address

This parameter displays the MAC address of the radio (the management Ethernet MAC address).

Active Software Version

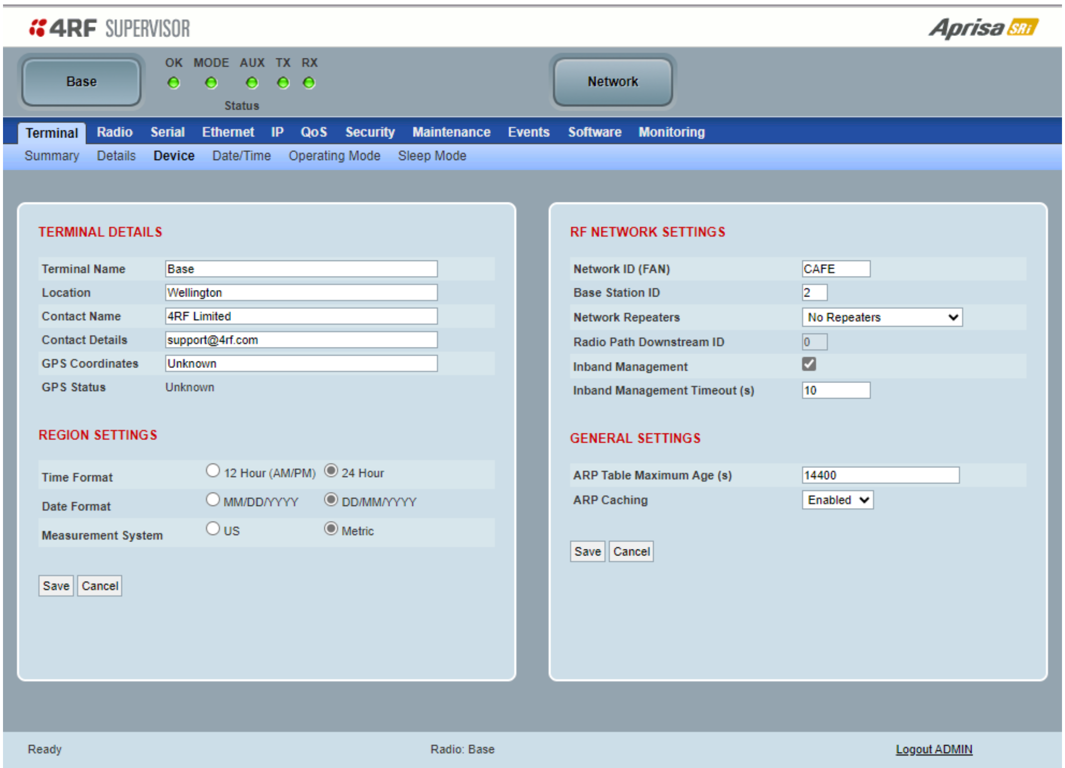
This parameter displays the version of the software currently operating the radio.

Previous Software Version

This parameter displays the software version that was running on the radio prior to the current software being activated.

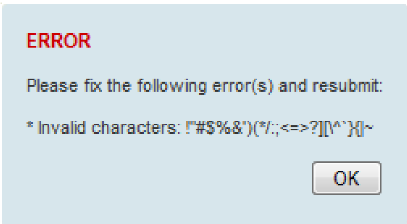
A new radio from the factory will display 'None' for the Previous SW Version.

Terminal > Device



TERMINAL DETAILS

The data entry in the next four fields can be up to 40 characters but cannot contain invalid characters. A popup warns of the invalid characters:



1. Enter the Terminal Name.
2. Enter the Location of the radio.
3. Enter a Contact Name. The default value is ‘4RF Limited’.
4. Enter the Contact Details. The default value is ‘support@4RF.com’.

GPS Coordinates

This parameter sets the GPS Coordinates for the radio location. It can be manually entered and saved or if the radio is fitted with a GPS Receiver, it can be set by clicking on the Update GPS button. The entry is two values of latitude and longitude comma delimited;

- The Latitude value must be a decimal number anywhere from -90 to 90
- The Longitude value must be a decimal number anywhere from -180 to 180

GPS Status

This field displays the status of the GPS Receiver if enabled (see ‘GPS Receiver’ on page 147).

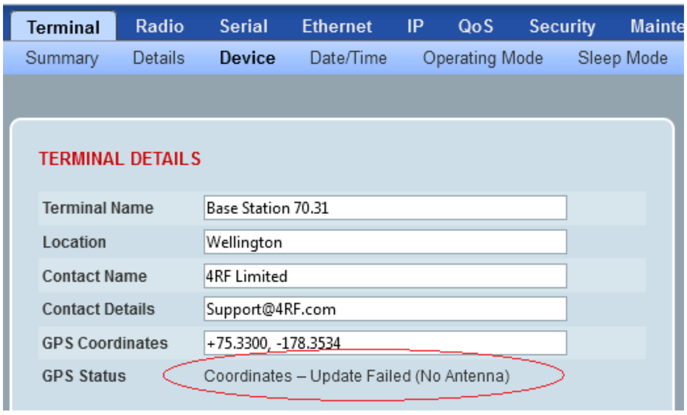
The GPS Horizontal Dilution Of Precision (HDOP) information provides a GPS signal quality rating;

DOP Value	Rating	Description
< 1	Ideal	Highest possible confidence level to be used for applications demanding the highest possible precision at all times.
1-2	Excellent	At this confidence level, positional measurements are considered accurate enough to meet all but the most sensitive applications.
2-5	Good	Represents a level that marks the minimum appropriate for making business decisions. Positional measurements could be used to make reliable in-route navigation suggestions to the user.
5-10	Moderate	Positional measurements could be used for calculations, but the fix quality could still be improved. A more open view of the sky is recommended.
10-20	Fair	Represents a low confidence level. Positional measurements should be discarded or used only to indicate a very rough estimate of the current location.
>20	Poor	At this level, measurements are inaccurate by as much as 300 meters with a 6-meter accurate device (50 DOP × 6 meters) and should be discarded.

Controls

The Update GPS button updates the GPS Coordinates field from the installed USB GPS Receiver.

If the GPS Receiver is enabled but is not operating or not receiving a valid GPS signal, the GPS Status will show ‘Update Failed’.



REGION SETTINGS

Time Format

This parameter sets the time format for all time-based results.

The default setting is 24 Hours.

Date Format

This parameter sets the date format for date-based results.

The default setting is DD/MM/YYYY.

Measurement System

This parameter sets the unit type for parameters like temperature readings.

The default setting is Metric.

RF NETWORK DETAILS

Network ID

This parameter sets the network ID of this base station node and its remote radios in the network. The entry is four hexadecimal chars (not case sensitive).

The default setting is CAFE.

Base Station ID

This parameter identifies the base station. All radios operating to the base station in the same network must use the same Base Station ID setting.

It is especially important to set different values for each network when two or more networks using the same frequencies are operating with some overlapping coverage. The entry is an integer from 1 to 32.

Network Repeaters

This parameter is set in base stations, remote radios, and repeater stations to indicate the use or not of repeaters in the network. All radios in the network must be set the same.

Option	Function
No Repeater	Use when regular PMP network operation is required.
One or more repeaters	Use when there is one or more repeaters in the network. Can support up to 31 multiple repeaters at any depth. Configuration and network typology is done by setting Upstream and Downstream IDs at the repeater where the base station only supports Downstream ID and remote radios only supports Upstream ID.

Radio Path Downstream ID (Base Station and Repeaters Only)

This parameter sets the Radio Path Upstream ID that this radio will allow connections from. Remotes or Repeaters which intend to connect to this device must have matching Radio Path Upstream IDs. The Base station must be set to 0. Allowed values on repeaters are 0 to 31.

Radio Path Upstream ID (Repeaters and Remotes Only)

This parameter sets the Radio Path Downstream ID that this radio will connect to. This value must match the Radio Path Downstream ID set in the Base or Repeater that this device is connecting to. Allowed values are 0 to 31.

Inband Management

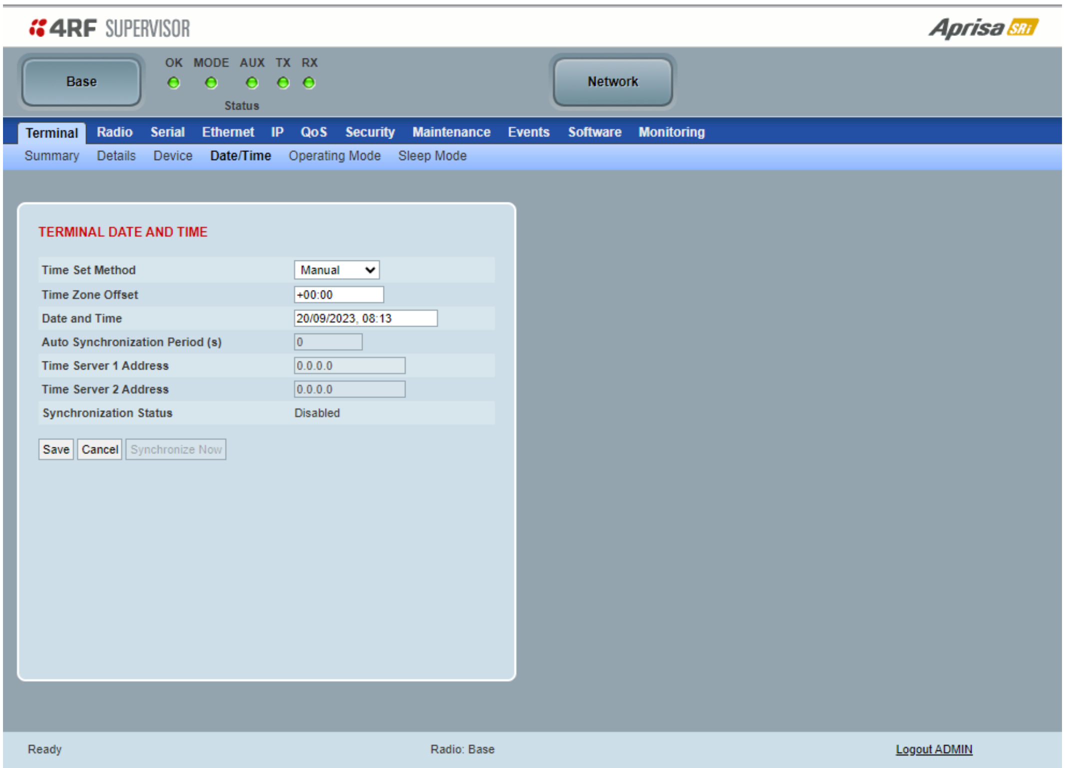
This parameter sets the Inband Management option.

If the Inband Management option is enabled, SuperVisor operating on a base station can also manage all the remote radios in the network.

Inband Management Timeout (sec)

This parameter sets the Inband Management timeout period. This determines the time the base station waits for a response from a remote before aborting the Inband Management request. The default setting is 10 seconds.

Terminal > Date / Time



TERMINAL DATE AND TIME

Sets the radio Date and Time. This information is controlled from a software clock.

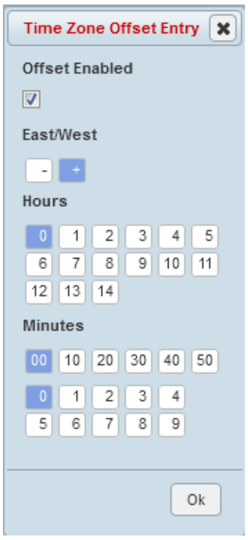
Time Set Method

This parameter sets the method for setting the Date and Time. The default setting is Manual.

Option	Function
Manual	Manual entry of Date and Time
SNTP	Date and Time Synchronization feature allows a radio to synchronize its date and time from an SNTP server. Using the SNTP feature will ensure that all radios in the network has the same date and time required for accurate network diagnostics. Configure SNTP on the base station which then sends the date and time to all the remote radios. It can be configured on a remote radio if required but not on all remotes as SNTP requests could overload the network. For high availability time/date synchronization, SNTP can be synchronized from two SNTP servers for server backup.

Time Zone Offset

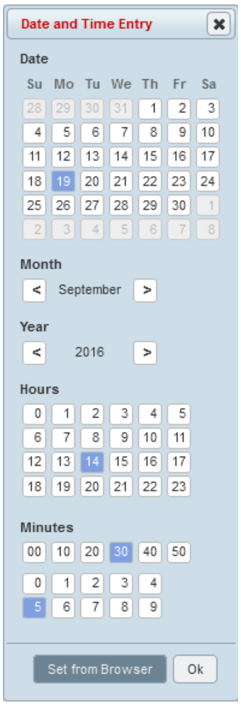
The Time Zone Offset is the number of hours / minutes offset from UTC time. The default setting is 'No Offset'. Clicking the Time Zone Offset field brings up a pop-up to enter the offset.



After selecting the offset, review the current date and time before saving the changes.

Date and Time

This sets the radio Date and Time. Clicking the Date and Time field brings up a pop-up to enter the date and time.



The 'Set from Browser' button sets the date and time directly from the browser date and time.

If the Set from Browser button is used and the offset for the browser and the radio are different, then SuperVisor will adjust the time displayed in the text box to be the local time for the radio e.g. clicking 5pm in Sydney (+10:00) will put 3 pm in the text box for a Perth based radio (+08:00).

Auto Synchronization Period (s)

This parameter sets the number of seconds between the end of the last SNTP server synchronization and the next SNTP server synchronization attempt. The minimum period is 60 seconds. A period of 0 seconds will disable SNTP server synchronization attempts.

The base station sends a broadcast message to the remote radios to synchronize the radio date and time at a rate controlled by the Announcement Period (see page 247).

Time Server 1 Address

This parameter sets the IP address of the first priority SNTP server. If the synchronization is successful to this server, Time Server 2 Address will not be used.

Time Server 2 Address

This parameter sets the IP address of the second priority SNTP server. If the synchronization fails using the SNTP server on Time Server 1 Address, synchronization will be attempted to the SNTP server on this address.

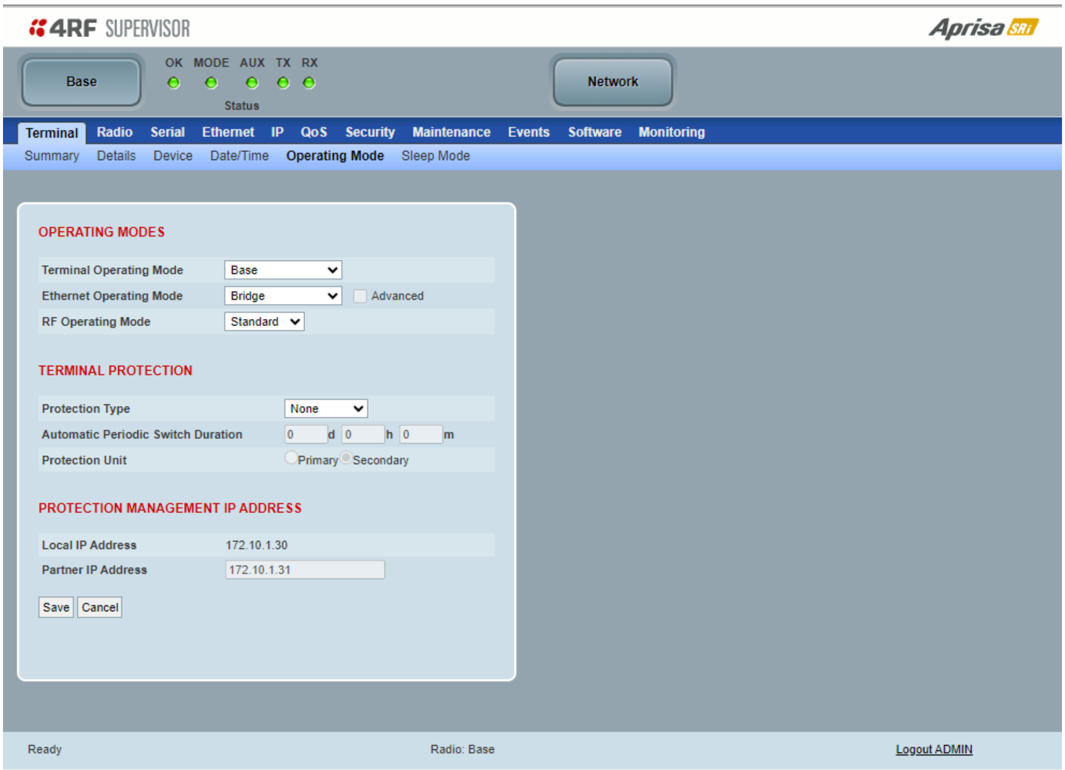
Synchronization Status

This field shows the status of the current synchronization or the result of the last synchronization.

Synchronize Now

This Synchronize Now button provides manual Synchronization.

Terminal > Operating Mode



OPERATING MODES

Terminal Operating Mode

The default setting is Remote.

Option	Function
Base	The base station manages all traffic activity between itself and remotes. It is the center-point of the network where in most cases will be connected to a SCADA master.
Base Repeater	The base-repeater has the same function as the base station but used when peer to peer connections between remotes is required via the base station.
Repeater	The Repeater operating mode forwards packets coming from base station and other repeaters e.g. in daisy chain LBS mode and /or remote radios.
Remote	The remote in most cases is used as the end-point of the SCADA network connected to an RTU or PLC device for SCADA network control and monitoring.

Ethernet Operating Mode

The Ethernet Operating Mode defines how Ethernet / IP traffic is processed in the radio. The default setting is Bridge.

Option	Function
Bridge	Bridge mode inspects each incoming Ethernet frame source and destination MAC addresses to determine if the frame is forwarded over the radio link or discarded.
Gateway Router	Gateway Router mode inspects each incoming IP source and destination IP addresses to determine if the packet is forwarded over the radio link or discarded. In this mode, all Ethernet interfaces have the same IP address and subnet.
Router	Router mode inspects each incoming IP source and destination IP addresses to determine if the packet is forwarded over the radio link or discarded. In this mode, each Ethernet interface has a different IP address and subnet.

Advanced

Enabled for Gateway Router and Router modes only. The default setting is unticked.

To enable Advanced routing, select the operating mode; Router or Gateway Router and tick the Advanced checkbox.

Advanced Gateway Router mode (AGRM) or Advanced Router mode (ARM) act like a true router between the Ethernet ports and RF interface port where the next hop is one of these ports. This means that the RF interface is a public interface exposed to the user with IP and MAC address like the Ethernet interface.

In AGRM mode, all Ethernet interfaces have the same IP address and subnet.

In ARM mode, each Ethernet interface has a different IP address and subnet.

See 'Advanced Gateway Router Mode (AGRM) and Advanced Router Mode (ARM)' on page 37 for a detailed explanation of advanced router modes.

Note 1: The Network Address Translation feature works only in Advanced Router or Advanced Gateway Router operating mode (see 'IP > NAT' on page 171).

Note 2: When the radio Ethernet Operating Mode is Router Mode or Advanced Router Modes, users must connect to SuperVisor via Ethernet Port 1 to have full management functionality when performing remote management to the other radios on the network.

RF Operating Mode

The RF Operating Mode defines the operation of the RF over-the-air. The default setting is Standard.

Option	Function
Standard	The radio operates normally.
Disabled	Disables all RF over-the-air communications from the RF port and turns off the transmitter and receiver to save power. This enables a radio to be used as a Terminal Server without RF.

TERMINAL PROTECTION

Protection Type

The Protection Type defines if a radio is a stand-alone radio or part of an Aprisa SRi Protected Station. The default setting is None.

Option	Function
None	The SRi radio is stand-alone radio (not part of an Aprisa SRi Protected Station).
Redundant (Protected Station)	Set to make this SRi radio part of an Aprisa SRi Protected Station. The RF ports and interface ports from two standard Aprisa SRi radios are switched to the standby radio if there is a failure in the active radio.

Automatic Periodic Switch Duration

The Automatic Periodic Switch Duration sets the time interval for automatic switchover from the active radio to the standby radio.

This feature will automatically switchover from the active radio to the standby radio if there are no alarms preventing the switchover to the standby radio. It can be used to provide confidence that the standby radio is still operational, maybe after many days of standby operation.

The maximum number of days that can be set is 49 days.

The default setting is 0 which disables the automatic switchover feature.

Protection Unit

The Protection Unit defines if this radio is the primary radio or secondary radio in a Protected Station.

One radio in the Protected Station is set to Primary and the other radio to Secondary.

It is recommended that radio A (the left radio) be configured as the Primary and that radio B (the right radio) be configured as the Secondary. The default setting is Primary.

This menu item is only applicable if this radio is to become part of an Aprisa SRi Protected Station.

PROTECTION MANAGEMENT IP ADDRESS

Local IP Address

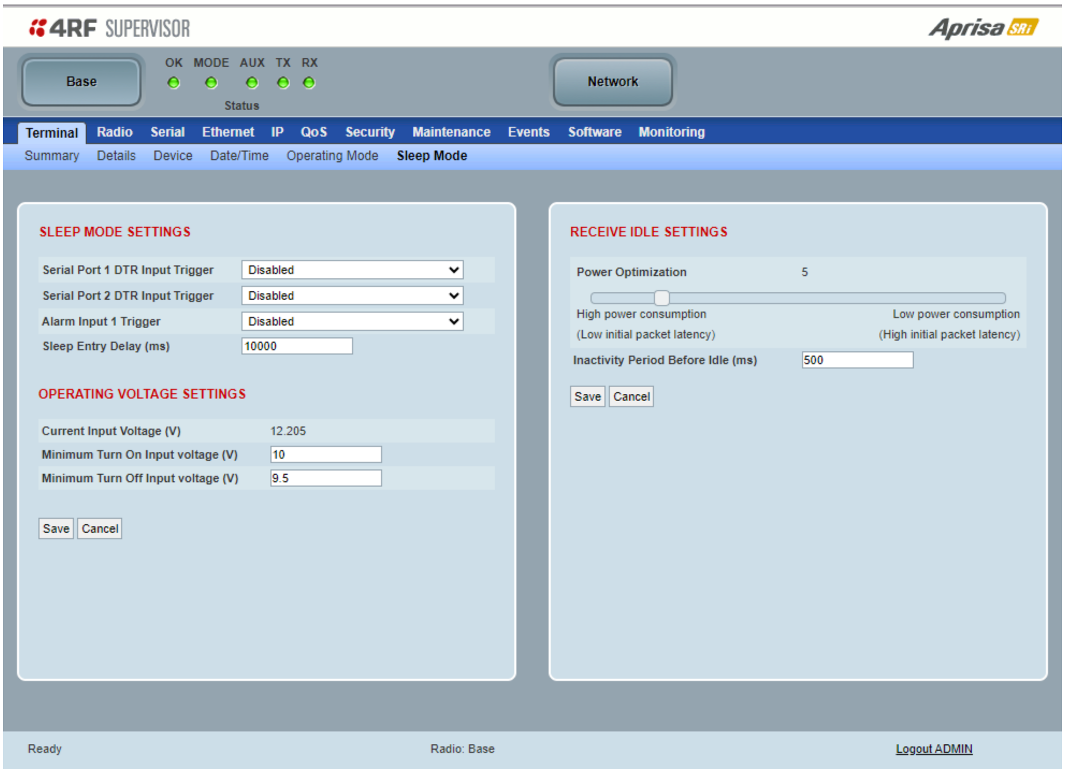
The Local IP Address shows the IP address of this radio.

Partner IP Address

The Partner IP Address parameter is used to set the partner IP address if this radio is to become part of a Protected Station.

Terminal > Sleep Mode

This is the Aprisa SRi remote radio Sleep Mode page.



SLEEP MODE SETTINGS

Sleep mode allows the radio to be put to sleep where it consumes very little power (< 0.5 watts with all Ethernet ports disabled) but allows rapid wake up. Once awake, remote devices will typically re-associate with the SRi network within 3 seconds, but this depends on signal conditions.

The sleep and wake up is controlled from the Alarm Input 1 or serial port DTR triggers. The Aprisa SRi will be in sleep mode if one or more of the Alarm Input 1 or serial port DTR triggers are set to Enabled, and one or more of the enabled sleep triggers are active. If sleep mode is enabled for serial port DTR trigger and the customer serial interface is not connected, the radio will sleep.

When radio is in sleep mode, the OK LED pulses once per second at a colour depending on the current state of the OK LED before sleep mode was entered and the other LEDs will be OFF.

Sleep mode will be disabled and sleeping radio will be woken up while a management user is logged into the radio or when a USB CLI cable is inserted in the management port.

Sleep mode will be disabled and sleeping radio will be woken up when an Ethernet cable is inserted into an enabled Ethernet port configured for ‘management and user data’, however 60 seconds after insertion, the radio will be allowed to enter sleep unless the user has logged into SuperVisor.

Pressing the radio ‘test’ button will also wake up a sleeping radio for 5 minutes.

Triggers

The triggers when enabled cause the radio to sleep or wake up. For the radio to sleep, all the enabled triggers must be OFF i.e., if only one enabled trigger goes ON, the radio will wake up.

Serial Port 1 / 2 DTR Trigger

The Serial Port 1 / 2 DTR Trigger controls the radio sleep and wake up. The default setting is Disabled.

Option	Function
Disabled	The Serial Port DTR has no effect on sleep mode.
Active Low (sleep when input is low)	The Serial Port DTR ON state causes the radio to wake up and the DTR OFF state allows the radio to sleep. Note: There must be valid RS-232 signals on either the RTS or RX lines for the radio to go to sleep (when DTR is ON).

The RS-232 specification defines valid control states as:

- ON state or 0-state (SPACE) condition = +3 to +12 volts
- OFF state or 1-state (MARK) condition = -3 to -12 volts

Alarm Input 1 Trigger

The Alarm Input 1 Trigger controls the radio sleep and wake up. The default setting is Disabled.

Option	Function
Disabled	The Alarm Input 1 has no effect on sleep mode.
Active Low(sleep when input is low)	The Alarm Input 1 high (ON) state causes the radio to wake up and the low (OFF) state allows the radio to sleep (see 'Alarm Inputs' on page 419 for alarm input specification). Note: If the alarm input is disconnected (e.g., alarm cable unplugged), the radio will go to sleep.

Sleep Entry Delay (ms)

The SRi will delay entering sleep mode after a sleep trigger detected for the specified amount of time.

The default value is 10000 ms.

Maximum Power Savings

If the Ethernet ports are not required for customer traffic, maximum power savings can be achieved by disabling them. This will however prevent SuperVisor management with Ethernet. The Ethernet ports can only be restored using remote management from base station SuperVisor, SNMP or the CLI.

To enable Ethernet ports from the CLI:

1. Connect the radio management port (MGMT) to your PC with a USB A to USB micro B cable. This will wake a radio that is sleeping.
2. Login to the CLI. The default login is Login: 'admin' Password: 'admin'
3. At the CLI prompt >> type 'set ethPort1Enabled 1' enter (for port 1)

OPERATING VOLTAGE SETTINGS

Power supply input voltage thresholds are used to trigger Aprisa SRi sleep mode to reduce power consumption.

The difference between the two thresholds Turn On and Turn Off defines the detection hysteresis.

In sleep mode, the main CPU, and serial ports are all shut down.

Minimum Turn On Input Voltage:

The SRi will not turn on when input supply voltage remains lower than this threshold. While voltage is lower than this threshold, but higher than minimum operating voltage of the Aprisa SRi, the OK led will flash once every 5 seconds. The valid values are from 10.0 V and 27.0 V but the value must always be higher than Minimum Turn Off Input Voltage.

The default value is 10 V.

Minimum Turn Off Input Voltage:

The SRi will turn off when the input supply voltage is lower than this threshold. The valid values are from 9.5 V to 26.5 V but the value must always be lower than Minimum Turn On Input Voltage.

The default value is 9.5 V.

Note: There must also be a 0.3 V difference between the ‘Minimum Turn On Input Voltage’ and the ‘Minimum Turn Off Input Voltage’.

RECEIVE IDLE SETTINGS

Remote radio power consumption in idle mode is lowered by reducing the operational duty cycle of the receiver during periods of low traffic demand or when it knows that packet reception is not possible. When the remote radio receiver is in idle mode, some beacons are skipped while the receiver is disabled to save power. The receiver is enabled to receive occasional beacons depending on user configuration of the receive idle level.

The receiver in the base station and repeaters is always on and never goes into idle mode.

Power Optimization Level

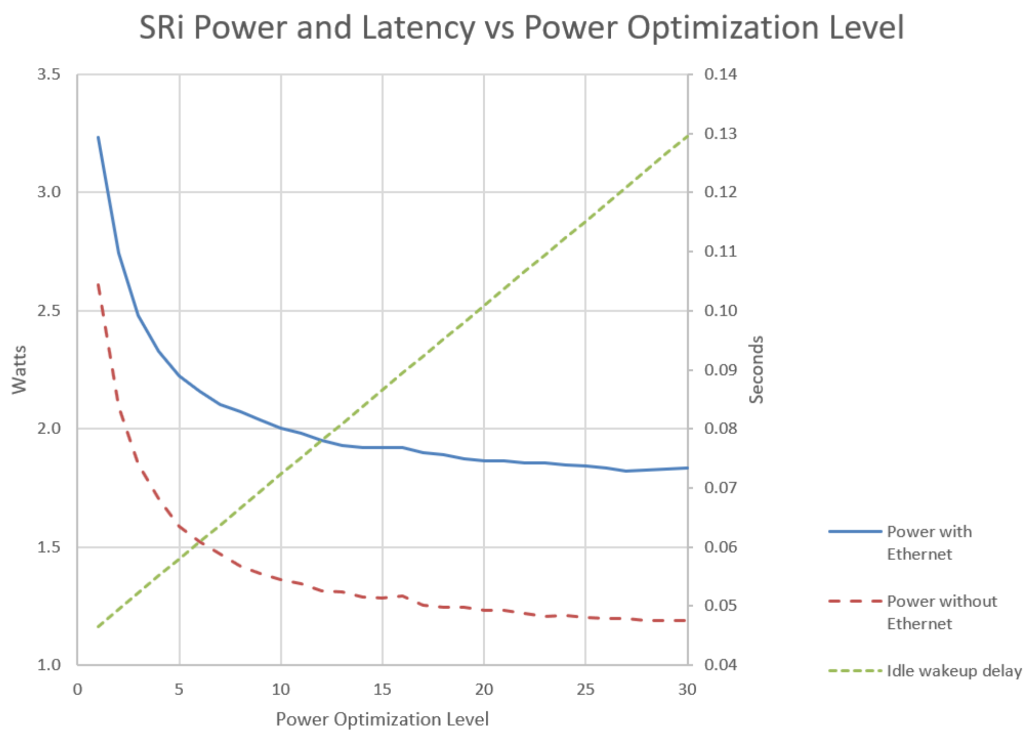
The Power Optimization Level sets the remote radio receiver on/off ratio between 0 (no power saving) and 30 (maximum power saving).

The longer the receiver is off for, the less the idle power consumption but the higher the initial packet latency.

The shorter the receiver is off for, the more the idle power consumption but the lower the initial packet latency.

The Power Optimization Level setting on each remote is only used before registration. Once registered, remotes use the value configured on the base.

The default setting is 5.



Inactivity Period Before Idle (ms)

The Inactivity Period Before Idle (ms) sets the delay remote radios will wait with no traffic on a network before entering a power saving 'idle' state.

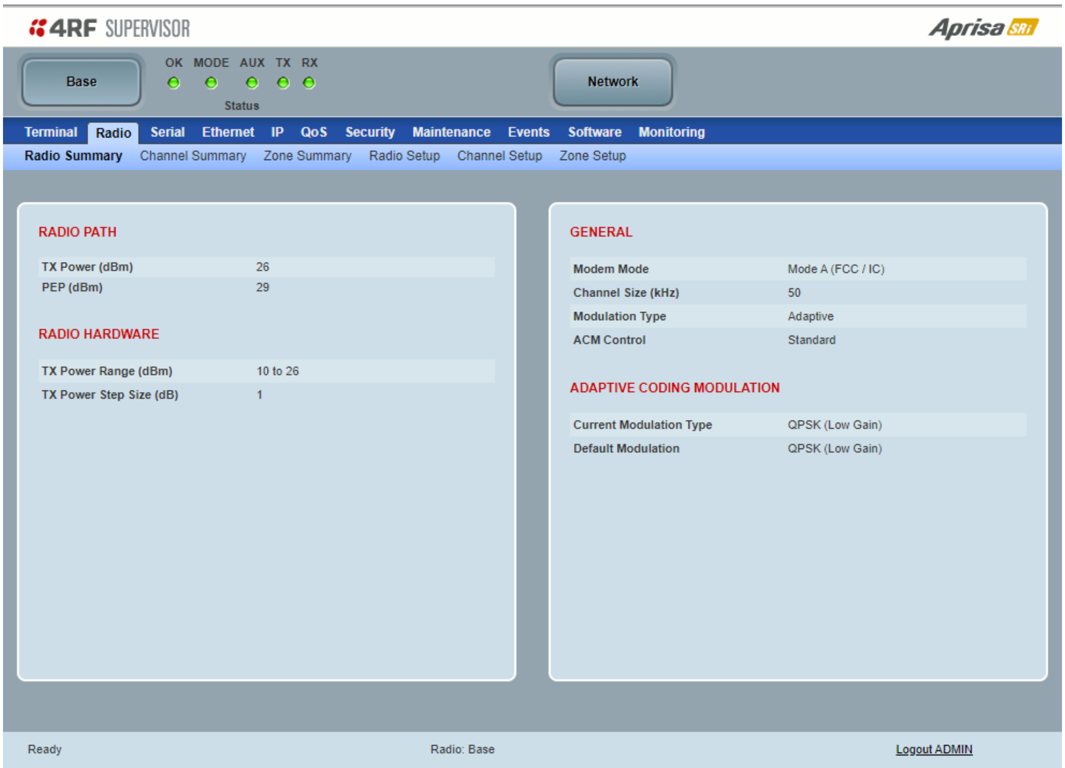
In remote radio, this value is used only before the remote radio receives the beacon from the base station and after that, it will use the value from the base station.

The default setting is 100 ms.

Radio

Radio > Radio Summary

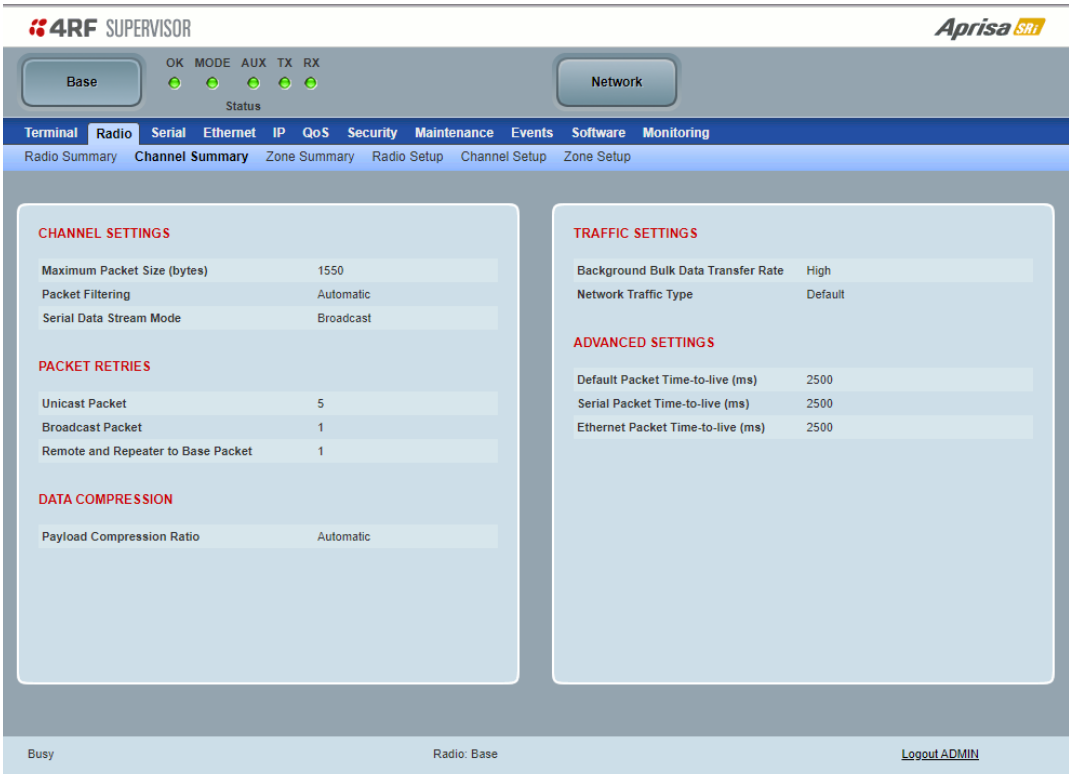
This page displays the current settings for the Radio parameters.



See ‘Radio > Radio Setup’ and ‘Radio > Channel Setup’ for setting details.

Radio > Channel Summary

This page displays the current settings for the Channel parameters.



See 'Radio > Channel Setup' for setting details.

DATA COMPRESSION

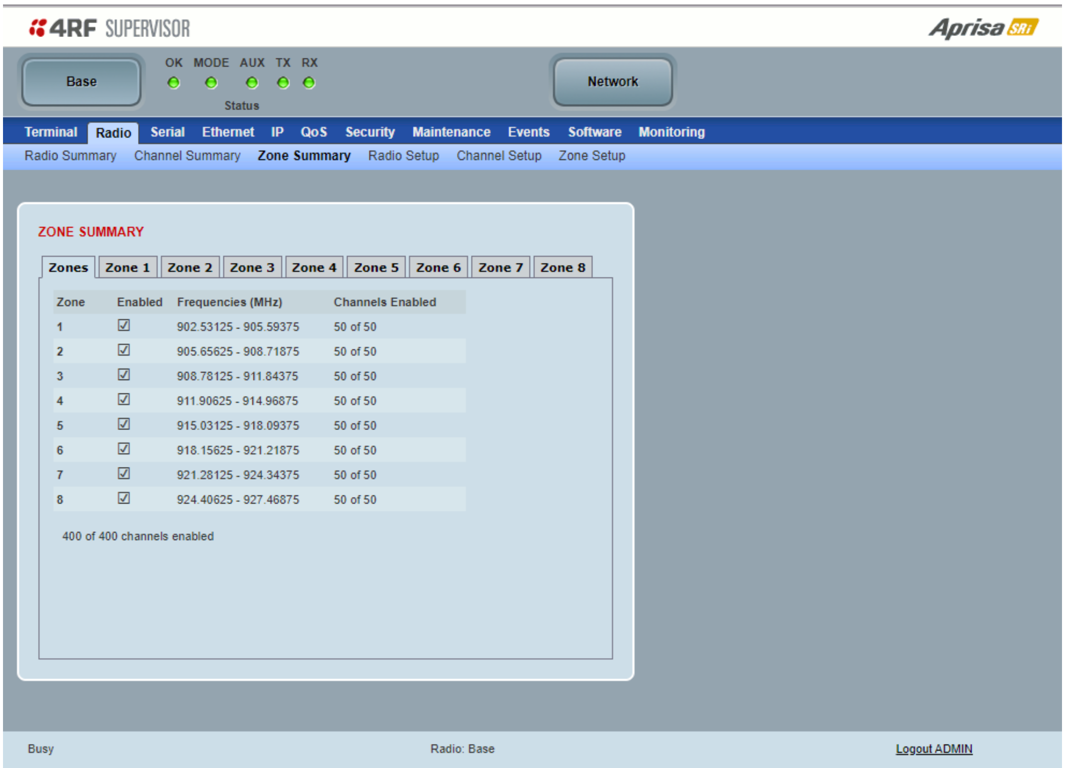
Payload Compression Ratio

The payload is compressed using level 3 QuickLZ data compression. Payload Compression is automatic and cannot be turned off by SuperVisor.

Compression is not attempted on data that is already compressed e.g. jpg files.

Radio > Zone Summary

This page displays the current settings for the Zones.



See ‘Radio > Channel Setup’ for setting details.

ZONE SUMMARY

Zone

The zone number defined in the regulatory specification. The maximum number of standard hop zones is 8.

Enabled

Displays the hop zones enabled.

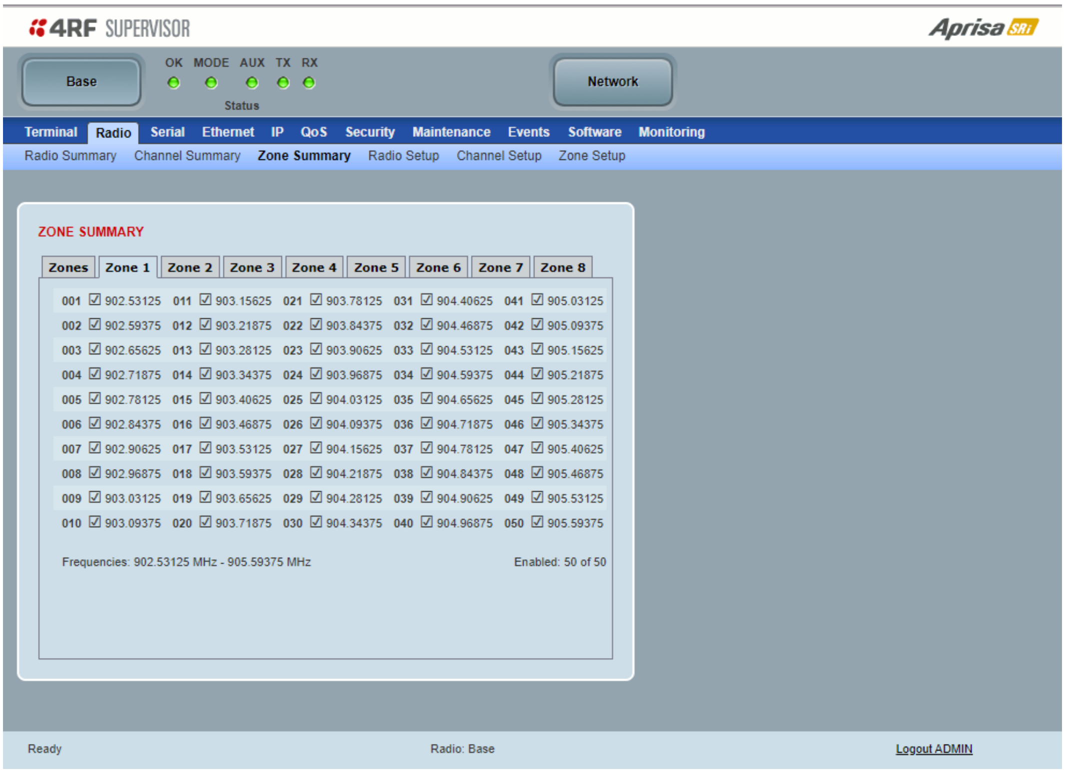
Frequencies

Displays the zone frequencies defined for the zone hop number.

Channels Enabled

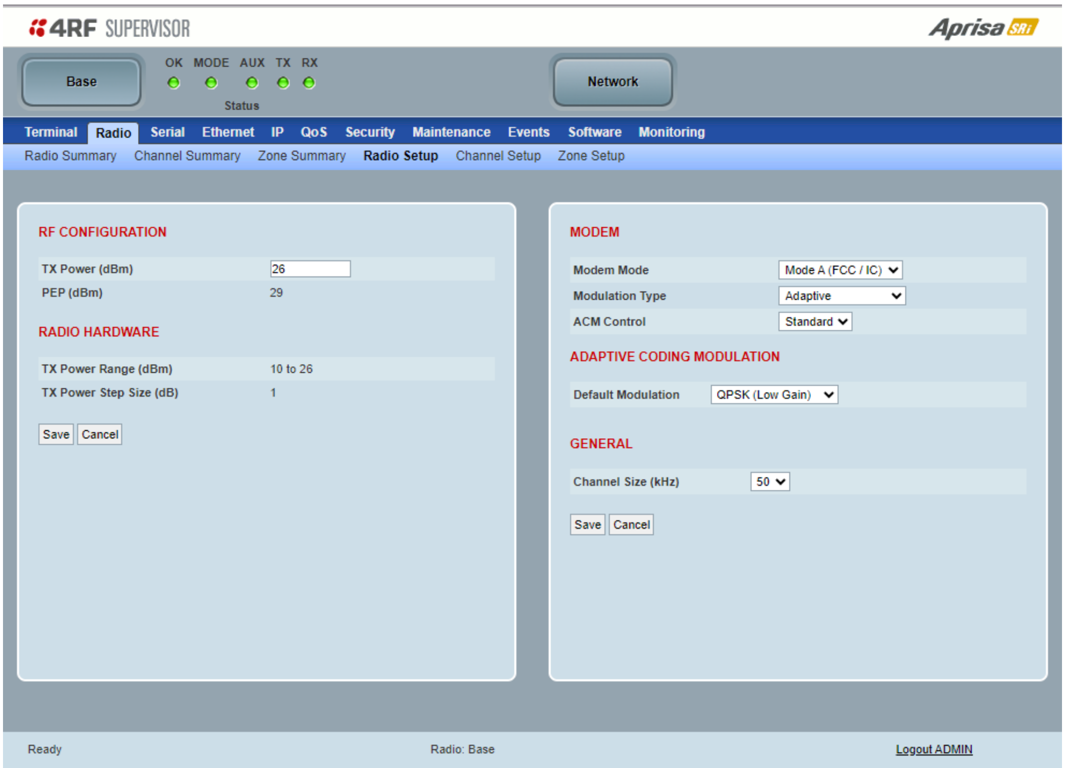
Displays the number of channels selected in the zone.

The Zone Summary > Zones shows the channels enabled per zone hop 1 to 8.



Radio > Radio Setup

Transmit frequency, maximum transmit power and channel size would normally be defined by a local regulatory body.



RF CONFIGURATION

TX Power

The transmitter power is the power measured at the antenna output port when transmitting. The transmitter power has a direct impact on the radio power consumption. The default setting is +26 dBm.

The maximum permitted transmitter power may be limited by the EIRP requirements. See 'Compliance Considerations' on page 66 for details.

If TX Power setting is higher than the high limit or lower than the low limit for the current modulation, an Informational Event (55 Terminal Unit Information) will be raised to notify the user that transmit power has been changed. This only applies to fixed modulation (not ACM).

The Peak Envelope Power (PEP) is calculated based on current configured TX power settings and modulation:

- QPSK PEP = TX Power Setting + 4 dBm
- 16 QAM PEP = TX Power Setting + 6 dBm
- 64 QAM PEP = TX Power Setting + 7 dBm

Note: The Aprisa SRi transmitter contains power amplifier protection which allows the antenna to be disconnected from the antenna port without product damage.

RADIO HARDWARE

The radio hardware displays the radio TX Power specifications.

MODEM

Modem Mode

This parameter sets the Modem Mode in the radio. The Modem Mode option list is dependent on the radio Hardware Variant (defined by the part number option ordered).

Option	Frequency Range	Part Number Option
Mode A (FCC / ISED)	902-928 MHz	C1
Mode B (ACMA / RSM)	915-928 MHz	C2
Mode C (ANATEL)	902-907.5 and 915-928 MHz	C3

Modulation Type

This parameter sets the TX Modulation Type for the radio.

Option	Function
Adaptive	Sets the modulation type to Adaptive Code Modulation. The remote radio receives the modulation type recommendation from the base and adjusts the modulation in the remote to base direction of transmission (upstream).
QPSK (Low Gain)	Sets the modulation to QPSK
16QAM (Low Gain)	Sets the modulation to 16 QAM
64QAM (Low Gain)	Sets the modulation to 64 QAM

The default setting is Adaptive.

When the Modulation Type is set to Adaptive, the transmitted modulation and coding will be determined by the signal quality of the link to the destination radio. Link quality for each radio is determined both concurrently and independently.

The link quality used for each packet depends on the destination;

- Remote to base, remote to repeater and repeater to base uses the quality of that link only.
- Unicast base to remote and base to repeater packets use the quality of that link only.
- Unicast repeater to remote packets use the lowest of either the repeater-remote link or the repeater-base link.
- Broadcast base to remote, base to repeater and repeater to remote packets (serial or broadcast IP or multicast IP) use the slowest link quality of all destinations.

ACM Control

This parameter enables / disables Adaptive Coding Modulation in the receive direction.

When ACM is enabled, the base station sends a modulation type recommendation to each remote radio based on the signal quality <u>for each individual remote radio</u>.

Option	Function
Disabled	Disables Adaptive Code Modulation for the upstream. The base station does not send a modulation type recommendation to any remote radio.
Standard	Enables Adaptive Coding Modulation for the radio receive direction. The ACM will switch down one ACM level if the link quality degrades in advance of the level where errored packets would be expected. The ACM will switch up when the link quality exceeds the performance threshold. This option preserves packet integrity but reduces network speeds.

The default setting is Standard.

ADAPTIVE CODING MODULATION

Default Modulation

This parameter is used when the Modulation Type is set to Adaptive, but the far end of the link has ACM Control set to 'Disabled'.

The default setting is QPSK (Low Gain).

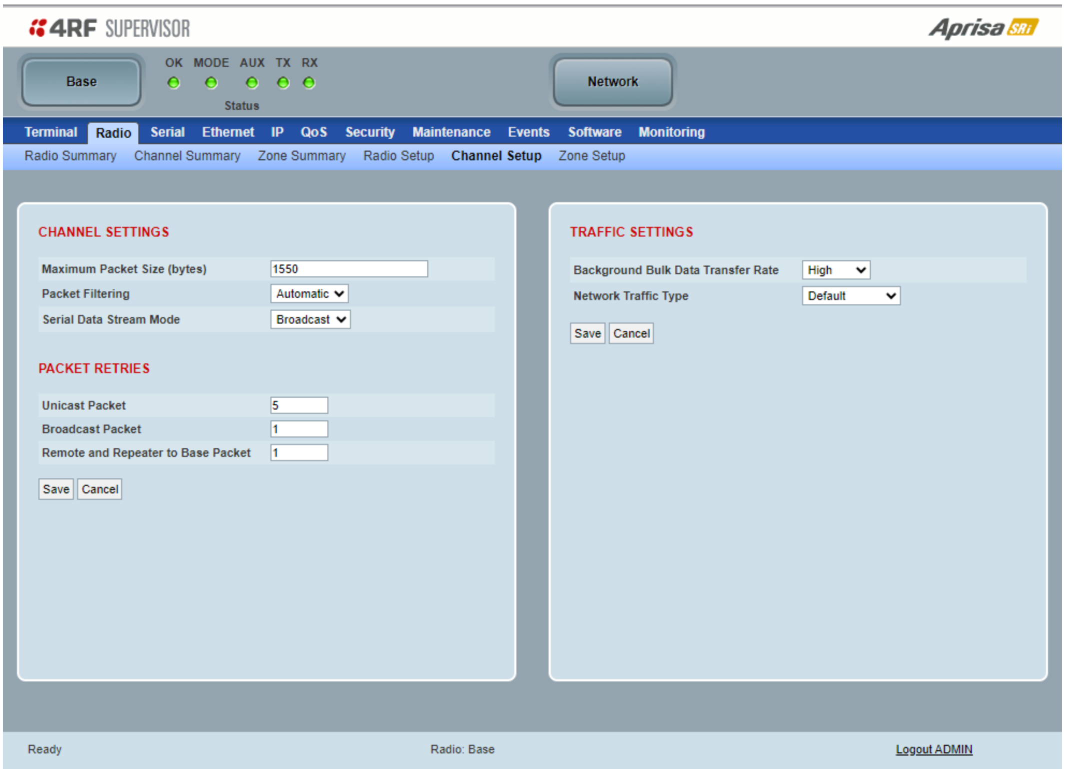
Option	Function
QPSK (Low Gain)	Sets the modulation to QPSK with Min Coded FEC.
16QAM (Low Gain)	Sets the modulation to 16 QAM with Min Coded FEC.
64QAM (Low Gain)	Sets the modulation to 64 QAM with Min Coded FEC.

GENERAL

Channel Size (kHz)

This parameter sets the Channel Size for the radio (see 'Channel Sizes' on page 411 for Radio Capacities). The default setting is 50 kHz.

Radio > Channel Setup



CHANNEL SETTINGS

Maximum Packet Size (Bytes)

This parameter sets the maximum over-the-air packet size in bytes. A smaller maximum Packet Size is beneficial when many remote radios are trying to access the channel, and smaller high priority packets must not be delayed by larger low priority packets sent by other radios.

The default setting is 1570 bytes.

This packet size includes the wireless protocol header and security payload (0 to 16 bytes). The length of the security header depends on the level of security selected.

When the SuperVisor > Security > Setup > Security Scheme setting is 'Disabled', the maximum user data transfer over-the-air is 1516 bytes.

When encryption is enabled, the entire packet of user data (payload) is encrypted. If authentication is being used, the security frame will be added (up to 16 bytes). The wireless protocol header is then added which is proprietary to the Aprisa SRi. This is not encrypted.

Packet Filtering

Each Aprisa SRi radio can filter packets not destined for itself. The Packet Filtering parameter controls this functionality.

In an Aprisa SRi network, all communication from remote radios is destined for the base station in the Aprisa SRi network communication protocol.

Option	Function
Disabled	Every packet received by the radio will be forwarded to the relevant interface.
Automatic	The radio will filter (discard) packets not destined for itself according to the Aprisa SRi traffic protocols

The default setting is Automatic.

Note: The Aprisa SRi network is transparent to the protocol being transmitted; therefore the Packet Filtering parameter is based on the Aprisa SRi addressing and network protocols, not the user (SCADA, etc.) traffic protocols.

Serial Data Stream Mode

This parameter controls the traffic flow in the radio serial ports.

Option	Function
Broadcast	Serial port traffic from the network is broadcast on all serial ports on this radio. This will include the RS-232 port derived from the USB port.
Segregate	Serial port traffic from the network from a specific port number is directed to the respective serial port only (see Segregated Port Directions).

The default setting is Broadcast.

PACKET RETRIES

The larger the number of retries, the greater the chance the packet will be delivered but reduces overall packet throughput.

Unicast Packet

Sets the number of unicast packet retries for the radio.

Base Station

The base station unicast packet retries sets the number of retries for a packet sent to remote radios. The default value is 5.

Remote Radios

The remote radio unicast packet sets the number of retries for a packet sent to the base station. The default value is Auto.

If the Auto is ticked, remote radios will use the Remote To Base Packet retries setting sent from the base station

If the Auto is unticked, remote radios will use the unicast packet retries set on the remote radio

Broadcast Packet

The base station broadcast packet repeats sets the number of broadcast packet repeats for packets sent to all remote radios. The maximum value that is accepted for retries is 254. The default value is 1.

Broadcast repeats should only be set greater than 1 if the reliability is shown to be poor, as it will degrade the performance of the network. A value of 2 repeats would normally be enough to improve the reliability.

Remote To Base Packet

Sets all remote radio unicast packet retries setting if the remote radio unicast packet Auto is ticked. The default value is 5.

TRAFFIC SETTINGS

Background Bulk Data Transfer Rate

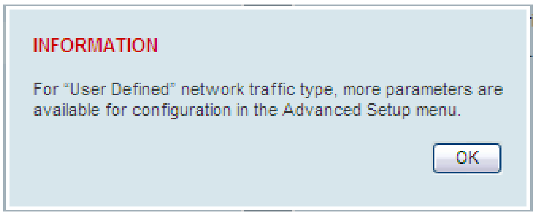
This parameter sets the data transfer rate for large amounts of management data.

Option	Function
High	Utilizes more of the available capacity for large amounts of management data. Highest impact on user traffic.
Medium	Utilizes a moderate of the available capacity for large amounts of management data. Medium impact on user traffic.
Low	Utilizes a minimal of the available capacity for large amounts of management data. Lowest impact on user traffic.

The default setting is high.

Network Traffic Type

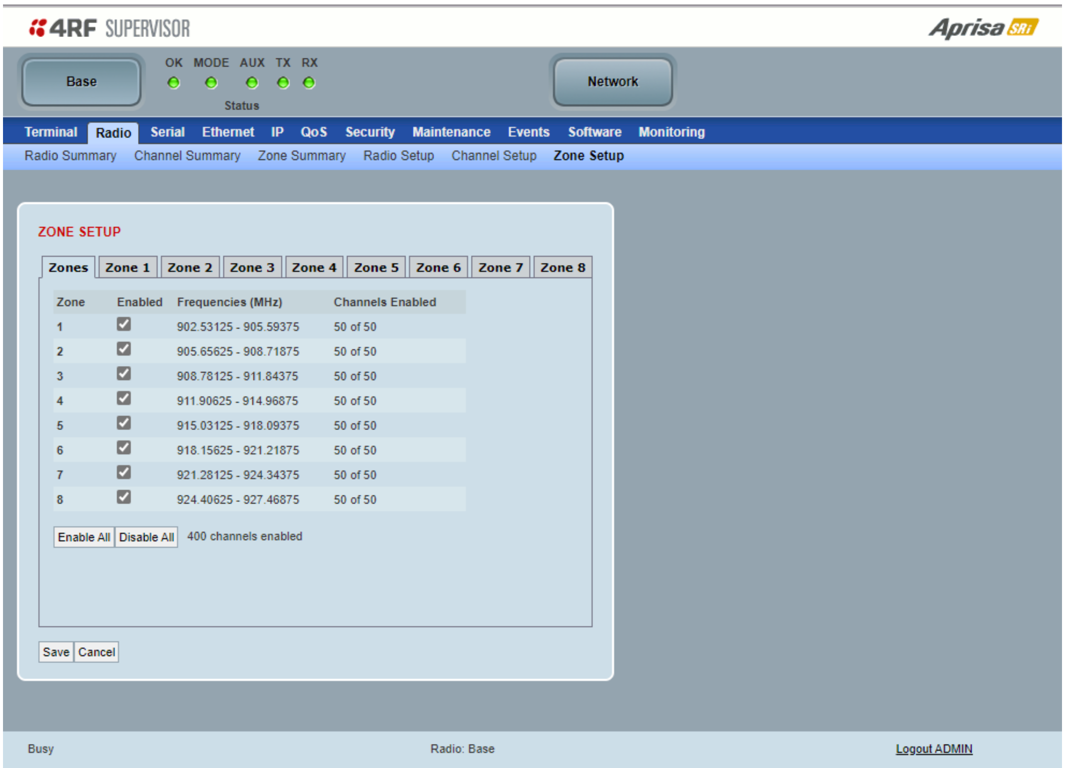
This parameter optimizes the channel settings for the predominant traffic type.

Option	Function
User Defined	Allows the user to define the channel settings (see ‘Radio > Advanced Setup’ on page 128). 
Serial Only	Optimizes the channel settings for the predominantly serial traffic.
Ethernet Only	Optimizes the channel settings for the predominantly Ethernet traffic.
Mixed	Optimizes the channel settings for a mix of Ethernet and serial traffic.

The default setting is Mixed.

Radio > Zone Setup

This page configures the Zone / Channel settings.



ZONE SETUP

Specific channels within the selected zone hop can be disabled if there is a known transmission within the channel that may cause interference to the operation of this network. The minimum number of enabled channels is 50.

On a remote radio the configured channels are only used to initiate communication with the base station. A remote can only connect with a base station if there is some overlap between configured channels on the base and the radio.

When a remote radio registers with the base station, the remote radio will automatically configure to use the zone channel list distributed by the base station. The zone channels displayed on the remote radio will continue to display the radio channels initially enabled (not the zone channel list distributed by the base station).

Zone

The zone number from 1 to 8.

Enabled

Enables / disables the entire hop zone of channels. If a channel is selected in a zone that is disabled, the zone will be enabled when the channel selection is saved. The default is all zones enabled.

Frequencies

The zone frequencies are pre-defined in the Aprisa SRi for the zone number. The zone frequencies are spaced at the hop frequency of 62.5 kHz.

Channels Enabled

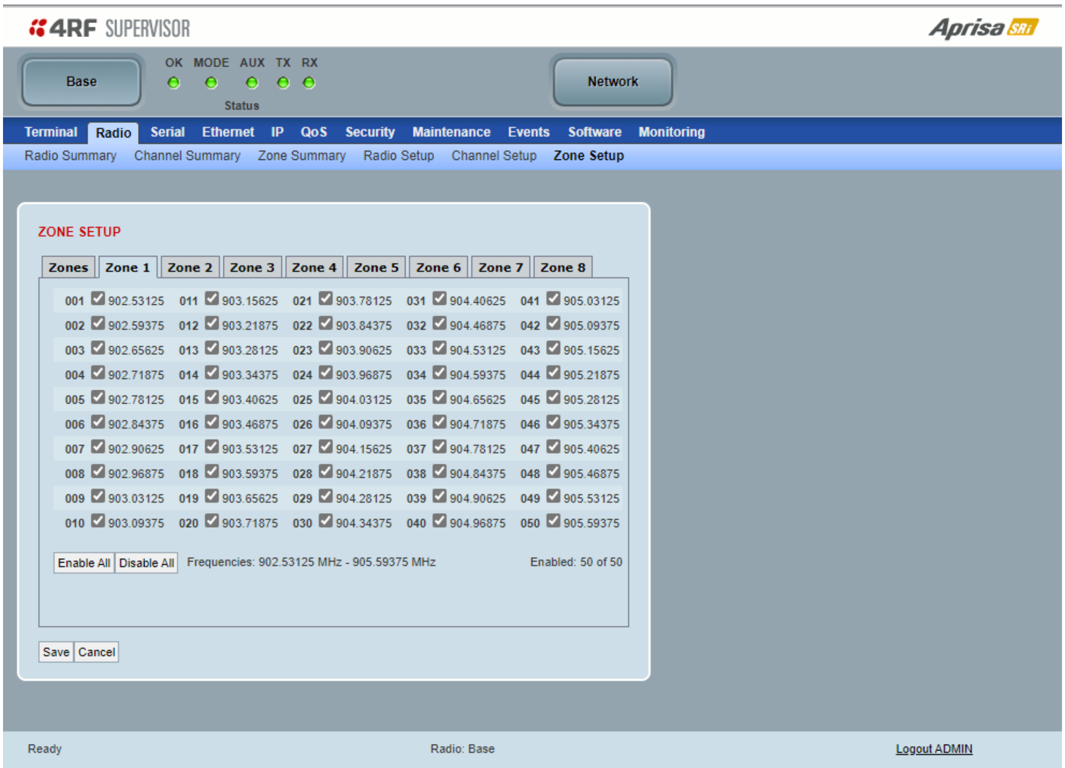
Displays the number of channels selected in the zone.

Controls

The Enable All button enables all zones and all channels in each zone.

The Disable All button disables all zones and all channels in each zone.

The Zone Setup > Zones 1 to 8 setup the channels per zone hop.



ZONE SETUP

Specific channels within the selected zone hop can be disabled if there is a known transmission within the channel that may cause interference to the operation of this network. The minimum number of enabled channels is 50.

Initially, remote radio channels are enabled to allow communication with the base station.

When a remote radio registers with the base station, the remote radio will automatically configure to use the zone channel list distributed by the base station. The zone channels displayed on the remote radio will continue to display the radio channels initially enabled (not the zone channel list distributed by the base station).

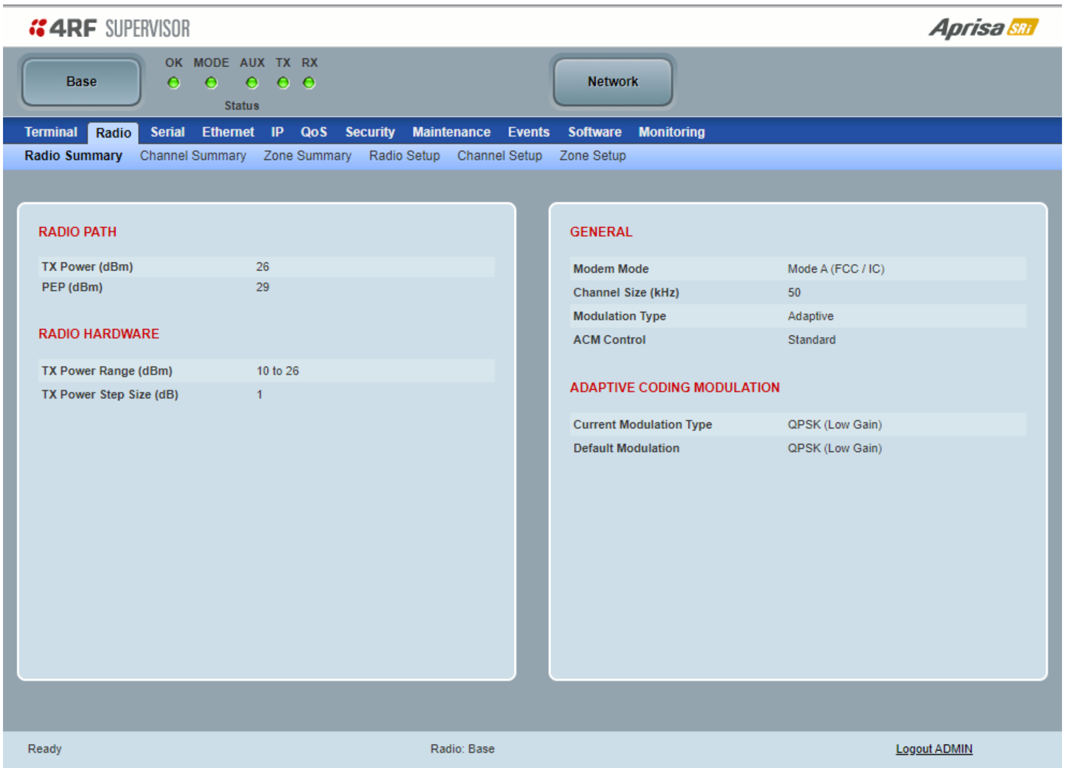
Controls

The Enable All button enables all channels in the zone.

The disable All button disables all channels in the zone.

Radio > Advanced Setup

This page is only visible when the Channel Setup > Network Traffic Type is set to User Defined.



ADVANCED CHANNEL SETTINGS

Default Packet Time to Live (ms)

This parameter sets the default time a packet is allowed to live in the system before being dropped if it cannot be transmitted over the air. It is used to prevent old, redundant packets being transmitted through the Aprisa SRi network. The default setting is 1500 ms.

In the case of serial poll SCADA networks such as MODBUS and IEC 60870.50.101, it is important to ensure the replies from the RTU are in the correct sequence and are not timed out replies from Master requests. If the TTL value is too long, the SCADA master will detect sequence errors.

It is recommended to use a TTL which is half the serial SCADA timeout. This is commonly called the ‘scan timeout’ or ‘link layer time out’ or ‘retry timeout’.

When using TCP protocols, a TTL of 1500 ms is recommended because a TCP re-transmission usually occurs after approximately 3 seconds.

In SCADA networks which use both serial and Ethernet, it is recommended that the TTL is set to half the serial SCADA timeout for serial remotes, and 1500 ms for Ethernet (TCP) remotes. For example, if the serial SCADA timeout is 1000 ms, a remote radio which is connected to the serial RTU should be set to 500 ms, a remote radio which is connected to an Ethernet (TCP) RTU should have a 1500 ms timeout.

In this case, the base station TTL should be set to 1500 ms as well; or whichever is the longer TTL of serial or Ethernet.

Serial Packet Time to Live (ms)

This parameter sets the time a serial packet is allowed to live in the system before being dropped if it cannot be transmitted over the air. The default setting is 800 ms.

Ethernet Packet Time to Live (ms)

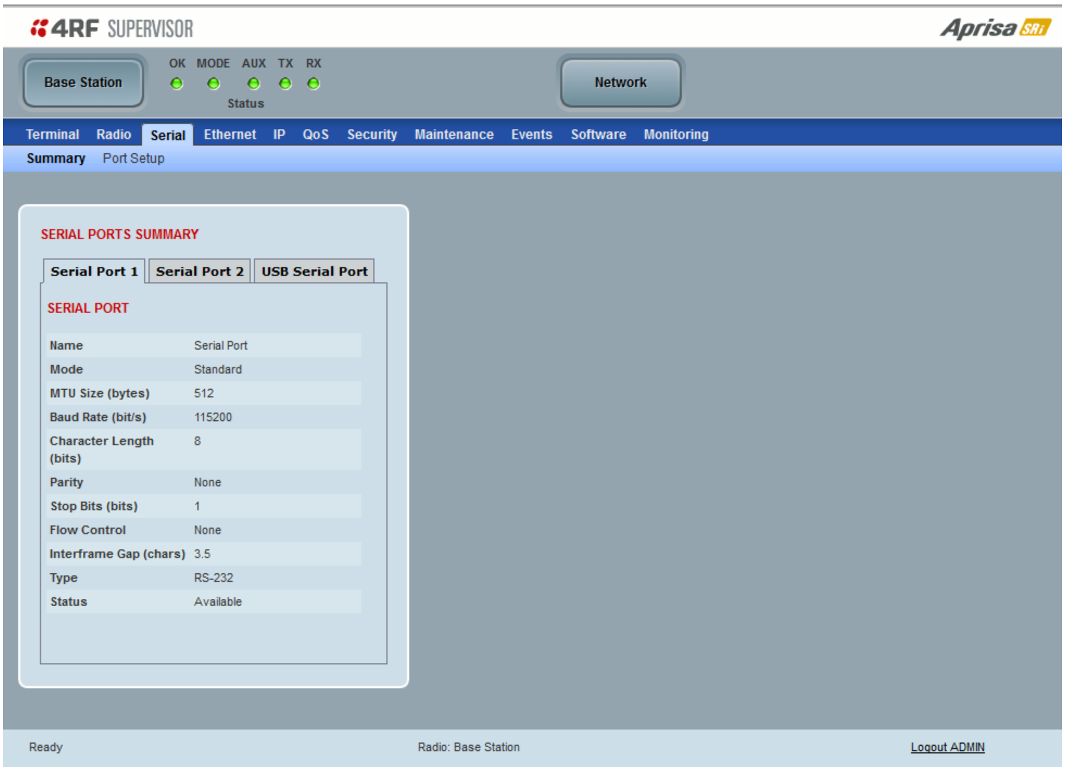
This parameter sets the time an Ethernet packet is allowed to live in the system before being dropped if it cannot be transmitted over the air. The default setting is 600 ms.

Serial

Serial > Summary

RS-232 Hardware Ports

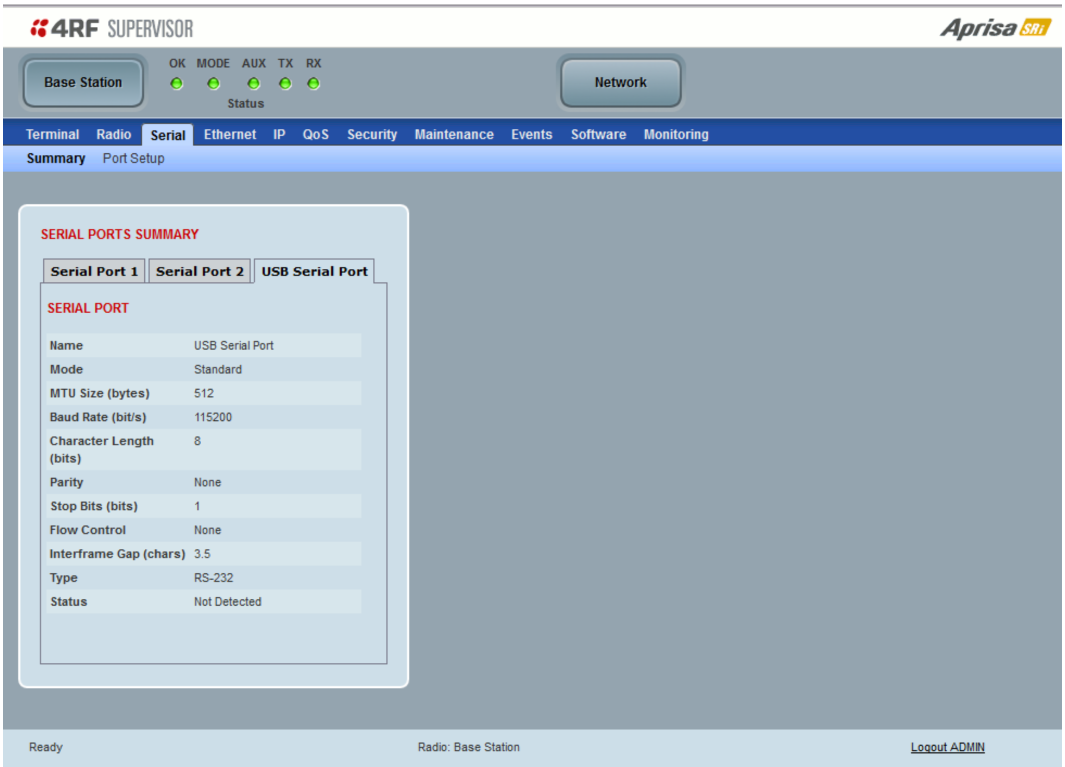
This page displays the current settings for the serial port parameters.



See ‘Serial > Port Setup’ on page 132 for configuration options.

USB Serial Ports

This page displays the current settings for the USB serial port parameters.



Type

This parameter displays the Serial Port interface type.

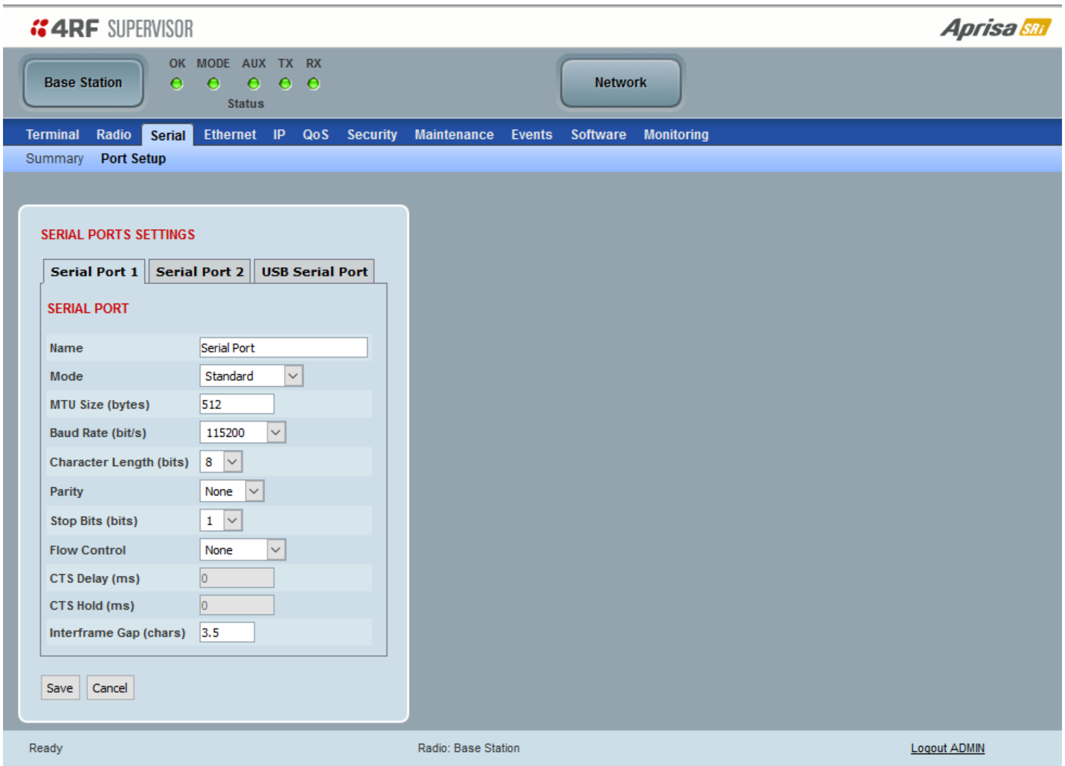
If the Name is USB Serial Port:

Option	Function
RS-232	Indicates that a USB to RS-232 serial converter is plugged into the radio.
RS-485	Indicates that a USB to RS-485 serial converter is plugged into the radio.

Serial > Port Setup

RS-232 Hardware Ports

This page provides the setup for the serial port settings.



SERIAL PORTS SETTINGS

Name

This parameter sets the port name which can be up to 32 characters.

Option	Function
Serial Port	This is for the standard RS-232 serial ports provided with the RJ45 connectors.
USB Serial Port	This is the optional RS-232 / RS-485 serial port provided with the USB host port connector with a USB to RS-232 / RS-485 RJ45 converter cable (see 'USB Serial Ports' on page 386).

Mode

This parameter defines the mode of operation of the serial port. The default setting is Standard.

Option	Function
Disabled	The serial port is not required.
Standard	The serial port is communicating with serial ports on other stations.
Mirrored Bits ®	Mirrored Bits® is a serial communications protocol used to exchange internal logic status messages directly between relays and devices used in line protection, remote control and monitoring, relay remote tripping, sectionalizing and other such applications. The protocol is often described as a relay-to-relay communications technology.
Terminal Server	A base station Ethernet port can communicate with both Ethernet ports and serial ports on remote radios. RS-232 traffic is encapsulated in IP packets (see 'Serial > Port Setup' Terminal Server on page 140).
SLIP	IP packets are encapsulated over RS-232 interface port (see 'Serial > Port Setup' Serial Line Interface Protocol (SLIP)' on page 143).

MTU Size (bytes)

This parameter sets the size of the packet in bytes received before it is transmitted if an inter-frame gap is not detected. The default setting is 512 bytes.

Baud Rate (bit/s)

This parameter sets the baud rate to 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600 or 115200 bit/s. The default setting is 115200 bit/s.

Character Length (bits)

This parameter sets the character length to 7 or 8 bits. The default setting is 8 bits.

Parity

This parameter sets the parity to Even, Odd or None. The default setting is None.

Stop Bits (bits)

This parameter sets the number of stop bits to 1 or 2 bits. The default setting is 1 bit.

Flow Control

This parameter sets the flow control of the serial port. The default setting is Disabled.

Option	Function
None	The Aprisa SRi radio port (DCE) CTS is in a permanent ON (+ve) state. This does not go to OFF if the radio link fails.
CTS-RTS	CTS / RTS hardware flow control between the DTE and the Aprisa SRi radio port (DCE) is enabled. If the Aprisa SRi buffer is full, the CTS goes OFF. In the case of radio link failure, the signal goes to OFF (-ve) state.

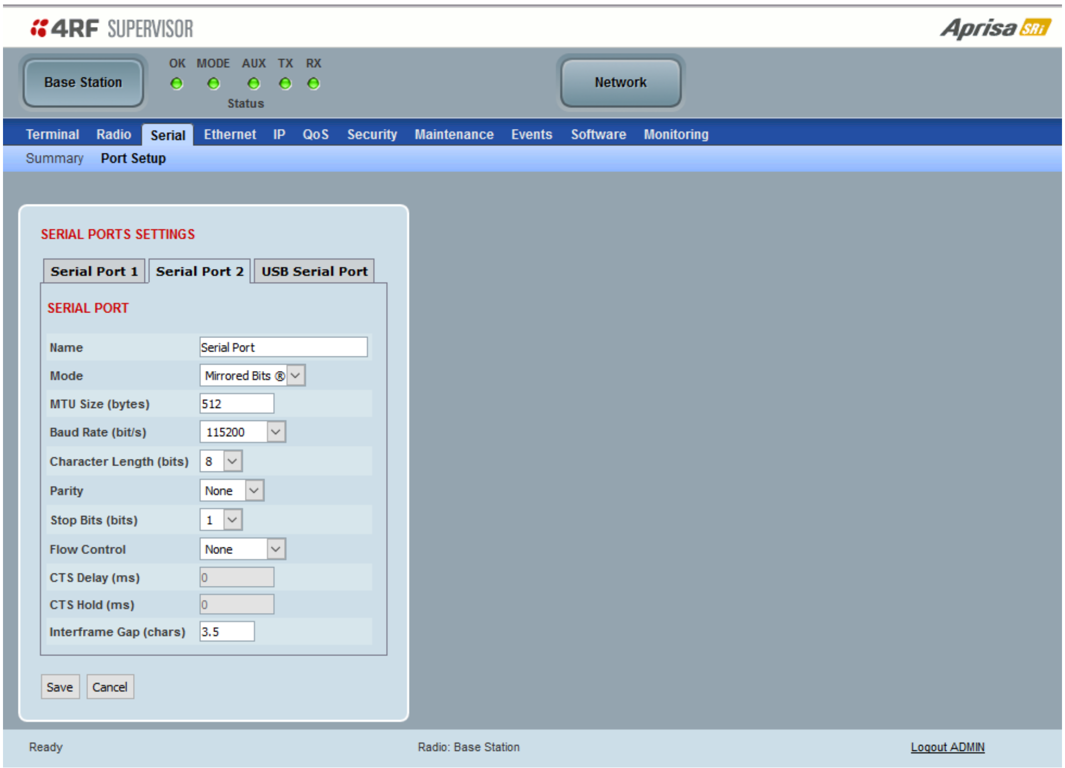
In terminal server mode, the serial packet is no different from an Ethernet packet and travels through various packet queues before being transmitted over the air. Thus, the serial flow control has no affect in terminal server mode.

Inter-Frame Gap (chars)

This parameter defines the gap between successive serial data frames. It is used to delimit the serial data to define the end of a packet. The Inter-Frame Gap limits are 0 to 20 chars in steps of 0.1 char. The default setting is 3.5 chars.

Mirrored Bits®

This menu item is only applicable if the serial port has an operating mode of Mirrored Bits.



Introduction

Mirrored Bits® is a serial communications protocol used to exchange internal logic status messages directly between relays and devices used in line protection, remote control and monitoring, relay remote tripping, sectionalizing and other such applications.

The protocol relies on near constant transmission of status bytes between the devices. It can only tolerate small delays between receipts of packets.

The protocol provides alarms states to monitor and report on radio channel performance. If a receiving device does not receive a status packet within a predefined time then it asserts an 'instantaneous channel monitor' error (ROK), this error clears as soon as the next status packet is received.

There are two more significant errors RBAD (ROK dropout for settable time) and CBAD (long term channel unavailability exceeding a settable threshold) that will be asserted if more extensive delays occur or the communications channel is lost.

The trigger or time period for asserting ROK varies between devices. Typically, the ROK error state is asserted if a receiving device does not receive a packet for a period > than 3 x the period taken to transmit a packet.

When optimizing for Mirrored Bits® operation, the target is to present a radio channel that does not result in ROK triggers occurring. Individual networks may be tolerant to occasional ROK alarms states if configured to make use of the more significant alarms.

Optimization

The Aprisa SRi provides a Half Duplex radio channel with variable latency. Error free transport of the protocol can be achieved through specific serial traffic configuration settings, which are dependent on the radio RF configuration, Mirrored Bits® devices and network characteristics.

Under some scenarios limited Ethernet transport may be supported without impacting Mirrored Bits® operation. If the network can tolerate occasional ROK errors Ethernet support may be increased. The level of impact on Mirrored Bits® is related to radio settings and the specifics of the Ethernet traffic including size and frequency of the Ethernet packets.

When attempting to configure the radios to support new devices or varying network requirements a standard configuration is used for the radios and the following two key serial data parameters are adjusted:

- Inter-Frame Gap (IFG) – used to detect new packets on the serial input to the radio
- Maximum Transmission Unit (MTU) – used to define the over the air (OTA) packet size

To date, 4RF has lab tested and confirmed operation with the follow SEL Mirrored Bits® devices. Contact 4RF for preferred configuration:

- 2411 PAC (Programmable Automation Controller)
- 2505 series remote I/O modules
- 321 series relays

4RF is working with customers to confirm support for other devices as they are identified. The remainder of this document details the configuration settings and general process to optimize the radio to support additional devices, in addition to listing expected latencies under different configurations.

General Configuration

The configurations and process are aligned with a 2505 series remote I/O module device with serial baud rate of 9600. As a 'fast' Mirrored Bits® device it is considered a good start point for optimization. For other baud rates please refer to the table in Initial Setup for Mirrored Bits® Support on page 138 for initial MTU and IFG settings.

The following are the recommended RF configurations and serial data configuration settings and to optimize the performance over Aprisa SRi radios.

Recommended RF configurations are:

- Radio > Channel Setup > Serial Data Stream Mode to 'Segregate'
- Radio > Channel Setup > Network Traffic Type to 'Serial Only'
- Radio > Radio Setup > Modulation – 64QAM (low gain)

Serial data port variable parameters

Two key serial port parameters will be adjusted during optimization. The following initial values have been determined as a suitable for the SEL 2505 device which is the fastest device 4RF has lab tested. It is a suitable start point to carry out optimization for other devices.

Inter-Frame Gap – initially set to 0.2

- IFG is dependent on serial line baud rate only
- The Mirrored Bits® protocol is essentially timed to a base clock, the slower the baud rate the longer the period to transmit a packet resulting in less time between packets
- A low baud rate is ideal as it increase the time period before a ROK error will occur as this is dependent on serial packet transmission time
- The minimum baud rate currently proven to provide reliable communications is 9600 bit, with this rate an IFG of 0.2 is required to be used
- With the 2505 device the IFG increases with increases in serial baud rate, while easier to detect gaps the ROK error period is reduced

MTU – initially set to 32 bytes

- Dependent on serial line baud rate, channel size, modulation, security settings, intended traffic mix and all other settings that influence OTA speed and capacity available for external traffic
- MTU affects latency, if a large MTU then the radio will ‘wait’ for the number of bytes before sending the packet OTA
- Ideally a low MTU will be used – the minimum needs to support the various settings above and intended mix of traffic
- MTU can be changed in steps of +/- 8 when trying different configurations
- Refer table in section 5 for start point of MTU based on channel size, modulation and serial baud rate, this assumes the general radio settings as above
- Increase by 8 for new devices or in attempt to support some Ethernet or other services

Initial Setup for Mirrored Bits® Support

The MTU can be adjusted up or down in steps of 8 bytes

- Increase by 8 bytes if Mirrored Bits® is not running without alarms or ROK assertions
- Decrease by 8 bytes if Mirrored Bits® is running error free, the target is to find the smallest MTU for reliable transport

If reliable Mirrored Bits® communications cannot be achieved after increasing the MTU by 10 steps or 80 bytes, then the following CLI commands can be used to extract low level packet information from the radio.

This information can be forwarded to 4RF to determine what is occurring and identify alternate configurations.

- Configure Radio / Mirrored Bits® equipment for 9600 baud rate.
- Connect Mirrored Bits® equipment to one of the serial ports and start traffic.
- Ensure no management traffic or other services are connected to the Ethernet or Serial ports.
- Login to the radio CLI as 'admin' and execute 'debug set 2 5' -> there will be continuous scrolling information.
- Screen capture one page of the scrolling information to send to 4RF.
- Remove serial cable and execute 'debug clear 2 5' via the CLI to clear the debug routine, alternatively reboot the radio.
- Note if the serial baud rate intended to be used is not 9600 then repeat for each different rate and clearly identify the screen prints by baud rate before forwarding to 4RF.

Note there are additional low level configurations which can improve performance. 4RF will detail these if required based on the information received.

Additional Setup for Improved Latency or Additional Services

Once reliable Mirrored Bits® communications has been achieved, experimentation can be undertaken to reduce latencies or provide support for additional services such as Ethernet based SCADA polling.

Increasing the MTU will impact latency for each packet (refer to table in section 4). A point may be reached where the gaps between individual packets are too high and the Mirrored Bits® ROK or other alarms will assert.

Increasing the MTU allows some 'space' in each packet for additional data from the second serial port or the Ethernet ports.

Support for Ethernet is highly dependent on the size and frequency of packets being sent. A level of trial and error is required. At the slower OTA data rates, support may be limited however with higher OTA data rates some services may be supported (such as polling).

It should be noted that if the Mirrored Bits® devices or network manager can accept occasional ROK assertions then there is more flexibility for other services.

Baud rate and Latency Table

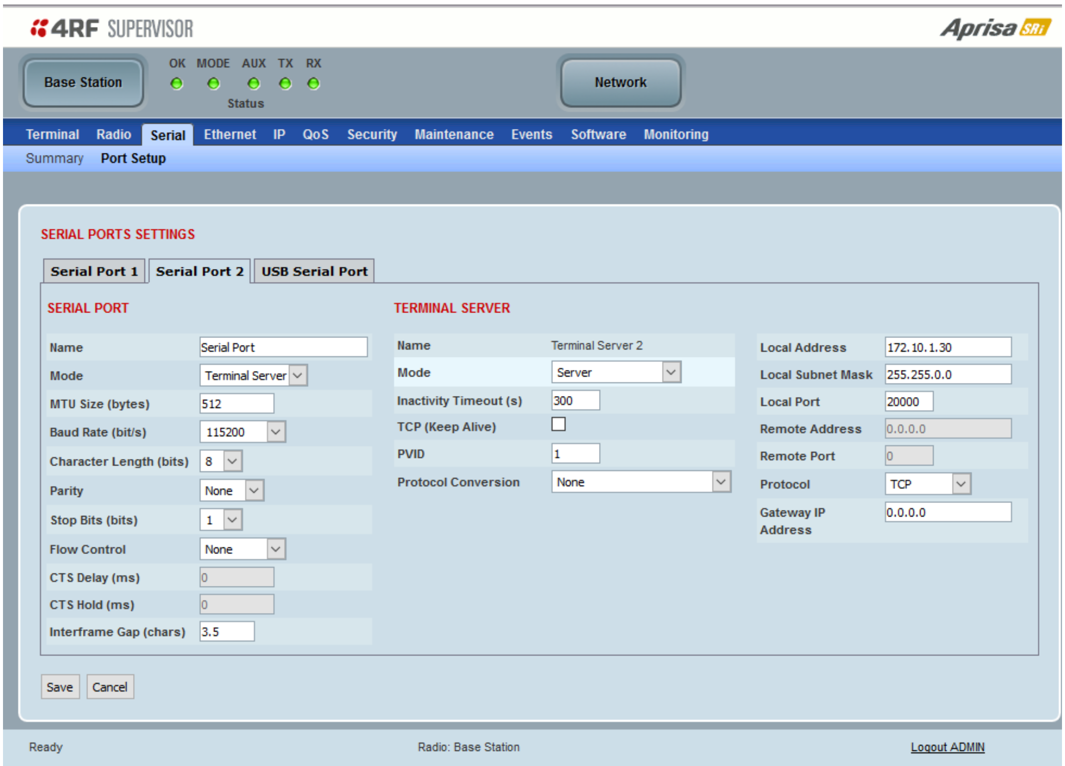
The following table lists the optimized MTU and IFG and resulting latency for the SEL 2505 device, one of the faster devices available so serves as an ideal starting point when introducing new devices. It is recommended that initial testing is carried out with one step size higher (8) on MTU.

Serial Baud Rate	Modulation	Channel Size	Minimum MTU Size	IFG SEL 2505	One Way Latency (ms)
9600	64 QAM Low	50	8	0.2	20.0
9600	16 QAM Low	50	16	0.2	-
9600	QPSK Low	50	24	0.2	42.5
19200	64 QAM Low	50	16	0.5	25.0
19200	16 QAM Low	50	24	0.5	-
19200	QPSK Low	50	24	0.5	-
38400	64 QAM Low	50	24	3	40.0
38400	16 QAM Low	50	24	3	-
38400	QPSK Low	50	40	3	62.5

Terminal Server

This menu item is only applicable if the serial port has an operating mode of Terminal Server.

The Terminal Server operating mode provides encapsulation of serial data from a local serial port into an IP packet (over TCP or UDP). This function is typically used for connecting a legacy serial RTU at a remote radio to an Ethernet SCADA server.



Mode

This parameter defines the mode of operation of the terminal server connection. The default setting is Client and Server.

Option	Function
Client	The radio will attempt to establish a TCP connection with the specified remote unit. Generally, this setting is for the base station with an Ethernet connection to the SCADA master.
Server	The radio will listen for a TCP connection on the specified local port. Generally, this setting is for the remote radio with a serial connection to the RTU. Data received from any client shall be forwarded to the associated serial port while data received from that serial port shall be forwarded to every client with an open TCP connection. If no existing TCP connections exist, all data received from the associated serial port shall be discarded.
Client and Server	The radio will listen for a TCP connection on the specified local port and if necessary, establish a TCP connection with the specified remote unit. Generally, this setting is used for the remote radio, but it should be used carefully as two connections might be established with the base station. Data received from any client shall be forwarded to the associated serial port while data received from that serial port shall be forwarded to every client with an open TCP connection.

Inactivity Timeout (seconds)

This specifies the duration (in seconds) to automatically terminate the connection with the remote TCP server if no data has been received from either the remote TCP server or its associated serial port for the duration of the configured inactivity time.

TCP Keep Alive

A TCP keep alive is a message sent by one device to another to check that the link between the two is operating, or to prevent the link from being broken.

If the TCP keep alive is enabled, the radio will be notified if the TCP connection fails.

If the TCP keep alive is disabled, the radio relies on the Inactivity Timeout to detect a TCP connection failure. The default setting is disabled.

Note: An active TCP keep alive will generate a small amount of extra network traffic.

PVID

This parameter sets the PVID (port VLAN ID) for each of the terminal servers on the radio.

Protocol Conversion

This parameter defines the mode of operation of the terminal server connection. The default setting is None.

Option	Function
None	No terminal server Protocol Conversion
Modbus TCP to Modbus RTU	The radio provides a gateway between Modbus TCP to Modbus RTU.
Modbus TCP to Modbus ASCII	The radio provides a gateway between Modbus TCP to Modbus ASCII.

Local Address

This parameter sets the serial Terminal Server local IP address.

<u>Bridge Mode</u>

The local IP address can be the same as the radio's configured IP address or the Virtual IP address for protected stations. If it is not the above, then it must be an IP address from a network different from the radio's network.

Note that the Terminal Server local IP address settings can be the same for other terminal servers in the radio.

<u>Router Mode</u>

The local IP address must be the same as port 1 (management IP address) of the radio’s configured port IP addresses or the Virtual IP address for protected stations.

<u>Gateway Router Mode</u>

The local IP address must be the same as the radio's configured IP address or the Virtual IP address for protected stations.

Local Port

This parameter sets the TCP or UDP port number of the local serial port.

The valid port number range is less than or equal to 49151 but with exclusions of 0, 20, 21, 23, 80, 161, 162, 443, 5445, 6445, 9930 or 9931. The default setting is 20000.

The user is responsible for ensuring that there is no conflict on the network.

Remote Address

This parameter sets the IP address of the server connected to the radio Ethernet port. When the remote address / port is configured as 0.0.0.0/0, each outgoing UDP packet will be sent to the source address of the last received UDP packet.

Remote Port

This parameter sets the port number of the server used in TCP client, TCP client server or UDP modes. The default setting is 0.

Protocol

This parameter sets the L4 TCP/IP or UDP/IP protocol used for terminal server operation. The default setting is TCP.

Gateway IP Address

This Terminal Server parameter sets the Gateway IP address of a router in the network that serves as the forwarding router to other networks when no other route specification matches the destination IP address of a packet.

This is useful when default gateway IP address of the radio and the Terminal Server Gateway IP Address are on different IP subnet networks.

When all radios are in router mode (GRM / RM) or advanced router mode (AGRM / ARM), the default gateway IP address of the radio and Gateway IP Address of the Terminal Server are the same, leaving the Gateway IP Address on the default value of 0.0.0.0 will serve the purpose. Only when the radio and Terminal Server are with different IP subnets and are connected to different router gateway IP addresses, the default value shall be set to the appropriate gateway IP address.

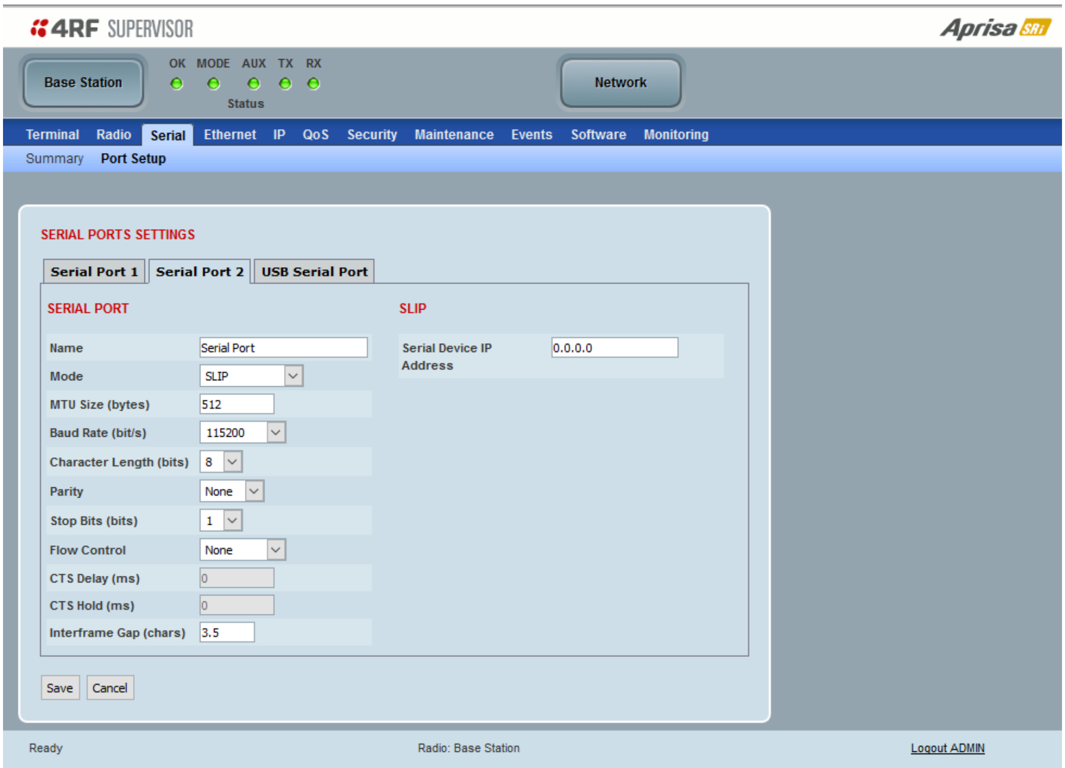
Serial Line Interface Protocol (SLIP)

This menu item is only applicable if the serial port has an operating mode of SLIP.

The SLIP operating mode provides IP packet encapsulation over RS-232 serial interface as per the SLIP protocol RFC 1055.

A SLIP serial interface contains the IP address of the serially connected RTU as per the RTU/PLC SLIP protocol. The SLIP interfaces on the remote radios can be part of the bridge network and can coexist and operate with a mix of Ethernet interfaces, serial SLIP and terminal server interfaces.

As the RTU/PLC serial SLIP interface doesn't support MAC addresses, a remote radio SLIP interface uses a proxy ARP function that returns its own MAC address for ARP requests based on the IP address of the RTU/PLC SLIP interface.



Serial Device IP Address

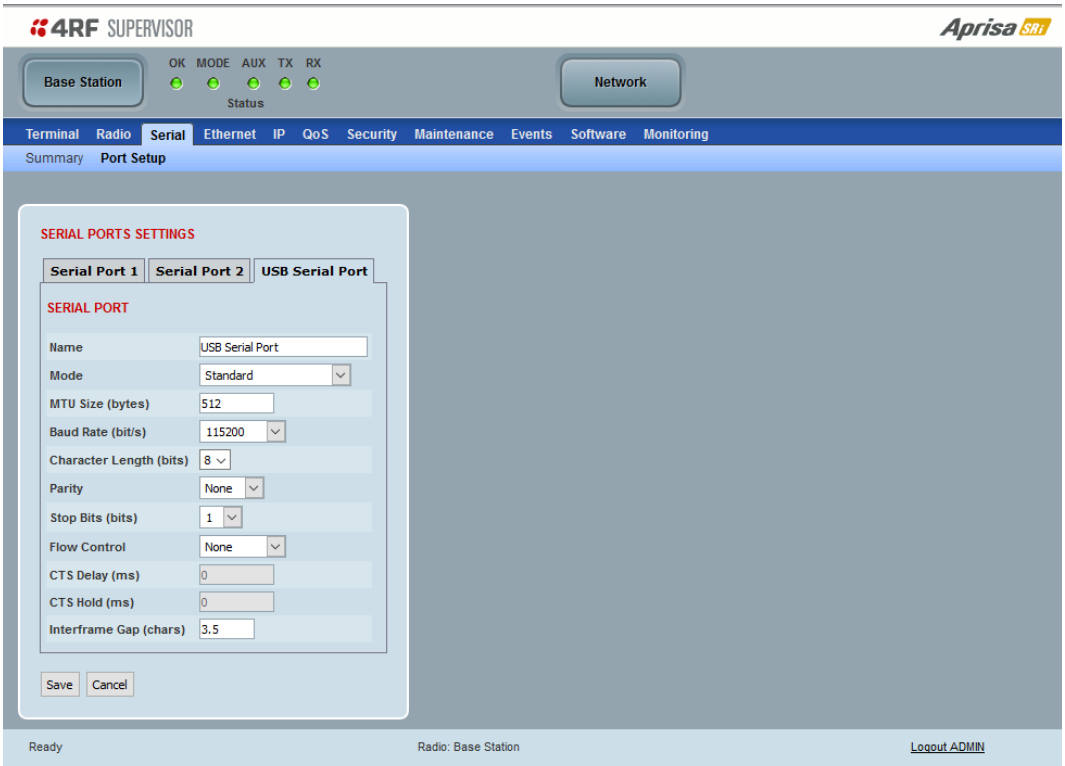
This parameter sets the IP address of the RTU connected on the configured serial port.

Baud Rate (bit/s)

This parameter sets the baud rate to 1200, 2400, 4800, 9600, 19200, 38400, 57600 or 115200 bit/s. The default setting is 115200 bit/s. The minimum supported baud rate is 1200 bit/s as SLIP will not work on baud rates below 1200.

USB Serial Ports

This page provides the setup for the USB serial port settings.



SERIAL PORTS SETTINGS

Mode

This parameter defines the mode of operation of the serial port. The default setting is Disabled.

Option	Function
Disabled	The serial port is not required.
Standard	The serial port is communicating with serial ports on other stations.
Terminal Server	A base station Ethernet port can communicate with both Ethernet ports and serial ports on remote radios. RS-232 traffic is encapsulated in IP packets (see 'Serial > Port Setup' Terminal Server on page 140).
CLI Management	The USB host port is used to access the radio Command Line Interface (CLI). A USB converter to RS-232 convertor will be required to connect to a PC.
GPS Receiver - NMEA0183	Set if a GPS receiver device is plugged into the radio USB port (see 'GPS Receiver' on page 147).

MTU Size (bytes)

This parameter sets the size of the packet in bytes received before it is transmitted if an inter-frame gap is not detected. Setting a smaller MTU may reduce latency, but this should only be done with streaming mode or else if serial protocol is known to allow gaps at the receiver. The default setting is 512 bytes.

Baud Rate (bit/s)

This parameter sets the baud rate to 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600 or 115200 bit/s. The default setting is 9600 bit/s.

Character Length (bits)

This parameter sets the character length to 7 or 8 bits. The default setting is 8 bits.

Parity

This parameter sets the parity to Even, Odd or None. The default setting is None.

Stop Bits (bits)

This parameter sets the number of stop bits to 1 or 2 bits. The default setting is 1 bit.

Flow Control

This parameter sets the flow control of the serial port. The default setting is Disabled.

Option	Function
None	The Aprisa SRi radio port (DCE) CTS is in a permanent ON (+ve) state.
CTS-RTS	CTS / RTS hardware flow control between the DTE and the Aprisa SRi radio port (DCE) is enabled. If the Aprisa SRi buffer is full the CTS goes OFF, otherwise CTS is ON.
CTS-Keying	CTS Keying is needed when working with devices that require to be keyed before sending data; • Driving legacy modems that use the CTS signal as a key-up signal. • Driving RS485 serial links, where the CTS signal is used as a Tx enable

CTS Delay ms

In CTS-Keying mode, this parameter sets the period the between the CTS being set and data being transmitted. The default setting is 0 ms.

CTS Hold Duration ms

In CTS-Keying mode, this parameter sets the the period the between the end of the data and CTS being cleared. The default setting is 0 ms.

Inter-Frame Gap (chars)

This parameter defines the gap between successive serial data frames. It is used to delimit the serial data to define the end of a packet.

Smaller values give better serial latency, however if this value is too small then packets may be incorrectly split and serial speed may be much slower. If this value is too large serial packets may be incorrectly joined together.

The Inter-Frame Gap limits are 0 to 9999 chars in steps of 0.1 char. The default setting is 3.5 chars.

An alarm event indicates if the value is set larger than the maximum for the serial mode selected.

GPS Receiver

This menu item is only applicable if a GPS Receiver device is plugged into the radio USB port.

The radio USB port supports NMEA 0183 - a combined electrical and data specification for communication between electronics systems and GPS receivers.

The currently supported GPS Receiver devices are;

	Part Number	Part Description
1	FTD FT X GPS	GPS Receiver, 1575 MHz, USB, Dongle Dimensions: 57 mm x 23 mm x 12.3 mm
2	APSB-GREC-T01-UA	4RF SR+ Acc, GNSS, Receiver, Type 01, USB A GNSS receiver and mushroom antenna Working mode GPS, GLONASS dual-mode Protocols NMEA,0183 Binary Waterproof grade: IPX67 Connector USB A, Cable length 15 metres Antenna dimensions H=150mm, DIA=100mm

MTU Size (bytes)

This parameter is not required for GPS Receiver device.

Baud Rate (bit/s)

Set to 4800 bit/s for both supported GPS Receiver devices above.

Character Length (bits)

Set to 8 bits.

Parity

Set to None.

Stop Bits (bits)

Set to 1 bit.

Flow Control

Set to Disabled.

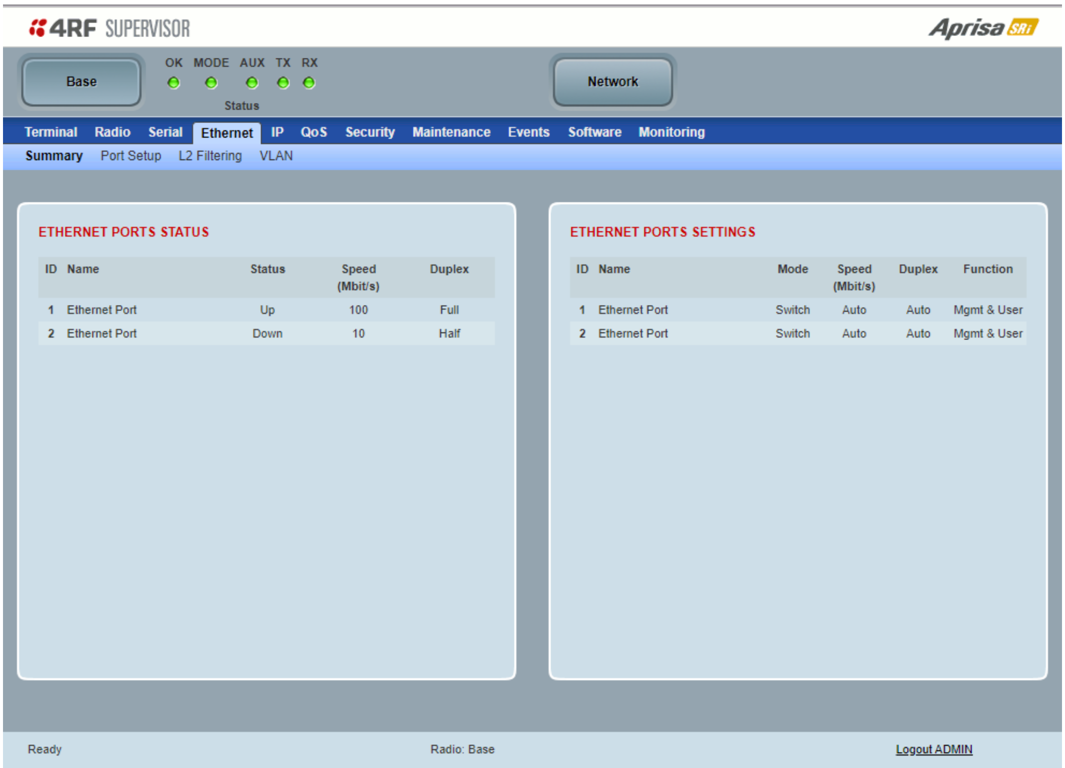
Inter-Frame Gap (chars)

This parameter is not required for GPS Receiver device.

Ethernet

Ethernet > Summary

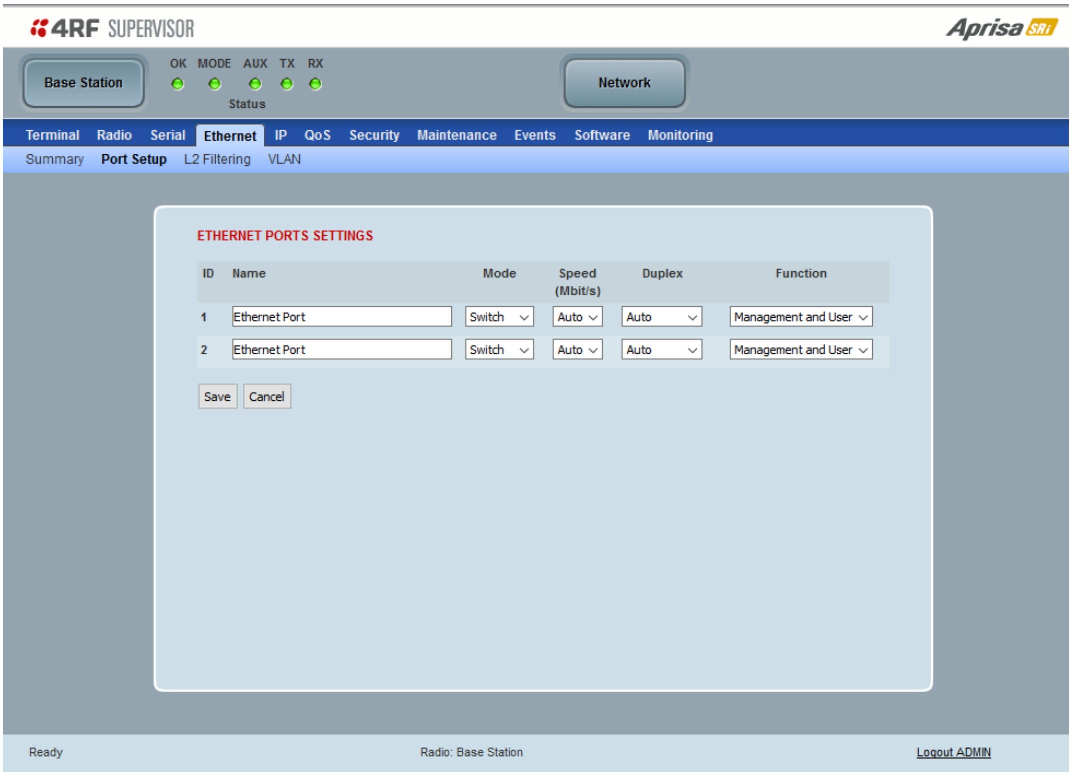
This page displays the current settings for the Ethernet port parameters and the status of the ports.



See ‘Ethernet > Port Setup’ for configuration options.

Ethernet > Port Setup

This page provides the setup for the Ethernet ports settings.



ETHERNET PORT SETTINGS

Mode

This parameter controls the Ethernet traffic flow. The default setting is Standard.

Option	Function
Standard	Enables Ethernet data communication over the radio link but Ethernet traffic is not switched locally between the two Ethernet ports.
Switch	Ethernet traffic is switched locally between the two Ethernet ports and communicated over the radio link
Disabled	Disables all Ethernet data communications.

Speed (Mbit/s)

This parameter controls the traffic rate of the Ethernet port. The default setting is Auto.

Option	Function
Auto	Provides auto selection of Ethernet Port Speed 10/100 Mbit/s
10	The Ethernet Port Speed is manually set to 10 Mbit/s
100	The Ethernet Port Speed is manually set to 100 Mbit/s

Duplex

This parameter controls the transmission mode of the Ethernet port. The default setting is Auto.

Option	Function
Auto	Provides auto selection of Ethernet Port duplex setting.
Half Duplex	The Ethernet Port is manually set to Half Duplex.
Full Duplex	The Ethernet Port is manually set to Full Duplex.

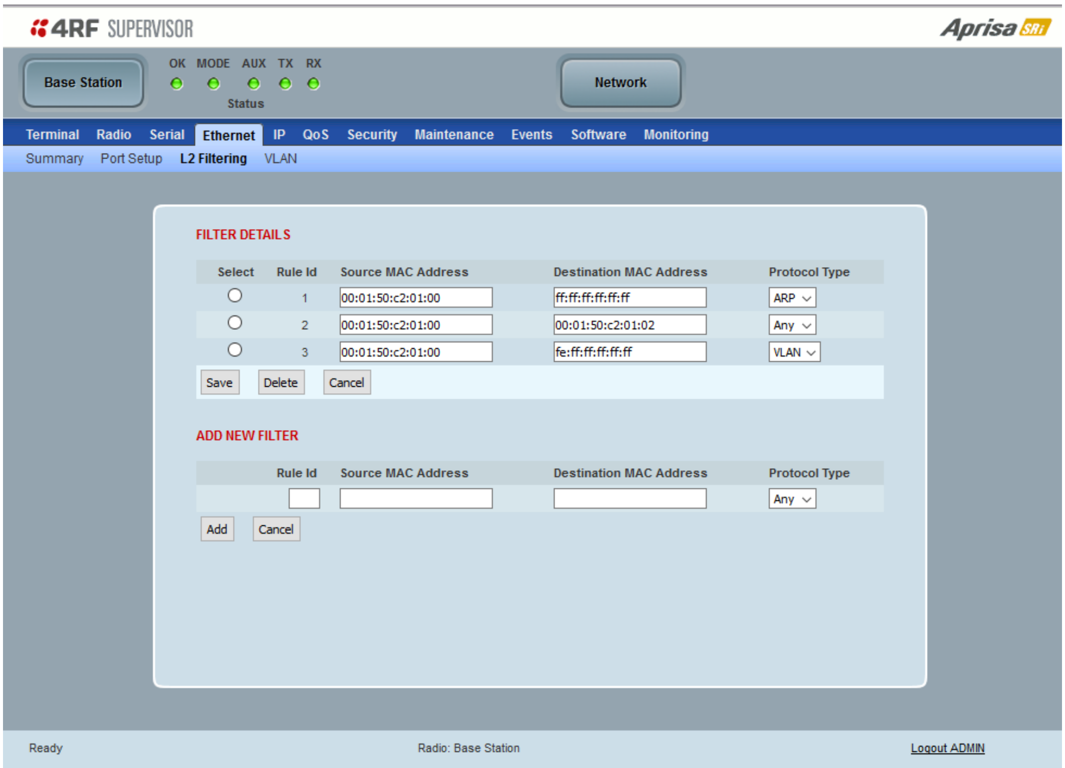
Function

This parameter controls the use for the Ethernet port. The default setting is Management and User.

Option	Function
Management Only	The Ethernet port is only used for management of the network.
Management and User	The Ethernet port is used for management of the network and User traffic over the radio link.
User Only	The Ethernet port is only used for User traffic over the radio link.

Ethernet > L2 Filtering

This page is only available if the Ethernet traffic option has been licensed (see 'Maintenance > Licence' on page 241).



FILTER DETAILS

L2 Filtering provides the ability to filter (white list) radio link user traffic based on specified Layer 2 MAC addresses.

User traffic originating from specified Source MAC Addresses destined for specified Destination MAC Addresses that meets the protocol type criteria will be transmitted over the radio link.

User traffic that does not meet the filtering criteria will not be transmitted over the radio link.

Management traffic to the radio will never be blocked.

Source MAC Address

This parameter sets the filter to the Source MAC address of the packet in the format 'hh:hh:hh:hh:hh:hh'.

If the Source MAC Address is set to 'FF:FF:FF:FF:FF:FF', traffic will be accepted from any source MAC address.

Destination MAC Address

This parameter sets the filter to the Destination MAC address of the packet in the format 'hh:hh:hh:hh:hh:hh'.

If the Destination MAC Address is set to 'FF:FF:FF:FF:FF:FF', traffic will be delivered to any destination MAC address.

Protocol Type

This parameter sets the EtherType accepted ARP, VLAN, IPv4, IPv6 or Any type.

Example:

In the screen shot, the rules are configured in the base station which controls the Ethernet traffic to the radio link.

Traffic from an external device with the Source MAC address 00:01:50:c2:01:00 is forwarded over the radio link if it meets the criteria. All other traffic will be blocked.

- Rule 1 If the Protocol Type is ARP going to any destination MAC address or
- Rule 2 If the Protocol Type is Any and the destination MAC address is 01:00:50:c2:01:02 or
- Rule 3 If the Protocol Type is VLAN tagged packets going to any unicast destination MAC address.

Special L2 Filtering Rules:

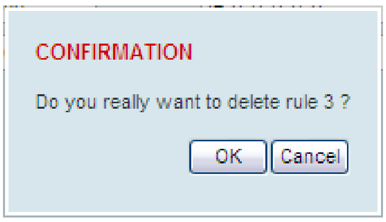
Unicast Only Traffic

This L2 filtering allows for Unicast only traffic and drop broadcast and multicast traffic. This filtering is achieved by adding the two rules:

Rule	Source MAC Address	Destination MAC Address	Protocol Type
Allow ARPS	FF:FF:FF:FF:FF:FF	FF:FF:FF:FF:FF:FF	ARP
Allow Unicasts from Any source	FF:FF:FF:FF:FF:FF	**FE**:FF:FF:FF:FF:FF	Any

To delete a L2 Filter:

1. Click on an existing rule 'Select'.
2. Click on Delete.



3. Click on OK.

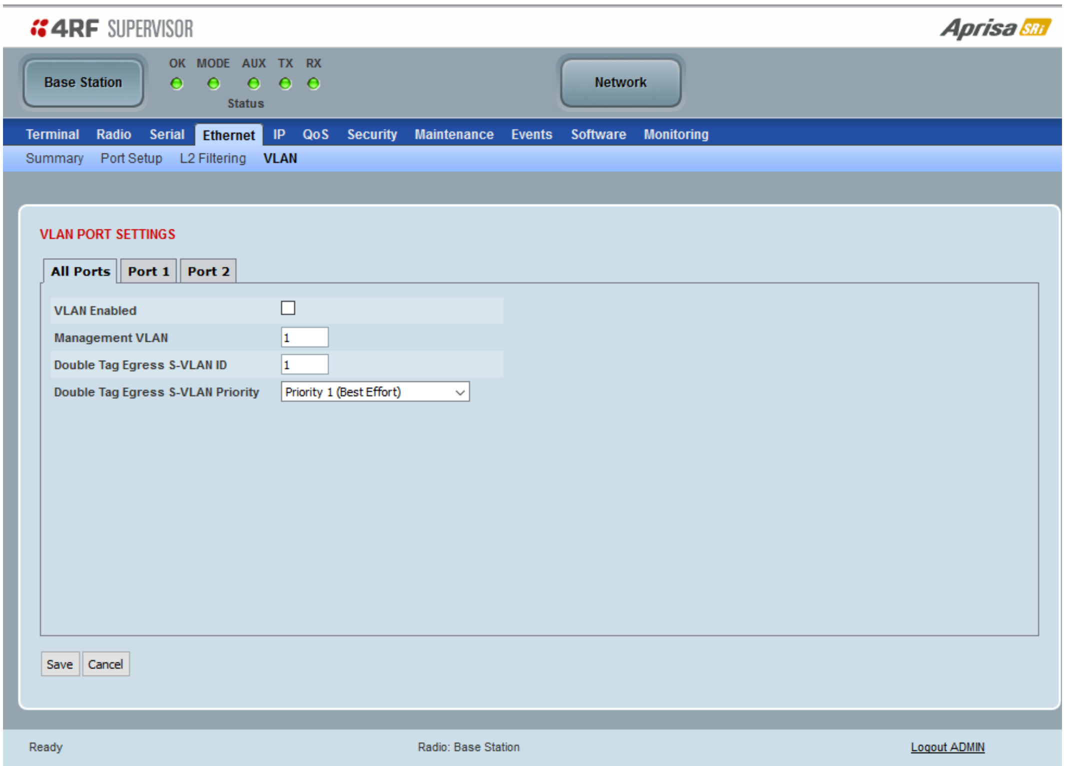
ADD NEW FILTER

To add a L2 Filter:

1. Enter the Rule ID number. This is a unique rule number between 1 and 25.
2. Enter the Source MAC address of the packet or 'FF:FF:FF:FF:FF:FF' to accept traffic from any MAC address.
3. Enter the Destination MAC address of the packet or 'FF:FF:FF:FF:FF:FF' to deliver traffic to any MAC address.
4. Select the Protocol Type to ARP, VLAN, IPv4, IPv6 or Any type.
5. Click on Add.

Ethernet > VLAN

This page is only available if the Ethernet traffic option has been licensed (see ‘Maintenance > Licence’ on page 241).



VLAN PORT SETTINGS – All Ports

This page specifies the parameters that relate to all Ethernet ports when working in Bridge Mode. Three parameters are global parameters for the Ethernet Bridge; enable / disable VLANs, Management VLAN ID and the Double VLAN ID(S-VLAN) and the priority bit. These parameters can't be defined per port and are globally defined for the Ethernet Bridge.

VLAN Enabled

This parameter sets if VLAN operation is required on the network. If it is enabled on the base station, it must also be enabled on the remote radios. The default is disabled.

Management VLAN

This parameter sets the VLAN ID for management traffic only. The value can be between 1 and 4094. The default is 1.

Double Tag Egress S-VLAN ID

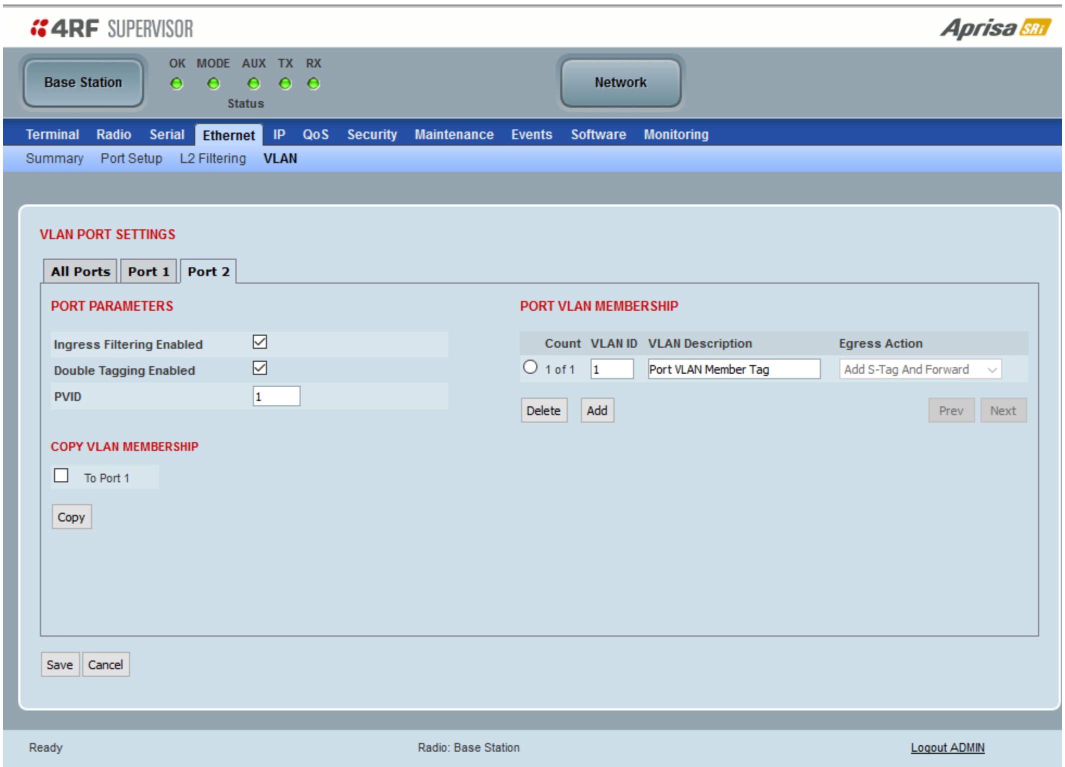
This parameter sets the S-VLAN ID (outer tag) in the egress direction. The value can be between 1 and 4094. The default is 1.

Double Tag Egress S-VLAN Priority

This parameter sets the S-VLAN egress traffic priority. The default is Priority 1 (Best Effort).

Option	**Egress Priority Classification**	**High / Low Priority**
Priority 0 Background	0	Lowest Priority
Priority 1 (Best Effort)	1	
Priority 2 (Excellent Effort)	2	
Priority 3 (Critical Applications)	3	
Priority 4 (Video)	4	
Priority 5 (Voice)	5	
Priority 6 (Internetwork Control)	6	
Priority 7 (Network Control)	7	Highest Priority

VLAN PORT SETTINGS – Port 2



PORT PARAMETERS

Ingress Filtering Enabled

This parameter enables ingress filtering. When enabled, if ingress VLAN ID is not included in its member set (inner tagged), the frame will be discarded.

If the Ingress Filtering is disabled, the Aprisa SRi supports ‘Admit All Frames’ so that all frames tagged, untagged and priority-tagged-frames are allowed to pass through the Ethernet ports. The default is disabled.

Double Tagging Enabled

This parameter enables double tagging on this specific port. When enabled, if the ingress traffic is double tagged, the Aprisa SRi will check and validate that the S-VLAN ID matches the S-VLAN defined in 'Double Tag Egress S-VLAN ID' in the 'all ports' tab. If there is a match, the packet will be forwarded into the Bridge and the S-VLAN outer tag will be removed, thus the radio network will only forward a single VLAN. If there isn’t a matching S-VLAN, the packet will be discarded. On egress, the outer tag (S-VLAN) is appended with the 'Double Tag Egress S-VLAN ID' defined in the 'all ports' tab (see page 153). The default is disabled.

If double tagging is enabled on the port, incoming frames should always be double tagged.

- If the incoming frame is untagged, then the PVID (port VLAN ID) is used and forwarded with the Port Ingress priority provided the PVID is configured in the Port VLAN Membership of any of the Ethernet ports. If not, the frames are dropped.
- If the incoming frame is single tagged, then PVID is used and forwarded with the Port Ingress priority provided the PVID is configured in the Port VLAN Membership of any of the Ethernet ports. If not the frames are dropped.

If double tagging is disabled on the port, incoming frames should always be single tagged, untagged or priority-tagged frames.

Double tagged frames are simply forwarded treating them as if they were single tagged frames. At the egress of the Ethernet port, such frames are forwarded only if the S-VLAN ID of that frame is a member of the Port VLAN Membership.

PVID (Port VLAN ID)

This parameter sets the frame VLAN ID when the ingress frame is untagged (e.g. when in 'port VLAN membership' the 'egress action' is set to 'untagged and forward') or priority-tagged (VLAN=0). The value can be between 1 and 4094. The default is 1.

Note: The Port VLAN Membership must contain the PVID. If the Port VLAN Membership does not contain the PVID, untagged or priority-tagged frames will be discarded.

COPY VLAN MEMBERSHIP

To Port

This parameter when set copies the port VLAN Membership settings to the other ports.

PORT VLAN MEMBERSHIP

VLAN ID

This parameter sets the VLAN ID of the port for a maximum 64 active VLANs. The value can be between 1 and 4094. The default is 1.

VLAN Description

This parameter is a freeform field used to identify the VLAN. It can be up to a maximum of 32 characters.

Egress Action

This parameter sets the action taken on the frame on egress from the Ethernet port. The default is Untag and forward.

Option	**Function**
Untag and forward	Removes the tagged information and forwards the frame. On Ingress, the VLAN tag will be added to the PVID tag.
Forward	Forwards the tagged frame as it is on egress. On Ingress, traffic is expected to include the VLAN tag with a member VLAN ID, otherwise the packet will be dropped.

Controls

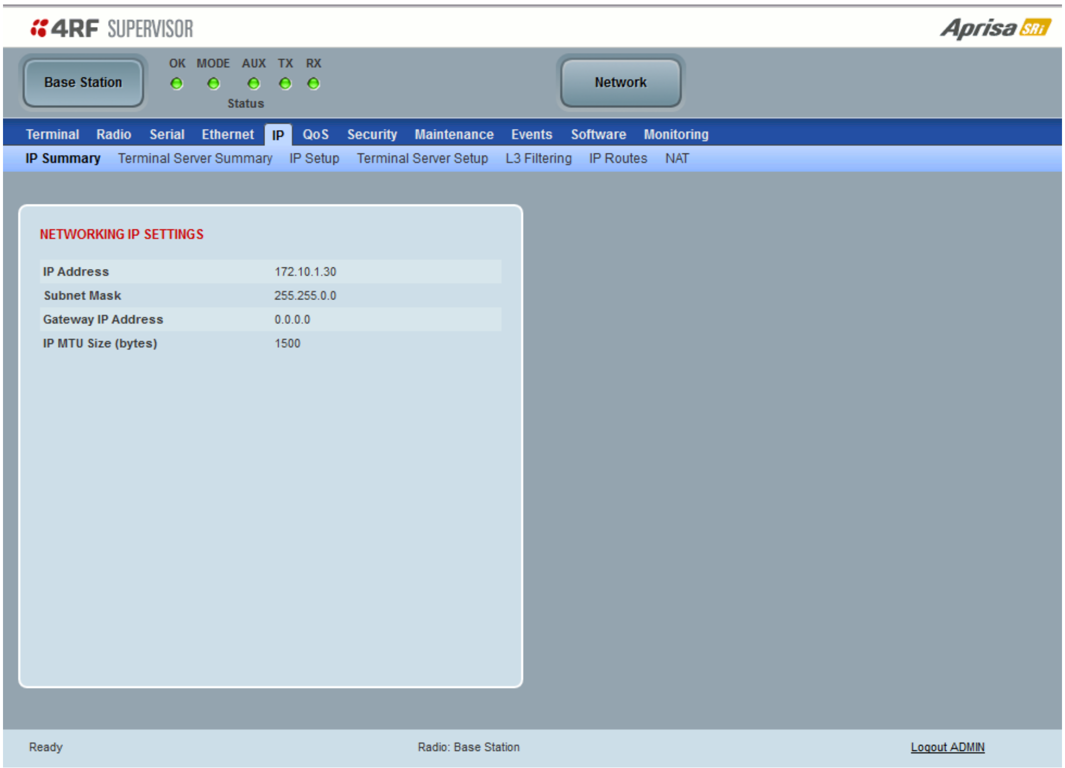
The Add button adds the selected entry.

The Delete button deletes the selected entry.

IP

IP > IP Summary > Bridge / Gateway Router Modes

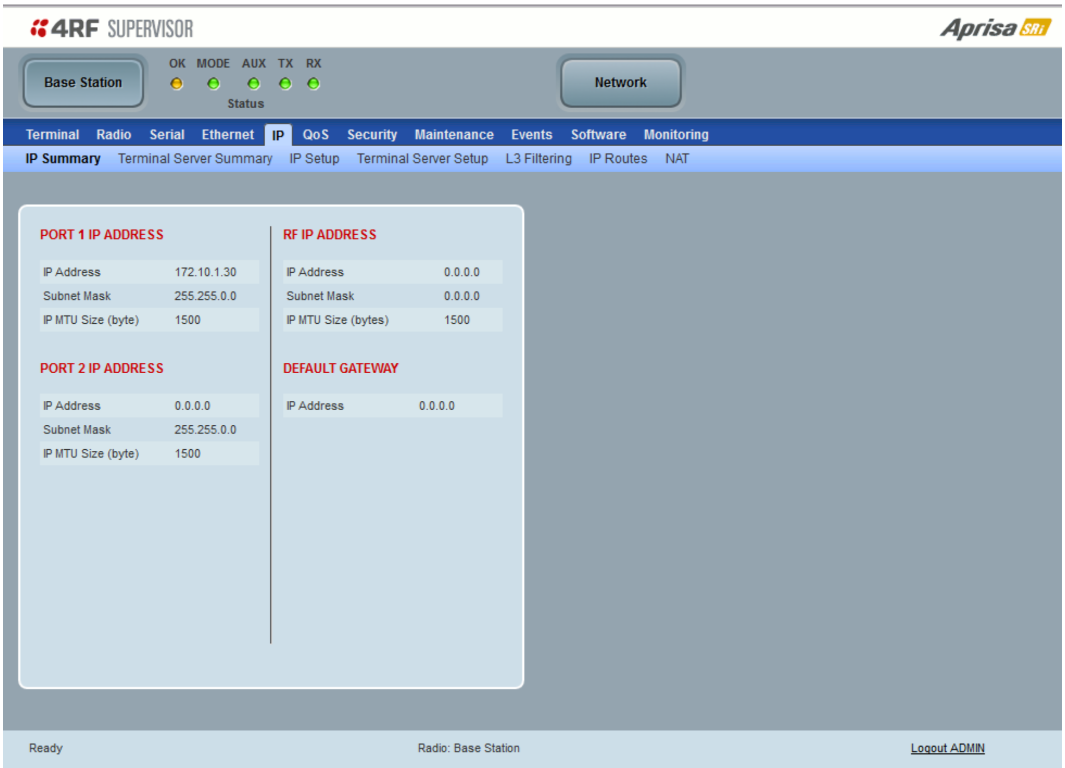
This page displays the current settings for the Networking IP Settings for an Ethernet Operating Mode of ‘Bridge’ or ‘Gateway Router’.



See ‘IP > IP Setup > Bridge / Gateway Router Modes’ on page 161 for configuration options.

IP > IP Summary > Router Mode

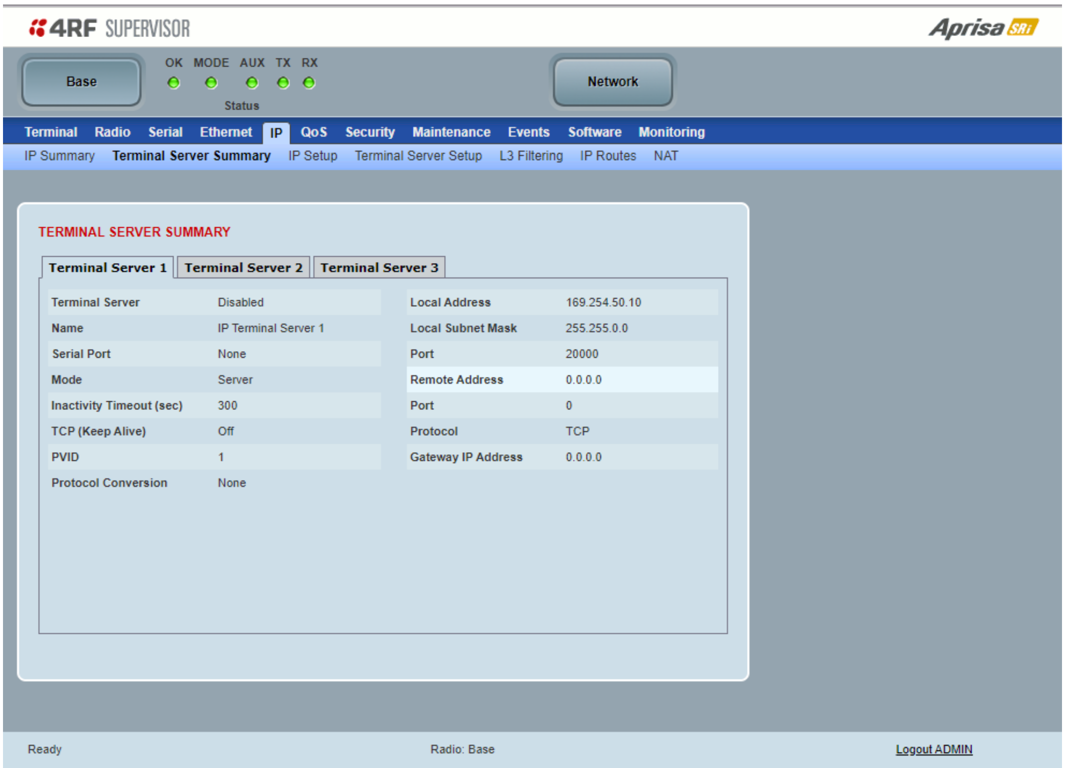
This page displays the current settings for the Networking IP Settings for an Ethernet Operating Mode of 'Router'.



See 'IP > IP Setup > Router Mode' on page 162 for configuration options.

IP > IP Terminal Server Summary

This page provides the setup for the IP Settings for an Ethernet Operating Mode of 'Bridge' or 'Gateway Router'.



TERMINAL SERVER SUMMARY

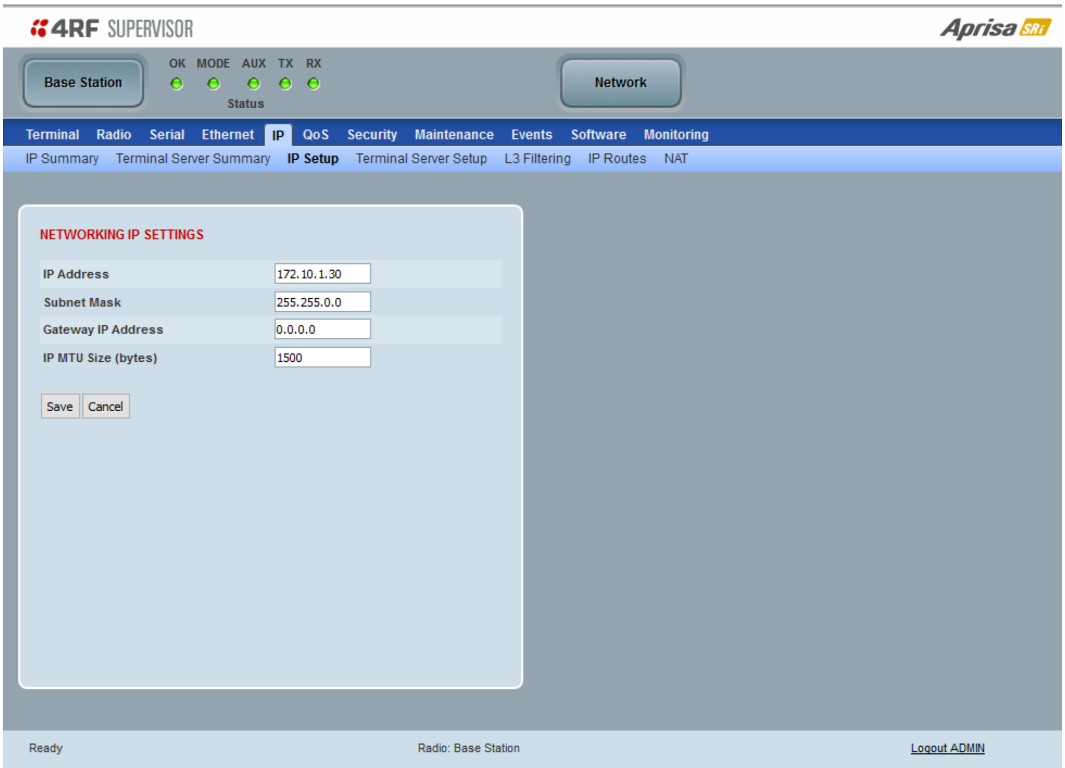
IP Terminal Server converts local incoming IP packets to a local physical serial port and to OTA serial packets.

This function is typically used on a base / master station to convert traffic to serial OTA for transmission to all remote radios

See 'IP > IP Terminal Server Setup' for configuration options.

IP > IP Setup > Bridge / Gateway Router Modes

This page provides the setup for the IP Settings for an Ethernet Operating Mode of 'Bridge' or 'Gateway Router'.



NETWORKING IP SETTINGS

IP Address

Set the static IP Address of the radio (Management and Ethernet ports) assigned by your site network administrator using the standard format xxx.xxx.xxx.xxx. This IP address is used both in Bridge mode and in Router mode. The default IP address is in the range 169.254.50.10.

Subnet Mask

Set the Subnet Mask of the radio (Management and Ethernet ports) using the standard format xxx.xxx.xxx.xxx. The default subnet mask is 255.255.0.0 (/16).

Gateway

Set the Gateway address of the radio, if required, using the standard format xxx.xxx.xxx.

A default gateway is the node on the network that traffic is directed to when an IP address does not match any other routes in the routing table. It can be the IP address of the router or PC connected to the base station. The default gateway commonly connects the internal radio network and the outside network. The default Gateway is 0.0.0.0.

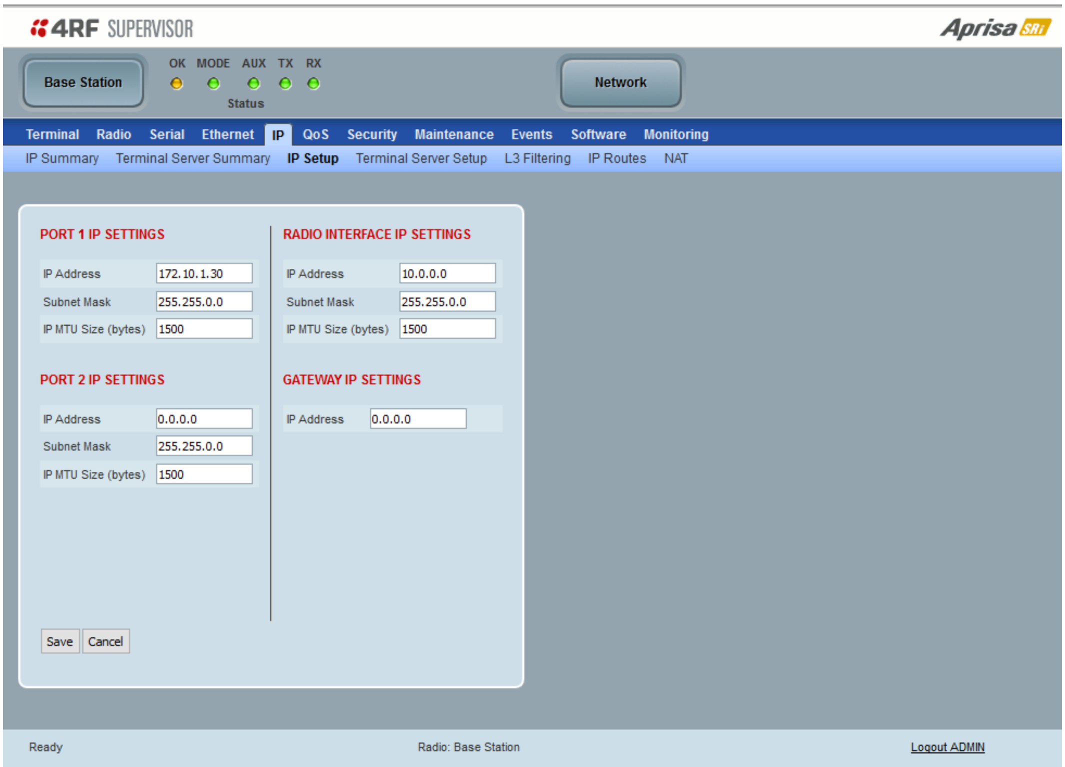
IP MTU Size (bytes)

Sets the IP Maximum Transmission Unit (MTU).

The IP MTU can be configured on each IP interface to improve compatibility and/or performance when integrating with devices using smaller than standard MTU sizes. The default setting is 1500.

IP > IP Setup > Router Mode

This page provides the setup for the IP Settings for and Ethernet Operating Mode of ‘Router’.



PORT SETTINGS

IP Address

Set the static IP Address of the radio Ethernet port (n) assigned by your site network administrator using the standard format xxx.xxx.xxx.xxx. This IP address is used for this Ethernet port Router mode.

Subnet Mask

Set the Subnet Mask of the of the radio Ethernet port (n) using the standard format xxx.xxx.xxx.xxx. The default subnet mask is 255.255.0.0 (/16).

Gateway

Set the Gateway address of the radio Ethernet port (n), if required, using the standard format xxx.xxx.xxx.

A default gateway is the node on the network that traffic is directed to when an IP address does not match any other routes in the routing table. It can be the IP address of the router or PC connected to the base station. The default gateway commonly connects the internal radio network and the outside network. The default Gateway is 0.0.0.0.

IP MTU Size (bytes)

Sets the IP Maximum Transmission Unit (MTU).

The IP MTU can be configured on each IP interface to improve compatibility and/or performance when integrating with devices using smaller than standard MTU sizes. The default setting is 1500.

RADIO INTERFACE IP SETTINGS

The RF interface IP address is the address that traffic is routed to for transport over the radio link. This IP address is only used when Router Mode is selected i.e. not used in Bridge Mode.

Radio Interface IP Address

Set the IP Address of the RF interface using the standard format xxx.xxx.xxx.xxx. The default IP address is in the range 10.0.0.0.

Radio Interface Subnet Mask

Set the Subnet Mask of the RF interface using the standard format xxx.xxx.xxx.xxx. The default subnet mask is 255.255.0.0 (/16).

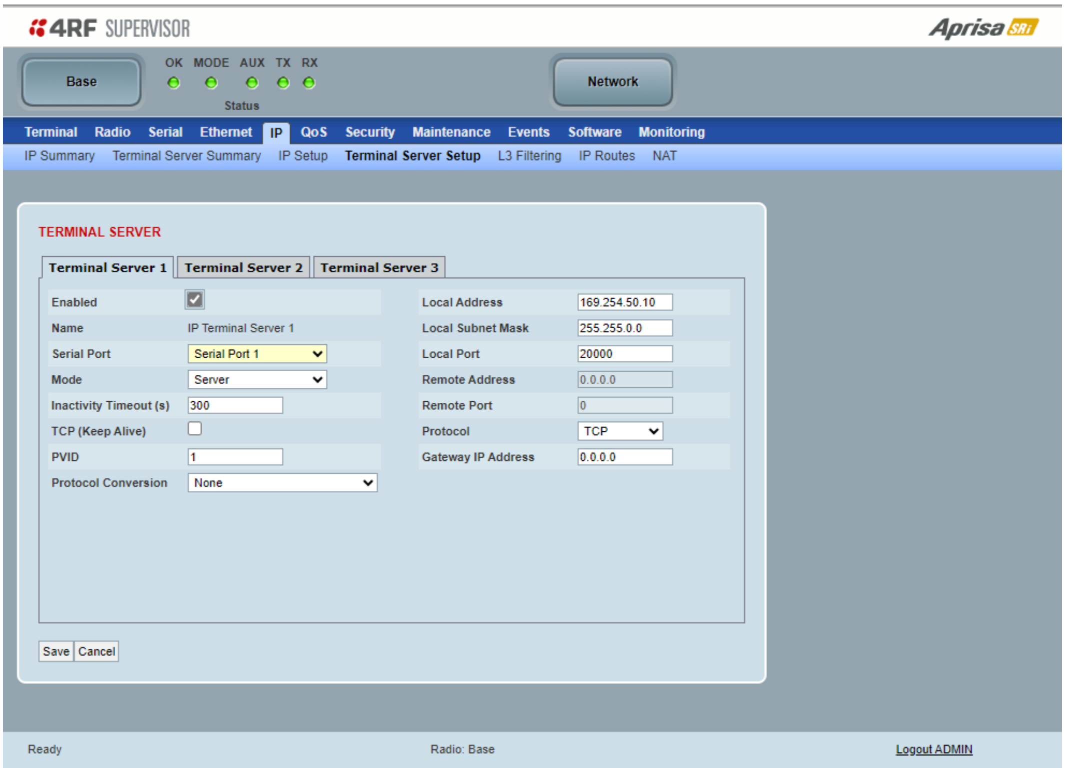
Note 1: If the base station RF interface IP address is a network IP address, and if the remote radio is also using a network IP address within the same subnet or different subnet, then the base radio will assign an automatic RF interface IP address from its own subnet.

When the base radio has a host specific RF interface IP address, then all the remotes must have a host specific RF interface IP address from the same subnet.

Note 2: When a remote radio is configured for Router Mode and the base radio is changed from Bridge Mode to Router Mode and the RF interface IP address is set to AUTO IP configuration (at least the last octet of the RF interface IP address is zero), it is mandatory to configure the network topology by using the 'Decommission Node' and 'Discover Nodes' (see 'Maintenance > Advanced' on page 247).

IP > IP Terminal Server Setup

This page provides the setup for the IP Settings for an Ethernet Operating Mode of ‘Bridge’ or ‘Gateway Router’.



TERMINAL SERVER

Enabled

This parameter enables IP terminal server.

IP Terminal Server converts local incoming IP packets to a local physical serial port and to OTA serial packets as well. This function is typically used on a base / master station to convert traffic to serial OTA for transmission to all remote radios.

Name

This parameter displays the IP terminal server port name.

Serial Port

This parameter selects the serial port to use IP terminal server.

Option	Function
Serial Port	This is the normal RS-232 serial ports provided with the RJ45 connector.
USB Serial Port	This is the optional RS-232 / RS-485 serial port provided with the USB host port connector with a USB to RS-232 / RS-485 RJ45 converter cable (see ‘USB Serial Ports’ on page 386).

Local Address

This parameter displays the IP address of this radio.

Local Port

This parameter sets the TCP or UDP port number of the local serial port.

The valid port number range is greater than or equal to 1024 and less than or equal to 49151 but with exclusions of 0, 5445, 6445, 9930 or 9931. The default setting is 20000.

Remote Address

This parameter sets the IP address of the server connected to the radio Ethernet port.

Remote Port

This parameter sets the TCP or UDP port number of the server connected to the radio Ethernet port. The default setting is 0.

Protocol

This parameter sets the L4 TCP/IP or UDP/IP protocol used for terminal server operation. The default setting is TCP.

Mode

This parameter defines the mode of operation of the terminal server connection. The default setting is Client and Server.

Option	Function
Client	The radio will attempt to establish a TCP connection with the specified remote unit. Generally, this setting is for the base station with an Ethernet connection to the SCADA master.
Server	The radio will listen for a TCP connection on the specified local port. Generally, this setting is for the remote radio with a serial connection to the RTU. Data received from any client shall be forwarded to the associated serial port while data received from that serial port shall be forwarded to every client with an open TCP connection. If no existing TCP connections exist, all data received from the associated serial port shall be discarded.
Client and Server	The radio will listen for a TCP connection on the specified local port and if necessary, establish a TCP connection with the specified remote unit. Generally, this setting is used for the remote radio but it should be used carefully as two connections might be established with the base station. Data received from any client shall be forwarded to the associated serial port while data received from that serial port shall be forwarded to every client with an open TCP connection.

Inactivity Timeout (seconds)

This specifies the duration (in seconds) to automatically terminate the connection with the remote TCP server if no data has been received from either the remote TCP server or its associated serial port for the duration of the configured inactivity time.

TCP Keep Alive

A TCP keep alive is a message sent by one device to another to check that the link between the two is operating, or to prevent the link from being broken.

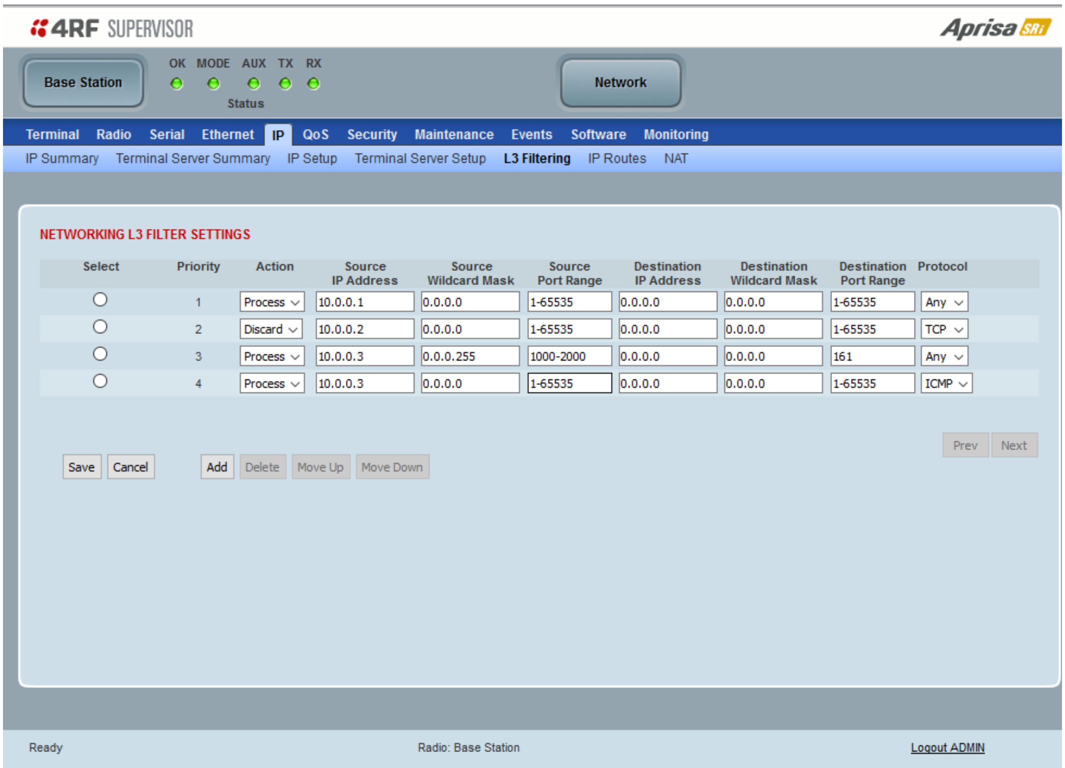
If the TCP keep alive is enabled, the radio will be notified if the TCP connection fails.

If the TCP keep alive is disabled, the radio relies on the Inactivity Timeout to detect a TCP connection failure. The default setting is disabled.

Note: An active TCP keep alive will generate a small amount of extra network traffic.

IP > L3 Filtering

This page is only available if the Ethernet traffic option has been licensed (see 'Maintenance > Licence' on page 241) and Router Mode selected. The filter operates in either Bridge Mode or Router Mode (see 'Terminal > Operating Mode' on page 107).



NETWORKING L3 FILTER SETTINGS

L3 Filtering provides the ability to evaluate traffic and take specific action based on the filter criteria.

This filtering can also be used for L4 TCP / UDP port filtering which in most cases relates to specific applications as per IANA official and unofficial well-known ports.

Entering a * into any to field will automatically enter the wildcard values when the data is saved.

Priority

This parameter shows the priority order in which the filters are processed.

Action

This parameter defines the action taken on the packet when it meets the filter criteria.

Option	Function
Process	Processes the packet if it meets the filter criteria
Discard	Discards the packet if it meets the filter criteria

Source IP Address

If the source IP address is set to 0.0.0.0, any source IP address will meet the filter criteria.

Source Wildcard Mask

This parameter defines the mask applied to the source IP address. 0 means that it must be a match.

If the source wildcard mask is set to 0.0.0.0, the complete source IP address will be evaluated for the filter criteria.

If the source wildcard mask is set to 0.0.255.255, the first 2 octets of the source IP address will be evaluated for the filter criteria.

If the source wildcard mask is set to 255.255.255.255, none of the source IP address will be evaluated for the filter criteria.

Note: The source wildcard mask operation is the inverse of subnet mask operation

Source Port Range

This parameter defines the port or port range for the source. To specify a range, insert a dash between the ports e.g. 1000-2000. If the source port range is set to 1-65535, traffic from any source port will meet the filter criteria.

Destination IP Address

This parameter defines the destination IP address of the filter. If the destination IP address is set to 0.0.0.0, any destination IP address will meet the filter criteria.

Destination Wildcard Mask

This parameter defines the mask applied to the destination IP address. 0 means that it must be a match.

If the destination wildcard mask is set to 0.0.0.0, the complete destination IP address will be evaluated for the filter criteria.

If the destination wildcard mask is set to 0.0.255.255, the first 2 octets of the destination IP address will be evaluated for the filter criteria.

If the destination wildcard mask is set to 255.255.255.255, none of the destination IP address will be evaluated for the filter criteria.

Note: The destination wildcard mask operation is the inverse of subnet mask operation

Destination Port Range

This parameter defines the port or port range for the destination. To specify a range, insert a dash between the ports e.g. 1000-2000. If the destination port range is set to 1-65535, traffic to any destination port will meet the filter criteria.

Protocol

This parameter defines the Ethernet packet type that will meet the filter criteria.

Controls

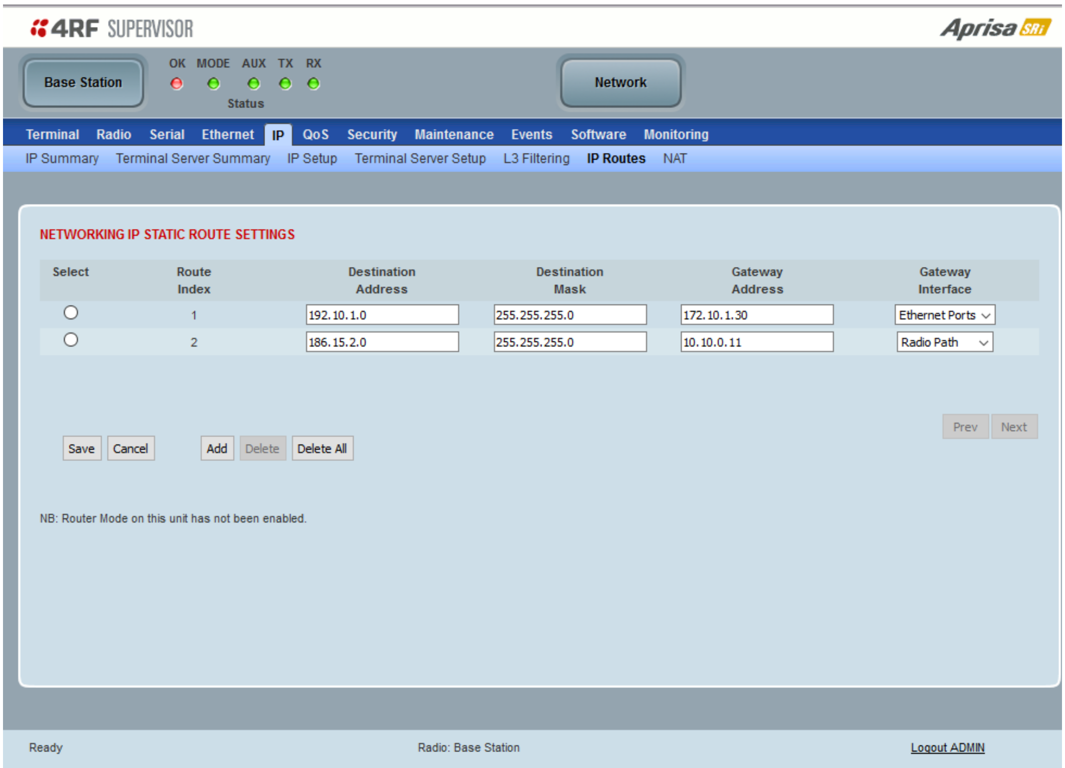
The Delete button deletes the selected entry.

The Move Up button moves the selected entry above the entry above it increasing its process priority.

The Move Down button moves the selected entry below the entry above it reducing its process priority.

IP > IP Routes

This page is only available if the Ethernet traffic option has been licensed (see 'Maintenance > Licence' on page 241) and Router Mode selected. It is not valid for Bridge Mode (see 'Terminal > Operating Mode' on page 107).



NETWORKING IP STATIC ROUTE SETTINGS

Static routing provides the ability to evaluate traffic to determine if packets are forwarded over the radio link or discarded based on the route criteria.

Route Index

This parameter shows the route index.

Destination Address

This parameter defines the destination IP address of the route criteria.

Destination Mask

This parameter defines the subnet mask applied to the Destination IP Address. 255 means that it must be a match.

If the destination subnet mask is set to 255.255.255.255, all octets of the Destination IP Address will be evaluated for the route criteria.

If the destination subnet mask is set to 255.255. 0.0, the first 2 octets of the Destination IP Address will be evaluated for the route criteria.

Gateway Address

This parameter sets the gateway address where packets will be forwarded to.

- If the gateway interface is set to Ethernet Ports, the gateway address is the IP address of the device connected to the Ethernet port.
- If the gateway interface is set to Radio Path, the gateway address is the IP address of the remote radio.

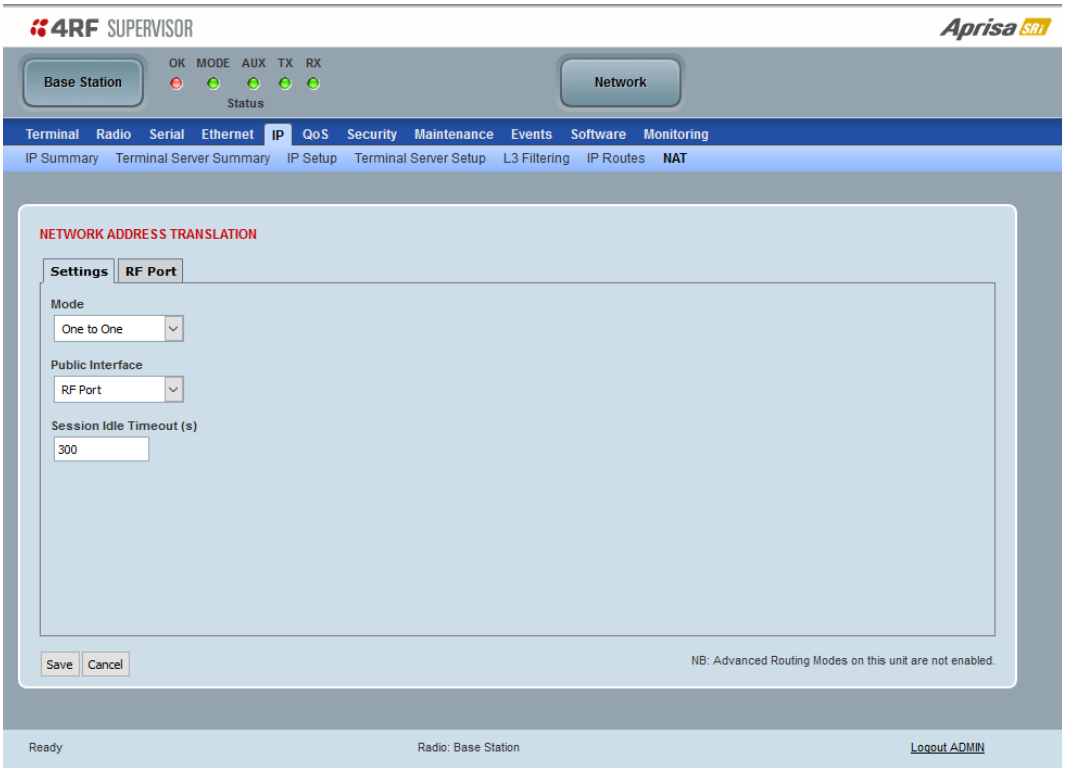
Gateway Interface

This parameter sets the destination interface.

Option	Function
Ethernet Ports	Packets are forwarded to the Ethernet interface port.
Radio Path	Packets are forwarded to the RF Interface radio path.

IP > NAT

This page is only available if the Ethernet traffic option has been licensed (see 'Maintenance > Licence' on page 241) and Router Mode selected. It is not valid for Bridge Mode (see 'Terminal > Operating Mode' on page 107).



NETWORK ADDRESS TRANSLATION

Mode

Option	Function
Disabled	No Network Address Translation
One to One	NAT mapping (translating) of public interface IP address space into another private interfaces IP address space and vice versa via AGRM/ARM router.
Port Forwarding	NAT mapping (translating) of public TCP/UDP port (or ICMP query ID) of a single public IP addresses into multiple private IP address space and vice versa via AGRM/ARM router.

One To One

The One-to-One Network Address Translation (NAT) remaps one public interface IP address space into another private interface IP address space and vice versa by modifying the IP network address information in IP datagram packet headers.

The NAT function is only available in Advanced Gateway Router Mode (AGRM) or Advanced Router Mode (ARM).

The current implementation of One-to-One NAT supports network configurations supported in AGRM / ARM mode, such as AGRM / ARM-Bridge, Bridge-AGRM / ARM and Bridge-Mix [AGRM / ARM and Bridge] i.e. other network configuration options are not supported by NAT, such as AGRM / ARM-AGRM / ARM network). For more detailed information about NAT see section 'Network Address Translation (NAT) Router' on page 42.

Public Interface

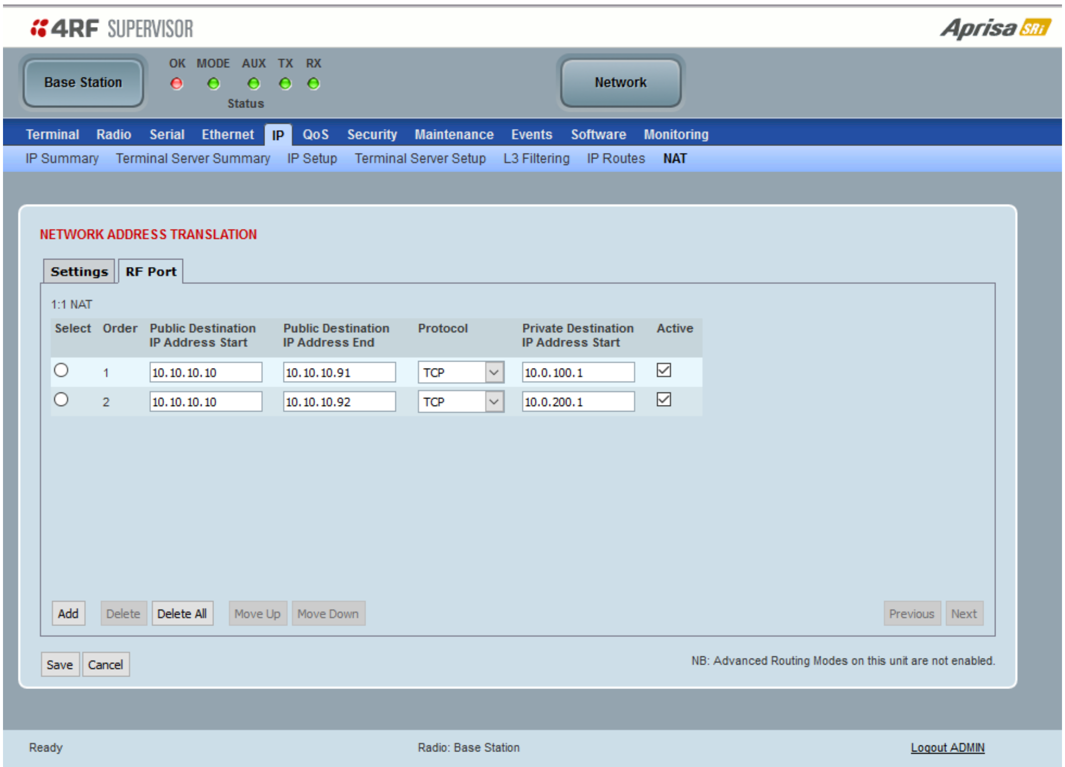
This parameter sets the Global external / public interface.

Option	Function
Radio Port	The public interface for NAT is the radio port.
Ethernet Port (n)	The public interface for NAT is Ethernet port n.

Session Idle Timeout

This time defines the NAT session period in the NAT session table. The session will be automatically removed once the idle timer expires. The Time is common for 'ANY' protocol. This timer will be reset to 0 in session table when a matching packet hits the NAT rule.

One To One > RF Port



The RF Port configures the inbound NAT translation rules (public to private interface translation direction) for the selected public interface which in this case is the RF port. NAT will perform the IP address translation on the inbound direction whenever there is a matching rule in the public IP address and protocol fields translating it to the private IP address. Outbound NAT translation function (private to public interface translation direction) will perform the IP address translation whenever there is a matching rule in the private IP address and protocol fields translating it to the public IP address.

Public Destination IP Address Start

The start of the public destination IP address range.

Public Destination IP Address End

The end of the public destination IP address range.

Protocol

The matching protocol where NAT should perform the IP address translation function. Supports ICMP, TCP, UDP or Any (Any means one among the list; ICMP, TCP, UDP).

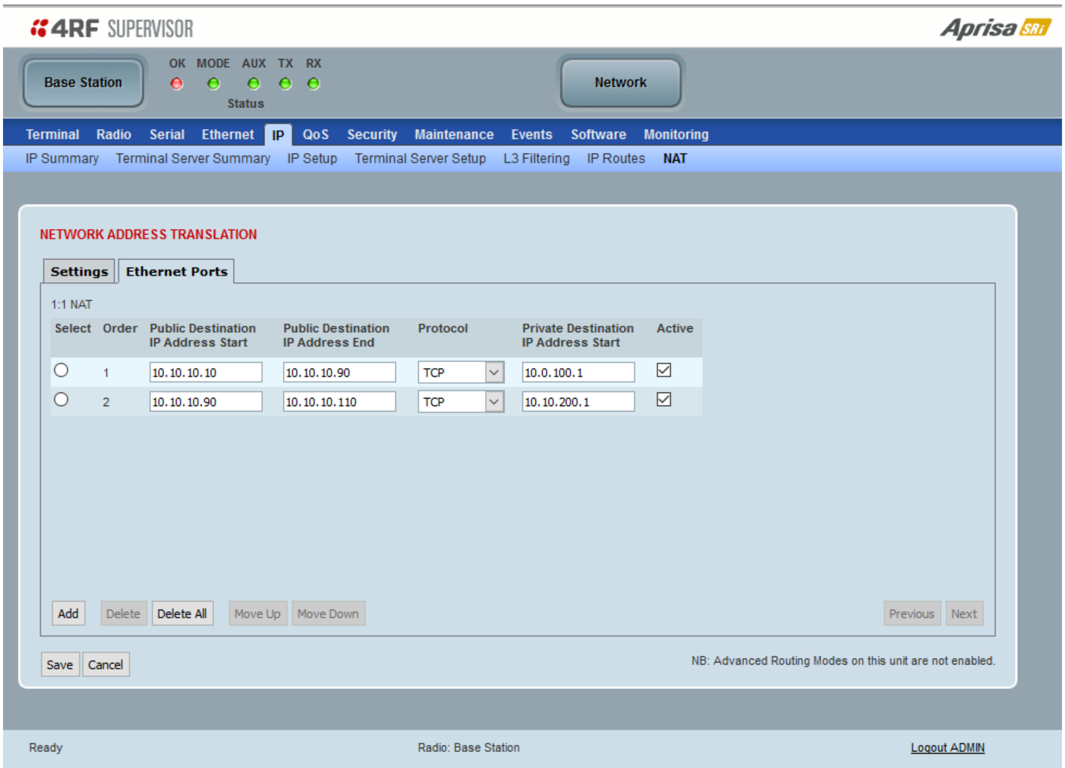
Private Destination IP Address Start

This is the start of the Private Destination IP address range. The end of the private destination IP address is automatically calculated from the start and end of public destination IP address range.

Active

If checked the rule becomes active, if unchecked the rule is inactive.

One To One > Ethernet Ports



The Ethernet Ports configures the inbound NAT translation rules (public to private interface translation direction) for the selected public interface which in this case is the Ethernet port. NAT will perform the IP address translation on the inbound direction whenever there is a matching rule in the public IP address and protocol fields translating it to the private IP address. Outbound NAT translation function (private to public interface translation direction) will perform the IP address translation whenever there is a matching rule in the private IP address and protocol fields translating it to the public IP address.

Public Destination IP Address Start

The start of the public destination IP address range.

Public Destination IP Address End

The end of the public destination IP address range.

Protocol

The matching protocol where NAT should perform the IP address translation function. Supports ICMP, TCP, UDP or Any (Any means one among the list; ICMP, TCP, UDP).

Private Destination IP Address Start

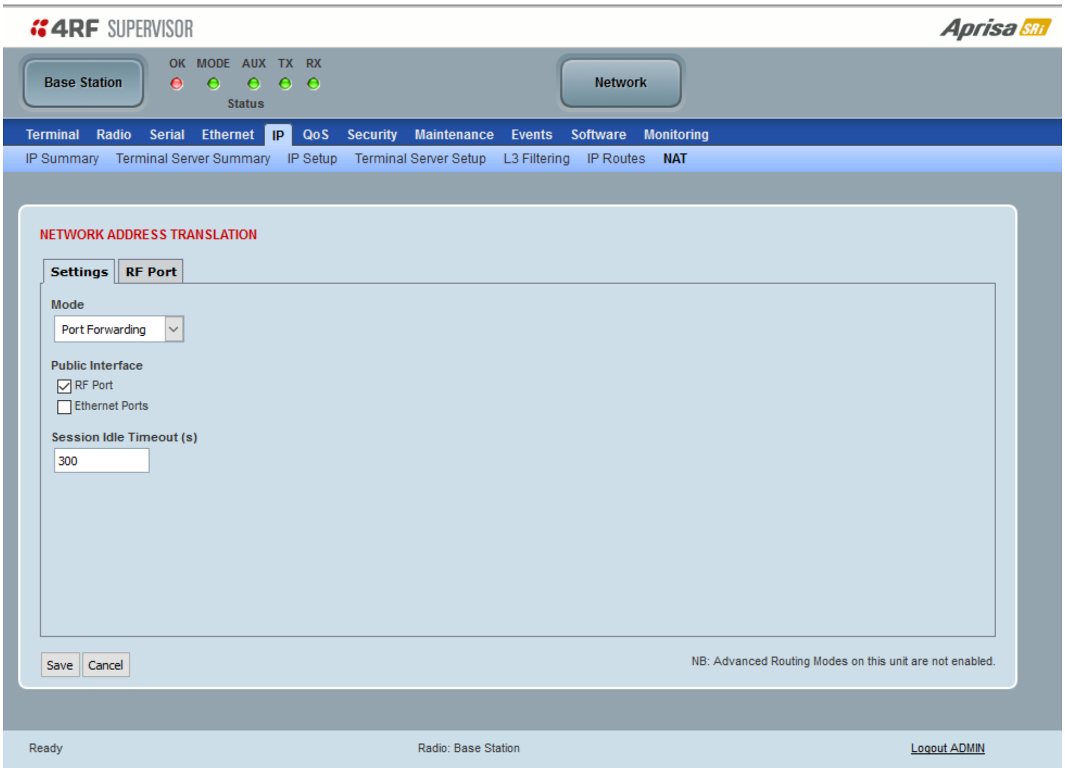
This is the start of the Private Destination IP address range. The end of the private destination IP address is automatically calculated from the start and end of public destination IP address range.

Active

If checked the rule becomes active, if unchecked the rule is inactive.

Port Forwarding

Port Forwarding NAT (NAPT) remaps the public TCP/UDP port (or ICMP query ID) of a single public IP address into multiple private IP address spaces and vice versa via AGRM/ARM router.



Public Interface

This parameter sets the Global external /public interface. The page varies depending on the router mode ARM and AGRM.

The table below shows the public interface options for ARM router (as shown in the screenshot above for 2E2S radio). In ARM, each Ethernet interface can be set with a different public IP address, thus a multiple Ethernet port can be used as a public interface. This is useful for example when radio is connected via two Ethernet ports to two different networks with different subnets for protection or for different services e.g. SCADA service and management service.

Option	Function
Radio Port	The public interface for NAT is the radio port.
Ethernet Port 1	The public interface for NAT is a Ethernet port 1.
Ethernet Port 2	The public interface for NAT is a Ethernet port 2.

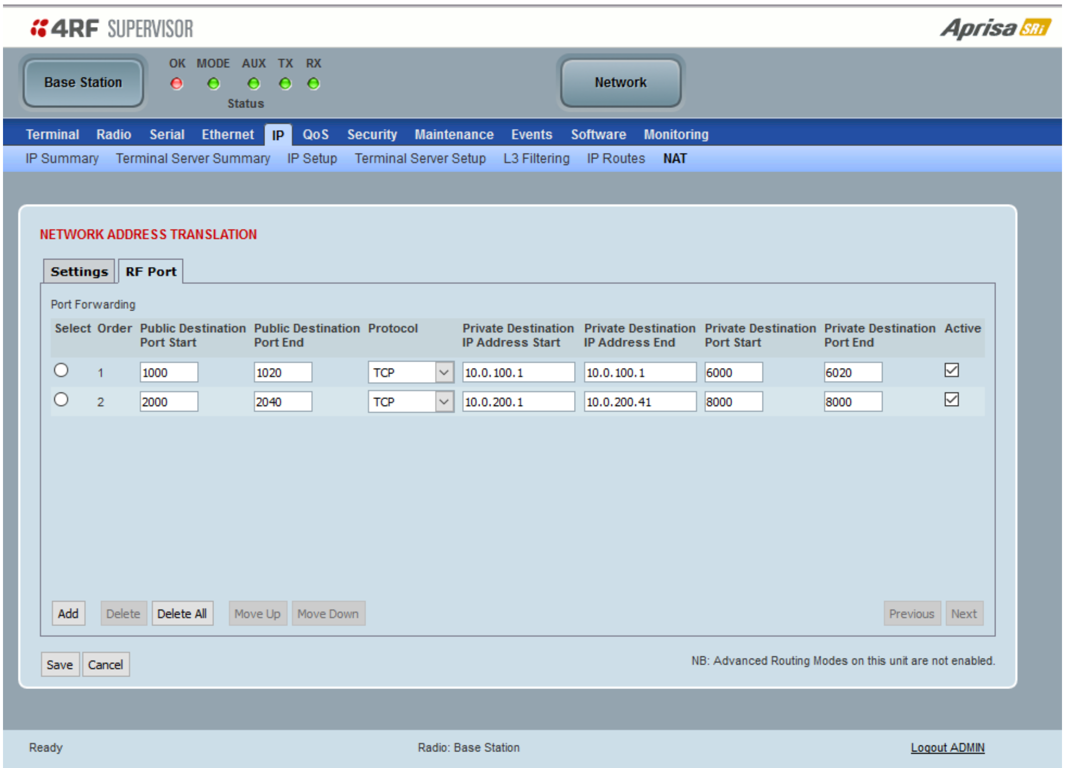
The table below shows the public interface options for a AGRM router, since in AGRM all Ethernet interfaces can be set with only a single public IP address.

Option	Function
Radio Port	The public interface for NAT is the radio port.
Ethernet Ports	The public interface for NAT is a Ethernet port.

Session Idle Timeout

This time defines the NAT session period in the NAT session table. The session will be automatically removed once the idle timer expires. The Time is common for 'ANY' protocol. This timer will be reset to 0 in session table when a matching packet hits the NAT rule.

Port Forwarding > RF Port



When the RF Port is selected as the public interface, then the inbound NAT session is from the radio RF port to the Ethernet private network side of the network (public to private interface), commonly used in remotes. NAT will perform the translation on the inbound direction whenever there is a matching rule in the public TCPU/UDP port, the single IP address of RF port and protocol fields translating it to the multiple private IP address space.

Outbound NAT translation function (private to public interface translation direction) will perform the IP address translation whenever there is a matching rule in the TCP/UDP port and private IP address and protocol fields or a dynamic rule is created translating it to the single public IP address and TCP/UDP port.

Public Destination Port Start

The start of the public destination port range between 0 to 65535.

Public Destination Port End

The end of the public destination port range between 0 to 65535.

Protocol

The matching protocol where NAT should perform the IP address translation function. Supports ICMP, TCP, UDP or Any (Any means one among the list; ICMP, TCP, UDP).

Private Destination IP Address Start

This is the start of the Private Destination IP address range.

Private Destination IP Address End

This is the end of the Private Destination IP address range.

Private Destination Port Start

The start of the private destination port range between 0 to 65535.

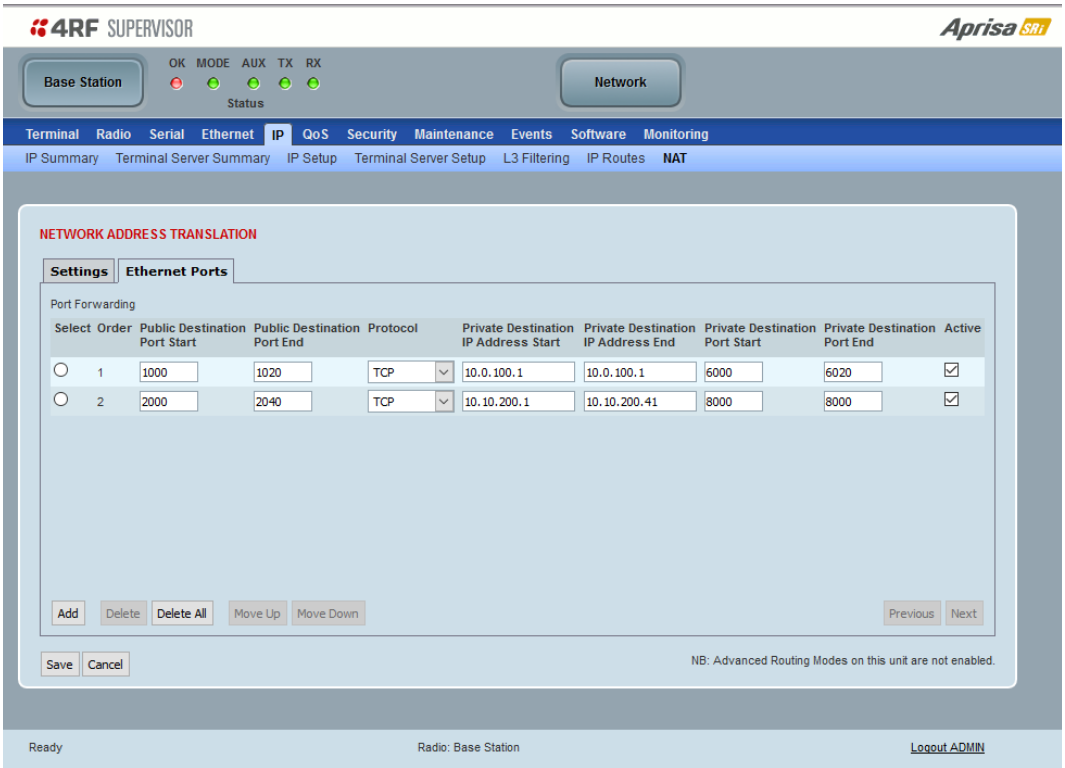
Private Destination Port End

The end of the private destination port range between 0 to 65535.

Active

If checked the rule becomes active, if unchecked the rule is inactive.

Port Forwarding > Ethernet Ports



When the Ethernet Port is selected as the public interface, then the inbound NAT session is from the Ethernet port to the RF port private network side of the network (public to private interface), commonly used in Base station. NAT will perform the translation on the inbound direction whenever there is a matching rule in the public TCPU/UDP port, the single IP address of the Ethernet port and protocol fields translating it to the multiple private IP address space.

Outbound NAT translation function (private to public interface translation direction) will perform the IP address translation whenever there is a matching rule in the TCP/UDP port and private IP address and protocol fields or a dynamic rule is created translating it to the single public IP address and TCP/UDP port.

Public Destination Port Start

The start of the public destination port range between 0 to 65535.

Public Destination Port End

The end of the public destination port range between 0 to 65535.

Protocol

The matching protocol where NAT should perform the IP address translation function. Supports ICMP, TCP, UDP or Any (Any means one among the list; ICMP, TCP, UDP).

Private Destination IP Address Start

This is the start of the Private Destination IP address range.

Private Destination IP Address End

This is the end of the Private Destination IP address range.

Private Destination Port Start

The start of the private destination port range between 0 to 65535.

Private Destination Port End

The end of the private destination port range between 0 to 65535.

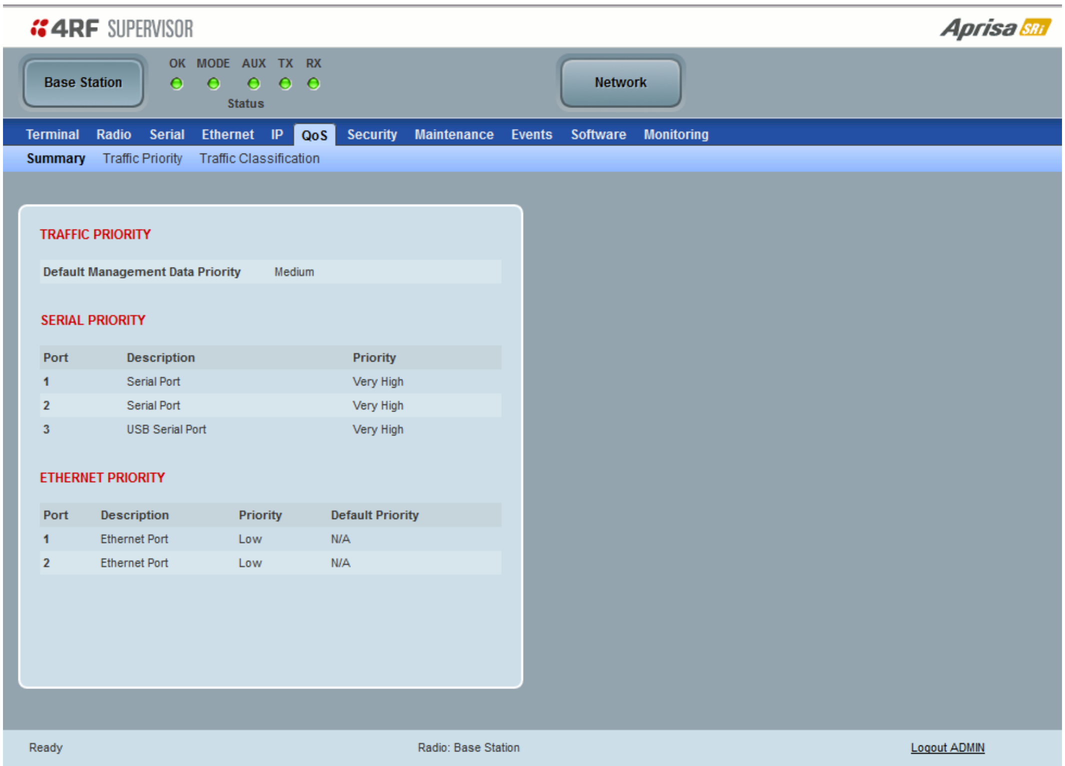
Active

If checked the rule becomes active, if unchecked the rule is inactive.

QoS

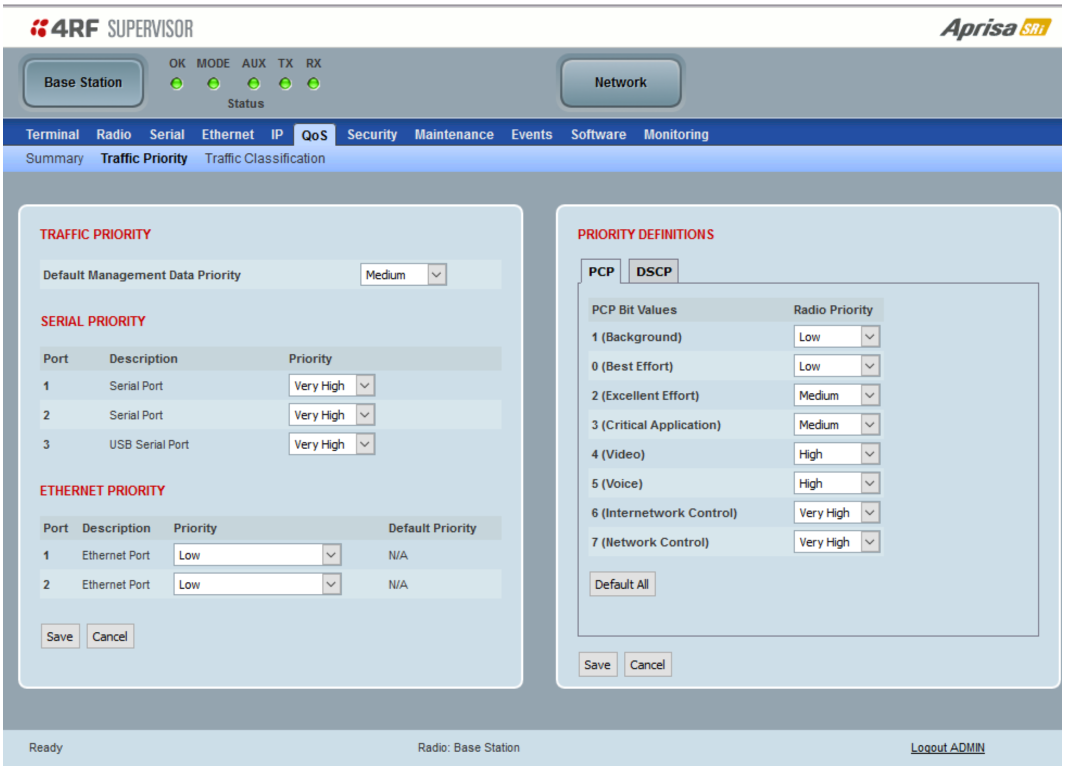
QoS > Summary

This page provides a summary of the QoS Settings.



See ‘QoS > Traffic Priority’ and ‘QoS > Traffic Classification’ for configuration options.

QoS > Traffic Priority



TRAFFIC PRIORITY

Default Management Data Priority

The Default Management Data Priority controls the priority of the Ethernet management traffic relative to Ethernet customer traffic. It can be set to Very High, High, Medium and Low. The default setting is Medium.

SERIAL PRIORITY

This parameter controls the per port priority of the serial customer traffic relative to the Ethernet customer traffic. If equal priority is required to Ethernet traffic, this setting must be the same as the Ethernet Data Priority setting.

The serial data priority can be set to Very High, High, Medium and Low. The default setting is Low.

A queuing system is used to prioritize traffic from the serial and Ethernet interfaces for over the air transmission. A weighting may be given to each data type and this is used to schedule the next transmission over the air e.g. if there are pending data packets in multiple buffers but serial data has a higher weighting it will be transmitted first. The serial buffer is 20 serial packets (1 packet can be up to 512 bytes).

There are four priority queues in the Aprisa SR: Very High, High, Medium and Low. Data is added to one of these queues depending on the priority setting. Data leaves the queues from highest priority to lowest: the Very High queue is emptied first, followed by High then Medium and finally Low.

ETHERNET PRIORITY

This parameter controls the per port priority of the Ethernet customer traffic relative to the serial customer traffic. If equal priority is required to serial traffic, this setting must be the same as the Serial Data Priority setting.

The Ethernet Priority enables users to set the priority of Ethernet port ingress frames. The priority for each port can be:

Priority	Description
Low	All port frames are set to low priority
Medium	All port frames are set to medium priority
High	All port frames are set to high priority
Very High	All port frames are set to very high priority
From Tagged Frame (PCP)	All port frames are set to PCP priority bits (VLAN priority) in VLAN tagged frames or priority tag (VLAN 0) frames. To enable, see 'PCP (Priority Code Point)' on page 184.
From Packet (DSCP)	All port frames are set to DSCP priority bits in an IP packet (DSCP in IPv4 TOS field). To enable, see 'DSCP (Differentiated Services Code Point)' on page 186.

The default setting is Low.

A queuing system is used to prioritize customer traffic from the serial and Ethernet interfaces for over the air transmission. A weighting may be given to each data type and this is used to schedule the next transmission over the air e.g. if there are pending data packets in multiple buffers but serial data has a higher weighting it will be transmitted first. The Ethernet buffer is 10 Ethernet packets (1 packet can be up to Ethernet MTU, 1536 bytes).

There are four priority queues in the Aprisa SRi: Very High, High, Medium and Low. Data is added to one of these queues depending on the priority setting. Data leaves the queues from highest priority to lowest: the Very High queue is emptied first, followed by High then Medium and finally Low.

Default Priority

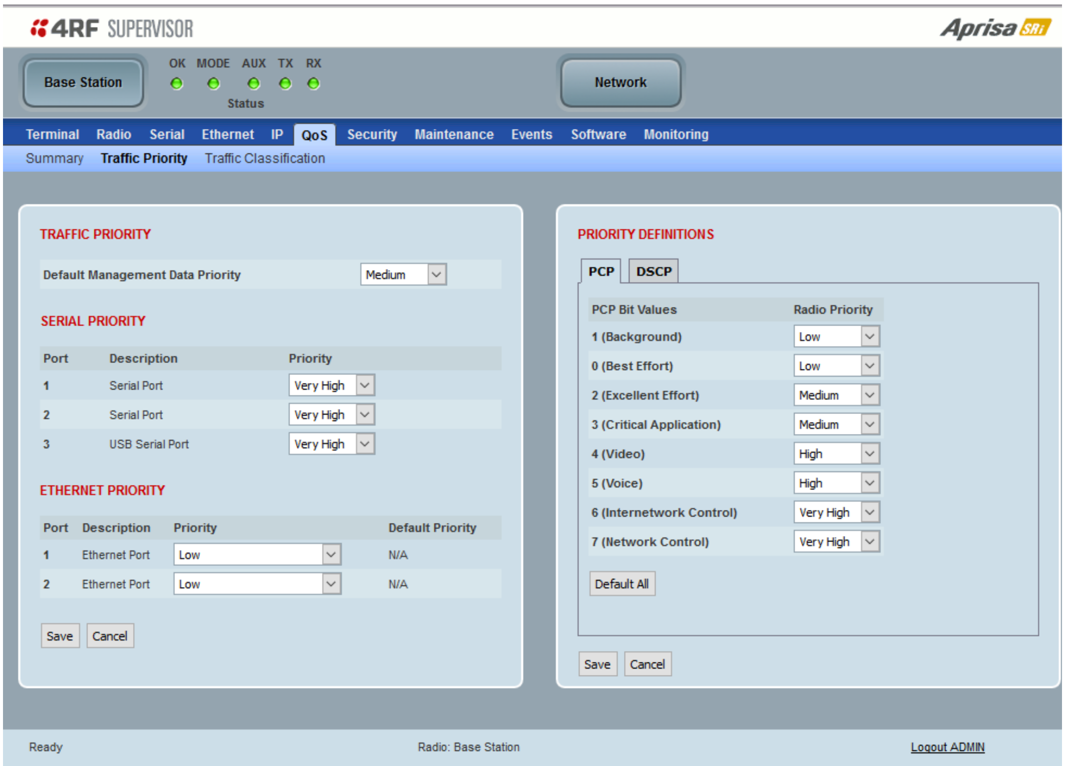
When the priority of an Ethernet port uses the PCP bits (VLAN priority) values the 'Default Priority' option is enabled, allowing the priority of untagged VLAN frames to be set.

When the priority of an Ethernet port uses the DSCP priority (in IPv4 TOS field) values the 'Default Priority' option is enabled, allowing the priority of ARP frames to be set.

PRIORITY DEFINITIONS

PCP (Priority Code Point)

These settings provide priority translation / mapping between the external radio LAN VLAN priority network and the radio internal VLAN priority network, using the VLAN tagged PCP (Priority Code Point) priority field in the Ethernet/VLAN frame.



The IEEE 802.1Q specification defines a standards-based mechanism for providing VLAN tagging and class of service (CoS) across Ethernet networks. This is accomplished through an additional VLAN tag, which carries VLAN tag ID and frame prioritization information (PCP field), inserted within the header of a Layer 2 Ethernet frame.

Priority Code Point (PCP) is a 3-bit field that indicates the frame priority level (or CoS). The operation of the PCP field is defined within the IEEE 802.1p standard, which is an extension of 802.1Q. The standard establishes eight levels of priority, referred to as CoS values, where CoS 7 ('111' in PCP filed) is the highest priority and CoS 0 ('000') is the lowest priority.

The radio in bridge mode used the PCP value in the VLAN tag to prioritize packets and provide the appropriate QoS treatment per traffic type. The radio implements 4 priority queuing techniques that base its QoS on the VLAN priority (PCP). Based on VLAN priority bits, traffic can be put into a particular Class of Service (CoS) queue. Packets with higher CoS will always serve first for OTA transfer and on ingress/egress Ethernet ports.

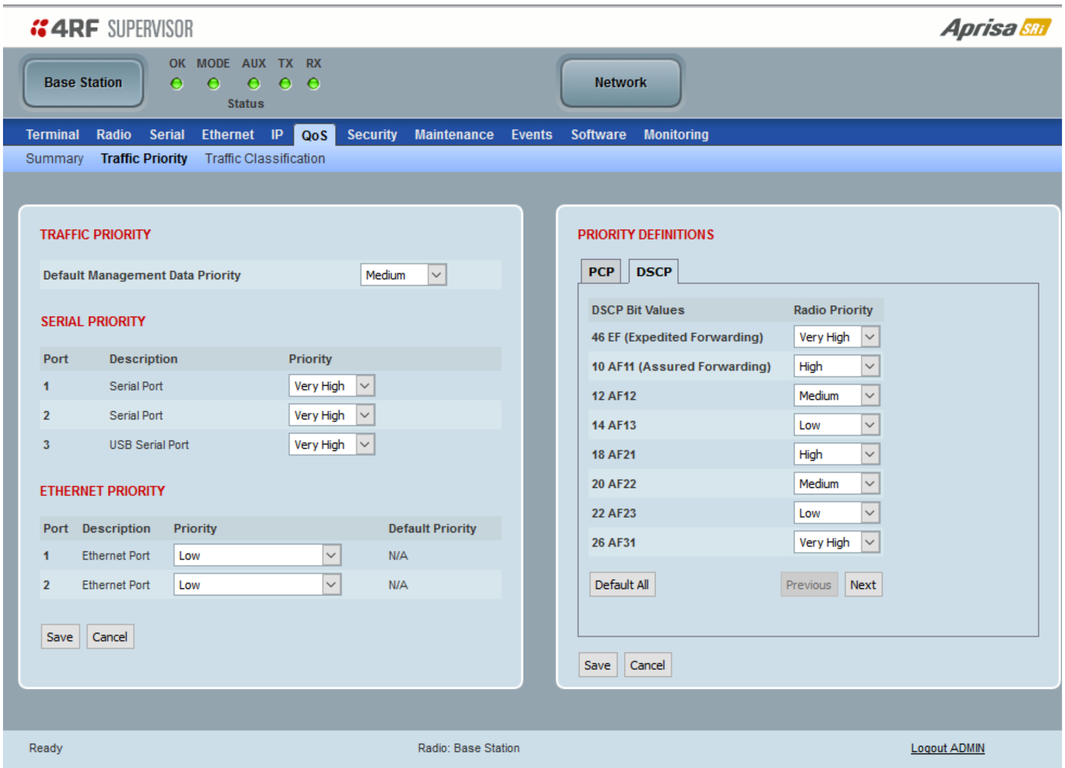
The 'PCP priority definition' tab is used to map ingress VLAN packet with PCP priority to the radio internal CoS (priority). Since, in most of the cases the radio VLAN network is connected to the corporate VLAN networks, the network administrator might like to have a different VLAN priority scheme of the radio network CoS. For example, management traffic in the multi-gigabit corporate VLAN network might be prioritize with priority 7 (highest priority) and SCADA traffic with priority 5, but in the narrow bandwidth radio network, SCADA traffic will be map to radio very high CoS / priority (i.e. set PCP 5 = Very high) and management traffic might will be map to radio medium CoS / priority (i.e. set PCP 7 = medium) in order to serve first the mission-critical SCADA traffic over the radio network.

This is done by mapping the external radio network VLAN priority to the internal radio CoS / priority using the ‘PCP priority definition’ tab. The radio support 4 queues, thus at maximum an 8 -> 4 VLAN priority / CoS mapping is done.

Default mapping of ingress packet VLAN priority to radio CoS / priority shown in the ‘PCP priority definition’ tab.

DSCP (Differentiated Services Code Point)

These settings provide translation / mapping between the external radio IP priority network and the radio internal IP priority network, using the DSCP (DiffServ Code Point) priority field in the IP packet header.



Differentiated Services (DiffServ) is a new model in which traffic is treated by routers with relative priorities based on the IPv4 type of services (ToS) field. DSCP (DiffServ Code Point) standard defined in RFC 2474 and RFC 2475. DiffServ increases the number of definable priority levels by reallocating bits of an IP packet for priority marking.

The DiffServ architecture defines the DiffServ (DS) field, which supersedes the ToS field in IPv4 to make per-hop behaviour (PHB) decisions about packet classification and traffic scheduling functions. The six most significant bits of the DiffServ field (in the IPv4 TOS field) is called as the DSCP. The standardized DiffServ field of the packet is marked with a value so that the packet receives a particular routing/forwarding treatment or PHB, at each router node. Using DSCP packet classification, traffic can be partition into multiple priority levels.

The radio in router mode uses the DSCP value in the IP header to select a PHB behaviour for the packet and provide the appropriate QoS treatment. The radio implements 4 priority queuing techniques that base its PHB on the DSCP in the IP header of a packet. Based on DSCP, traffic can be put into a particular priority / CoS (Class of Service) queue. Packets with higher CoS will always serve first for OTA transfer and on ingress / egress Ethernet ports.

The 'DSCP priority definition' tab is used to map ingress IP packet with DSCP priority to the radio internal priority / CoS. Since, in most of the cases the radio routed network is connected to the corporate routed networks, the network administrator might like to have a different routed network priority scheme of the radio network, for example management traffic in the multi-gigabit corporate routed network might be prioritize with DSCP EF (expedite forwarding) code (DSCP highest priority), and SCADA traffic with DSCP AF11 (assured forwarding) code (high priority), but in the narrow bandwidth radio network, SCADA traffic will be map to radio very high CoS / priority (i.e. set AF11 = Very high) and management traffic might map to radio low CoS / priority (i.e. set EF = Low) in order to serve first the mission-critical SCADA traffic over the radio network.

This is done by mapping the external radio network DSCP priority to the internal radio CoS / priority levels using the 'DSCP priority definition' tab. The radio support four queues, thus at maximum a 64 -> 4 CoS / priority mapping is done.

Default mapping of ingress packet DSCP priority to radio CoS shown in the 'DSCP priority definition' tab. The radio maps all 64 DSCP values. The user can configure most common used 21 DSCP codes and the rest are mapped by default to low CoS / priority.

QoS > Traffic Classification

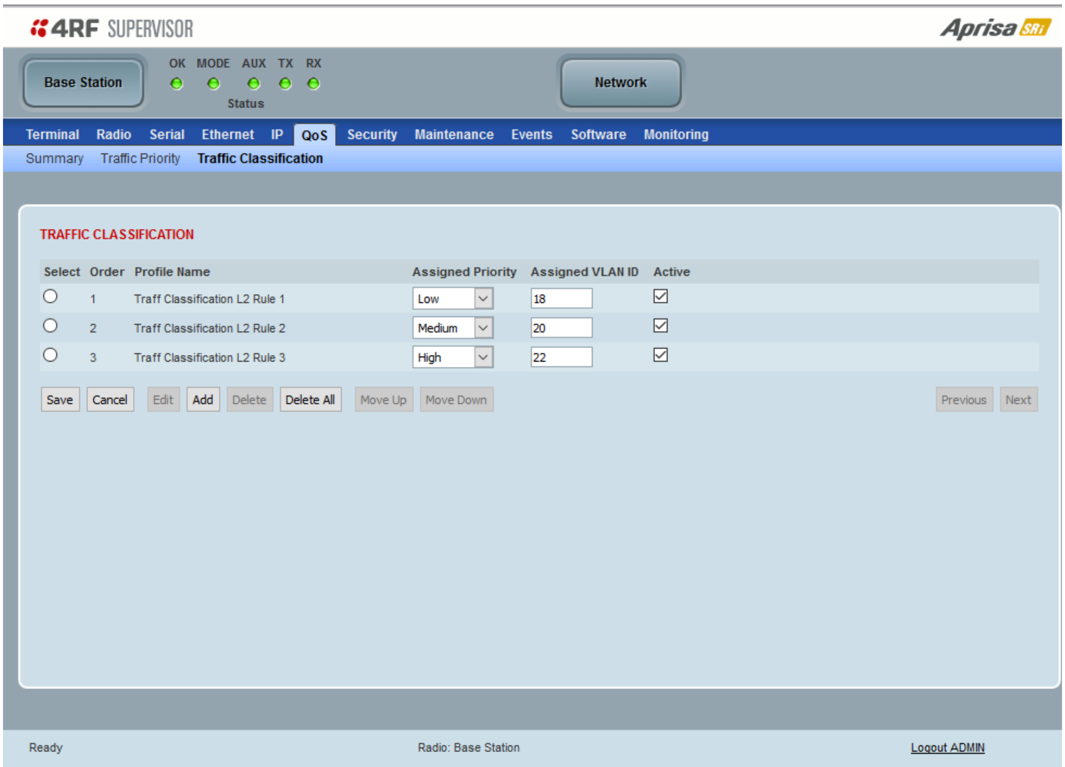
These settings provide multiple traffic classification profiles based on classification rules. Profiles for a specific traffic type, protocol or application can be assigned to a particular VLAN and CoS / priority in bridge mode or to CoS / priority in router mode to provide the appropriate QoS treatment.

For example, SCADA traffic, management traffic, FTP traffic, can each have its own profile build with a set of classification rules. A profile can be build using multiple classification rules based on ports, Ethernet, IP, TCP / UDP headers fields (i.e. L1/2/3/4 header fields) such as: Ethernet port #1, VLAN ID, VLAN priority, IP DSCP Priority, MAC/IP address, TCP / UDP port fields to identify and classify the specific traffic type. When an ingress packet matches the profile L2/3/4 header fields settings, the packet is assigned to a particular VLAN and CoS / priority in bridge mode or to CoS / priority in router mode to provide the appropriate QoS treatment.

The radio supports four CoS / priority queues: very high, high, medium and low. These queues are connected to a strict priority scheduler which dispatches packets from the queues out to the egress port by always serving first the ‘very high’ priority queue, whenever there is a packet in this queue. When the highest priority queue empties, the scheduler will serve the next high priority queues and so on. So, when SCADA traffic is assigned to a ‘Very high’ priority, it will always be served first and send over-the-air (OTA) whenever SCADA traffic enters to the radio, giving it the highest priority over other traffic type.

These settings are different for Bridge Mode and Router Mode.

Bridge Mode Traffic Classification Settings



TRAFFIC CLASSIFICATION

VLAN bridge mode traffic classification settings provide mapping / assigning of profiles (set by rules to match a specific traffic type) to a VLAN ID and VLAN CoS / priority. The profile which is used to match to a specific traffic type will be identified in the radio network by its associated VLAN ID and VLAN CoS / priority to provide the appropriate QoS treatment. CoS / Priority can be set to very high, high, medium, low priority.

Profile name

A free form field to enter the profile name with a maximum of 32 chars.

Assigned Priority

Traffic packets that match the applied profile rules will be assigned to the selected 'assigned priority' setting of Very High, High, Medium and Low. This field cannot be set to Don't Care.

This applies profile rule mapping to the VLAN CoS / Priority with the appropriate internal radio assigned priority setting of Very High, High, Medium and Low.

Assigned VLAN ID

Traffic packets that match the applied profile rules will be assigned to the selected 'assigned VLAN ID' setting of VLAN ID in the range of 0 to 4095.

A VLAN ID of an ingress packet matching the classification rule (see 'VLAN ID' rule in next page) shall be changed to the 'assigned VLAN ID' setting, if below conditions are met:

1. The VLAN ID of Ingress packet is same as PVID of the ingress port.
2. Packet is received untagged at the port

If the VLAN ID of the tagged ingress packet is not the same as the PVID of the ingress port, then it shall not be changed and the 'assigned VLAN ID' setting is ignored i.e. ingress VLANs will pass-through unchanged.

If 'assigned VLAN ID' value is set in the 'port VLAN membership' under Ethernet > VLAN (port x tab), then this VLAN will be available for ingress and egress on the Ethernet and RF ports, otherwise this VLAN will only be available in one direction on the egress RF port.

For example, if the base station Ethernet port 1 'assigned VLAN ID' = 100 (VLAN-100) and it is also defined in the 'port VLAN membership' under Ethernet > VLAN (port 1 tab) and the remote sends a packet to the base with a VLAN of 100, this packet will be egress out to Ethernet port 1 (tagged or untagged based on the 'egress action' definition). If the VLAN-100 wasn't set in the 'port VLAN membership', then the base station will drop a packet from the remote.

This setting parameter can be 'Don't Care' (Assigned VLAN ID = 0) which means that the VLAN ID of ingress frame will never be modified.

Active

Activates or deactivates the profile rule.

Controls

The Save button saves all profiles to the radio.

The Cancel button removes all changes since the last save or first view of the page if there has not been any saves. This button will un-select all the Select radio buttons.

The Edit button will show the next screen for the selected profile where the profile can be configured. This button will be disabled unless a profile is selected.

The Add button adds a new profile,

- If no profile was selected then the new profile is added to the end of the list,
- If a profile is selected the new profile is added after that profile.

The Delete button will delete the selected profile. The button will be disabled unless a profile has been selected.

The Delete All button will delete all the profiles. A pop-up will ask if the action is correct. If the answer is yes, then all profiles are deleted in SuperVisor. The Save button must be pressed to delete all the profiles in the radio.

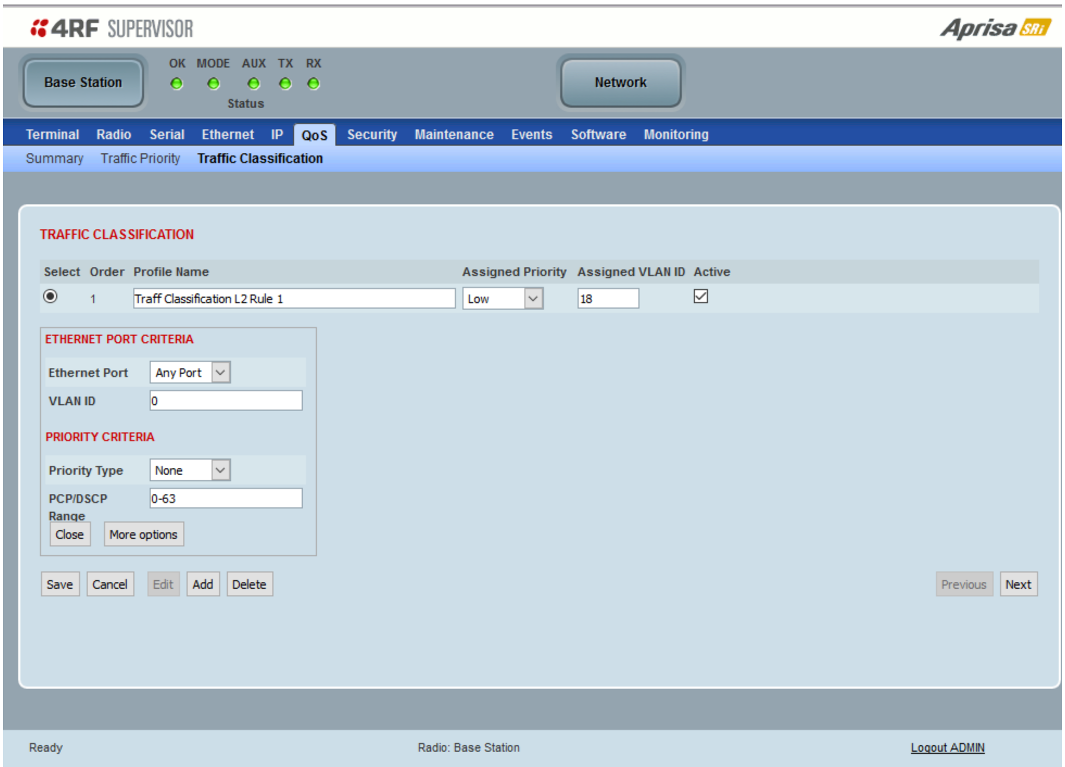
The Move up button will move the selected profile up one in the order of profiles.

The Move Down button will move the selected profile down one in the order of profiles.

The Previous button displays the previous page in the list of profiles. A pop up will be displayed if any profile has been modified and not saved, preventing the previous page being displayed.

The Next button will display the next page in the list of profiles.

To edit a traffic classification, select the profile and click on the Edit button.



ETHERNET PORT CRITERIA

Ethernet Port

Set the layer 1 Ethernet port number or all Ethernet ports in the selected profile classification rule.

VLAN ID

Sets the layer 2 packet Ethernet header VLAD ID field in the selected profile classification rule. Valid values are between 0 and 4095. This VLAN ID should be enabled in the system for using this parameter during classification.

Enable this VLAN in the network by setting the same VLAN ID value in PVID (port VLAN ID) and in the PORT VLAN MEMBERSHIP under 'VLAN PORT SETTINGS – Port ' on page 155. If the VLAN ID is set to zero, all VLAN IDs will meet the criteria.

PRIORITY CRITERIA

Priority Type

Set the layer 2 Ethernet or layer 3 IP packet header priority type fields in the selected profile classification rules.

Priority Type	Description
None	Do not use any layer 2 / 3 Ethernet or IP header priority fields in the selected profile classification rules.
PCP	Use the layer 2 Ethernet header priority field of PCP (Priority Code Point) VLAN priority bits (per IEEE 802.1p/q) in the selected profile classification rules.
DSCP	Use the layer 3 IP header TOS field used as DSCP (Differentiated Services Code Point per RFC 2474 and RFC 2475) priority bit in the selected profile classification rules.

PCP / DSCP Range

As per the 'priority type' selection, this parameter sets the PCP priority value/s or DSCP priority value/s fields in the selected profile classification rule. The value can be set to a single priority or a single range (no multiple ranges are allowed), for example, the PCP selected priority value can be 7 or a range of priority values like 4-7.

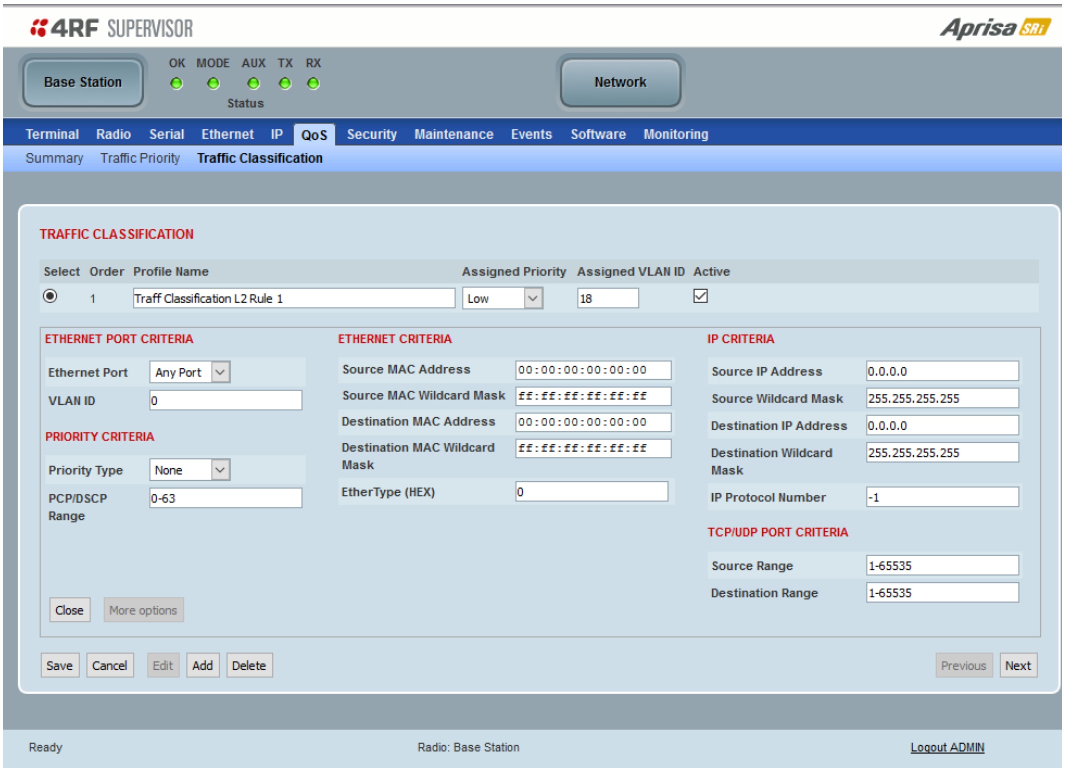
The following table shows the layer 2 packet VLAN tag header PCP priority field values.

PCP Value (Decimal)	PCP Priority	Priority Level
7	Priority [7]	Highest
6	Priority [6]	
5	Priority [5]	
4	Priority [4]	
3	Priority [3]	
2	Priority [2]	
1	Priority [1]	
0	Priority [0]	Lowest

The following table shows the layer 3 packet IP header DSCP priority field values.

DSCP Value (Decimal)	DSCP Priority
46	EF (Expedited Forwarding)
10	AF11 (Assured Forwarding)
12	AF12
14	AF13
18	AF21
20	AF22
22	AF23
26	AF31
28	AF32
30	AF33
34	AF41
36	AF42
38	AF43
0	CS0/Best Effort (BE)
8	CS1 (Class Selector)
16	CS2
24	CS3
32	CS4
40	CS5
48	CS6
56	CS7

Click on More Options if more Layer 2/3/4 (Ethernet / IP / TCP or UDP) packet header fields are required for the selected profile classification rule. This page describes all the possible fields that can be used for the classification rules in bridge mode.



ETHERNET CRITERIA

Source MAC Address

This parameter sets the Layer 2 Ethernet packet header Source MAC Address field in the selected profile classification rule in the format of ‘hh:hh:hh:hh:hh:hh’.

Source MAC Wildcard Mask

This parameter sets the wildcard mask of the ‘Source MAC Address’. If the Source MAC Address is set to ‘FF:FF:FF:FF:FF:FF’, all source MAC addresses will meet the criteria.

Destination MAC Address

This parameter sets the Layer 2 Ethernet packet header Destination MAC Address field in the selected profile classification rule in the format of ‘hh:hh:hh:hh:hh:hh’.

Destination MAC Wildcard Mask

This parameter sets the wildcard mask of the ‘Destination MAC Address’. If the Destination MAC Address is set to ‘FF:FF:FF:FF:FF:FF’, all destination MAC addresses will meet the criteria.

EtherType (Hex)

This parameter sets the Layer 2 Ethernet packet header EtherType field in the selected profile classification rule. EtherType is a 16 bit (two octets) field in an Ethernet frame. It is used to indicate which protocol is encapsulated in the payload of an Ethernet Frame.

EtherType Examples:

Protocol	EtherType Value (Hexadecimal)
IPv4	0800
ARP	0806
IPv6	86DD
VLAN	8100

IP CRITERIA

Source IP Address

This parameter sets the Layer 3 IP packet header Source IP Address field in the selected profile classification rule. This parameter is written in the standard IPv4 format of 'xxx.xxx.xxx.xxx'.

Source IP Wildcard Mask

This parameter sets the wildcard mask applied to the 'Source IP Address'. This parameter is written in the standard IPv4 format of 'xxx.xxx.xxx.xxx'.

0 means that it must be a match. If the wildcard mask is set to 0.0.0.0, the complete Source IP Address will be evaluated for the classification rule.

If the wildcard mask is set to 0.0.255.255, the first 2 octets of the Source IP Address will be evaluated for the classification rule.

If the wildcard mask is set to 255.255.255.255, none of the Source IP Address will be evaluated for the classification rule.

Note: The wildcard mask operation is the inverse of subnet mask operation

Destination IP Address

This parameter sets the Layer 3 IP packet header Destination IP Address field in the selected profile classification rule. This parameter is written in the standard IPv4 format of 'xxx.xxx.xxx.xxx'.

Destination IP Wildcard Mask

This parameter sets the wildcard mask applied to the 'Destination IP Address'. This parameter is written in the standard IPv4 format of 'xxx.xxx.xxx.xxx'.

0 means that it must be a match. If the wildcard mask is set to 0.0.0.0, the complete Destination IP Address will be evaluated for the classification rule.

If the wildcard mask is set to 0.0.255.255, the first 2 octets of the Destination IP Address will be evaluated for the classification rule.

If the wildcard mask is set to 255.255.255.255, none of the Destination IP Address will be evaluated for the classification rule.

Note: The wildcard mask operation is the inverse of subnet mask operation

IP Protocol Number

This parameter sets the Layer 3 IP packet header ‘Protocol’ field in the selected profile classification rule. This field defines the protocol used in the data portion of the IP datagram.

Protocol number Examples:

Protocol	Protocol value (decimal)
ICMP	1
TCP	6
UDP	17

TCP / UDP PORT CRITERIA

Source Range

This parameter sets the Layer 4 TCP / UDP packet header Source Port or Source Port range field in the selected profile classification rule. To specify a range, insert a dash between the ports e.g. 1000-2000. If the source port range is set to 1-65535, traffic from any source port will meet the criteria.

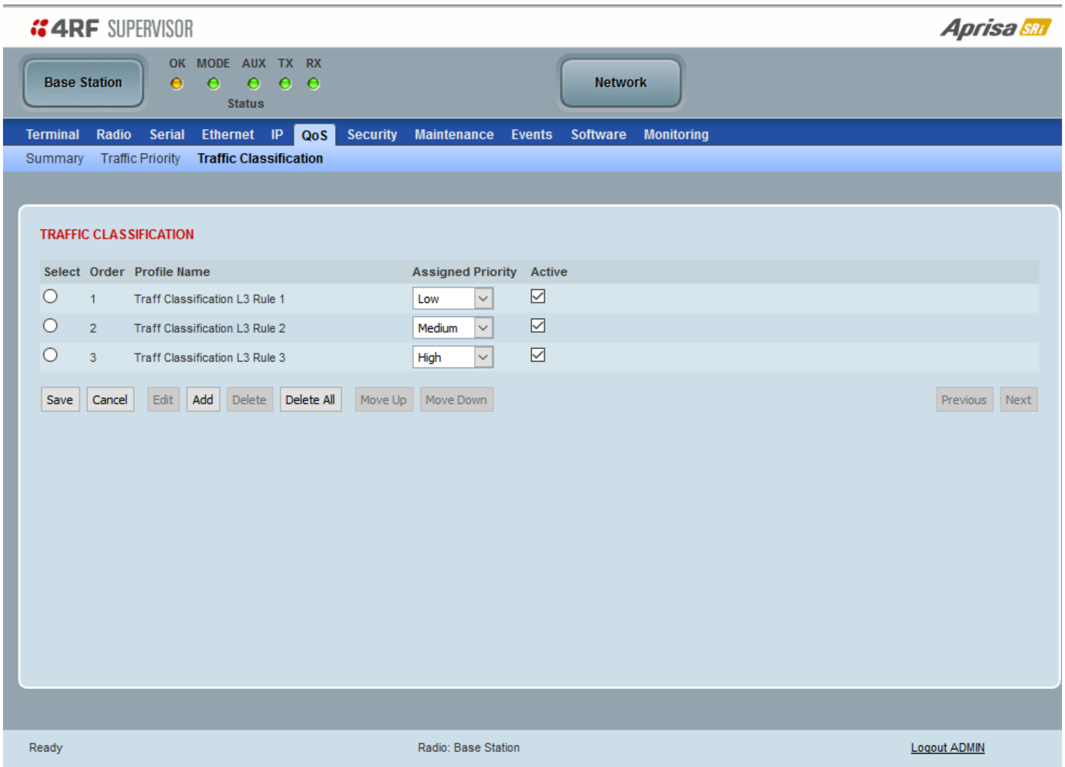
Destination Range

This parameter sets the Layer 4 TCP / UDP packet header Destination Port or Destination Port range field in the selected profile classification rules. To specify a range, insert a dash between the ports e.g. 1000-2000. If the source port range is set to 1-65535, traffic from any source port will meet the criteria.

Examples for TCP / UDP Port Numbers:

Protocol	TCP / UDP Port # (decimal)
Modbus	502
IEC 60870-5-104	2,404
DNP 3	20,000
SNMP	161
SNMP TRAP	162

Router Mode Traffic Classification Settings



TRAFFIC CLASSIFICATION

Router Mode traffic classification settings provide mapping / assigning of profiles (set by rules to match a specific traffic type) to a CoS / priority. The profile which is used to match to a specific traffic type will be identified in the radio network by its associated CoS / priority to provide the appropriate QoS treatment. CoS / Priority can be set to very high, high, medium, low priority.

Profile name

A free form field to enter the profile name with a maximum of 32 chars.

Assigned Priority

Traffic packets that match the applied profile rules will be assigned to the selected ‘assigned priority’ setting of Very High, High, Medium and Low. This field cannot be set to Don’t Care.

Active

Activate or deactivate the profile rule.

Controls

The Save button saves all profiles to the radio.

The Cancel button removes all changes since the last save or first view of the page if there have not been any saves. This button will un-select all the Select radio buttons.

The Edit button will show the next screen for the selected profile where the profile can be configured. This button will be disabled unless a profile is selected.

The Add button adds a new profile,

- If no profile was selected then the new profile is added to the end of the list,
- If a profile is selected the new profile is added after that profile.

The Delete button will delete the selected profile. The button will be disabled unless a profile has been selected.

The Delete All button will delete all the profiles. A pop-up will ask if the action is correct. If the answer is yes, then all profiles are deleted in SuperVisor. The Save button must be pressed to delete all the profiles in the radio.

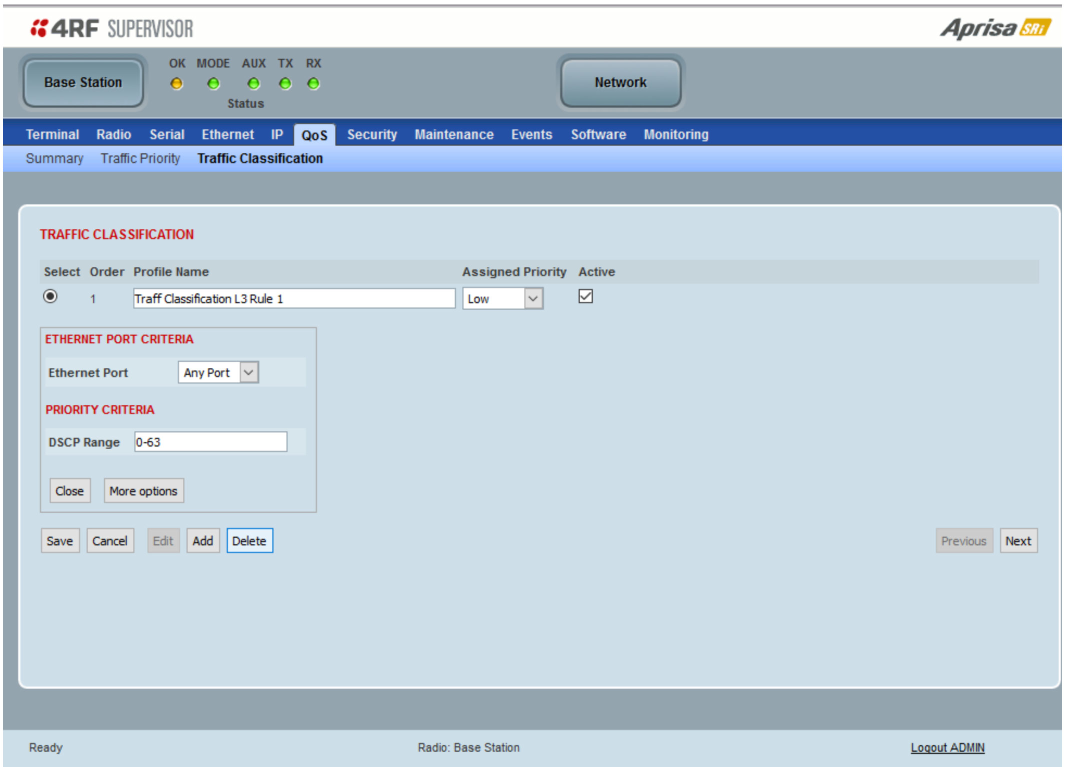
The Move up button will move the selected profile up one in the order of profiles.

The Move Down button will move the selected profile down one in the order of profiles.

The Previous button displays the previous page in the list of profiles. A pop up will be displayed if any profile has been modified and not saved, preventing the previous page being displayed.

The Next button will display the next page in the list of profiles.

To edit a traffic classification, select the profile and click on the Edit button.



ETHERNET PORT CRITERIA

Ethernet Port

Set the layer 1 Ethernet port number or all Ethernet ports in the selected profile classification rules.

PRIORITY CRITERIA

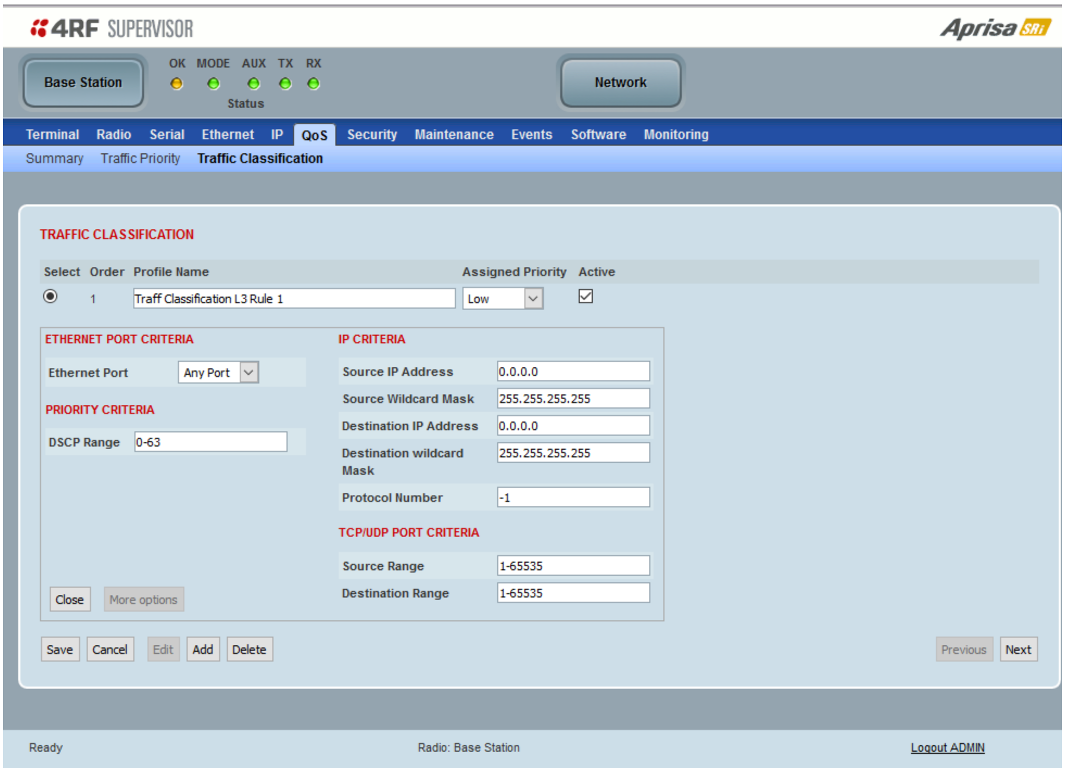
DSCP Range

Sets the DSCP priority value/s field in the selected profile classification rule. The value can be set to a single priority or a single range (no multiple range are allowed), for example, priority value can be 46 (EF) or a range of priority values like 10-14.

The following table shows the layer 3 packet IP header DSCP priority field values.

DSCP Value (Decimal)	DSCP Priority
46	EF (Expedited Forwarding)
10	AF11 (Assured Forwarding)
12	AF12
14	AF13
18	AF21
20	AF22
22	AF23
26	AF31
28	AF32
30	AF33
34	AF41
36	AF42
38	AF43
0	CS0/Best Effort (BE)
8	CS1 (Class Selector)
16	CS2
24	CS3
32	CS4
40	CS5
48	CS6
56	CS7

Click on More Options if more Layer 3/4 packet header fields are required for the selected profile classification rule. This page describes all the possible fields that can be used for the classification rules in router mode.



IP CRITERIA

Source IP Address

This parameter sets the Layer 3 packet IP header Source IP Address field in the selected profile classification rules. This parameter is written in the standard IPv4 format of ‘xxx.xxx.xxx.xxx’.

Source IP Wildcard Mask

This parameter sets the wildcard mask applied to the ‘Source IP Address’. This parameter is written in the standard IPv4 format of ‘xxx.xxx.xxx.xxx’.

0 means that it must be a match. If the wildcard mask is set to 0.0.0.0, the complete Source IP Address will be evaluated for the classification rules.

If the wildcard mask is set to 0.0.255.255, the first 2 octets of the Source IP Address will be evaluated for the classification rules.

If the wildcard mask is set to 255.255.255.255, none of the Source IP Address will be evaluated for the classification rules.

Note: The wildcard mask operation is the inverse of subnet mask operation

Destination IP Address

This parameter sets the Layer 3 packet IP header Destination IP Address field in the selected profile classification rules. This parameter is written in the standard IPv4 format of ‘xxx.xxx.xxx.xxx’.

Destination IP Wildcard Mask

This parameter sets the wildcard mask applied to the 'Destination IP Address'. This parameter is written in the standard IPv4 format of 'xxx.xxx.xxx.xxx'.

0 means that it must be a match. If the wildcard mask is set to 0.0.0.0, the complete Destination IP Address will be evaluated for the classification rules.

If the wildcard mask is set to 0.0.255.255, the first 2 octets of the Destination IP Address will be evaluated for the classification rules.

If the wildcard mask is set to 255.255.255.255, none of the Destination IP Address will be evaluated for the classification rules.

Note: The wildcard mask operation is the inverse of subnet mask operation

Protocol Number

This parameter sets the Layer 3 IP packet header 'Protocol' field in the selected profile classification rule. This field defines the protocol used in the data portion of the IP datagram.

Protocol number Examples:

Protocol	Protocol value (decimal)
ICMP	1
TCP	6
UDP	17

TCP / UDP Port Criteria

Source Range

This parameter sets the Layer 4 TCP / UDP packet header Source Port or Source Port range field in the selected profile classification rule. To specify a range, insert a dash between the ports e.g. 1000-2000. If the source port range is set to 1-65535, traffic from any source port will meet the criteria.

Destination Range

This parameter sets the Layer 4 TCP / UDP packet header Destination Port or Destination Port range field in the selected profile classification rule. To specify a range, insert a dash between the ports e.g. 1000-2000. If the source port range is set to 1-65535, traffic from any source port will meet the criteria.

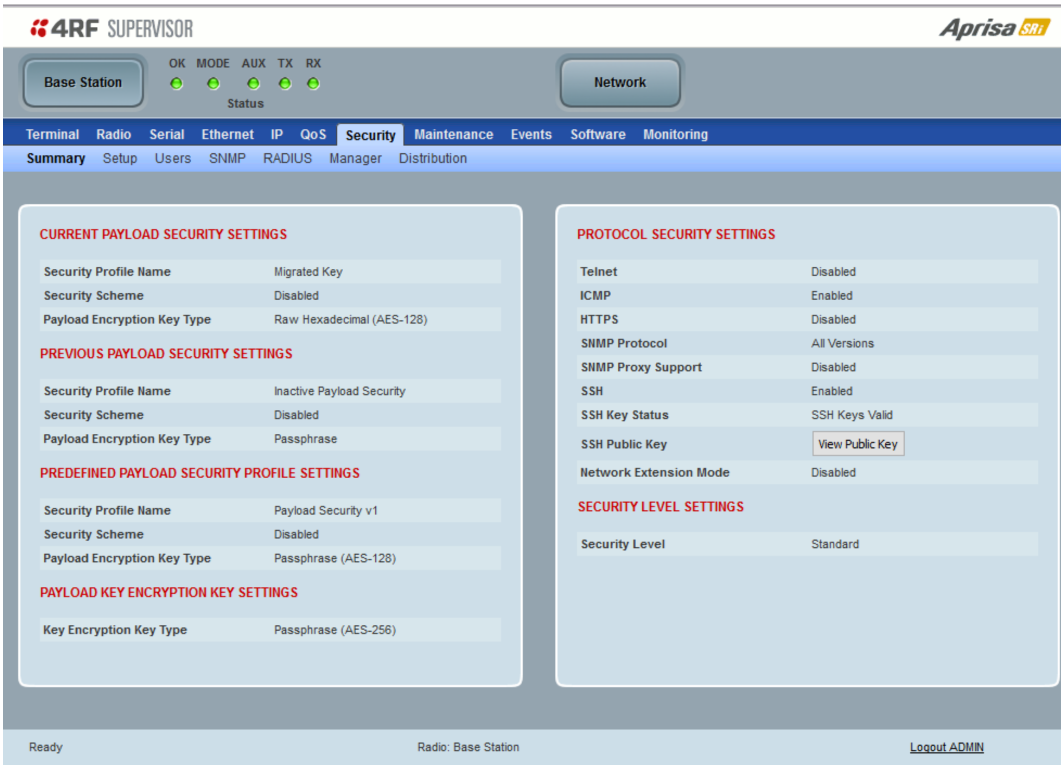
Examples for TCP / UDP Port Numbers:

Protocol	TCP / UDP Port # (decimal)
Modbus	502
IEC 60870-5-104	2,404
DNP 3	20,000
SNMP	161
SNMP TRAP	162

Security

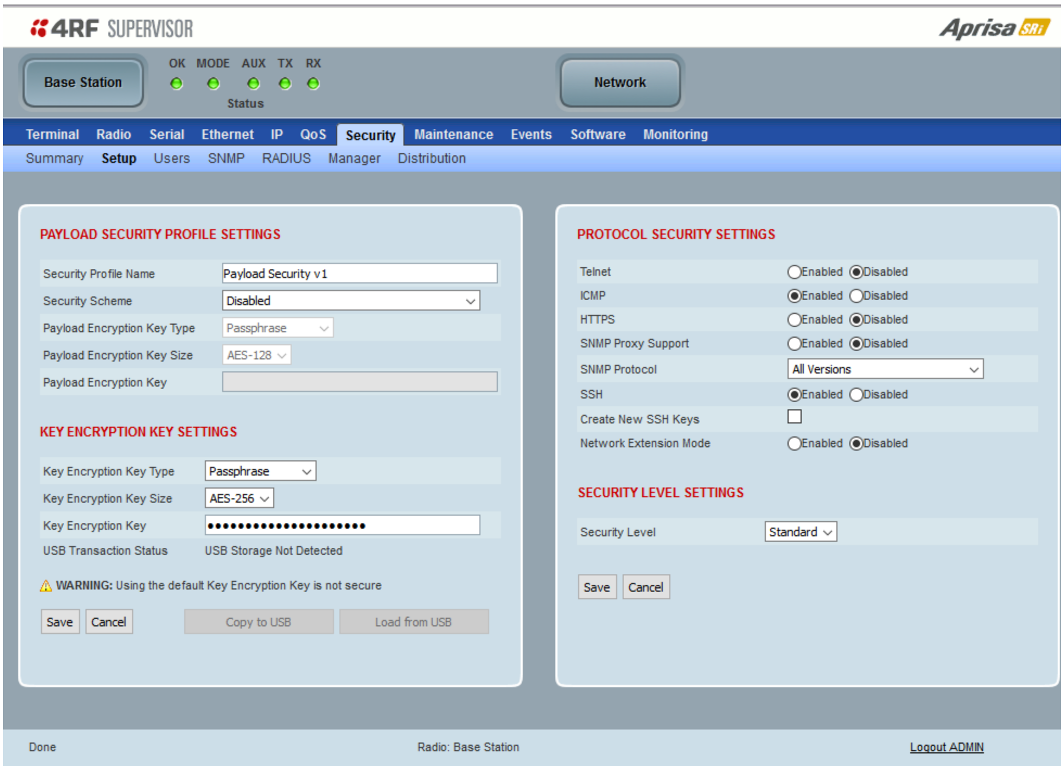
Security > Summary

This page displays the current settings for the Security parameters.



See ‘Security > Setup’ and ‘Security > Manager’ for configuration options.

Security > Setup



PAYLOAD SECURITY PROFILE SETTINGS

Security Profile Name

This parameter enables the user to predefine a security profile with a specified name.

Security Scheme

This parameter sets the security scheme to one of the values in the following table:

Security Scheme
Disabled (No encryption and no Message Authentication Code)
AES Encryption + CCM Authentication 128 bit
AES Encryption + CCM Authentication 64 bit
AES Encryption + CCM Authentication 32 bit
AES Encryption only
CCM Authentication 128 bit
CCM Authentication 64 bit
CCM Authentication 32 bit

The default setting is Disabled.

Payload Encryption Key Type

This parameter sets the Payload Encryption Key Type:

Option	Function
Pass Phrase	Use the Pass Phrase password format for standard security.
Raw Hexadecimal	Use the Raw Hexadecimal key format for better security. It must comply with the specified encryption key size e.g. if Encryption Type to AES128, the encryption key must be 16 bytes (32 chars)

The default setting is Pass Phrase.

Payload Encryption Key Size

This parameter sets the Encryption Type to AES128, AES192 or AES256. The default setting is AES128.

The higher the encryption size the better the security.

Payload Encryption Key

This parameter sets the Payload Encryption password. This key is used to encrypt the payload.

Pass Phrase

Good password policy:

- contains at least eight characters, and
- contains at least one upper case letter, and
- contains at least one lower case letter, and
- contains at least one digit or another character such as @+... , and
- is not a term in a familiar language or jargon, and
- is not identical to or derived from the accompanying account name, from personal characteristics or from information from one's family/social circle, and
- is easy to remember, for instance by means of a key sentence

Raw Hexadecimal

The Raw Hexadecimal key must comply with the specified encryption key size e.g. if Encryption Type to AES128, the encryption key must be 16 bytes (32 chars).

KEY ENCRYPTION KEY SETTINGS

The Key Encryption Key provides the ability to encrypt the Payload Encryption Key so it can be safely transmitted over the radio link to remote radios.

The Key Encryption Key Type, Key Encryption Key Size and Key Encryption Key must be the same on all radios in the network.

Key Encryption Key Type

This parameter sets the Payload Encryption Key Type:

Option	Function
Pass Phrase	Use the Pass Phrase password format for standard security.
Raw Hexadecimal	Use the Raw Hexadecimal key format for better security. It must comply with the specified encryption key size e.g. if Encryption Type to AES128, the encryption key must be 16 bytes (32 chars)

The default setting is Pass Phrase.

Key Encryption Key Size

This parameter sets the Encryption Type to AES128, AES192 or AES256. The default setting is AES128.

The higher the encryption type the better the security.

Key Encryption Key

This parameter sets the Key Encryption Key. This is used to encrypt the payload encryption key.

USB Transaction Status

This parameter shows if a USB flash drive is plugged into the radio host port .

Option	Function
USB Storage Not Detected	A USB flash drive is not plugged into the radio host port.
USB Storage Detected	A USB flash drive is plugged into the radio host port.

Note: 4RF radios only support the FAT32 file system for flash drives. If the flash drive is a different format such as exFAT or NTFS, you will need to reformat it to FAT32.

Also, some brands of USB flash drives may not work with 4RF radios.

Controls

The ‘Save’ button saves the Key Encryption Key settings to the radio. If the Security Level is set to ‘Strong’ (see ‘Security Level’ on page 212), this button will be grayed out.

The ‘Load From USB’ button loads the Key Encryption Key settings from the USB flash drive. If a USB flash drive is not detected, this button will be grayed out.

The ‘Copy To USB’ button copies the Key Encryption Key settings to a file called ‘asrkek.txt’ on the USB flash drive. This settings file can be used to load into other radios. If a USB flash drive is not detected or the Security Level is set to ‘Strong’ (see ‘Security Level’ on page 212), this button will not be shown.

Key Encryption Key Summary

The security of over-the-air-rekeying depends on a truly random Key Encryption Key. This is why the use of a Raw Hexadecimal key is recommended as a plain text phrase based on known spelling and grammar constructs is not very random. The *default* Key Encryption Key is provided only to allow testing of the security mechanism and is not intended for operational use. Using the default Key Encryption Key undermines the security of the AES payload encryption because an attacker using the default Key Encryption Key would immediately recover the AES payload key after the first over-the-air-rekeying event.

When the Security Level is set to ‘Strong’, various protections are applied to the Key Encryption Key setting to prevent tampering. In addition, the Key Encryption Key Type, Key Encryption Key Size, and the Key Encryption Key itself are all loaded from a customer prepared USB key. This is a one way operation to prevent key recovery from radios. While the ability to save a Key Encryption Key to USB exists in Standard Security Level, the Strong Security Level Key Encryption Key is not compromised because the Strong Key Encryption Key is not the same as the Standard Security Level Key Encryption Key.

PROTOCOL SECURITY SETTINGS

Telnet option

This parameter option determines if you can manage the radio via a Telnet session. The default setting is disabled.

ICMP option (Internet Control Message Protocol)

This parameter option determines whether the radio will respond to a ping. The default setting is disabled.

HTTPS option

This parameter option determines if you can manage the radio via an HTTPS session (via a Browser). The default setting is disabled.

SNMP Proxy Support

This parameter option enables an SNMP proxy server in the base station. This proxy server reduces the radio link traffic during SNMP communication to remote radios. This option applies to the base station only. The default setting is disabled.

This option can also be used if the radio has Serial Only interfaces.

SNMP Protocol

This parameter sets the SNMP Protocol:

Option	Function
Disabled	All SNMP functions are disabled.
All Versions	Allows all SNMP protocol versions.
SNMPv3 Only	Only SNMPv3 transactions will be accepted including authenticated or encrypted transactions
SNMPv3 With Authentication Only	Only SNMPv3 transactions authenticated using HMAC-MD5 or HMAC-SHA will be accepted (as per table below).
SNMPv3 With Encryption Only	Only SNMPv3 transactions with an encrypted type of DES or AES will be accepted (as per table below).

The default setting is All Versions.

The default SNMPv3 with Authentication User Details provided are:

User Name	Encryption Type	Authentication Type	Context Name	Authentication Passphrase	Encryption Passphrase
noAuthUser	-	-	noAuth	noAuthUser	noAuthUser
desUserMD5	DES	MD5	priv	desUserMD5	desUserMD5
desUserSHA	DES	SHA	priv	desUserSHA	desUserSHA
authUserMD5	-	MD5	auth	authUserMD5	authUserMD5
authUserSHA	-	SHA	auth	authUserSHA	authUserSHA
privUserMD5	AES	MD5	priv	privUserMD5	privUserMD5
privUserSHA	AES	SHA	priv	privUserSHA	privUserSHA

SNMPv3 Authentication Passphrase

The SNMPv3 Authentication Passphrase can be changed via the SNMPv3 secure management protocol interface (not via SuperVisor).

When viewing / managing the details of the users via SNMPv3, the standard SNMP-USER-BASED-SM-MIB interface is used. This interface can be used to change the SNMPv3 Authentication Passphrase of the users.

The SNMPv3 Authentication Passphrase of a user required to be changed cannot be changed by the same user i.e. a different user must be used for the transactions.

Generate New Keys from SNMPv3 USM User Passphrases

Net-SNMP is a suite of open source software for using and deploying the SNMP protocol. Similar functionality is built into many commercial SNMP managers.

This next step of loading the Aprisa SRi radios with keys generated from USM user passphrases requires the SNMPv3 USM Management utility provided as part of NET-SNMP.

The utility is called 'snmpusm'. It provides a range of commands including the management of changing passwords for SNMPv3 users. In order to use this utility, the user will need to install NET-SNMP on a Linux (or Windows®) or machine. The examples below are from the Linux environment. This tool automatically obtains the engine ID from the target radio before generating the keys and loading them into the target.

To change a user authentication passphrase:

The following are examples of:

Changing the privUserSHA user encryption key / password from privUserSHA to privUserSHANew:

c:\usr\bin>snmpusm -v 3 -u privUserSHA -n priv -l authPriv -a SHA -A privUserSHA -x AES -X privUserSHA -Cx 172.17.70.17 passwd privUserSHA privUserSHANew

Changing the privUserSHA user authentication key / password from privUserSHA to privUserSHANew:

c:\usr\bin>snmpusm -v 3 -u privUserSHA -n priv -l authPriv -a SHA -A privUserSHA -x AES -X privUserSHANew -Ca 172.17.70.17 passwd privUserSHA privUserSHANew

Changing the desUserSHA user encryption key / password from desUserSHA to desUserSHANew:

c:\usr\bin>snmpusm -v 3 -u desUserSHA -n priv -l authPriv -a SHA -A desUserSHA -x DES -X desUserSHA -Cx 172.17.70.17 passwd desUserSHA desUserSHANew

Changing the desUserSHA user authentication key / password from desUserSHA to desUserSHANew:

c:\usr\bin>snmpusm -v 3 -u desUserSHA -n priv -l authPriv -a SHA -A desUserSHA -x DES -X desUserSHANew -Ca 172.17.70.17 passwd desUserSHA desUserSHANew

Changing the privUserMD5 user encryption key / password from privUserMD5 to privUserMD5New:

c:\usr\bin>snmpusm -v 3 -u privUserMD5 -n priv -l authPriv -a MD5 -A privUserMD5 -x AES -X privUserMD5 -Cx 172.17.70.17 passwd privUserMD5 privUserMD5New

Changing the privUserMD5 user authentication key / password from privUserMD5 to privUserMD5New:

c:\usr\bin>snmpusm -v 3 -u privUserMD5 -n priv -l authPriv -a MD5 -A privUserMD5 -x AES -X privUserMD5New -Ca 172.17.70.17 passwd privUserMD5 privUserMD5New

Changing the desUserMD5 user encryption key / password from desUserMD5 to desUserMD5New:

c:\usr\bin>snmpusm -v 3 -u desUserMD5 -n priv -l authPriv -a MD5 -A desUserMD5 -x DES -X desUserMD5 -Cx 172.17.70.17 passwd desUserMD5 desUserMD5New

Changing the desUserMD5 user authentication key / password from desUserMD5 to desUserMD5New:

c:\usr\bin>snmpusm -v 3 -u desUserMD5 -n priv -l authPriv -a MD5 -A desUserMD5 -x DES -X desUserMD5New -Ca 172.17.70.17 passwd desUserMD5 desUserMD5New

Changing the authUserSHA user authentication key / password from authUserSHA to authUserSHANew:

c:\usr\bin>snmpusm -v 3 -u authUserSHA -n auth -l authNoPriv -a SHA -A authUserSHA -Ca 172.17.70.17 passwd authUserSHA authUserSHANew

Changing the authUserMD5 user authentication key / password from authUserMD5 to authUserMD5New:

c:\usr\bin>snmpusm -v 3 -u authUserMD5 -n auth -l authNoPriv -a MD5 -A authUserMD5 -Ca 172.17.70.17 passwd authUserMD5 authUserMD5New

Notes

-Cx option is to change the Encryption key/password

-Ca option is to change the Authentication key/password

Other information on this utility can be obtained from the utility command help itself or online.

Summary

It is necessary to record the new passphrases loaded into the Aprisa SRi radios and then load the passphrases into the SNMP manager. There is a separate passphrase for the two supported forms of authentication (MD5 and SHA1) only as well as the two forms of authentication used in combination the two forms of encryption (DES and AES). It is vital to change all passphrases even if the depreciated mechanism is not used (MD5 and DES) otherwise an attacker could still use the default passphrases.

Reset Unknown Passphrases with the Command Line Interface

As it is not possible for users to read previously set passphrases, a CLI command is available from Aprisa SRi software release 1.4.0 to 'reset' the SNMPv3 USM users back to defaults.

Note: USM users are not related to CLI and SuperVisor users. This command will only be accessible to the CLI 'admin' user logins.

To reset unknown passphrases:

1. Telnet into each radio in the network and via the CLI reset the passphrases
2. Login to the radio with:

   Login: admin

   Password: *********
3. Set all SNMP3 users to default values with the 'snmpusm reset' command (see 'SNMP3 users to default values' below for the list of default values).
4. Reboot the radio with the 'reboot' command.

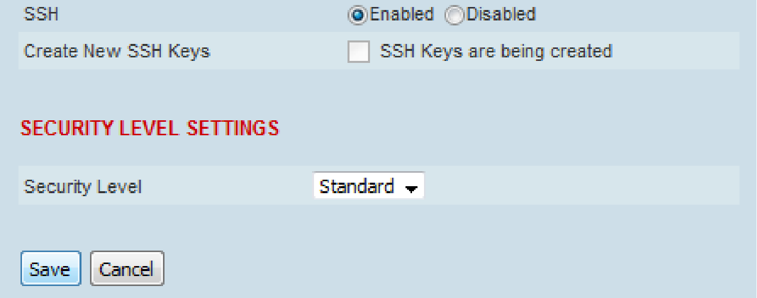
SSH

This parameter enables / disables Secure Shell (SSH). The default setting is enabled.

Create New SSH Keys

This parameter creates replacement public and private SSH keys.

Tick the check box and click Save. This process can take a few minutes.



Network Extension Mode

This parameter enables this radio to be part of the extended network radio list. The default setting is disabled.

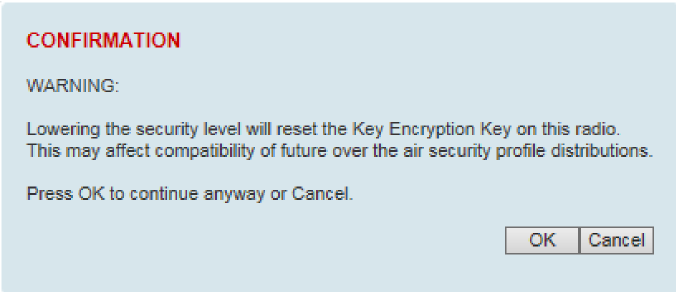
SECURITY LEVEL SETTINGS

Security Level

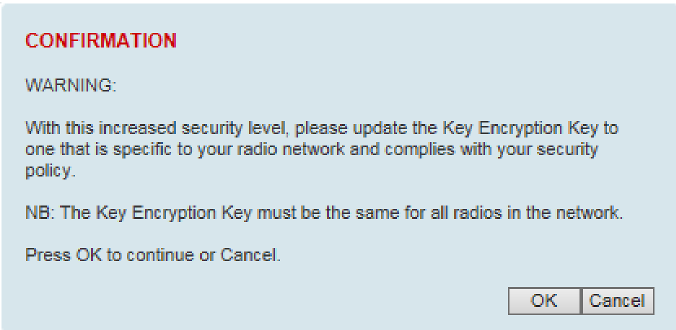
This parameter sets the Security Level active security features. The default setting is Standard.

Option	Payload Encryption	HTTPS	SNMPv3	USB KEK Only
Standard	✓	✓	✓	
Strong	✓	✓	✓	✓

If the Security Level is reduced, there will be a pop up message warning that Key Encryption Key will be reset to the default value.



If the Security Level is increased, there will be a pop up message reminding the user to enter a new Key Encryption Key.



If the Security Level is set to ‘Strong’, the ‘Save’ button will be grayed out and the ‘Copy To USB’ button will not be shown.

When the Security Level is set to ‘Strong’, the radio Key Encryption Key is used to encrypt a saved configuration file. If a saved configuration file encryption Key Encryption Key does not match the radio Key Encryption Key, the saved configuration will not be accepted / loaded. See ‘File - Configuration Settings’ on page 243.

SNMPv3 Context Addressing

SNMPv3 is not user configurable, and user can use this option with any NMS. The radio SNMP management interface supports SNMPv3/2 context addressing. The SNMv3 context addressing allows the user to use secure SNMPv3 management while improving NMS performance.

A NMS (Network Management System) can access any remote radio directly by using its IP address or via the base / master station SNMPv3 context addressing. The SNMPv3 context addressing can compress the SNMPv3 management traffic OTA (Over The Air) to the remote radio by up to 90% relative to direct OTA SNMPv3 access to remote radio, avoiding the radio narrow bandwidth traffic loading.

To use Context Addressing to communicate with a remote radio:

- Address the SNMP transaction to the base station i.e., use the base station's IP address.
- In the SNMP Context Name / Community String, use a string in the format of e.g., 'public.runit_172.10.1.15'.
    - The 'public' portion is the actual community string that is required for the SNMP transaction.
    - The '.' is required to separate the remaining portion of the string.
    - The 'runit_' portion is to indicate that a remote radio registered to the base station is being addressed.
    - and the '172.10.1.15' portion is the actual IP address of the remote radio.

In this example, when the SNMP transaction is received by the base station, it is redirected to the specified remote radio using the SNMP context addressing protocol of communications. The response to the original SNMP transaction that was directed to the base station will contain the necessary information from the remote radio and will be in a standard format – appearing as a normal SNMP transaction response.

net-snmp command examples (where 'SNMP Protocol=All Version' at 'Supervisor > Security > Setup' page):

Example 1: Getting the Terminal Name (APRISASR-MIB: termName) - 1.3.6.1.4.1.14817.7.4.1.1.1.1.1.0 from a remote radio IP address 10.30.56.81 via Base station IP address 10.30.56.80.

snmpget –v2c –c public.runit_10.30.56.81 10.30.56.80 1.3.6.1.4.1.14817.7.4.1.1.1.1.1.0

Example 2: Getting the TX Power (RFCONFIG-MIB: rfConfigPowerOutputSet) - 1.3.6.1.4.1.14817.3.14.2.30.0

snmpget –v2c –c public.runit_10.30.56.81 10.30.56.80 1.3.6.1.4.1.14817.3.14.2.30.0

Example 3: Reading the IP address

snmpget -v2c -c "public.runit_172.17.70.32" 172.17.70.31 1.3.6.1.4.1.14817.7.4.1.1.4.1.1.0

Example 4 : Reading the IP address using SNMPv3

snmpget -v3 -u privUserSHA -n "priv.runit_172.17.70.32" -l authPriv -a SHA -A privUserSHA -x AES -X privUserSHA 172.17.70.31 1.3.6.1.4.1.14817.7.4.1.1.4.1.1.0

Example 5: SNMPWALK

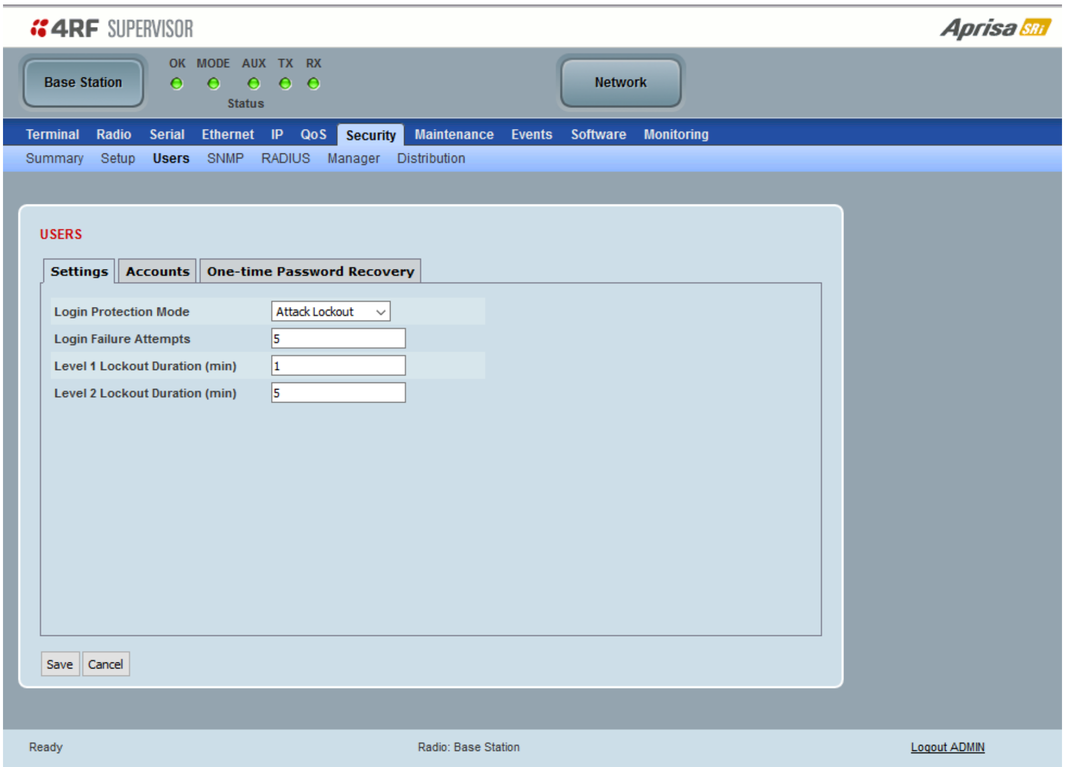
snmpwalk -v2c -c public.runit_10.30.56.81 10.30.56.80 1.3.6.1.4.1.14817.7

Example 6: SNMPWALK using retry and timeout parameters

snmpwalk -r1 -t5 -v2c -c public.runit_10.30.56.81 10.30.56.80 1.3.6.1.4.1.14817.7

Security > Users

Settings



Login Protection Mode

This parameter sets the Login Protection Mode. They provide user account lockout mechanisms to mitigate brute force password guessing attacks.

Option	Function
Disabled	Disables login protection
Attack Slowdown	In this mode, the user account will be locked out for the duration specified in Level 1 Lockout Duration and Level 2 Lockout Duration, cycling between the two. This mode slows down attacks.
Attack Lockout	In this mode, the user account will be permanently locked out if the protection mechanism has reached Locked Level 1 and Locked Level 2 and the next login attempt fails. The user account must then be manually unlocked by an 'Admin' user account either from SuperVisor or via SNMP. This mode blocks persistent attacks.

Attack Slowdown

The Attack Slowdown login protection lockout mechanism will be processed as follows:

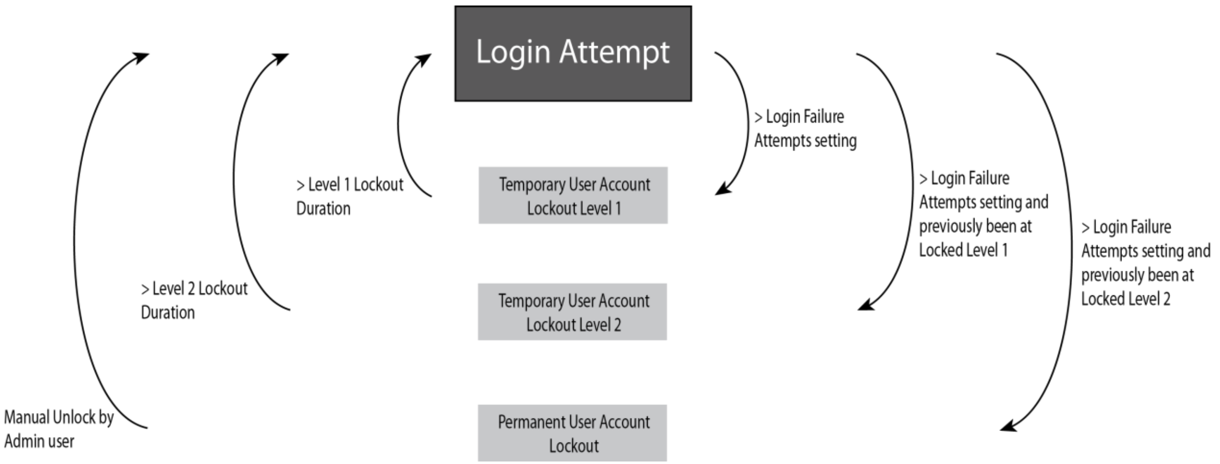
- When the number of login failure attempts is less than the setting of the 'Login Failure Attempts' field, the login attempt is processed.
- When the number of login failure attempts is greater than the setting of the 'Login Failure Attempts' field, the user account will be:
    - temporarily disabled at level 1 for the 'Level 1 Lockout Duration' period, if the user account was not previously already released from locked level 2.
    - temporarily disabled at level 2 for the 'Level 2 Lockout Duration' period, if the user account was previously already released from locked level 1.

This lockout mode will cycle the lockout of the accounts between locked level 1 and locked level 2.

Attack Lockout

The Attack Lockout login protection lockout mechanism will be processed as follows:

- When the number of login failure attempts is less than the setting of the 'Login Failure Attempts' field, the login attempt is processed.
- When the number of login failure attempts is greater than the setting of the 'Login Failure Attempts' field, the user account will be:
    - temporarily disabled at level 1 for the 'Level 1 Lockout Duration' period, if the user account was not previously already released from locked level 1.
    - temporarily disabled at level 2 for the 'Level 2 Lockout Duration' period, if the user account was previously already released from locked level 1.
    - permanently disabled if the user account was previously already released from locked level 2. The user account must then be manually unlocked by an 'Admin' user account either from SuperVisor or via SNMP.



Login Failure Attempts

When Login Protection Mode is active, this parameter sets the maximum number of consecutive failed login attempts before the relevant user account lockout process is initiated. This field can be set from 3 to 10 times and the default value is 5.

Level 1 Lockout Duration (min)

When Login Protection Mode is active and the user account is in the state of 'locked level 1', the user account will be locked out for the duration specified. This field can be set from 1 to 15 minutes and the default value is 1 minute.

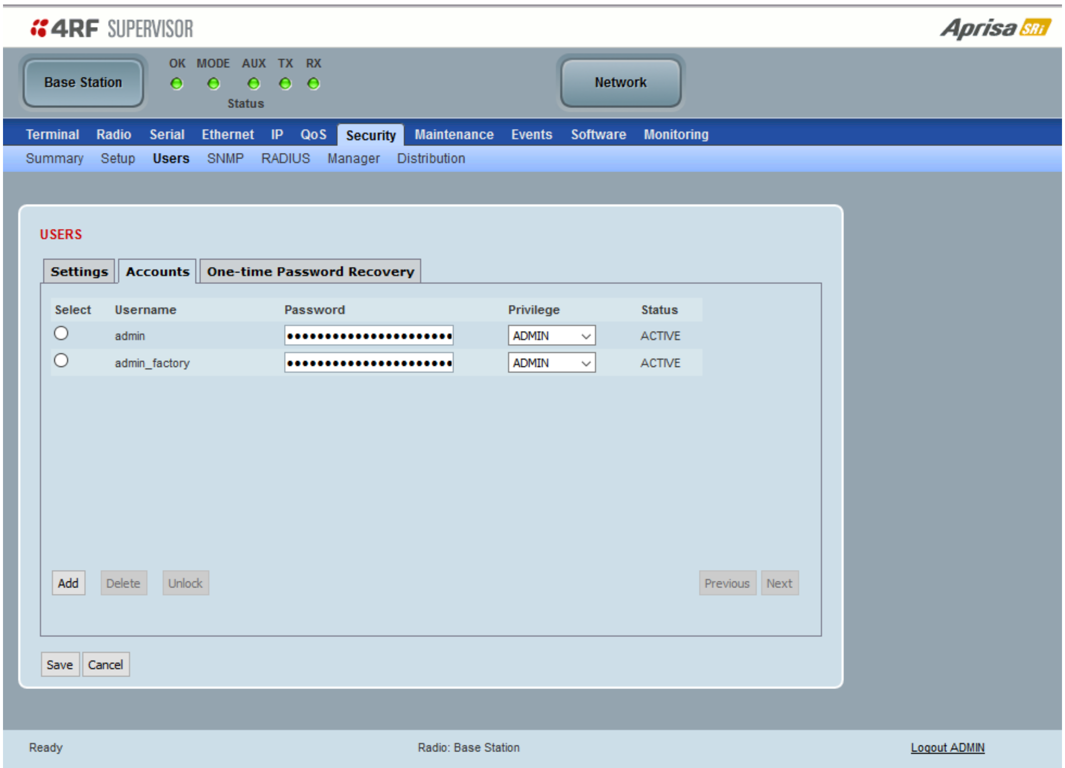
A user account in the state of 'locked level 1' shall be unlocked and put in the released from level 1 lockout state after this level 1 lockout duration has expired.

Level 2 Lockout Duration (min)

When Login Protection Mode is active and the user account is in the state of 'locked level 2', the user account will be locked out for the duration specified. This field can be set from 5 to 30 minutes and the default value is 5 minutes.

A user account in the state of 'locked level 2' shall be unlocked and put in the released from level 2 lockout state after this level 2 lockout duration has expired.

Accounts



Note: You must login with ‘admin’ privileges to add, disable, delete a user or change a password.

Shows a list of the current user accounts setup in the radio.

To add a new user:

1. Click Add.

If the currently viewed page is full (displaying 8 user accounts), SuperVisor shall automatically display the last user account page when a new user is added. However, if there are unsaved changes on the current page, the user shall be prompted to save the changes first before adding a new user.

2. Enter the Username.

A username can be up to 32 characters but cannot contain tabs. Usernames are case sensitive.

3. Enter the Password.

A password can be 8 to 32 printable characters but cannot contain tabs. Passwords are case sensitive.

Good password policy:

- contains at least one upper case letter, and
- contains at least one lower case letter, and
- contains at least one digit, and
- is not a term in a familiar language or jargon, and
- is not identical to or derived from the accompanying account name, from personal characteristics or from information from one's family/social circle, and
- is easy to remember, for instance by means of a key sentence.

4. Select the User Privileges

There are four pre-defined User Privilege settings to allocate access rights to users. These user privileges have associated default usernames and passwords of the same name.

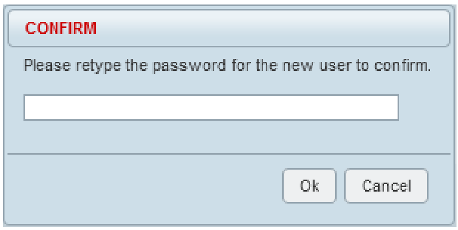
The default login is 'admin'.

This login has full access to all radio parameters including the ability to add and change users. There can only be a maximum of two usernames with admin privileges and the last username with admin privileges cannot be deleted.

User Privilege	Default Username	Default Password	User Privileges
View			Users in this group can only view the summary pages.
Technician			Users in this group can view and edit parameters except Security > Users and Security > Setup.
Engineer			Users in this group can view and edit parameters except Security > Users.
Admin	admin	admin	Users in this group can view and edit all parameters.

See 'SuperVisor Menu' on page 93 for the list of SuperVisor menu items versus user privileges.

When the password is changed, you will be prompted for confirmation of the password to avoid mistypes.



The Status will show PENDING until the entry is saved.

5. Click Save.

Status

The Status indicates whether a user account is active or locked out.

Option	Function
ACTIVE	The user account is currently active.
PENDING	The user account has been entered but not saved.
LOCKED (Level 1)	Login Protection Mode is active, and the user account has been locked out due to repeated unsuccessful login attempts. The account will remain locked out for a period defined in 'Level 1 Lockout Duration' at the 'Security > Users' > Settings tab.
LOCKED (Level 2)	Login Protection Mode is active, and the user account has been locked out due to repeated unsuccessful login attempts. The account will remain locked out for a period defined in 'Level 2 Lockout Duration' at the 'Security > Users' > Settings tab.
LOCKED	Login Protection Mode is active, and the user account has been locked out due to repeated unsuccessful login attempts. The user account is permanently locked out.

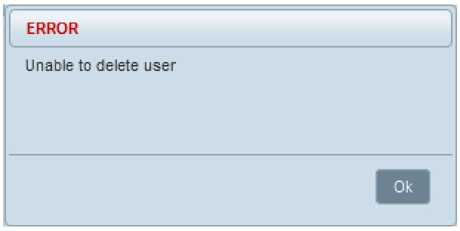
This tab shall also provide the interface for the ADMIN user to unlock any locked user accounts.

The 'Unlock' button shall be disabled unless a locked account is selected, in which case, clicking the button will unlock the selected account.

To delete a user:

1. Select Terminal Settings > Security > Users
2. Click on the Select button for the user you wish to delete.
3. Click 'Delete
4. Click Save.

The user can delete any user account as long as there is at least one ADMIN account left on the radio. If the user attempts to delete the last ADMIN account on the radio (and click Save), an error popup shall be displayed.

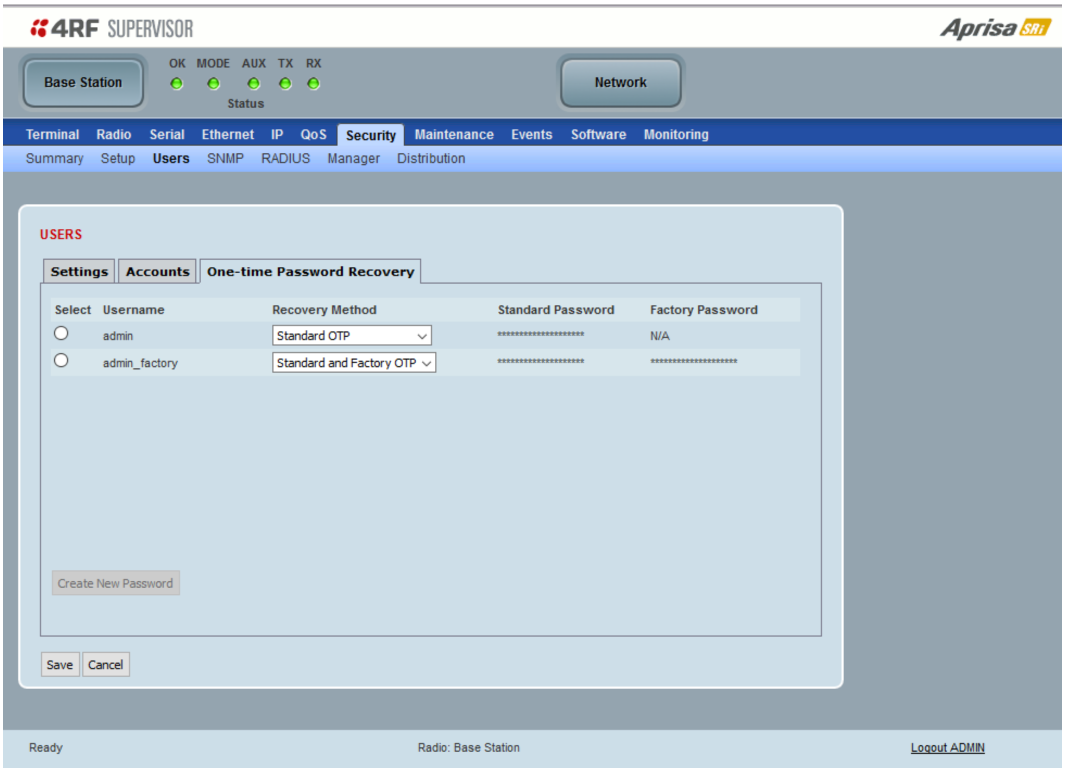


To change a Password:

1. Select Terminal Settings > Security > Users
2. Click on the Select button for the user you wish to change the Password.
3. Enter the Password.
4. Click Save.

A password can be 8 to 32 characters but cannot contain tabs.

One-time Password Recovery



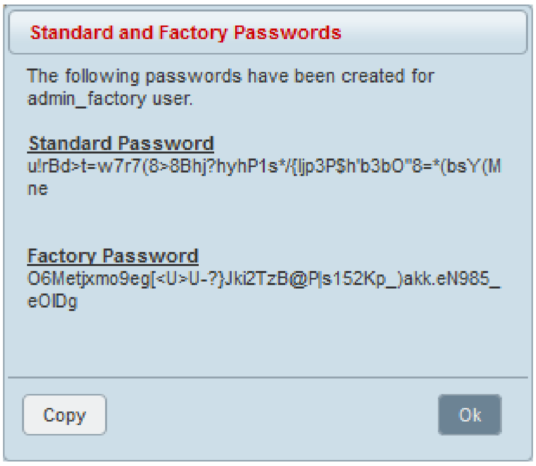
The One-time Password Recovery is a future proofing mechanism that allows an Admin user access to change the Admin password if the Admin user is permanently locked out or the Admin password is unknown. OTP passwords can be entered on this page and then saved in a text file for future use.

If these passwords are used to login to a radio, the password is immediately changed so it can't be used again.

Recovery Method

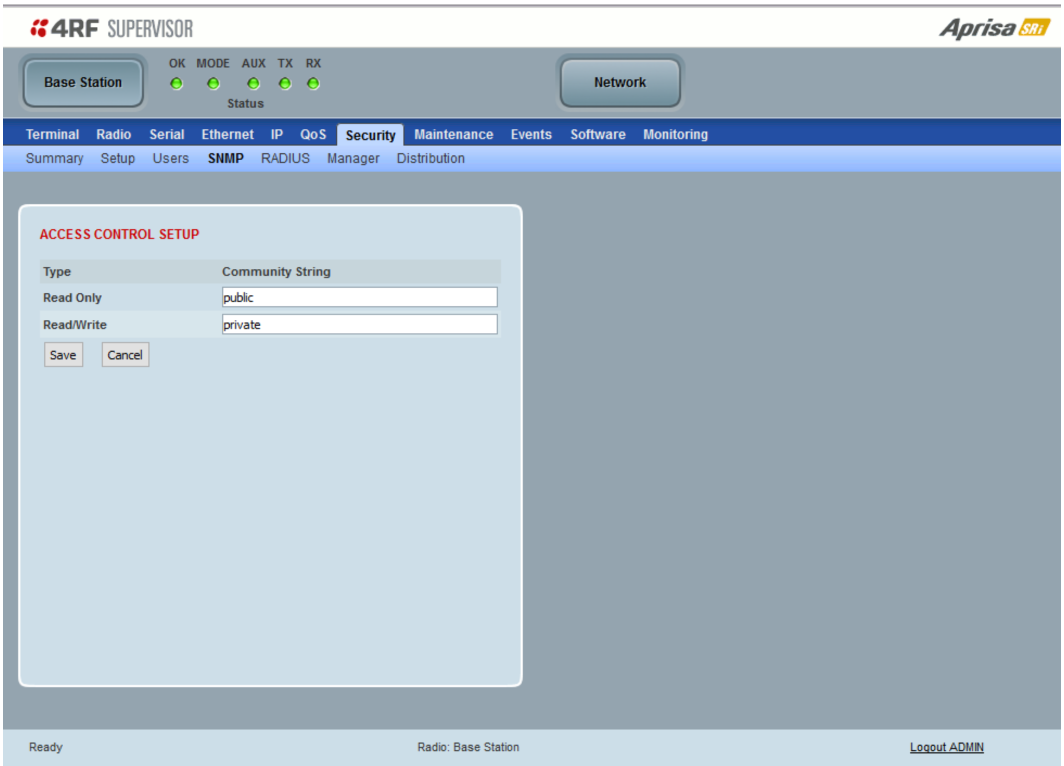
Option	Function
Standard OTP	Using the 'Standard OTP' password when logging into a radio, allows the user to change the radio Admin password so it can then be used to login and access the radio.
Standard and Factory OTP	Using the 'Standard and Factory OTP password' when logging into a radio, allows the user to change the radio Admin password BUT also restores the entire radio to Factory Defaults so be careful using this!

Whenever new passwords are generated for a user, a popup box shall be displayed with the new passwords in clear text.



The Copy button copies the generated passwords to the clipboard, for storage in a text file for future use.

Security > SNMP



In addition to web-based management (SuperVisor), the network can also be managed using the Simple Network Management Protocol (SNMP) using any version of SNMP v1/2/3. MIB files are supplied, and these can be used by a dedicated SNMP Manager, such as Castle Rock's SNMPc, to access most of the radio's configurable parameters.

For communication between the SNMP manager and the radio, Access Controls and Community strings must be set up as described in the following sections.

A SNMP **Community String** is used to protect against unauthorized access (similar to a password). The SNMP agent (radio or SNMP manager) will check the community string before performing the task requested in the SNMP message.

ACCESS CONTROL SETUP

A SNMP **Access Control** is the IP address of the radio used by an SNMP manager or any other SNMP device to access the radio. The Aprisa SRi allows access to the radio from any IP address.

Read Only

The default Read Only community string is public.

Read Write

The default ReadWrite community string is private.

SNMP Manager Setup

The SNMP manager community strings must be set up to access the base station and remote radios.

To access the base station, a community string must be setup on the SNMP manager the same as the community string setup on the radio (see 'Security > SNMP' on page 222).

SNMP access to remote radios can be achieved by using the radio's IP address and the normal community string or by proxy in the base station.

SNMP Access via Base Station Proxy

To access the remote radios via the base station proxy, the community strings must be setup on the SNMP manager in the format:

cccccccc:bbbbbb

Where:

cccccccc is the community string of the base station.

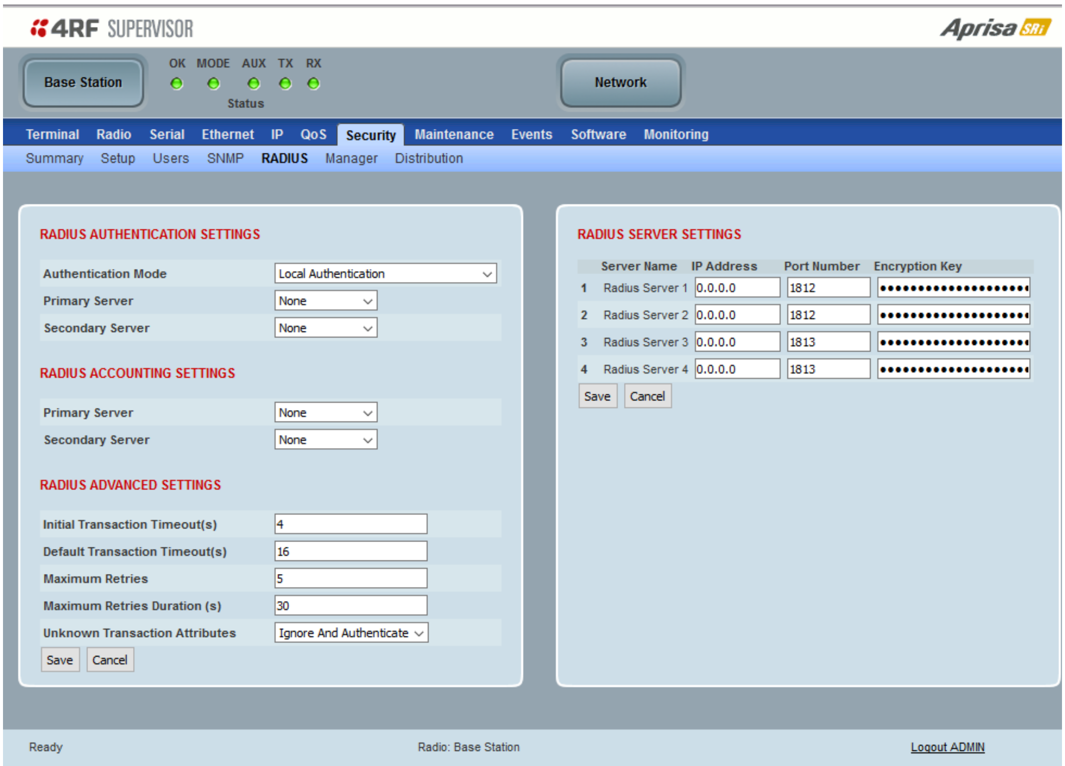
and

bbbbbb is the last 3 bytes of the remote radio MAC address (see 'Network Status > Network Table' on page 303).

The SNMP Proxy Support must be enabled for this method of SNMP access to operate (see 'SNMP Proxy Support' on page 208).

Security > RADIUS

This page displays the current settings for the Security RADIUS.



RADIUS - Remote Authentication Dial In User Service

RADIUS is a client / server system that secures the radio link against unauthorized access. It is based on open standard RFCs: RFC 2865/6, 5607, 5080 and 2869. It is used for remote user Authorization, Authentication and Accounting.

When a user logs into a radio with RADIUS enabled, the user's credentials are sent to the RADIUS server for authentication of the user.

Transactions between the RADIUS client and RADIUS server are authenticated through the use of a shared secret, which is never sent over the network.

For a RADIUS server to respond to the radio, it must be configured with the following **Management-Privilege-level** attributes:

Admin Level = 4

Technician Level = 2

Viewer Level = 1

Alternatively, for Admin level only, for a RADIUS server to respond to the radio, it must be configured with attributes Service-Type (6) = Administrative (6) which will grant the user admin access to the radio.

A RADIUS server can act as a proxy client to other RADIUS servers or other kinds of authentication servers.

RADIUS AUTHENTICATION SETTINGS

Authentication Mode

This parameter sets the Authentication Mode.

Option	Function
Local Authentication	No radius Authentication – allows any local user privilege. All user login attempts are authenticated against local accounts only.
Radius Authentication	Only radius Authentication – no local user privilege. All user login attempts are authenticated against the Radius server accounts only.
Radius Authentication and Local admin	All user login attempts are first authenticated against the Radius server accounts. If the authentication fails, it is then authenticated against local admin accounts only.
Radius Then Local Authentication	All user login attempts are first authenticated against the Radius server accounts. If the authentication fails, it is then authenticated against local accounts.
Local Then Radius Authentication	All user login attempts are first authenticated against the local accounts. If the authentication fails, it is then authenticated against the Radius server accounts.
Radius Authentication with Local Fallback	All user login attempts are authenticated against the Radius server accounts unless the Radius server is not contactable. If unable to connect to the Radius server, only then it is authenticated against the local accounts.

Primary Server

This parameter sets which radius server is used as the primary server for authentication. Select one of the possible authentication servers setup in Radius Server Settings.

Secondary Server

This parameter sets which radius server is used as the secondary server for authentication. Select one of the possible authentication servers setup in Radius Server Settings.

RADIUS ACCOUNTING SETTINGS

Primary Server

This parameter sets which radius server is used as the primary server for accounting (log of user activity). Select one of the possible accounting servers setup in Radius Server Settings.

Secondary Server

This parameter sets which radius server is used as the secondary server for accounting. Select one of the possible accounting servers setup in Radius Server Settings.

RADIUS ADVANCED SETTINGS

Initial Transaction Timeouts (IRT) (seconds)

This parameter sets the initial time to wait before the retry mechanism starts when the server is not responding.

Default Transaction Timeouts (MRT) (seconds)

This parameter sets the maximum time between retries.

Maximum Retries (MRC)

This parameter sets the maximum number of retry attempts when the server is not responding.

Maximum Retries Duration (MRD) (seconds)

This parameter sets the maximum duration it will attempt retries when the server is not responding.

Unknown Transaction Attributes

This parameter sets the radio’s response to unknown attributes received from the radius server.

Option	Function
Ignore and Authenticate	Ignore the unknown attributes and accept the authentication received from the radius server
Reject and Deny	Reject the authentication received from the radius server

RADIUS SERVER SETTINGS

Server Name

You can enter up to four radius servers 1-4.

IP Address

The IP address of the Radius server.

Port Number

The Port Number of the Radius server. RADIUS uses UDP as the transport protocol.

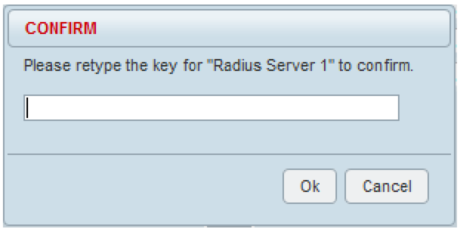
- UDP port 1812 is used for authentication / authorization.
- UDP port 1813 is used for accounting.

Old RADIUS servers may use unofficial UDP ports 1645 and 1646.

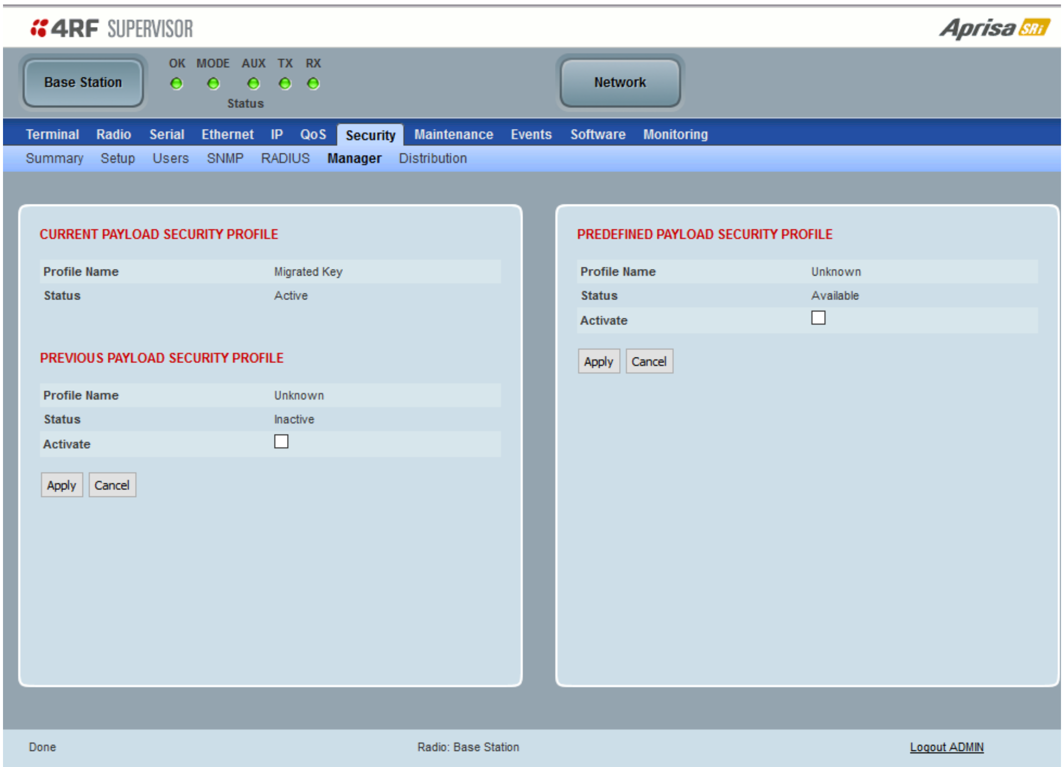
Encryption Key

The password of the Radius server. This can include lower / upper case, numbers and special characters (~!@#$%^&*()_+{}|) to be used in the encryption key.

When the password is changed, you will be prompted for confirmation of the password to avoid mistypes.



Security > Manager



CURRENT PAYLOAD SECURITY PROFILE

Profile Name

This parameter shows the predefined security profile active on the radio.

Status

This parameter displays the status of the predefined security profile on the radio (always active).

PREVIOUS PAYLOAD SECURITY PROFILE

Profile Name

This parameter displays the security profile that was active on the radio prior to the current profile being activated.

Status

This parameter displays the status of the security profile that was active on the radio prior to the current profile being activated.

Option	Function
Active	The security profile is active on the radio.
Inactive	The security profile is not active on the radio but could be activated if required.

Activate

This parameter activates the previous security profile (restores to previous version).

PREDEFINED PAYLOAD SECURITY PROFILE

Profile Name

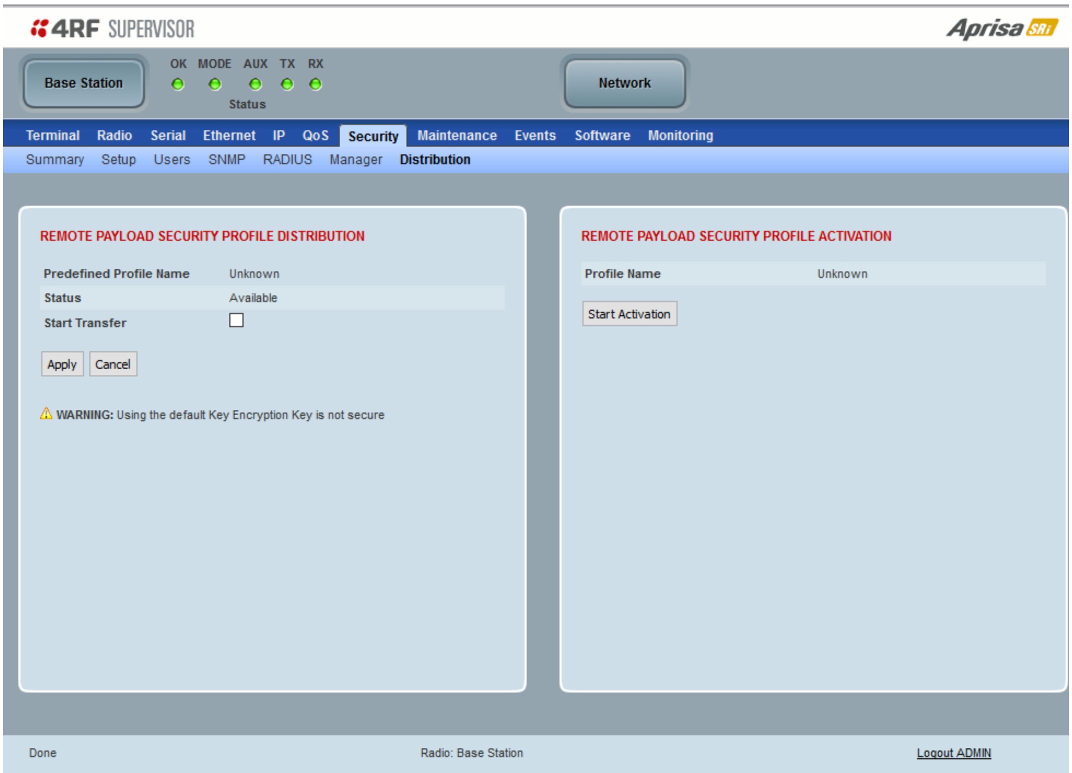
This parameter displays the new security profile that could be activated on the radio or distributed to all remote radios with Security > Distribution.

Status

This parameter displays the status of the new security profile.

Option	Function
Unavailable	A predefined security profile is not available on this radio. To create a predefined security profile, go to 'Security > Setup' on page 204.
Available	A predefined security profile is available on this radio for distribution and activation.

Security > Distribution



REMOTE PAYLOAD SECURITY PROFILE DISTRIBUTION

Predefined Profile Name

This parameter displays the predefined security profile available for distribution to remote radios.

Status

This parameter shows if a predefined security profile is available for distribution to remote radios.

Option	Function
Unavailable	A predefined payload security profile is not available on this radio.
Available	A predefined payload security profile is available on this radio for distribution and activation.

Start Transfer

This parameter, when activated distributes (broadcasts) the new payload security profile to all remote radios in the network.

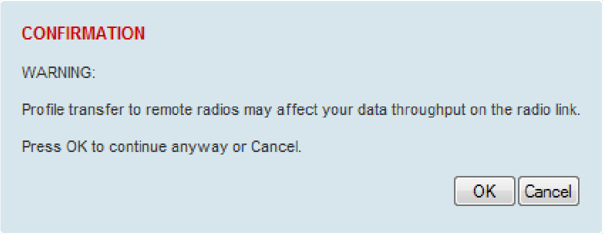
Note: The distribution of the payload security profile to remote radios does not stop customer traffic from being transferred.

Payload security profile distribution traffic is classified as 'management traffic' but does not use the Ethernet management priority setting. Security profile distribution traffic priority has a fixed priority setting of 'very low'.

To distribute the payload security profile to remote radios:

This process assumes that a payload security profile has been setup (see 'Security > Setup' on page 204).

1. Tick Start Transfer and click Apply.



Note: This process could take up to 1 minute per radio depending on channel size, Ethernet Management Priority setting and the amount of customer traffic on the network.

2. When the distribution is completed, activate the software with the Remote Payload Security Profile Activation.

REMOTE PAYLOAD SECURITY PROFILE ACTIVATION

When the security profile has been distributed to all the remote radios, the security profile is then activated in all the remote radios with this command.

The base station will always attempt to distribute the profile successfully. This broadcast distribution has its own retry mechanism. The user can find out if all the remote radios have the latest profile when the managed activation process is attempted. A pop up confirmation will be shown by SuperVisor with relevant information and the user can decide whether to proceed or not. The user can attempt to redistribute again if needed. If the decision is made to continue, on completion of the activation process, communication with the remote radios that did not have the new security profile will be lost.

Predefined Profile Name

This parameter displays the predefined security profile available for activation on all remote radios.

To activate the security profile in remote radios:

This process assumes that a security profile has been setup into the base station (see 'Security > Setup' on page 204) and distributed to all remote radios in the network.

Note: Do not navigate SuperVisor away from this page during the activation process (SuperVisor can lose PC focus).

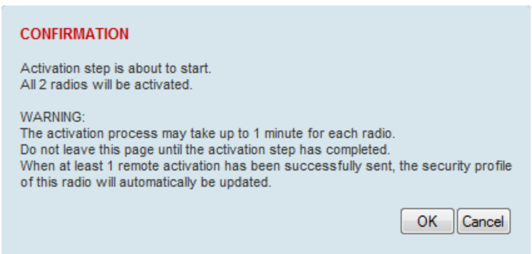
---

1. Click Start Activation

The remote radios will be polled to determine which radios require activation:

Result	Function (X of Y)
Remote Radios Polled for New Profile	X is the number of radios polled to determine if the radio contains the new security profile. Y is the number of remote radios registered with the base station.
Remote Radios Activated	X is the number of radios activated. Y is the number of radios with the new security profile requiring activation.
Remote Radios On New Profile	X is the number of radios activated and on the new security profile. Y is the number of radios with the new security profile that have been activated.

When the activation is ready to start:

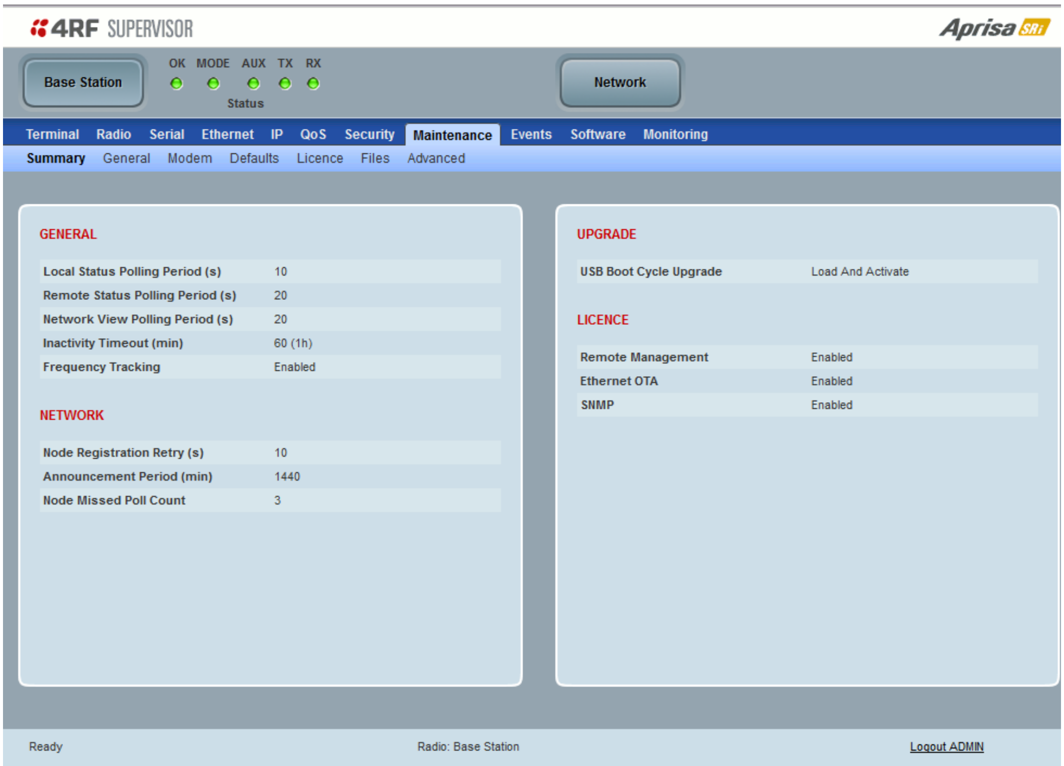


3. Click on 'OK' to start the activation process or Cancel to quit.

Maintenance

Maintenance > Summary

This page displays the current settings for the Maintenance parameters.



GENERAL

Local Status Polling Period (sec)

This parameter displays the rate at which SuperVisor refreshes the Local Radio alarm LED states and RSSI value.

Remote Status Polling Period (sec)

This parameter displays the rate at which SuperVisor refreshes the Remote Radio alarm LED states and RSSI value.

Network View Polling Period (sec)

This parameter displays the rate at which SuperVisor polls all remote radios for status and alarm reporting.

Inactivity Timeout (min)

This parameter displays the period of user inactivity before SuperVisor automatically logs out of the radio.

Frequency Tracking

This parameter displays if Frequency Tracking is enabled or disabled.

NETWORK

Node Registration Retry (sec)

This parameter displays the base station poll time at startup or the remote radio time between retries until registered.

Announcement Period (min)

This parameter displays the period between base station announcement messages. The announcement messages are used to distribute the base station date and time to remote radios. The default setting is 1440 minutes (24 hours).

Setting this parameter to 0 will stop periodic announcement messages being transmitted.

Node Missed Poll Count

This parameter displays the number of times the base station attempts to poll the network at startup or if a duplicate IP is detected when a remote radio is replaced.

UPGRADE

USB Boot Cycle Upgrade

This parameter shows the type of USB Boot Cycle upgrade defined in ‘Software Setup > USB Boot Upgrade’ on page 265.

LICENCE

Remote Management

This parameter displays if Remote Management is enabled or disabled. The default setting is enabled.

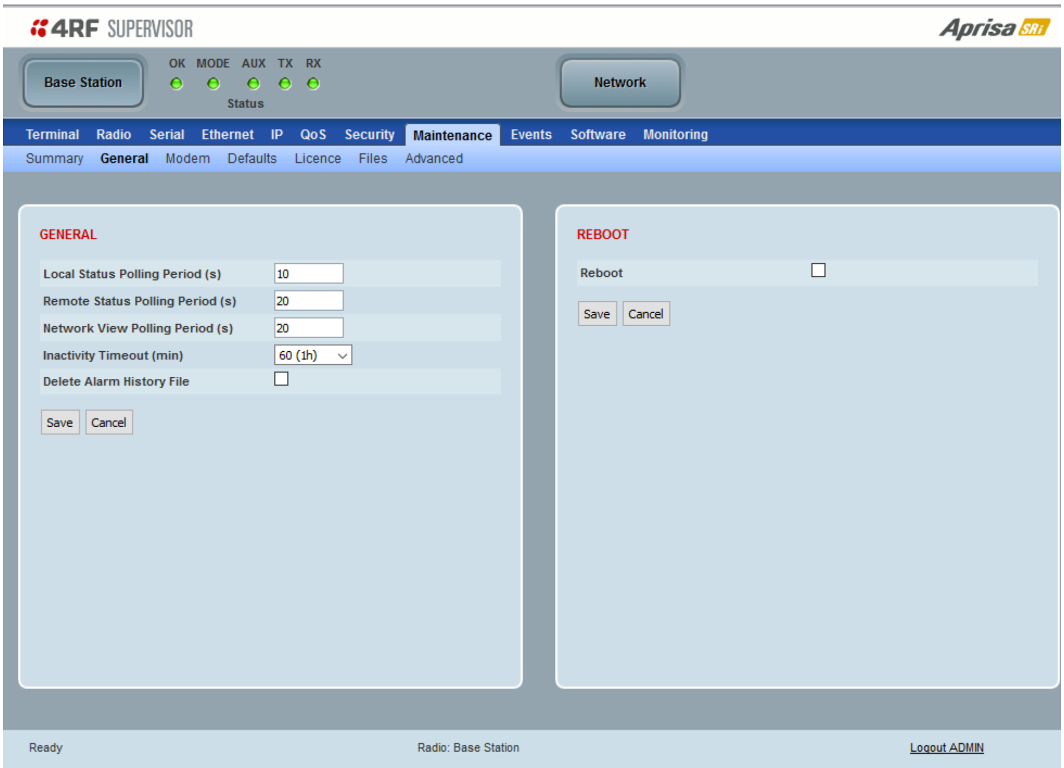
Ethernet OTA (over the air)

This parameter displays if Ethernet traffic is enabled or disabled. The Ethernet OTA will be enabled if the Ethernet feature licence has been purchased (see ‘Maintenance > Licence’ on page 241).

SNMP Management

This parameter displays if SNMP management is enabled or disabled. The default setting is enabled.

Maintenance > General



GENERAL

Local Status Polling Period (sec)

This parameter sets the rate at which SuperVisor refreshes the Local Radio alarm LED states and RSSI value. The default setting is 10 seconds.

Network View Polling Period (sec)

This parameter sets the rate at which SuperVisor polls all remote radios for status and alarm reporting. The default setting is 20 seconds.

Remote Status Polling Period (sec)

This parameter sets the rate at which SuperVisor refreshes the Remote Radio alarm LED states and RSSI value. To avoid problems when managing Aprisa SRi Networks, ensure that the Remote Polling Period is set to be longer than the Inband Management Timeout (set on page 100). The default setting is 20 seconds.

Inactivity Timeout (min)

This parameter sets the period of user inactivity before SuperVisor automatically logs out of the radio. The default setting is 15 minutes.

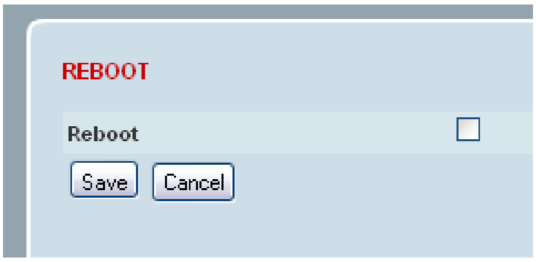
Delete Alarm History file

This parameter, when activated deletes the alarm history file stored in the radio.

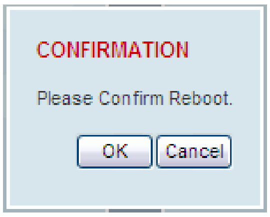
REBOOT

To reboot the radio:

1. Select Maintenance > General.
2. Tick the ‘Reboot’ checkbox.



3. Click ‘Save’ to apply the changes or ‘Cancel’ to restore the current value.



4. Click ‘OK’ to reboot the radio or ‘Cancel’ to abort.

All the radio LEDs will flash repeatedly for 1 second.

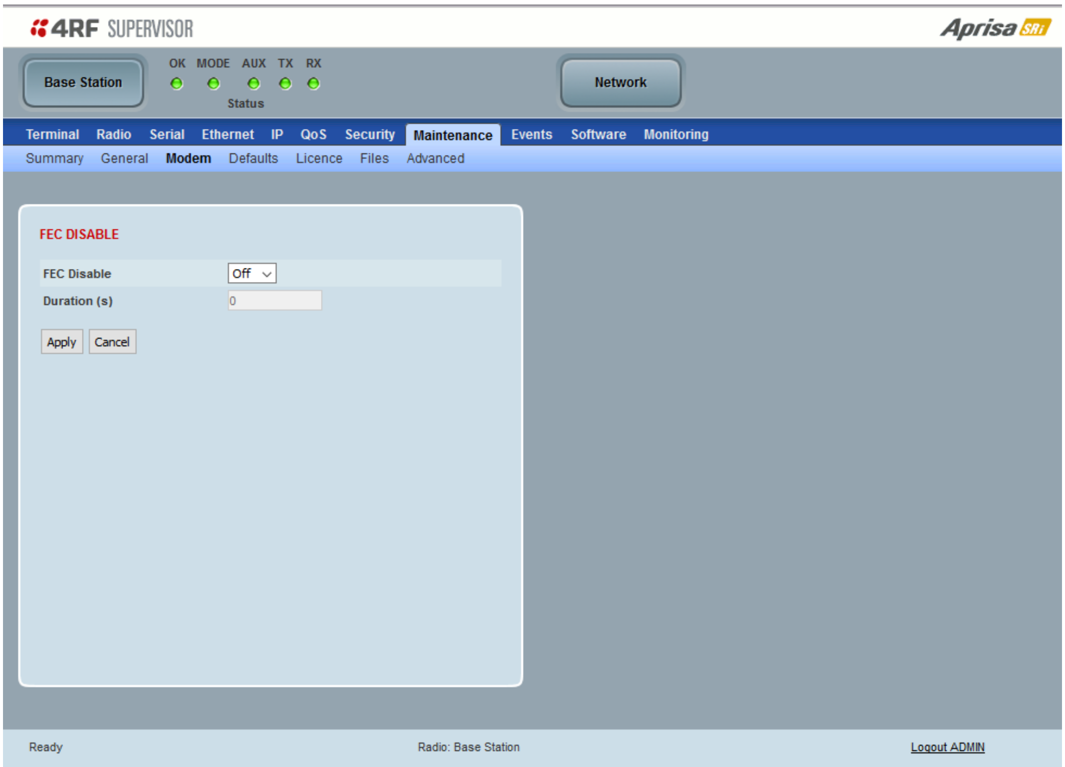
The radio will be operational again in about 10 seconds.

The OK, MODE, and AUX LEDs will light green and the TX and RX LEDs will be green (steady or flashing) if the network is operating correctly.

5. Login to SuperVisor.

Maintenance > Modem

<u>Base Station</u>



FEC DISABLE

FEC Disable

This diagnostic function allows the user to temporarily disable forward error correction on the channel when diagnosing problems on the link.

Therefore, enabling this diagnostic function would temporarily disable FEC on the channel and the associated maintenance mode alarm would activate.

Note that the opposite is not true for this diagnostic function. In other words, this diagnostic function does not provide the user with the option to temporarily enable forward error correction on the channel.

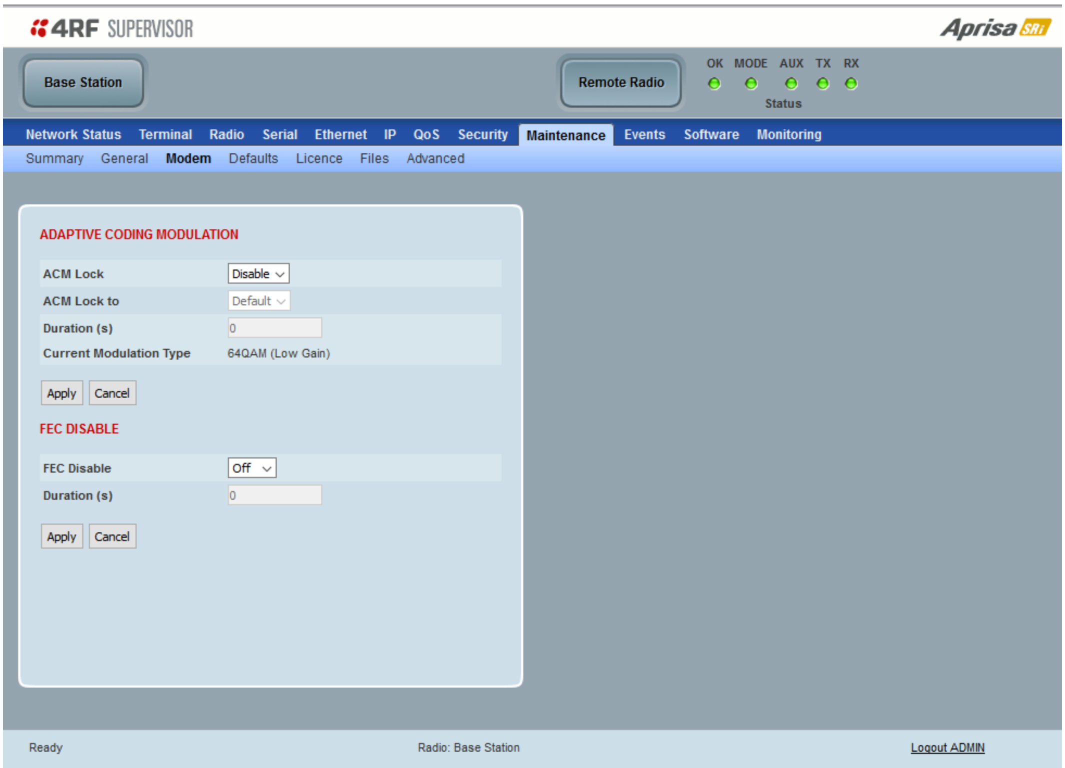
All diagnostic functions are not persistent and will be return to disabled states should the system restart.

Option	**Function**
Enable	Enables the FEC Disable diagnostic function
Disable	Disables the FEC Disable diagnostic function
Timer	Allows the FEC to be disabled but only for a predetermined period.

Duration (s)

This parameter defines the period required for disabling the FEC. When this period elapses, the FEC is enabled.

Remote radio



ADAPTIVE CODING AND MODULATION

ACM Lock

This parameter sets whether adaptive modulation can be locked or not.

Option	Function
Disable	Disables manual locking of the adaptive modulation i.e. allows for automatic adaptive modulation.
Enable	Allows the adaptive modulation to be manually locked
Timer	Allows the adaptive modulation to be manually locked but only for a predetermined period.

ACM Lock To

This parameter manually locks the adaptive modulation.

Option	Function
Default	Manually locks the adaptive modulation to the default
Current	Manually locks the adaptive modulation to the current modulation at that time.

Duration (s)

This parameter defines the period required for manually locking the adaptive modulation. When this period elapses, the adaptive modulation becomes automatic.

FEC DISABLE

FEC Disable

This diagnostic function allows the user to temporarily disable forward error correction on the channel when diagnosing problems on the link.

Therefore, enabling this diagnostic function would temporarily disable FEC on the channel and the associated maintenance mode alarm would activate.

Note that the opposite is not true for this diagnostic function. In other words, this diagnostic function does not provide the user with the option to temporarily enable forward error correction on the channel.

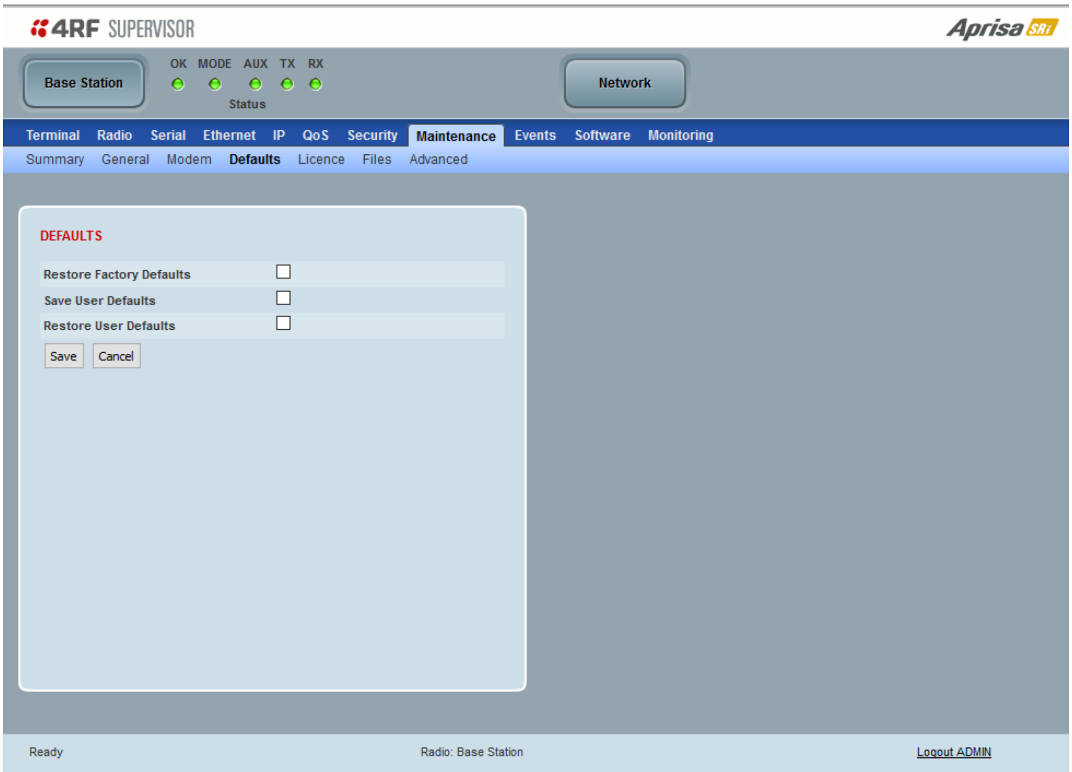
All diagnostic functions are not persistent and will be return to disabled states should the system restart.

Option	Function
Enable	Enables the FEC Disable diagnostic function
Disable	Disables the FEC Disable diagnostic function
Timer	Allows the FEC to be disabled but only for a predetermined period.

Duration (s)

This parameter defines the period required for disabling the FEC. When this period elapses, the FEC is enabled.

Maintenance > Defaults

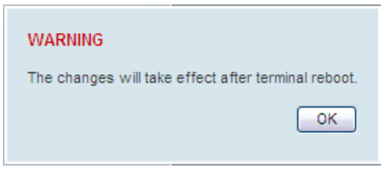


DEFAULTS

The Maintenance Defaults page is only available for the local terminal.

Restore Factory Defaults

When activated, all radio parameters will be set to the factory default values. This includes resetting the radio IP address to the default of 169.254.50.10.



Note: Take care using this command.

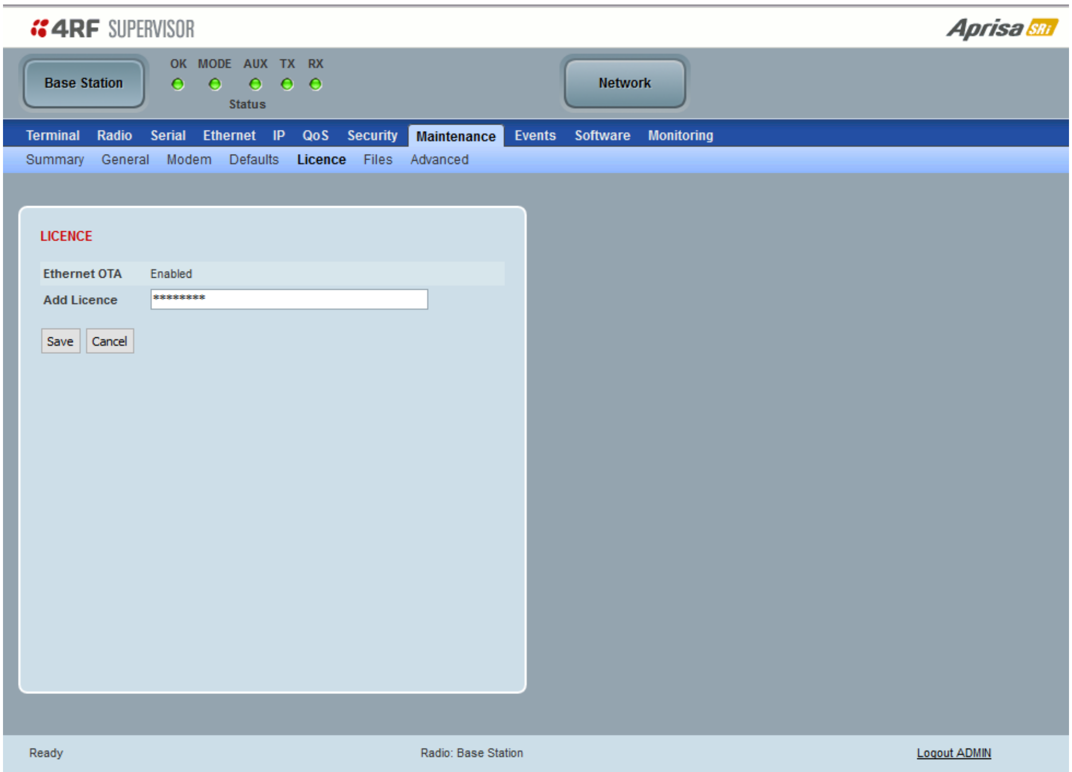
Save User Defaults

When activated, all current radio parameter settings will be saved to non-volatile memory within the radio.

Restore User Defaults

When activated, all radio parameters will be set to the settings previously saved using ‘Save User Defaults’.

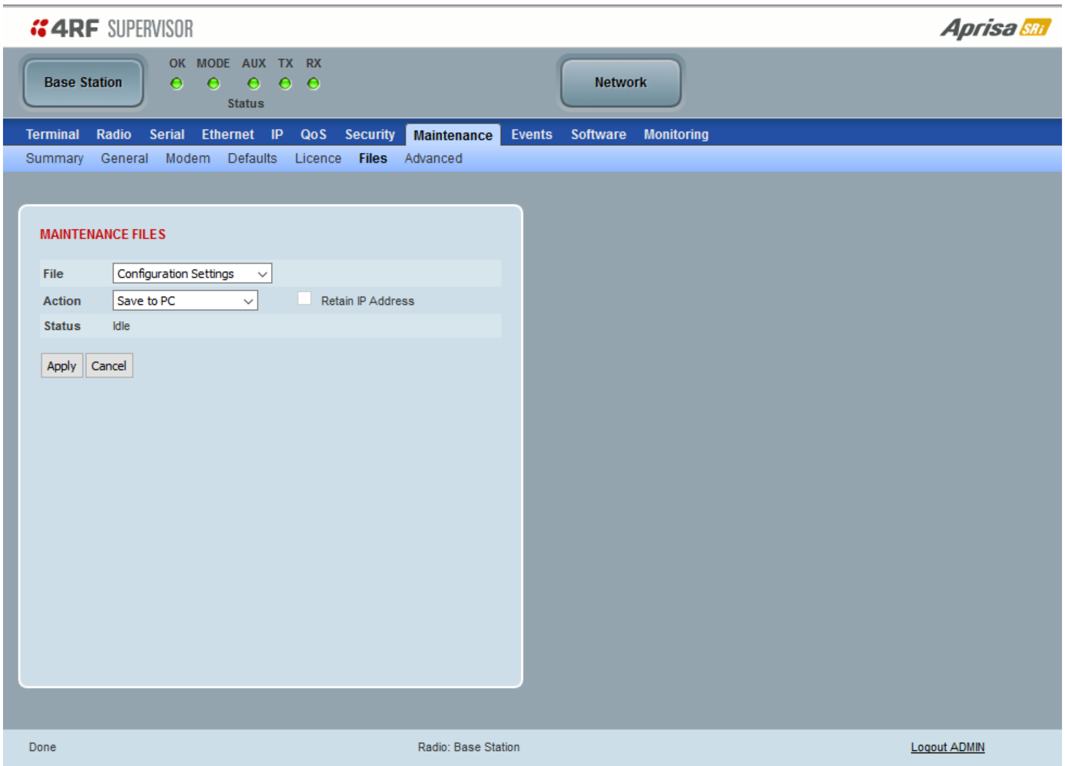
Maintenance > Licence



LICENCE

In this software version, Remote Management, Ethernet Traffic and SNMP management are enabled by default.

Maintenance > Files



MAINTENANCE FILES

There are three maintenance file types which can saved / restored to / from PC or USB flash drive:

Note: 4RF radios only support the FAT32 file system for flash drives. If the flash drive is a different format such as exFAT or NTFS, you will need to reformat it to FAT32.

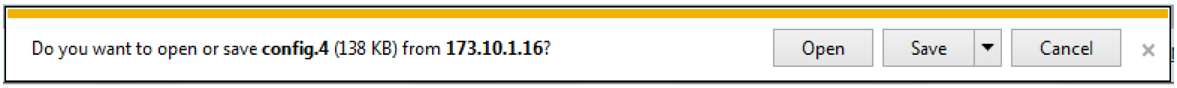
Also, some brands of USB flash drives may not work with 4RF radios.

File - Configuration Settings

This feature enables the configuration of a radio to be saved to a file for configuration backup or for copying to another radio, however the target radio being restored must be operating on the same software version as the source radio the configuration file was saved from e.g. if the configuration file was saved from a radio operating on software version 1.4.0, it can only be restored to a radio operating on software version 1.4.0.

Action

Action	Option
Save to PC	This saves the file with a filename of ‘Config.4’ to a binary encrypted file. This can then be saved from the Browser popup (example is Windows Internet Explorer 11). The file should be renamed to be able to identify the radio it was saved from. When the Security Level is set to ‘Strong’, the radio Key Encryption Key is used to encrypt the saved configuration file.



Save to Radio USB	This saves the file with a filename of ‘asrcfg_1.4.0’ to a binary encrypted file on the radio USB flash drive root directory.
Restore from PC	This restores all user configuration settings from a binary encrypted file on a PC directory to the radio. A reboot warning message will warn of a pending reboot after the PC file is selected. Clicking OK will open a browser file selection window to select the file. When the Security Level is set to ‘Strong’, the Key Encryption Key of the saved configuration file must be known as it must match the Key Encryption Key of the radio. **Note:** If you are using Explorer, it must be IE10 or above for this feature to work correctly.
Restore from Radio USB	This restores all user configuration settings from a binary encrypted file on the USB root directory to the radio.

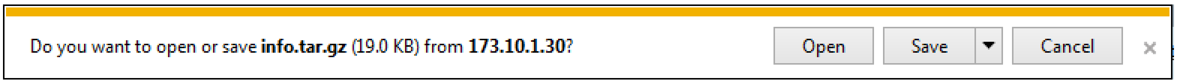
Note: ‘Payload Encryption Key’ and ‘Key Encryption Key’ parameters (see ‘Security > Setup’) are not saved to the configuration file. When a ‘Restore from PC’ or ‘Restore from Radio USB’ is used, these parameters will retain their existing values so are not changed by the operation of restoring the configuration file.

Note: If the remote radios are running software versions prior to 1.0.6, the configuration file cannot be downloaded over the air.

File - Event History Log

Action

Action	Option
Save to PC	This saves the Event History Log file with a filename of ‘Info.tar.gz’ to a binary encrypted file. This can then be saved from the Browser popup (example is Windows Internet Explorer 11). The file should be renamed to be able to identify the radio it was saved from. The ‘tar.gz’ file is normally for sending back to 4RF Limited for analysis but can be opened with widely available archive tools e.g. WinRar or 7-ZIP.

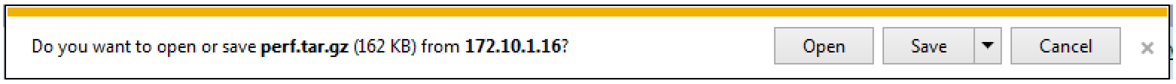


Save to Radio USB	This saves the file with a filename of e.g. ‘alarm_173.10.1.30_2014-11-10,15.54.14.txt’ to a text file on the radio USB flash drive root directory.

File - Performance History Log

Action

Action	Option
Save to PC	This saves the Performance History Log file with a filename of 'Perf.tar.gz'. This can then be saved from the Browser popup (example is Windows Internet Explorer 11). The file should be renamed to be able to identify the radio it was saved from. The 'tar.gz' file is normally for sending back to 4RF Limited for analysis but can be opened with widely available archive tools e.g. WinRar or 7-ZIP.



The Performance Log file contains the following files:

- perfQhour.csv

  This file contains the performance data for the radio recorded on a quarter hourly basis. Up to 24 hours of data is stored in this file.

- perfDaily.csv

  This file contains the performance data for the radio recorded on a daily basis. Up to 31 days of data is stored in this file.

- perfUnitQhour.csv

  This file contains the performance data for the RF path of the radio to each remote radio, recorded on a quarter hourly basis. Up to 24 hours of data for each RF path is stored in this file.

- perfUnitDaily.csv

  This file contains the performance data for the RF path of the radio to each remote radio, recorded on a daily basis. Up to 31 days of data for each RF path is stored in this file.

4RF has developed templates for viewing the data from the Performance Log files. These templates include the instructions for importing and graphing the log data.

The Performance History Log Templates are available from the 4RF website http://www.4rf.com/secure (login required) or from 4RF.

File - Configuration Script

Action

Action	Option
Load and Execute	This loads and executes configuration script files. There are sample Master Configuration script files available from the 4RF website http://www.4rf.com/secure. The purpose of these files is to use as templates to create your own configuration scripts. Note: Be careful using this feature as incompatible configurations will change the radios settings and break radio connectivity.

Note: Activating this function will over-write all existing configuration settings in the radio (except for the non-saved settings e.g. security passwords, licence keys etc) without any verification of the command setting in the radio. Precautions should be taken to prevent radio outages with incorrect radio configurations. The following process steps are recommended:

a. Save the current radio configuration to a PC or USB before uploading the new configuration script file

b. Upload the new configuration script file to the radio

c. If for some reason the radio doesn't work as expected, the saved configuration file can be uploaded to the radio (roll back to previous configuration).

Retain IP Address

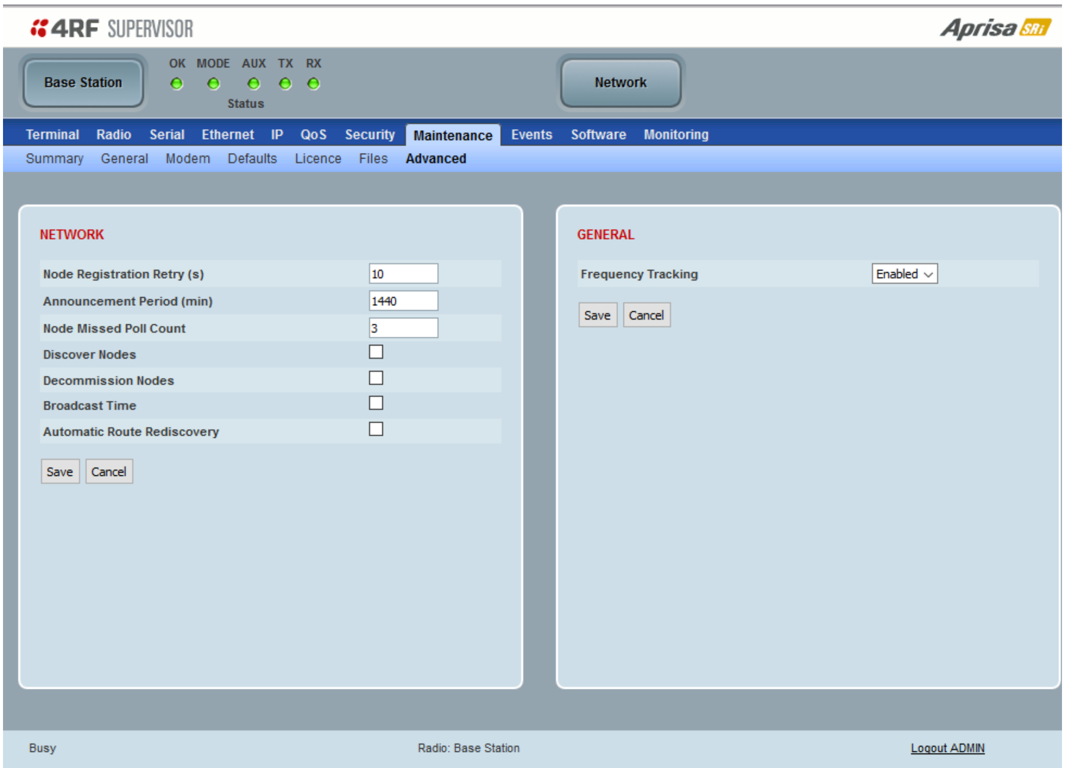
This parameter when enabled ensures that the radio IP address is not changed when the radio configuration settings are restored from a configuration file with a different IP radio address. It prevents the radio losing connectivity when the configuration settings are restored from a configuration file.

Revert Config if Connection Lost

When the Maintenance Files feature is used on remote radios from the base station, this parameter allows the configurations to be restored to the previous configuration if the connection is lost.

This must be set before executing the Configuration Settings / Configuration Script restore functions.

Maintenance > Advanced



NETWORK

Node Registration Retry (sec)

This parameter sets the base station poll time at startup or the remote radio time between retries until registered. The default setting is 10 seconds.

Announcement Period (min)

This parameter displays the period between base station announcement messages. The announcement messages are used to distribute the base station date and time to remote radios. The default setting is 1440 minutes (24 hours).

Setting this parameter to 0 will stop periodic announcement messages being transmitted.

Node Missed Poll Count

This parameter sets the number of times the base station attempts to poll the network at startup or if a duplicate IP is detected when a remote radio is replaced. The default setting is 3.

Discover Nodes

This parameter when activated triggers the base station to poll the network with Node Missed Poll Count and Node Registration Retry values.

Decommission Node(s)

This parameter when activated resets the network registrations to remove the entire network from service.

Note: Take care using this option.

Broadcast Time

This parameter when activated sends the base station Date / Time setting to all the remote radios in the network and sets their Date / Time. This option applies to the base station only.

Automatic Route Rediscovery

This parameter enables the radio to transmit route discovery messages when packets are unacknowledged.

When enabled, unacknowledged unicast packets are converted into uni-broadcast messages and sent through the network. All nodes see the message and populate their routing tables accordingly.

When the destination node is reached, it sends a route response message via the shortest path. The intermediate nodes see this message and populate their routing tables in the reverse direction, thus re-establishing the route.

The default setting is disabled.

Delete Received Channel List – Remote Radios Only

This parameter deletes the existing zone channel list and uses the configured zone channel allocation setup with Zone Setup on page 125 until it re-registers with the base station and receives the new distributed zone channel list.

GENERAL

Frequency Tracking

Frequency Tracking enables the receiver to track any frequency drift in the transmitter to maintain optimum SNR and radio link performance over the full temperature range.

When enabled, remote radios adjust their receive frequency to the frequency of the incoming packet rate and the base station notifies remote radios if their transmit frequency requires adjustment.

The default setting is Enabled.

Events

The Events menu contains the setup and management of the alarms, alarm events and traps.

Events > Alarm Summary

There are two types of events that can be generated on the Aprisa SRi radio. These are:

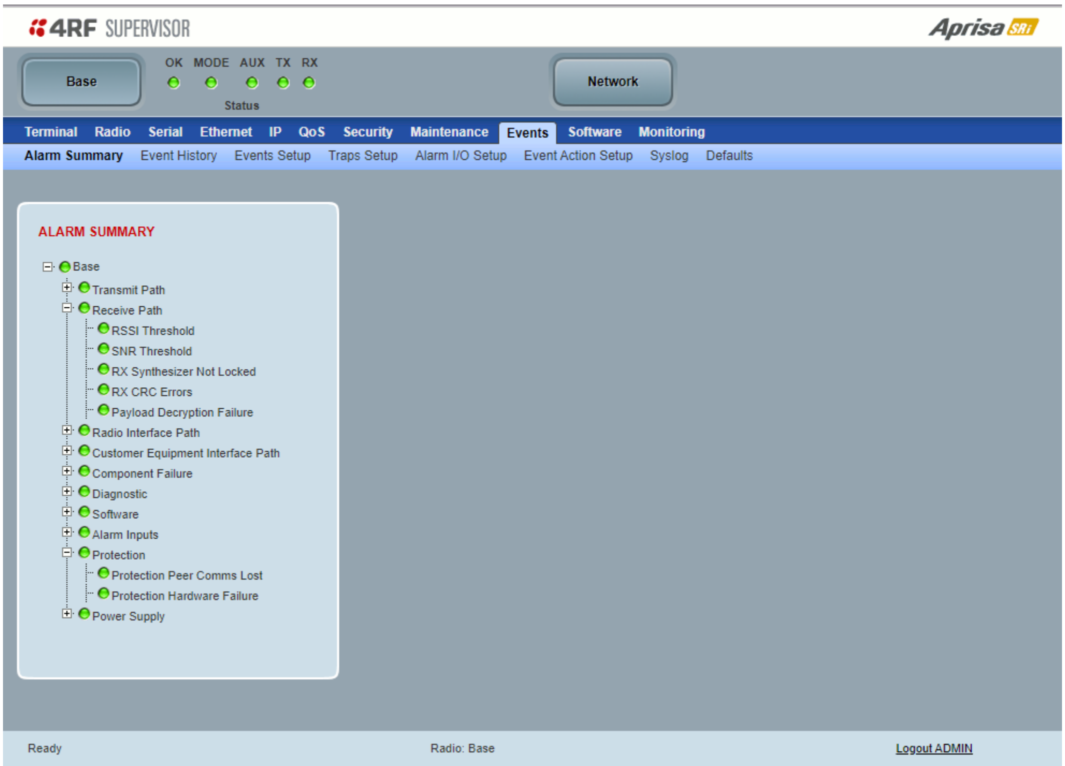
1. Alarm Events

Alarm Events are generated to indicate a problem on the radio.

2. Informational Events

Informational Events are generated to provide information on key activities that are occurring on the radio. These events do not indicate an alarm on the radio and are used to provide information only.

See 'Alarm Types and Sources' on page 402 for a complete list of events.

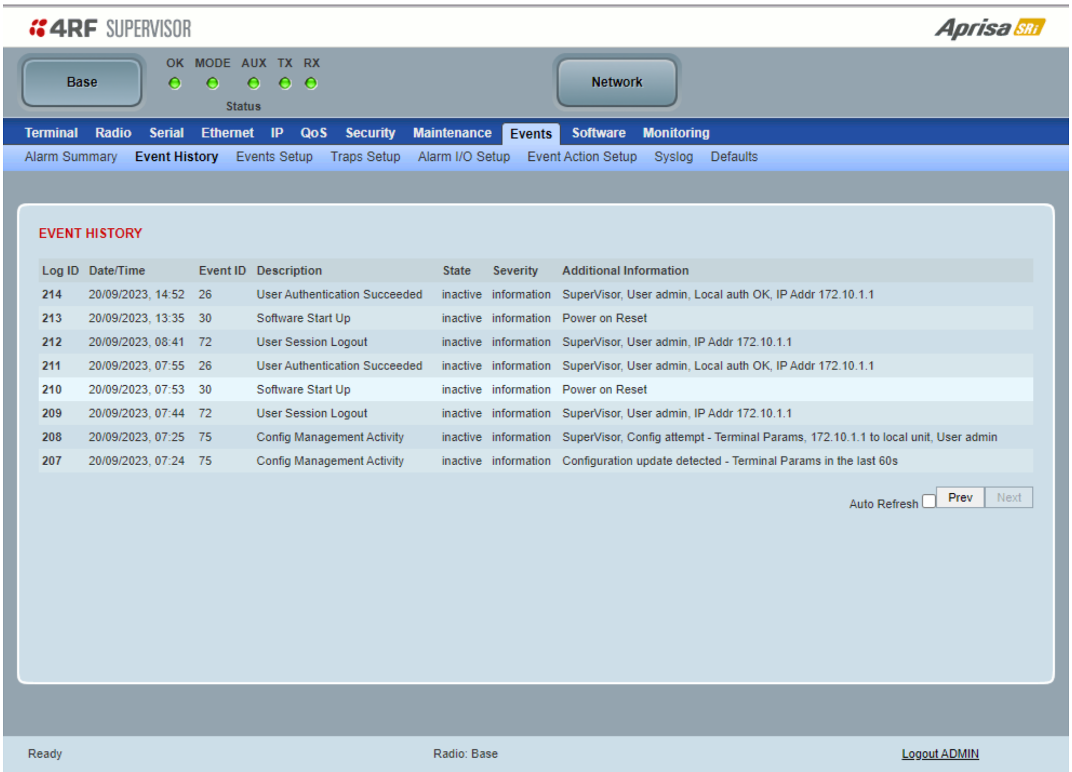


ALARM SUMMARY

The Alarm Summary is a display tree that displays the current states of all radio alarms. The alarm states refresh automatically every 12 seconds.

LED Colour	Severity
Green	No alarm
Orange	Warning alarm
Red	Critical, major or minor alarm

Events > Event History



EVENT HISTORY

The last 1500 events are stored in the radio. The complete event history list can be downloaded to a USB flash drive (see 'File - Event History Log' on page 244).

The Event History can display the last 50 events stored in the radio in blocks of 8 events.

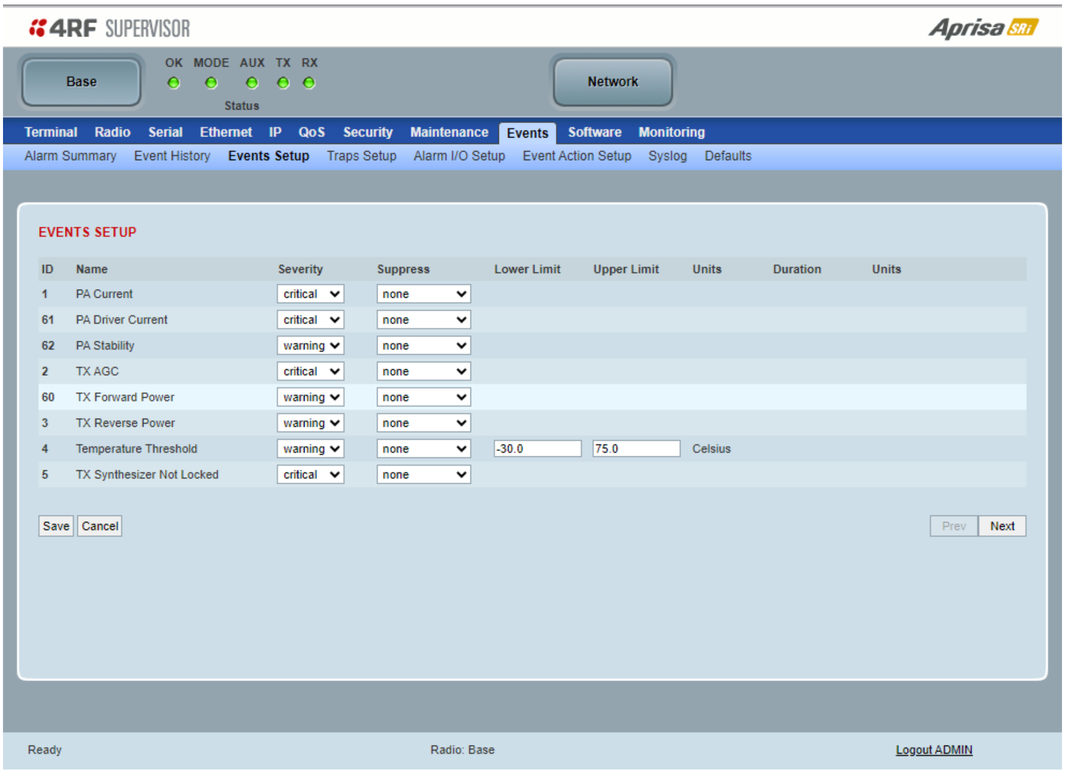
The Next button will display the next page of 8 events and the Prev button will display the previous page of 8 events. Using these buttons will disable Auto Refresh to prevent data refresh and page navigation contention.

The last 50 events stored in the radio are also accessible via an SNMP command.

Auto Refresh

The Event History page selected will refresh automatically every 12 seconds if the Auto Refresh is ticked.

Events > Events Setup



EVENTS SETUP

Alarm event parameters can be configured for all alarm events (see 'Alarm Events' on page 403).

All active alarms for configured alarm events will be displayed on the Monitoring pages (see 'Monitoring' on page 281).

Severity

The Severity parameter sets the alarm severity.

Severity	Function
Critical	The Critical severity level indicates that a service affecting condition has occurred and an immediate corrective action is required. Such a severity can be reported, for example, when a managed object becomes totally out of service and its capability must be restored.
Major	The Major severity level indicates that a service affecting condition has developed and an urgent corrective action is required. Such a severity can be reported, for example, when there is a severe degradation in the capability of the managed object and its full capability must be restored.
Minor	The Minor severity level indicates the existence of a non-service affecting fault condition and that corrective action should be taken in order to prevent a more serious (for example, service affecting) fault. Such a severity can be reported, for example, when the detected alarm condition is not currently degrading the capacity of the managed object.
Warning	The Warning severity level indicates the detection of a potential or impending service affecting fault, before any significant effects have been felt. Action should be taken to further diagnose (if necessary) and correct the problem in order to prevent it from becoming a more serious service affecting fault.
Information	No problem indicated – purely information

Suppress

This parameter determines if the action taken by an alarm.

Option	Function
None	Alarm triggers an event trap and is logged in the radio
Traps	Alarm is logged in the radio but does not trigger an event trap
Traps and Log	Alarm neither triggers an event trap nor is logged in the radio

Lower Limit / Upper Limit

Threshold alarm events have lower and upper limit settings. The alarm is activated if the current reading is outside the limits.

Example: 9 RX CRC Errors

The Upper Limit is set to 0.7 and the Duration is set to 5 seconds.

If in any 5 second period, the total number of errored packets divided by the total number of received packets exceeds 0.7, the alarm will activate.

Units (1)

The Units parameter shows the unit for the Lower Limit and Upper Limit parameters.

Duration

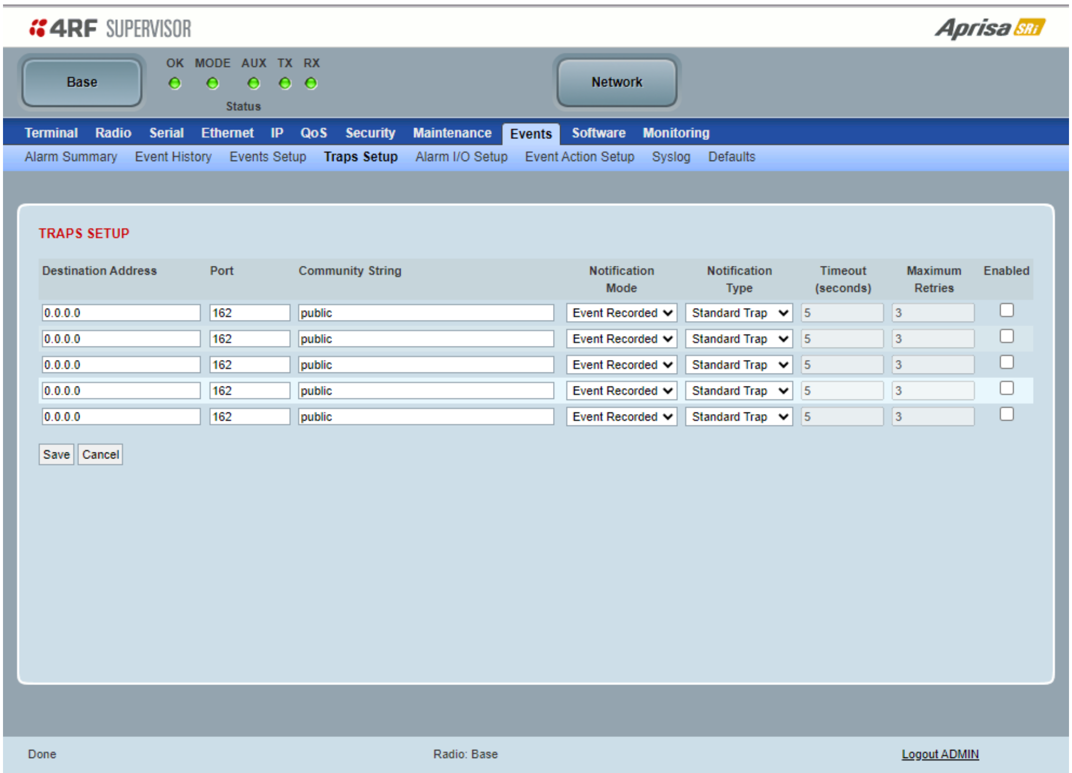
This parameter determines the period to wait before an alarm is raised if no data is received.

Units (2)

This parameter shows the unit for the Duration parameters.

The Next button will display the next page of 8 alarm events and the Prev button will display the previous page of 8 alarm events.

Events > Traps Setup



TRAPS SETUP

All events can generate SNMP traps. The types of traps that are supported are defined in the 'Notification Mode'.

Destination Address

This parameter sets the IP address of the server running the SNMP manager.

Port

This parameter sets the port number the server running the SNMP manager.

Community String

This parameter sets the community string which is sent with the IP address for security. The default community string is 'public'.

Notification Mode

This parameter sets when an event related trap is sent:

Option	Function
None	No event related traps are sent.
Event Recorded	When an event is recorded in the event history log, a trap is sent.
Event Updated	When an event is updated in the event history log, a trap is sent.
All Events	When an event is recorded or updated in the event history log, a trap is sent.

Notification Type

This parameter sets the type of event notification:

Option	Function
Standard Trap	Provides a standard SNMP trap event
Inform Request	Provides a SNMP v2 Inform Request trap event including trap retry and acknowledgement

Notification Type set to Inform Request:

Timeout (second)

This parameter sets the time interval to wait for an acknowledgement before sending another retry.

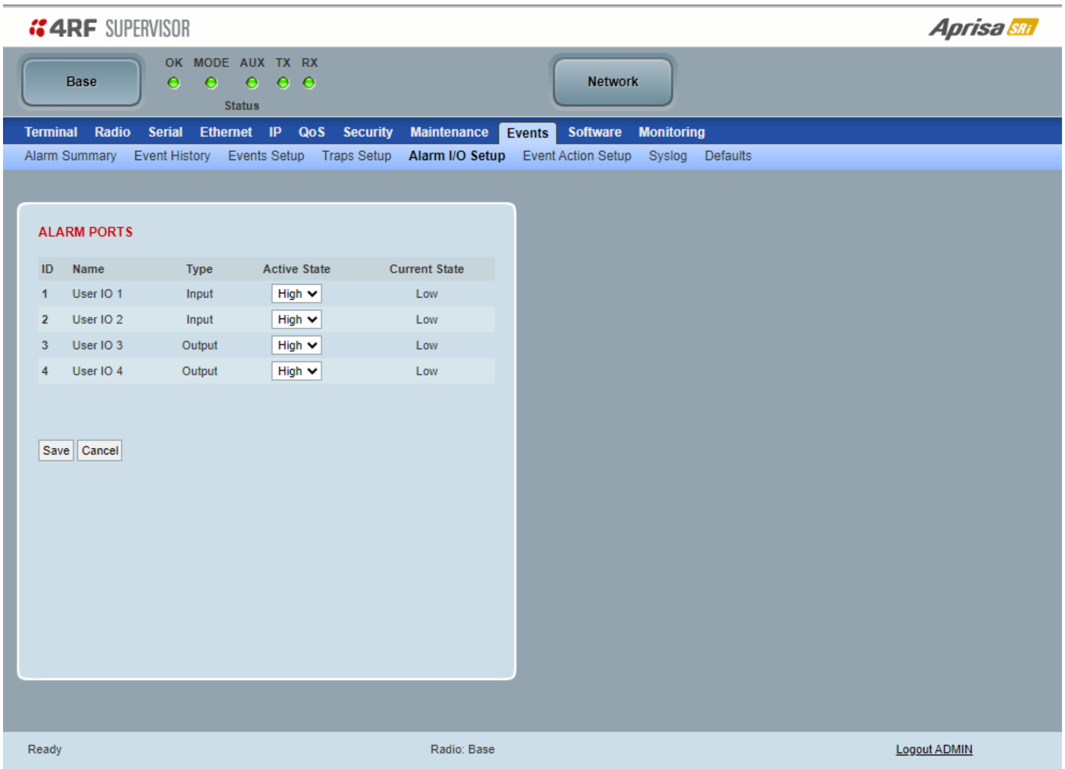
Maximum Retries

This parameter sets the maximum number of retries to send the event without acknowledgement before it gives up.

Enabled

This parameter determines if the entry is used.

Events > Alarm I/O Setup



ALARM PORTS

This page provides control of the two hardware alarm inputs and two hardware alarm outputs provided on the alarm connector.

The alarm inputs are used to transport alarms to the other radios in the network. The alarm outputs are used to receive alarms from other radios in the network.

Name

The alarm IO number.

Type

The Type shows if the alarm is an input or output.

Active State

The Active State parameter sets the alarm state when the alarm is active.

Alarm Input

Option	Function
Low	The alarm is active low i.e. a ground contact on the port will cause an active alarm state
High	The alarm is active high i.e. an open contact on the port will cause an active alarm state

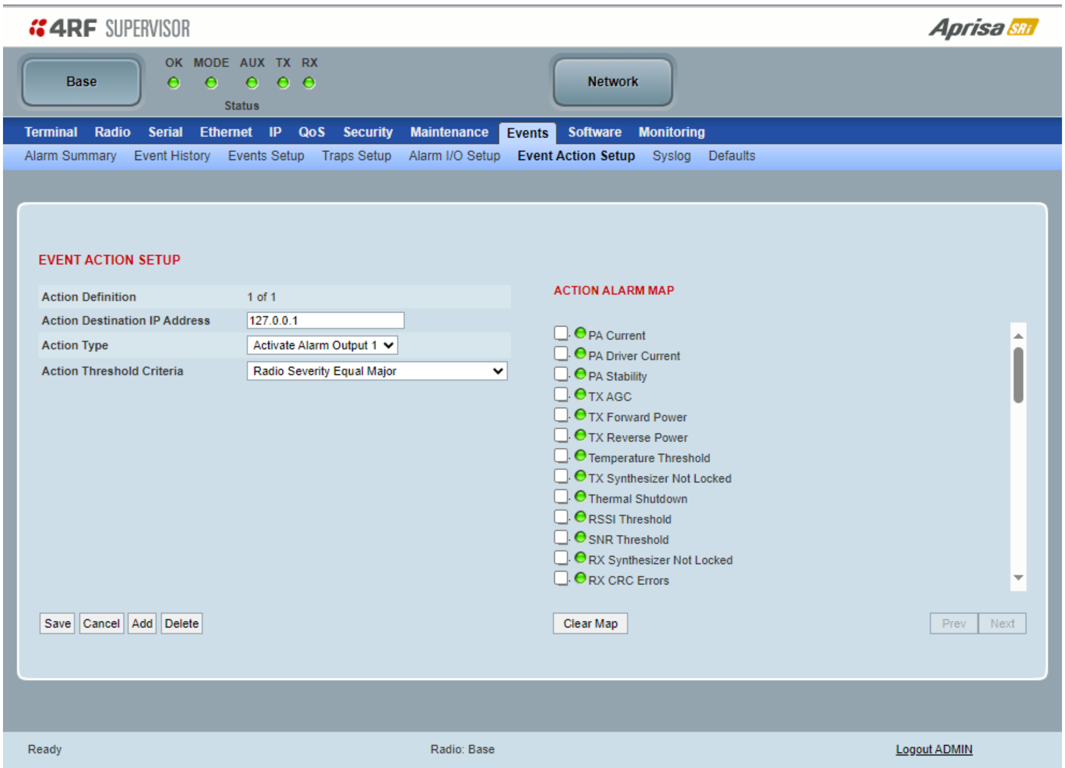
Alarm Output

Option	Function
Low	The alarm is active low i.e. the active alarm state will generate a ground contact output
High	The alarm is active high i.e. the active alarm state will generate a open contact output

Current State

The Current State shows the current state of the alarm.

Events > Event Action Setup



EVENT ACTION SETUP

This page provides control of the mapping of events to specific actions. Specific alarm events can setup to trigger outputs.

Action Definition

This parameter shows the number of the event action setup and the maximum number of setups stored.

Action Destination IP Address

This parameter sets the IP address of the radio that will output the action type.

Action Type

This parameter sets the action type that will be activated on the radio.

Option	Function
None	This action setup does not activate any alarm output
Activate Alarm Output 1	This action setup activates alarm output 1
Activate Alarm Output 2	This action setup activates alarm output 2

Action Threshold Criteria

This parameter sets the radio event that will trigger the action output.

Option	Function
None	No action output.
Radio Severity Equal Critical	Activates the action output when a radio alarm is critical alarm
Radio Severity Equal Major	Activates the action output when a radio alarm is a major alarm
Radio Severity Equal Minor	Activates the action output when a radio alarm is minor alarm
Radio Severity Equal Warning	Activates the action output when a radio alarm is a warning alarm
Radio Severity Equal Cleared	Activates the action output when a radio alarm is cleared
Radio Severity Equal or Worse than Major	Activates the action output when a radio alarm is a major alarm or a critical alarm
Radio Severity Equal or Worse than Minor	Activates the action output when a radio alarm is a minor alarm, a major alarm or a critical alarm
Radio Severity Equal or Worse than Warning	Activates the action output when a radio alarm is a warning, a major alarm, a minor alarm or a critical alarm

Controls

The Save button saves the current event action setup.

The Cancel button cancels the new event action setup.

The Add button adds a new event action setup.

The Delete button deletes the current event action setup.

The Clear Map button clears all alarm selections on the current setup.

To add an event action setup:

1. Click on the Add button.
2. Enter the Action Destination IP Address. This is the IP address of the radio that will output the action type.
3. Select the Action Type from the list.
4. Select the Action Threshold Criteria from the list.
5. Tick the alarms required for the event action setup from the Action Alarm Map. You can clear all alarm selections with the Clear Map button.
6. Click on Save.

Events > Syslog

This menu allows configuring events that are recorded in the History Log, to also be sent to remote servers using the syslog protocol (compliant with RFC 5424 and RFC 5426). Messages from the Aprisa SRi contain a MSG field with. Example message:

<13>1 2020-04-09T01:08:45+00:00 AprisaSRi - 14 5000 - {"logId":"449","timestamp":"2020-04-09T01:08:45+00:00","eventId":"24","auth":"0","eventName":"AlarmInput1","alarmStatus":"active","severity":"Warning","message":"Input 1 is Active"}

The MSG field contains json formatted fields that match the fields seen in the Events-> History Log screen:

logId: Integer identifier

timestamp: The time the event occurred, in RFC3339 format

eventid: Integer identifier of the type of event. Identifiers are defined in the 4RF-EVENT MIB

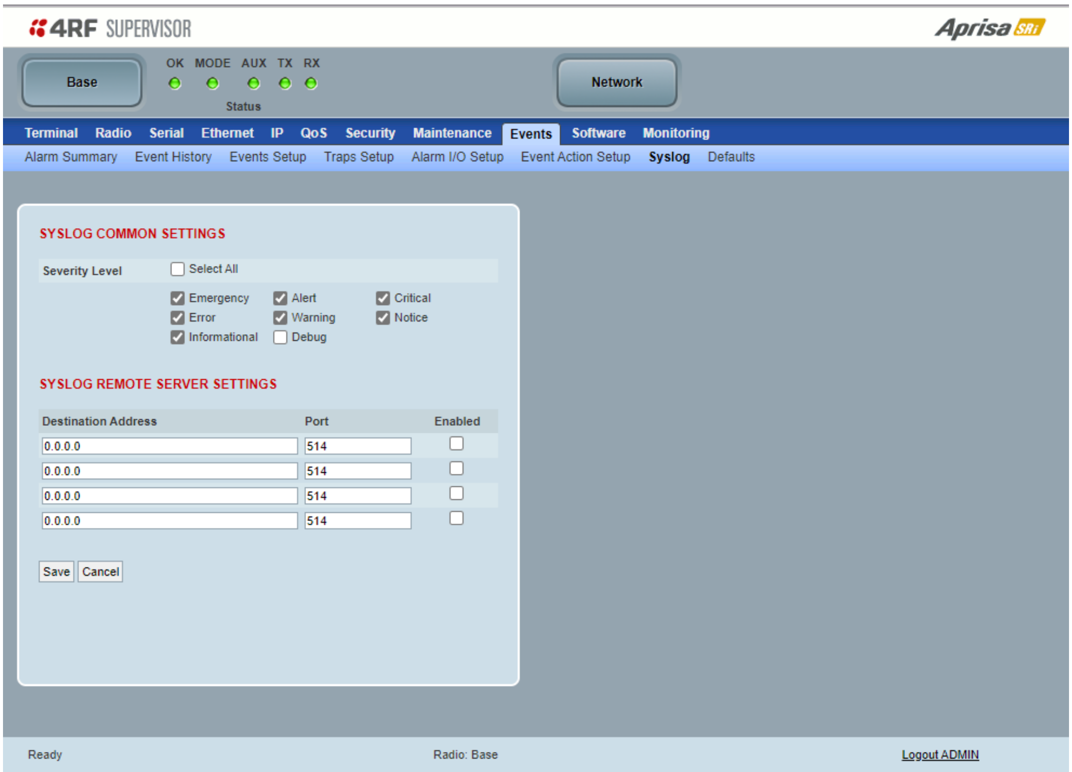
auth: 1 for authorization (login/logout) messages, 0 otherwise

eventName: String name of the event (maps to the eventid)

alarmStatus: State of the alarm (active or inactive)

severity: Can be Information, Warning, Minor, Major, or Cleared

message: Detailed description of the event and what caused it to occur



SYSLOG COMMON SETTINGS

Severity Level

The Severity Level selection options provide filtering of Syslog messages by the eight syslog severity options: Emergency, Alert, Critical, Error, Warning, Notice, Informational and Debug.

SYSLOG REMOTE SERVER SETTINGS

Destination Address

The IP address of the remote syslog server. May be IPv4 or IPv6 address.

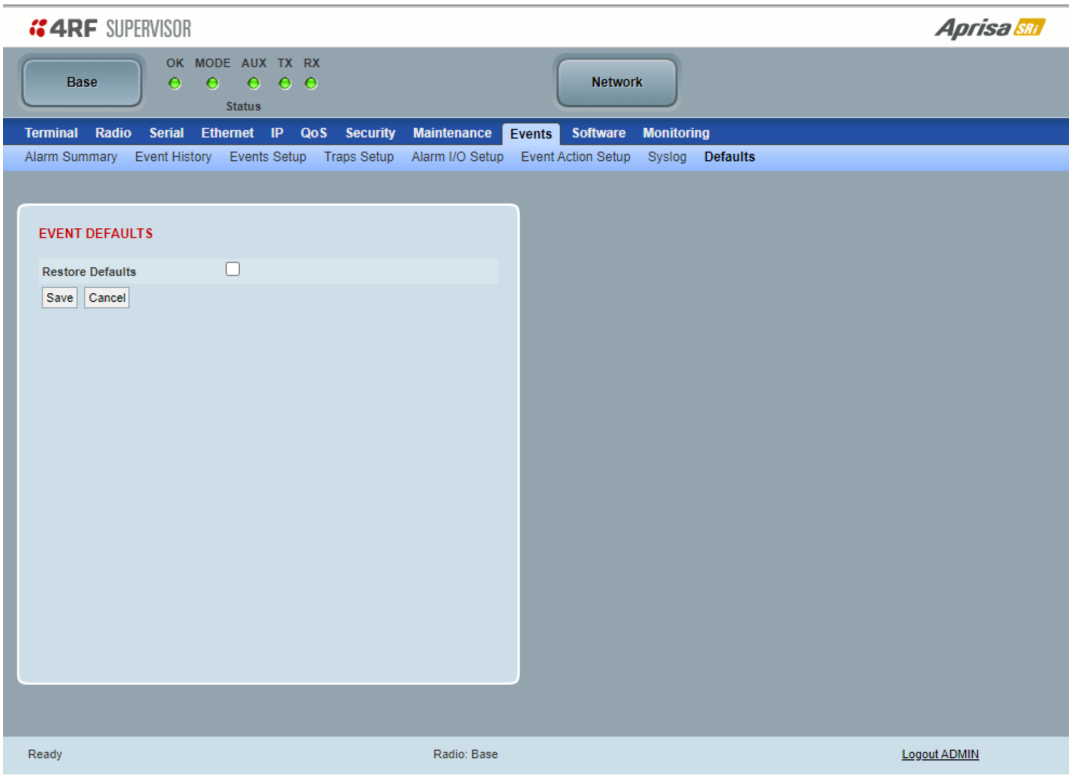
Destination Port

The TCP / UDP port of the remote syslog server. Defaults to 514.

Enabled

Syslog messages are only sent to enabled servers.

Events > Defaults



EVENT DEFAULTS

Restore Defaults

This parameter when activated restores all previously configured event parameters using ‘Events > Events Setup’ to the factory default settings.

Software

The Software menu contains the setup and management of the system software including network software distribution and activation. The distribution of the system software to the remote radios is encrypted by the AES session key over-the-air.

Single Radio Software Upgrade

The radio software can be upgraded on a single Aprisa SRi radio (see 'Single Radio Software Upgrade' on page 397). This process would only be used if the radio was a replacement or a new station in an existing network.

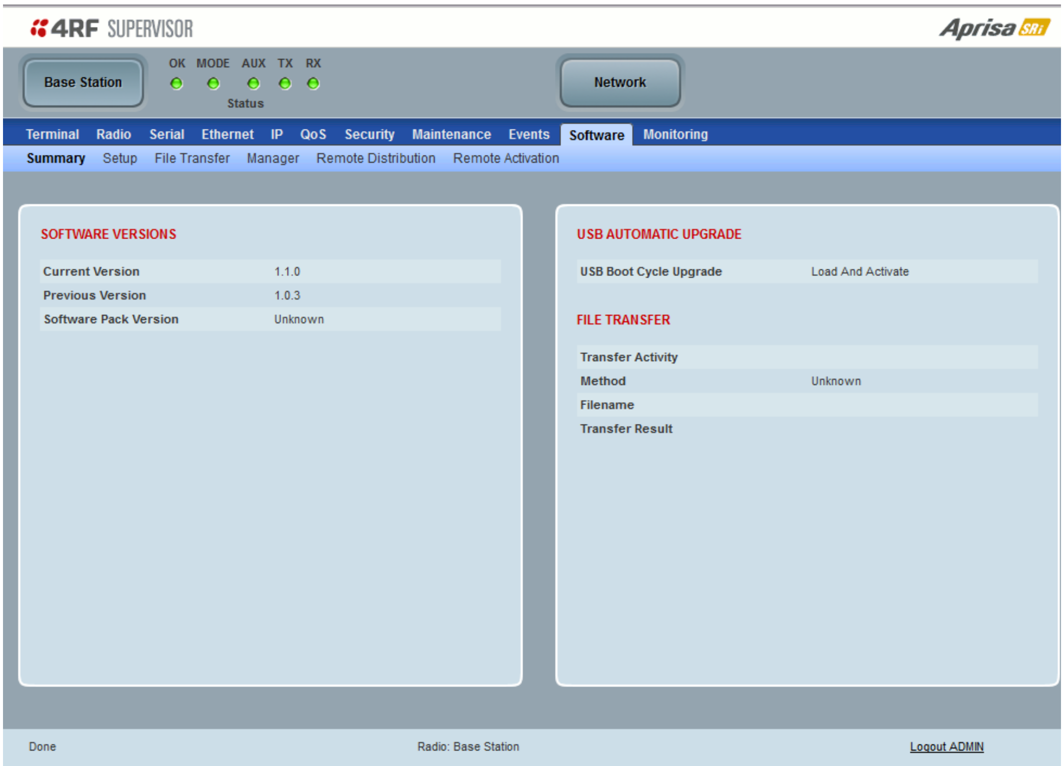
Network Software Upgrade

The radio software can be upgraded on an entire Aprisa SRi radio network remotely over the radio link (see 'Network Software Upgrade' on page 393). This process involves following steps:

1. Transfer the new software to base station with 'Software > File Transfer'
2. Distribute the new software to all remote radios with 'Software > Remote Distribution'
3. Activate of the new software on remote radios with 'Software > Remote Activation'.
4. Finally, activate the new software on the base station radio with 'Software > Manager'. Note: activating the software will reboot the radio.

Software > Summary

This page provides a summary of the software versions installed on the radio, the setup options and the status of the File Transfer.



SOFTWARE VERSIONS

Current Version

This parameter displays the software version running on the radio.

Previous Version

This parameter displays the software version that was running on the radio prior to the current software being activated.

Software Pack Version

On the base station, this parameter displays the software version available for distribution to all radios in the network.

On the all stations, this parameter displays the software version ready for activation.

USB AUTOMATIC UPGRADE

USB Boot Upgrade

This parameter shows the type of USB Boot upgrade defined in 'Software Setup > USB Boot Upgrade' on page 265.

FILE TRANSFER

Transfer Activity

This parameter shows the status of the transfer, ‘Idle’, ‘In Progress’ or ‘Completed’.

Method

This parameter shows the file transfer method. When the software distribution is in progress, this parameter will change to ‘Over the Air’ (from xx.xx.xx.xx) to show that the interface is busy and the transfer is in progress.

File

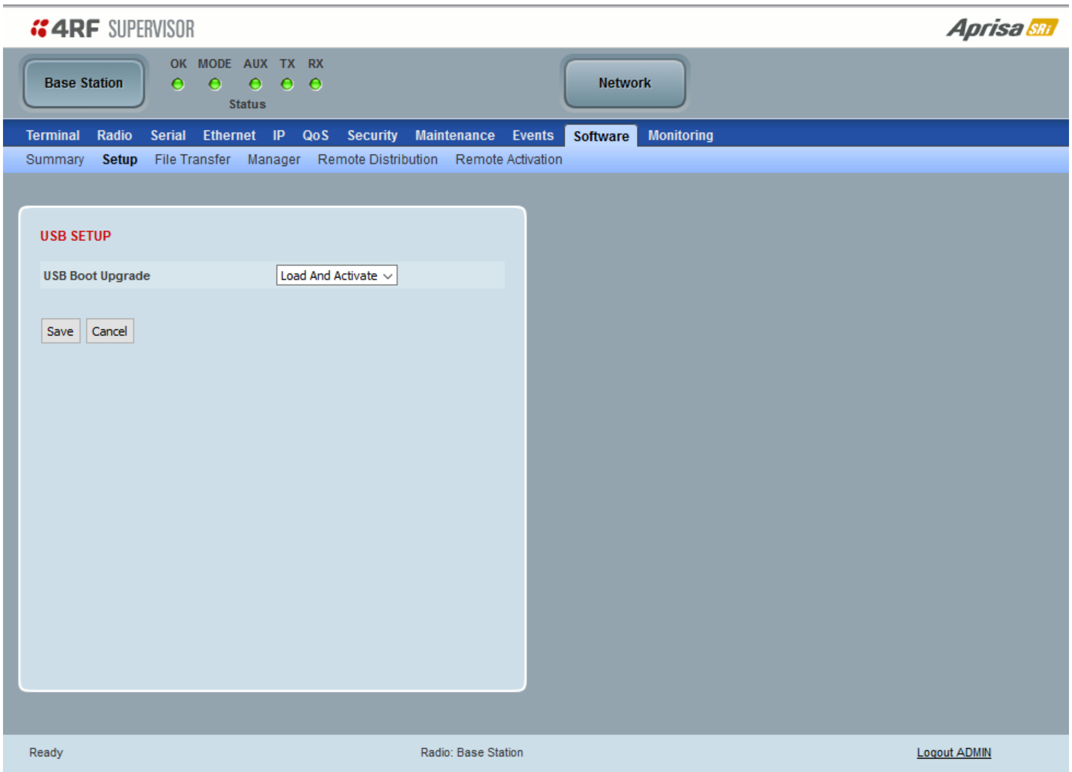
This parameter shows the software file source.

Transfer Result

This parameter shows the progress of the transfer.

Software > Setup

This page provides the setup of the USB flash drive containing a Software Pack.



USB SETUP

USB Boot Upgrade

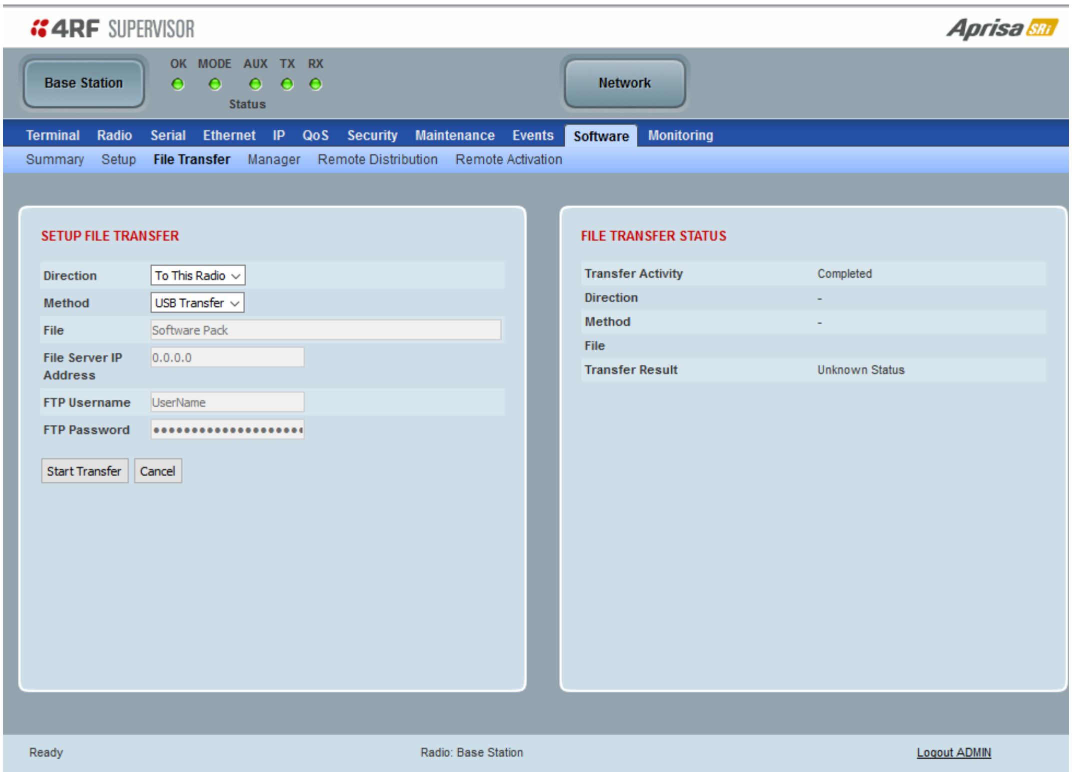
This parameter determines the action taken when the radio power cycles and finds a USB flash drive in the Host port. The default setting is ‘Load Only’.

Option	Function
Load and Activate	New software will be uploaded from a USB flash drive in to the Aprisa SRi when the radio is power cycled and activated automatically.
Load Only	New software will be uploaded from a USB flash drive in to the Aprisa SRi when the radio is power cycled. The software will need to be manually activated (see ‘Software > Manager’ on page 270).
Disabled	Software will not be uploaded from a USB flash drive into the Aprisa SRi when the radio is power cycled.

Note: This parameter must be set to ‘Disabled’ if the ‘File Transfer and Activate’ method of upgrade is used. This ‘Disabled’ setting prevents the radio from attempting another software upload when the radio boots (which it does automatically after activation).

Software > File Transfer

This page provides the mechanism to transfer new software from a file source into the radio.



SETUP FILE TRANSFER

Direction

This parameter sets the direction of file transfer. In this software version, the only choice is 'To the Radio'.

Method

This parameter sets the method of file transfer.

Option	Function
USB Transfer	Transfers the software from the USB flash drive to the radio.
FTP	Transfers the software from an FTP server to the radio.
HTTP / HTTPS	Transfers the software directly from a PC software pack file to the radio.

File

This parameter shows the software file source.

FTP Username

This parameter sets the Username to access the FTP server.

FTP Password

This parameter sets the Password to access the FTP server.

FILE TRANSFER STATUS

Transfer Activity

This parameter shows the status of the transfer, ‘Idle’, ‘In Progress’ or ‘Completed’.

Direction

This parameter shows the direction of file transfer. In this software version, the only choice is ‘To The Radio’.

Method

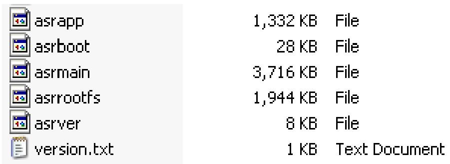
This parameter shows the file transfer method.

File

This parameter shows the software file source.

Transfer Result

This parameter shows the progress of the transfer:

Transfer Result	Function
Starting Transfer	The transfer has started but no data has transferred.
In Progress (x %)	The transfer has started and has transferred x % of the data.
Successful	The transfer has finished successfully.
File Error	The transfer has failed. Possible causes of failure are: • Is the source file available e.g. USB flash drive plugged in • Does the file source contain the Aprisa SRi software release files; 

To transfer software into the Aprisa SRi radio:

USB Transfer Method

1. Unzip the software release files into the root directory of a USB flash drive.
2. Insert the USB flash drive into the host port .
3. Click on 'Start Transfer'.

FILE TRANSFER STATUS	
Transfer Activity	In Progress
Direction	To This Radio
Method	USB Transfer
File	Software Pack
Transfer Result	In Progress (30%)

4. When the transfer is completed, remove the USB flash drive from the host port. If the SuperVisor 'USB Boot Upgrade' setting is set to 'Disabled' (see 'USB Boot Upgrade' on page 265), the USB flash drive doesn't need to be removed as the radio won't try to load from it.

Go to Supervisor > Software > Manager and activate the Software Pack (see 'Software > Manager' on page 270). The radio will reboot automatically.

If the file transfer fails, check the Event History page (see 'Events > Event History' on page 250) for more details of the transfer.

Note: Some brands of USB flash drives may not work with 4RF radios.

FTP Method

1. Unzip the software release files into a temporary directory.
2. Open the FTP server and point it to the temporary directory.
3. Enter the FTP server IP address, Username and password into SuperVisor.
4. Click on 'Start Transfer'.

FILE TRANSFER STATUS	
Transfer Activity	In Progress
Direction	To This Radio
Method	FTP (172.17.10.11)
File	Software Pack
Transfer Result	In Progress (1%)

Go to Supervisor > Software > Manager and activate the Software Pack (see 'Software > Manager' on page 270). The radio will reboot automatically.

If the file transfer fails, check the Event History page (see 'Events > Event History' on page 250) for more details of the transfer.

HTTP / HTTPS Method

1. Unzip the software release files into a temporary directory.
2. Click on ‘Start Transfer’.
3. Browse to the *.swpack file in the temporary directory and open the file.

FILE TRANSFER STATUS

Transfer Activity	In Progress
Direction	To This Radio
Method	HTTPS
File	Software Pack
Transfer Result	In Progress (5%)

Go to Supervisor > Software > Manager and activate the Software Pack (see ‘Software > Manager’ on page 270). The radio will reboot automatically.

If the file transfer fails, check the Event History page (see ‘Events > Event History’ on page 250) for more details of the transfer.

Transfer Result

This parameter shows the progress of the transfer:

Transfer Result	Function
Starting Transfer	The transfer has started but no data has transferred.
In Progress (x %)	The transfer has started and has transferred x % of the data.
Successful	The transfer has finished successfully.
File Error	The transfer has failed.
Completing Transfer	The data has fully transferred (100%) to the radio but file validation is in progress.

Note: To check that the Aprisa SRi software upgrade file (.swpack) is valid, obtain the checksum (sha1) file for that software release contained in the Software Release zip file on the 4RF website https://www.4rf.com/secure.

On windows open a command prompt and type ‘certutil -hashfile <updatefile>.swpack SHA1’. Next open the sha1 file in a text editor such as notepad and confirm the hashes match.

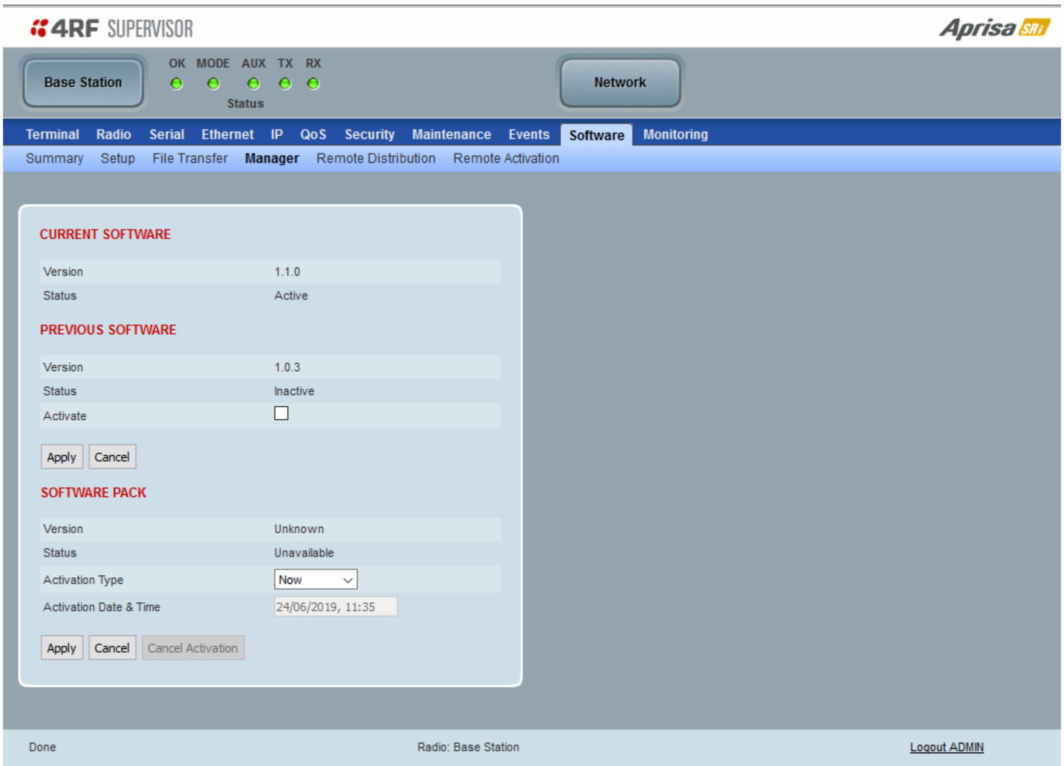
On linux type ‘sha1sum -c <updatefile>.sha1’ and check that the output contains ‘OK’.

Software > Manager

This page summarises and manages the software versions available in the radio.

The manager is predominantly used to activate new software on single radios. Network activation is performed with 'Software > Remote Activation'.

Both the previous software (if available) and Software Pack versions can be activated on the radio from this page.



CURRENT SOFTWARE

Version

This parameter displays the software version running on the radio.

Status

This parameter displays the status of the software version running on the radio (always active).

PREVIOUS SOFTWARE

Version

This parameter displays the software version that was running on the radio prior to the current software being activated.

Status

This parameter displays the status of the software version that was running on the radio prior to the current software being activated.

Option	Function
Active	The software is operating the radio.
Inactive	The software is not operating the radio but could be re-activated if required.

Activate

This parameter activates the previous software version (restores to previous version).

The Aprisa SRi will automatically reboot after activation.

SOFTWARE PACK

Version

This parameter displays the software pack version available for distribution on base station and activate on all stations.

Status

This parameter displays the status of the software pack version.

Option	Function
Available	On the base station, the software pack is available for distribution. On all stations, the software pack is available for activation.
Activating	The software pack is activating in the radio.
Unavailable	There is no software pack loaded into the radio.

Activate

This parameter activates the software pack.

The Aprisa SRi will automatically reboot after activation.

Activation Type

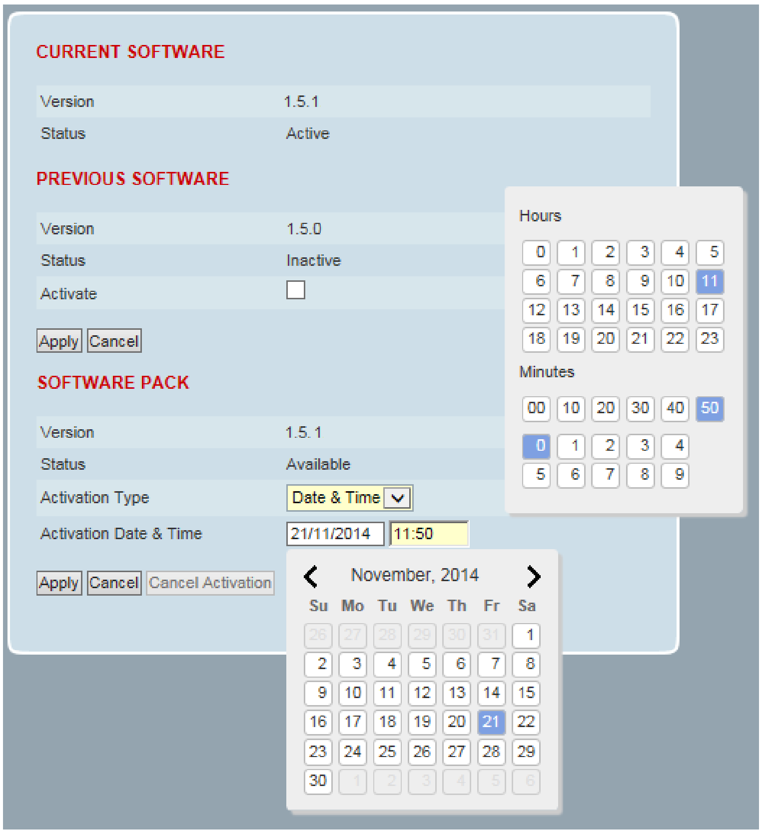
This parameter sets when the software pack activation will occur.

Option	Function
Now	Activates the software pack now.
Date & Time	Activates the software pack at the Date & Time set in the following parameter.

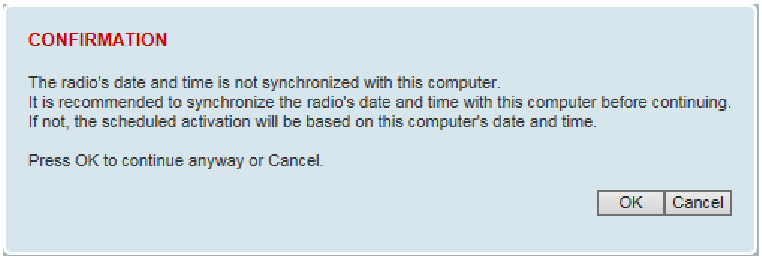
Activation Date & Time

This parameter sets the Date & Time when the software pack activation will occur.

This setting can be any future date and 24 hour time.



If the network base station radio date / time is not synchronized, you will get the following popup:



You can manually enter the base station radio date / time or use the Date And Time Synchronization from a SNTP server feature (see ‘Terminal > Date / Time’ on page 104).

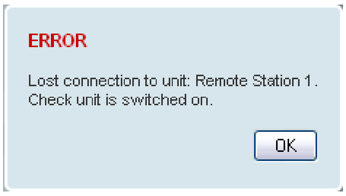
To activate a software version:

1. Tick the software version required to be activated (previous software or software pack).
2. Click ‘Apply’.

The page will display a Status of ‘Activating’.

Once started, activation cannot be cancelled.

When the activation is completed, the radio will reboot. This will cause the current SuperVisor session to expire.



3. Login to SuperVisor to check the result.

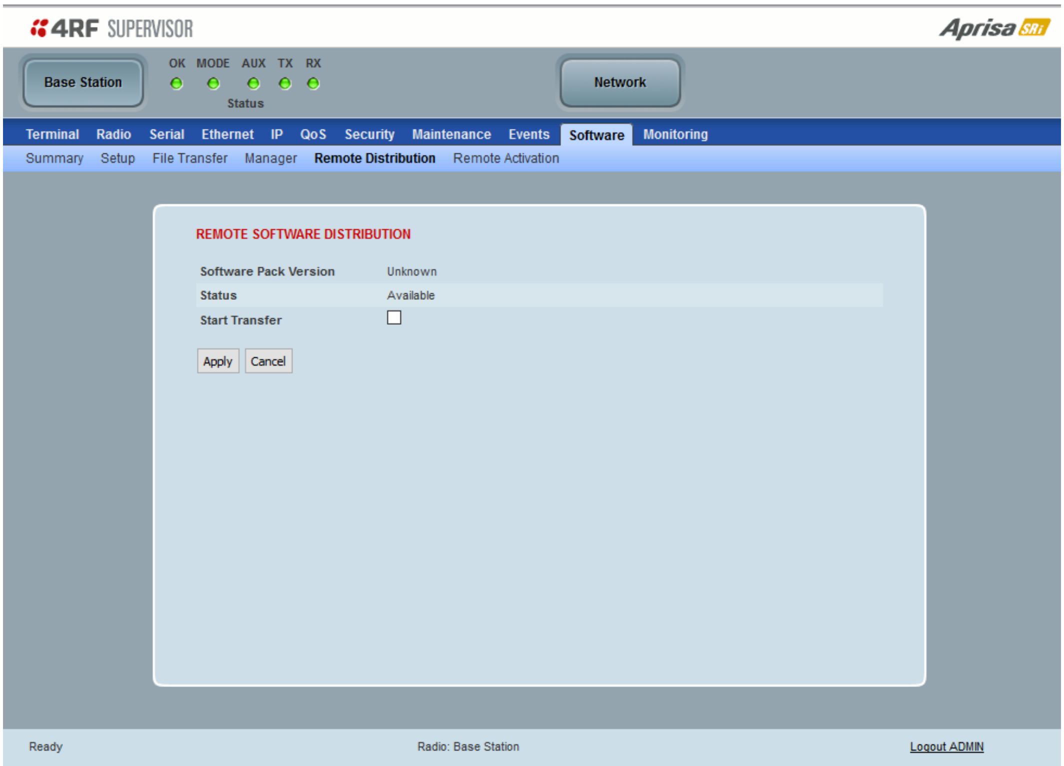
Software > Remote Distribution

This page provides the mechanism to distribute software to all remote radios into the Aprisa SRi network (network) and then activate it.

The Software Pack that was loaded into the base station with the file transfer process (see 'Software > File Transfer' on page 266) can be distributed via the radio link to all remote radios.

This page is used to manage the distribution of that software pack to all remote radios on the network.

This page is only available when the radio is configured as a Base Station.



REMOTE SOFTWARE DISTRIBUTION

Software Pack Version

This parameter displays the software pack version available for distribution on base station and activate on all stations.

Status

This parameter displays the status of the software pack version.

If a Software Pack is not available, the status will display 'Unavailable' and the software distribution mechanism will not work.

Start Transfer

This parameter when activated, distributes (broadcasts) the new Software Pack to all remote radios in the network.

Note: The distribution of software to remote radios does not stop customer traffic from being transferred. However, due to the volume of traffic, the software distribution process may affect customer traffic.

The impact of software distribution traffic upon customer traffic is controlled by two settings. The traffic uses the 'Default Management Data Priority' QoS setting, and the rate of packets at this priority is controlled with the 'Background Bulk Data Transfer Rate' setting in Radio > Channel Setup.

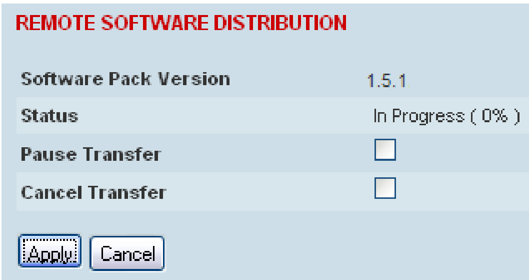
To distribute software to remote radios:

This process assumes that a Software Pack has been loaded into the base station with the file transfer process (see 'Software > File Transfer' on page 266).

1. Distribution is performed only to the radios listed in the Network Table and powered on. If a radio is listed in the network table, but cannot be contacted, it will slow down the distribution of software.

   To ensure that the Network Table is up to date, it is recommended running the node discover function (see 'Discover Nodes' on page 247).

2. Click on 'Start Transfer'.



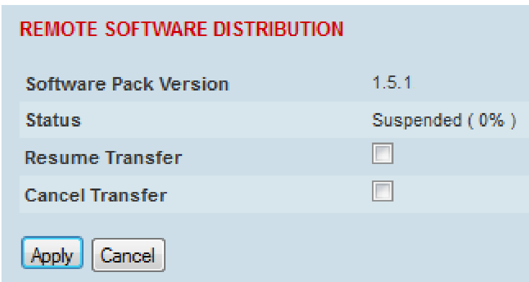
Note: This process could take anywhere between 40 minutes and several hours depending on channel size, Ethernet Management Priority setting and the amount of customer traffic on the network.

---

3. When the distribution is completed, activate the software with the Remote Software Activation.

Pause Transfer

This parameter, when activated, pauses the distribution process and shows the distribution status. The distribution process will continue from where it was paused with Resume Transfer.



Cancel Transfer

This parameter, when activated, cancels the distribution process immediately.

During the distribution process, it is possible to navigate away from this page and come back to it to check progress. The SuperVisor session will not timeout.

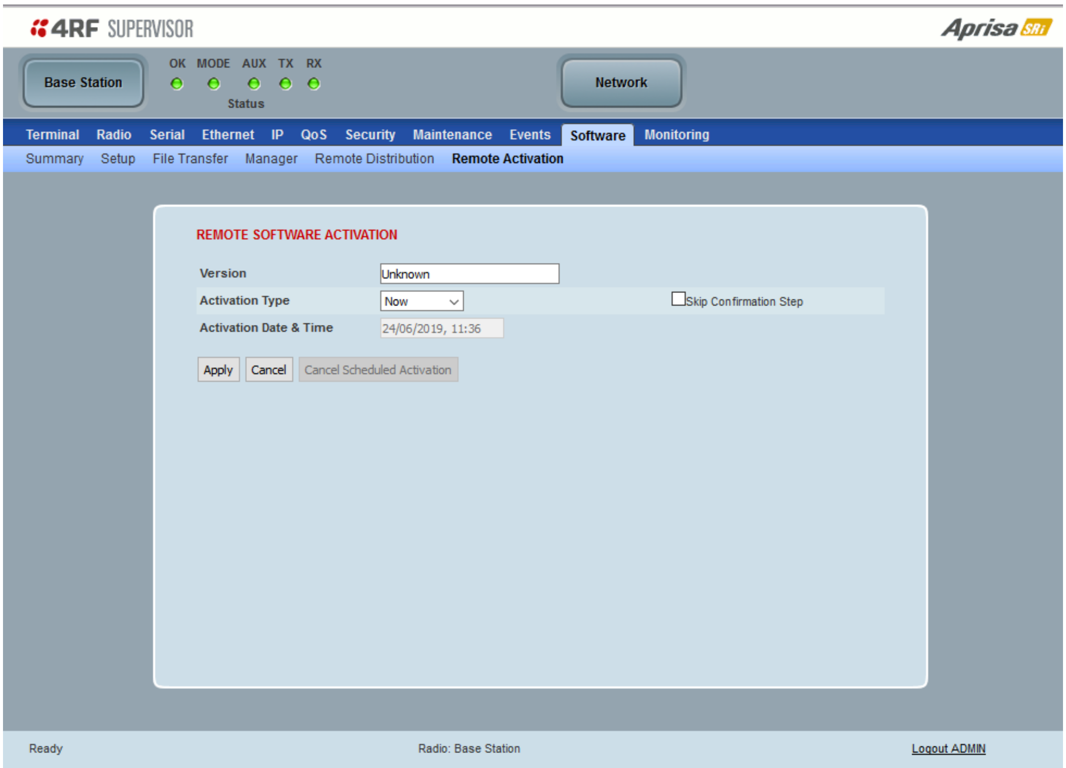
Software > Remote Activation

This page provides the mechanism to activate software on all remote radios.

The Software Pack was loaded into the base station with the file transfer process (see 'Software > File Transfer' on page 266) and was distributed via the radio link to all remote radios.

This page is used to manage the activation of that software pack on all remote radios on the network.

This page is only available when the radio is configured as a Base Station.



REMOTE SOFTWARE ACTIVATION

When the software pack version has been distributed to all the remote radios, the software is then activated in all the remote radios with this command. If successful, then activate the software pack in the base station to complete the network upgrade.

Version

This parameter displays the software version for activation. The default version is the software pack version but any valid software version can be entered in the format 'n.n.n'.

Activation Type

This parameter sets when the software pack activation will occur.

Option	Function
Now	Activates the software pack now.
Date & Time	Activates the software pack at the Date & Time set in the following parameter.

Activation Date & Time

This parameter sets the Date & Time when the software pack activation will occur.

This setting can be any future date and 24 hour time.

Skip Confirmation Step

This parameter when enabled skips the confirmation step during the activation process.

Normally, the confirmation step will require use intervention to accept the confirmation which will halt the activation process. Skipping the confirmation will enable the activation process to continue without use intervention.

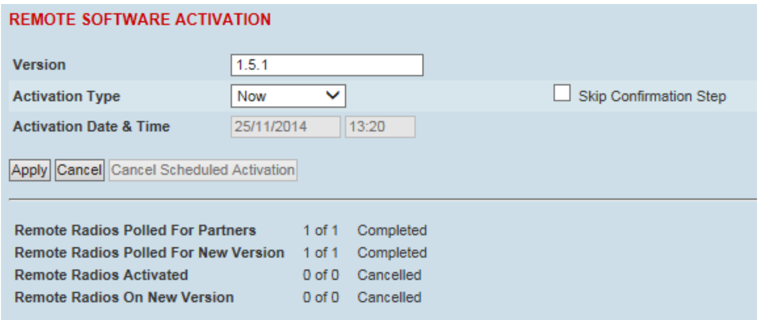
To activate software in remote radios:

This process assumes that a Software Pack has been loaded into the base station with the file transfer process (see 'Software > File Transfer' on page 266) and distributed to all remote radios in the network.

Note: Do not navigate SuperVisor away from this page during the activation process (SuperVisor can lose PC focus).

---

1. Enter the Software Pack version (if different from displayed version).

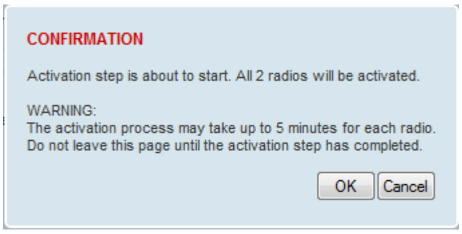


2. Select the Activation type.
3. Click Apply.

The remote radios will be polled to determine which radios require activation:

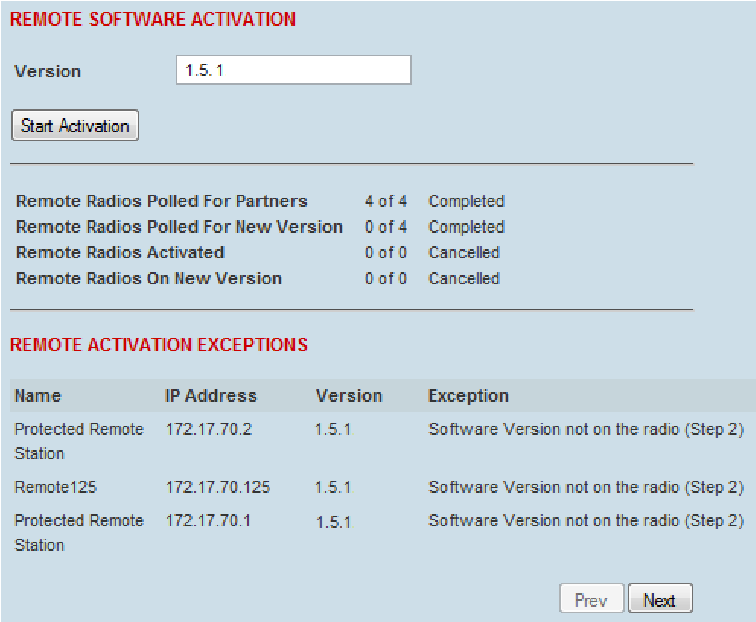
Result	Function (X of Y)
Remote Radios Polled for New Version	X is the number of radios polled to determine the number of radios that contain the new software version. Y is the number of remote radios registered with the base station.
Remote Radios Activated	X is the number of radios that contain the new software version and have been activated. Y is the number of radios that contain the new software version and can be activated.
Remote Radios On New Version	X is the number of radios that has been successfully activated and now running the new version of software. Y is the number of radios that the activation command was executed on. **Note:** When upgrading from software version 1.2.5 to 1.2.6 or later, communication to all remote radios will be lost due to a MAC protocol change. This will prevent this function from working correctly. In this case, activate the new software on the base station and run the Discover Nodes function on 'Maintenance > Advanced' page 247.

When the activation is ready to start:



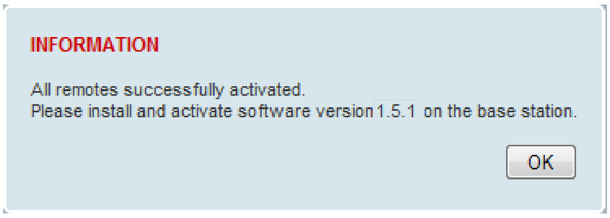
4. Click on 'OK' to start the activation process or Cancel to quit.

The page will display the progress of the activation.



The example shows that during the activation process there were exceptions that may need to be investigated.

When all the remote radios have been activated, the base station radio must now be activated with (see ‘Software > Manager’ on page 270).



4. Click on ‘OK’ to start the activation on the base station.

Activation Type

This parameter sets when the remote software activation will occur.

Option	Function
Now	Activates the remote software now.
Date & Time	Activates the remote software at the Date & Time set in the following parameter.

Skip Confirmation Step

This parameter when enabled skips the confirmation step during the activation process.

Normally, the confirmation step will require use intervention to accept the confirmation which will halt the activation process. Skipping the confirmation will enable the activation process to continue without use intervention.

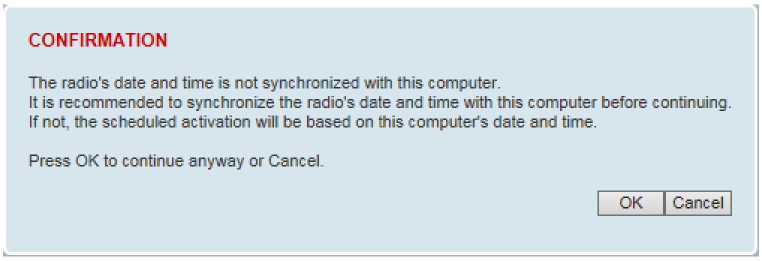
Activation Date & Time

This parameter sets the Date & Time when the remote software activation will occur.

This setting can be any future date and 24 hour time.

When the date and time is set, the remotes will be polled to setup the scheduled activation date and time.

If the network base station radio date / time is not synchronized, you will get the following popup:



You can manually enter the base station radio date / time or use the Date And Time Synchronization from a SNTP server feature (see 'Terminal > Date / Time' on page 104).

Monitoring

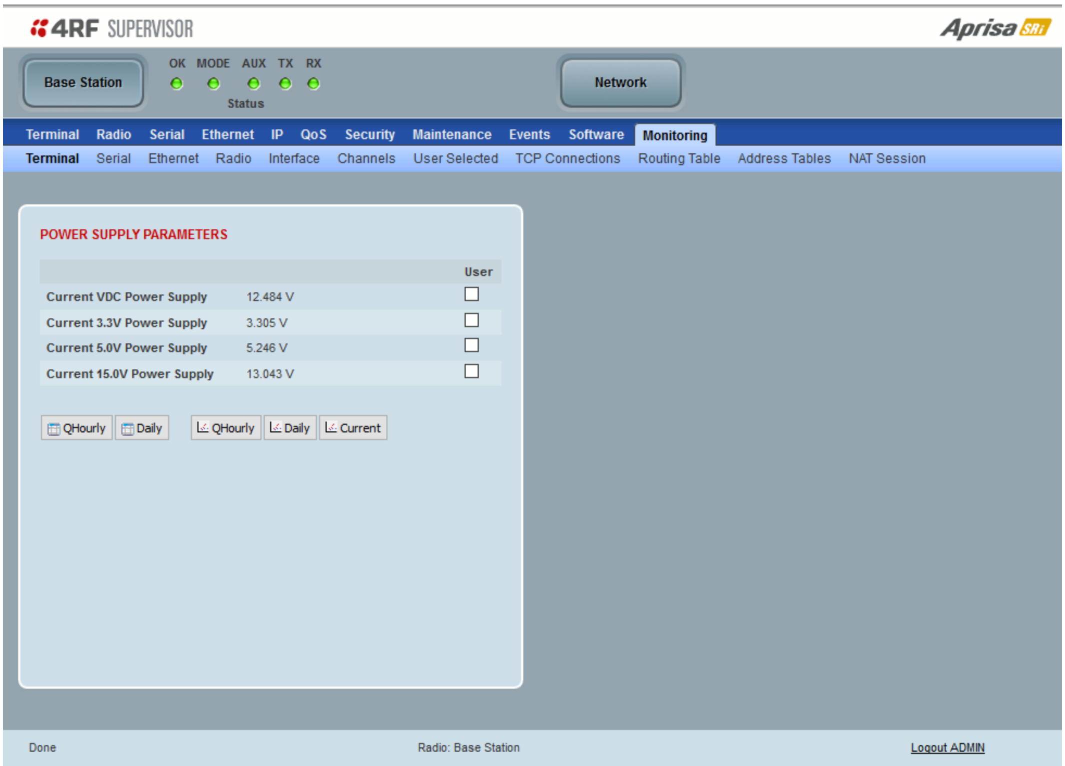
The Terminal, Serial, Ethernet, Radio and User Selected Monitored Parameter results have history log views for both Quarter Hourly and Daily.

Monitored parameter data is accumulated into 2 sets:

- 15 minutes of data, for 96 readings for the last 24 hours
- 24 hours of data, for 31 readings for the last 31 days.

Monitoring > Terminal

This page displays the current radio internal and external input source radio power supply voltage diagnostic parameters.

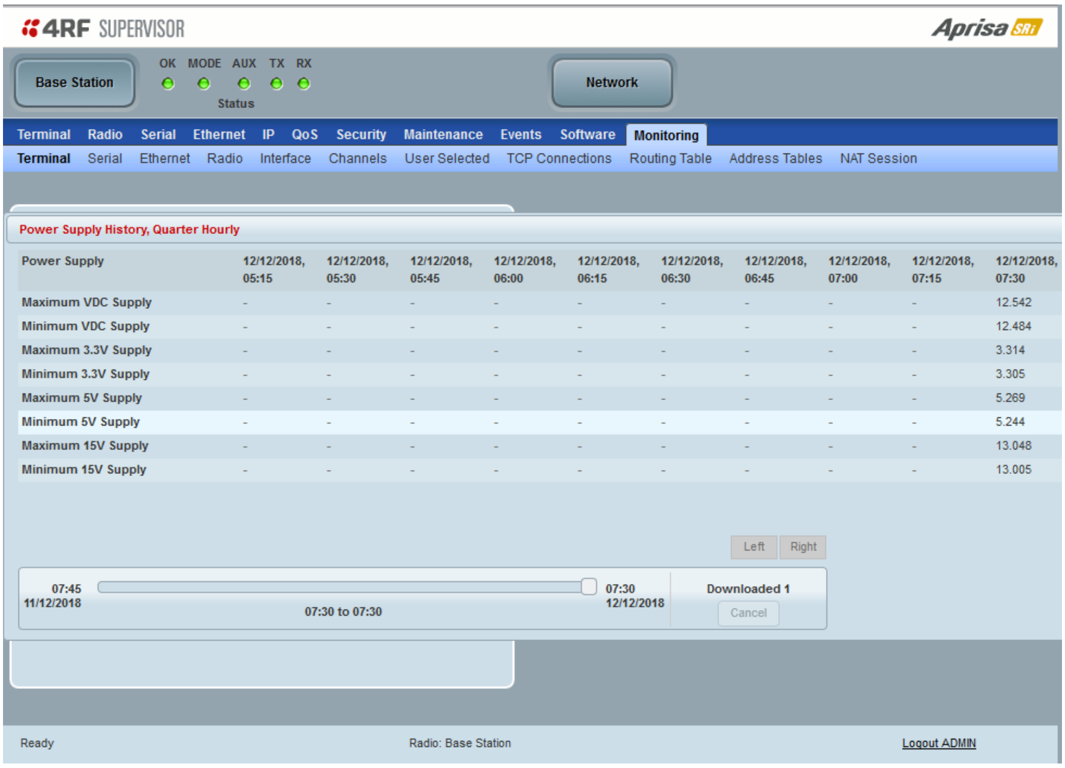


POWER SUPPLY PARAMETERS

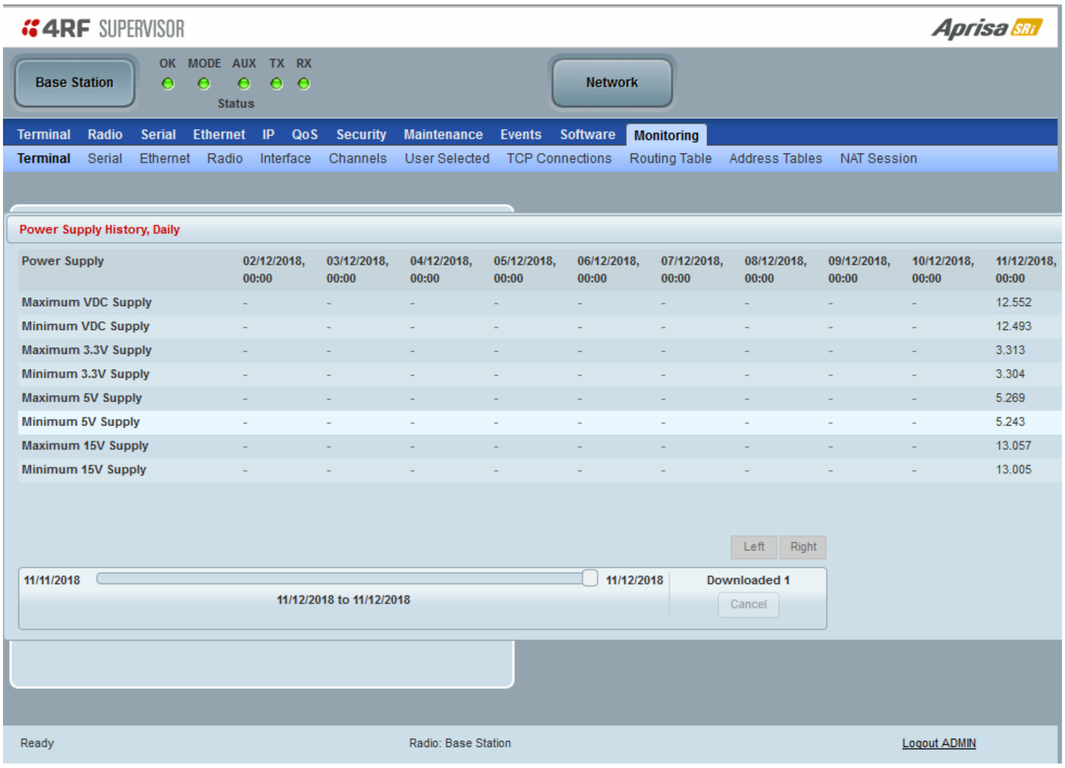
Monitored Parameter	Function	Normal Operating Limits
Current VDC Power Supply	Parameter to show the current power supply input voltage	10 to 30 VDC
Current 3.3 Volts Power Supply	Parameter to show the current 3.3 volt power rail voltage	3.1 to 3.5 VDC
Current 5.0 Volts Power Supply	Parameter to show the current that the current 5.0 volt power rail voltage	4.7 to 5.5 VDC
Current 7.2 Volts Power Supply	Parameter to show the current that the current 7.2 volt power rail voltage	6.9 to 7.5 VDC
Current 15 Volts Power Supply	Parameter to show the current that the current 15 volt power rail voltage. The 15 volt power supply is used to power the transmitter driver and power amplifier.	12.7 to 13.5 VDC

Controls

The History Quarter Hourly button presents a log of results every quarter of an hour.



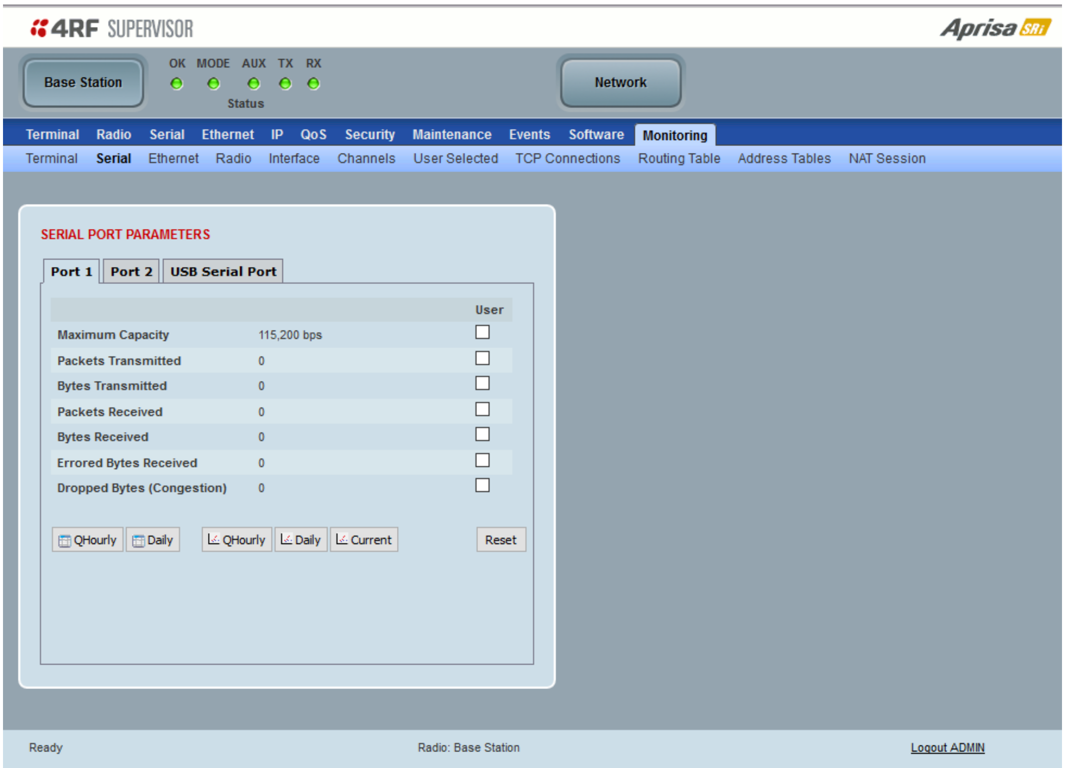
The History Daily button presents a log of results every day.



Monitoring > Serial

This page displays the current radio performance monitoring parameters per serial port in packet and byte level granularity, for serial port high level statistics and troubleshooting.

The results shown are since the page was opened and are updated automatically every 12 seconds.



SERIAL PORT PARAMETERS

All Serial Ports

Monitored Parameter	Function	Normal Operating Limits
Maximum Capacity	Parameter to show the maximum serial data rate of the serial port	Equal to the serial port baud rate setting
Packets Transmitted	Parameter to show the number of packets transmitted to the customer from the serial port	
Packets Received	Parameter to show the number of packets received from the customer into the serial port	
Bytes Received	Parameter to show the number of bytes received from the customer into the serial port	
Errored Bytes Received	Parameter to show the number of bytes received from the customer into the serial port that have errors	
Dropped Bytes (Congestion)	Parameter to show the number of bytes received from the customer into the serial port that are dropped due to over the air congestion	

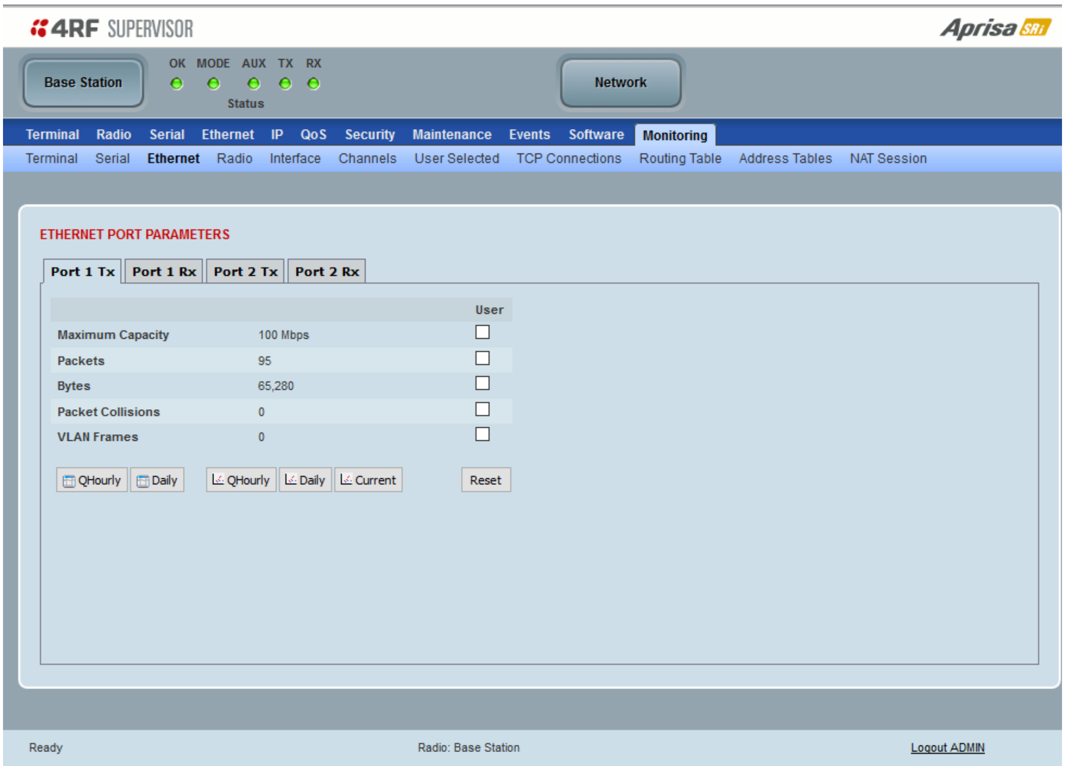
Controls

The Reset button clears the current results.

Monitoring > Ethernet

This page displays the current radio performance monitoring parameters per Ethernet port transmission (TX) out of the radio in packet and byte level granularity, for Ethernet port high level statistics and troubleshooting.

The results shown are since the page was opened and are updated automatically every 12 seconds.



ETHERNET PORT PARAMETERS

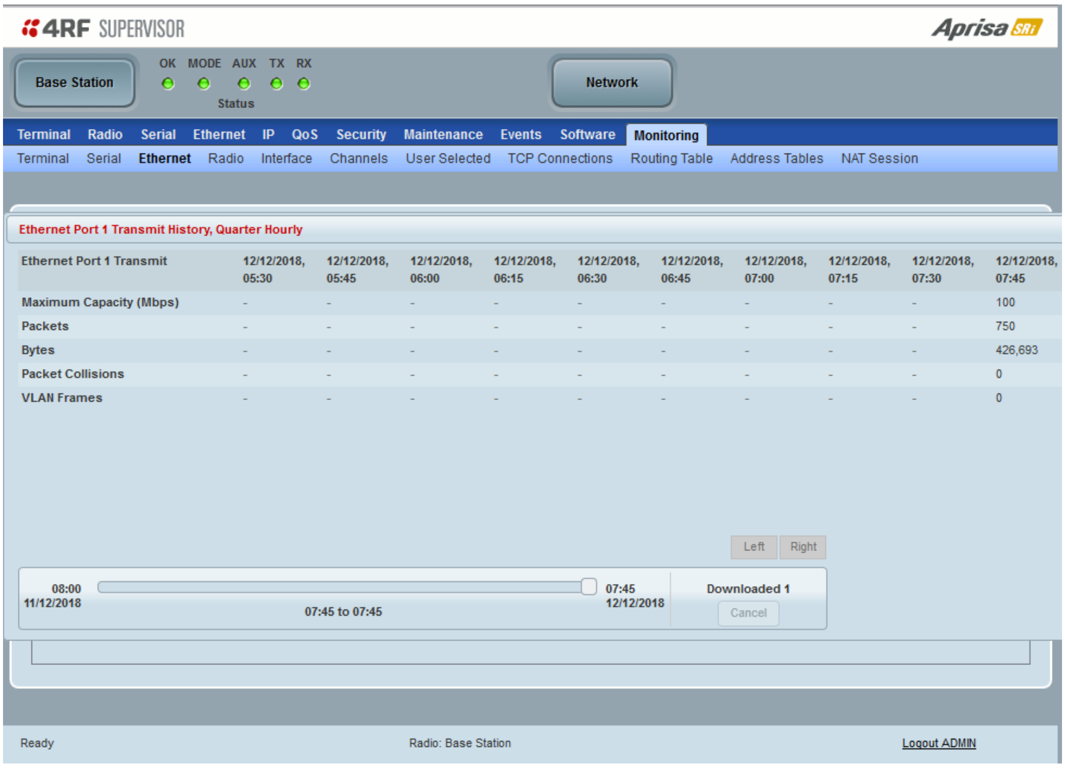
All Ethernet Ports TX

Monitored Parameter	Function	Normal Operating Limits
Maximum Capacity	Parameter to show the maximum Ethernet data rate of the Ethernet port	Equal to the Ethernet port speed setting
Packets	Parameter to show the number of packets transmitted to the customer from the Ethernet port	
Bytes	Parameter to show the number of bytes transmitted to the customer from the Ethernet port	
Packet Collisions	Parameter to show the number of packet collisions on the data transmitted to the customer from the Ethernet port on a shared LAN	
VLAN Frames	Parameter to show the number of VLAN tagged frames transmitted to the customer from the Ethernet port	

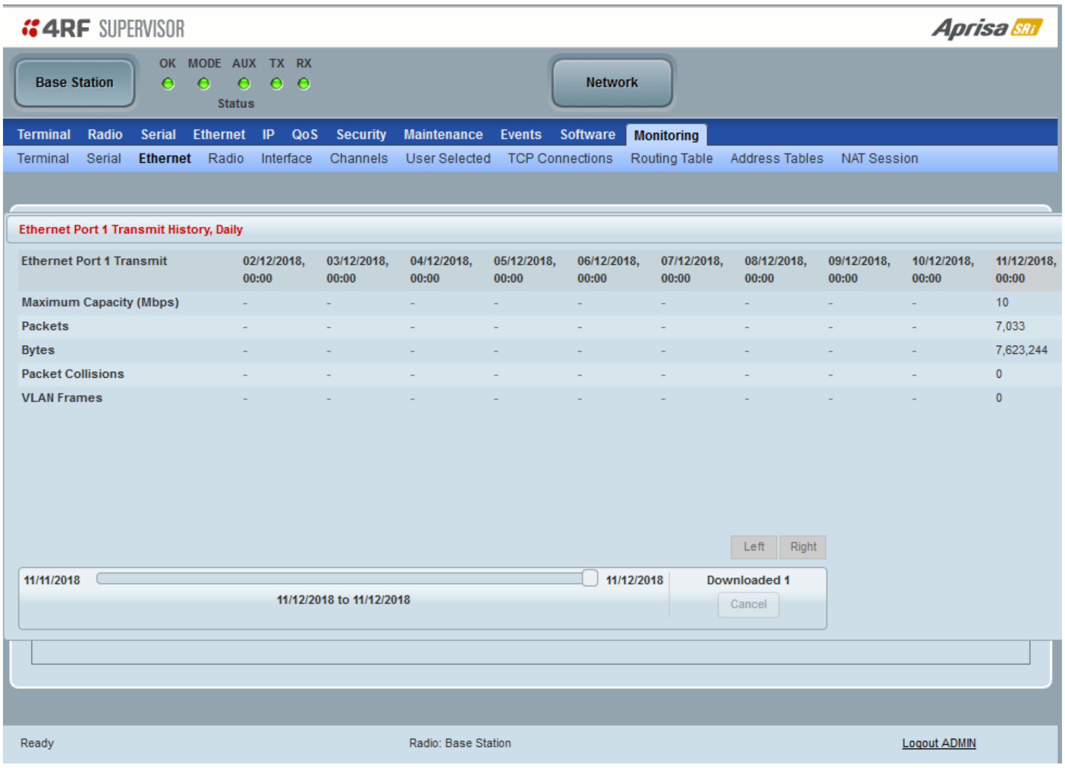
Controls

The Reset button clears the current results.

The History Quarter Hourly button presents a log of results every quarter of an hour.

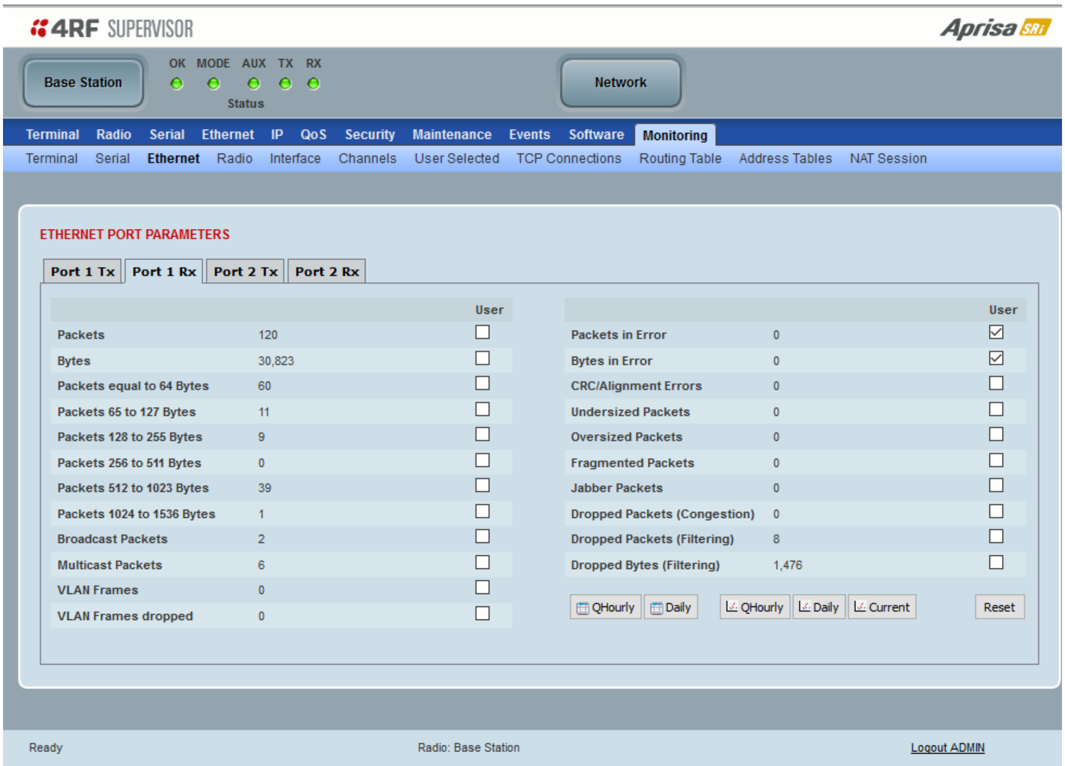


The History Daily button presents a log of results every day.



This page displays the current radio performance monitoring parameters per Ethernet port received (RX) data in packet and byte level granularity, for Ethernet port high level statistics and troubleshooting.

The results shown are since the page was opened and are updated automatically every 12 seconds.



ETHERNET PORT PARAMETERS

All Ethernet Ports RX

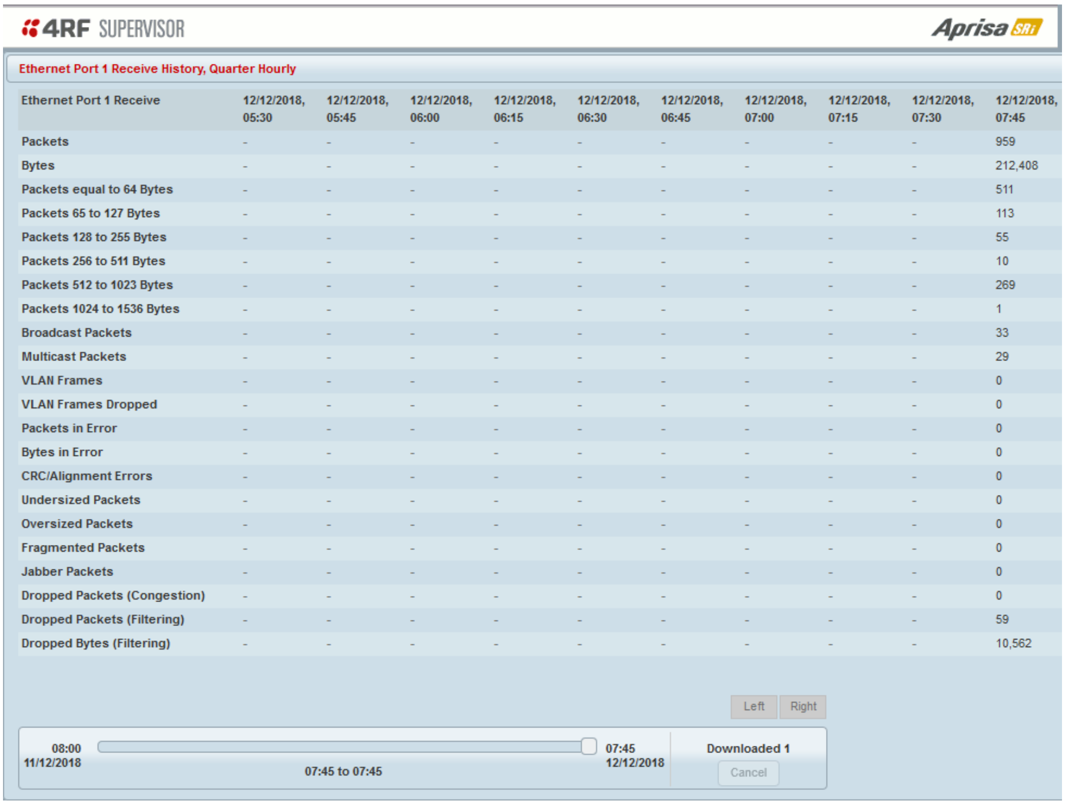
Monitored Parameter	Function
Packets	Parameter to show the number of packets received by the customer from the Ethernet port (including broadcasts, multicasts, unicasts, FCS/CRC error, alignment error, undersize, jabber, oversize, and fragments)
Bytes	Parameter to show the number of bytes received by the customer from the Ethernet port (including broadcasts, multicasts, unicasts, FCS/CRC error, alignment error, undersize, jabber, oversize, and fragments and excluding IFG framing bytes/bits)
Packets equal to 64 bytes	Parameter to show the number of packets received from the customer into the Ethernet port that are equal to 64 bytes (including broadcasts, multicasts, unicasts, FCS/CRC error, alignment error, undersize, jabber, oversize, and fragments)
Packets 65 to 127 bytes	Parameter to show the number of packets received from the customer into the Ethernet port that are between 65 and 127 bytes (including broadcasts, multicasts, unicasts, FCS/CRC error, alignment error, undersize, jabber, oversize, and fragments)
Packets 128 to 255 bytes	Parameter to show the number of packets received from the customer into the Ethernet port that are between 128 and 255 bytes (including broadcasts, multicasts, unicasts, FCS/CRC error, alignment error, undersize, jabber, oversize, and fragments)
Packets 256 to 511 bytes	Parameter to show the number of packets received from the customer into the Ethernet port that are between 256 and 511 bytes (including broadcasts, multicasts, unicasts, FCS/CRC error, alignment error, undersize, jabber, oversize, and fragments)
Packets 512 to 1023 bytes	Parameter to show the number of packets received from the customer into the Ethernet port that are between 512 and 1023 bytes (including broadcasts, multicasts, unicasts, FCS/CRC error, alignment error, undersize, jabber, oversize, and fragments)
Packets 1024 to 1536 bytes	Parameter to show the number of packets received from the customer into the Ethernet port that are between 1024 and 1536 bytes (including broadcasts, multicasts, unicasts, FCS/CRC error, alignment error, undersize, jabber, oversize, and fragments)

Monitored Parameter	Function
Broadcast Packets	Parameter to show the number of broadcast packets received from the customer into the Ethernet port. Broadcast packets are good packets received that were directed to the broadcast address. Note that this does not include multicast packets.
Multicast Packets	Parameter to show the number of multicast packets received from the customer into the Ethernet port. Multicast packets are packets that were directed to a multicast address. Note that this number does not include packets directed to the broadcast address.
VLAN Frames	Parameter to show the number of VLAN tagged frames received from the customer into the Ethernet port, including filtering, congestion but excludes VLAN dropped packets
VLAN Frames Dropped	Parameter to show the number of VLAN tagged frames received from the customer into the Ethernet port that were dropped due to filtered VLAN frames (filtering configuration in VLAN configuration). L3 filtered packets, bad packets or congestion dropped packets are not counted in this parameter.
Packet In Error	Parameter to show the number of errored packets received from the customer into the Ethernet port caused by CRC errors, FCS Errors, alignment errors, oversized packets, undersized packets, fragmented packets and jabber packets
Bytes In Error	Parameter to show the number of errored bytes received from the customer into the Ethernet port
CRC / Alignment Error	Parameter to show the number of CRC / alignment errors received from the customer into the Ethernet port. CRC / alignment errors are defined as frames that had a length excluding framing bits, but including FCS octets of between 64 and 1518 octets, inclusive, but had either a bad Frame Check Sequence (FCS) with an integral number of octets (FCS Error) or a bad FCS with a non-integral number of octets.
Undersized Packets	Parameter to show the number of undersized packets received from the customer into the Ethernet port. Undersized packets are less than 64 octets long excluding framing bits, but including FCS octets.
Oversized Packets	Parameter to show the number of oversized packets received from the customer into the Ethernet port. Oversized packets are longer than 1518 octets excluding framing bits, but including FCS octets.
Fragmented Packets	Parameter to show the number of fragmented packets received from the customer into the Ethernet port. Fragmented packets have either a bad Frame Check Sequence (FCS) with an integral number of octets (FCS Error) or a bad FCS.
Jabber Packets	Parameter to show the number of jabber packets received from the customer into the Ethernet port
Dropped Packets (congestion)	Parameter to show the number of dropped packets received from the customer into the Ethernet port due to congestion
Dropped Packets (filtering)	Parameter to show the number of dropped packets received from the customer into the Ethernet port caused by packet L2 / L3 filtering
Dropped Bytes (filtering)	Parameter to show the number of dropped bytes received from the customer into the Ethernet port caused by packet L2 / L3 filtering

Controls

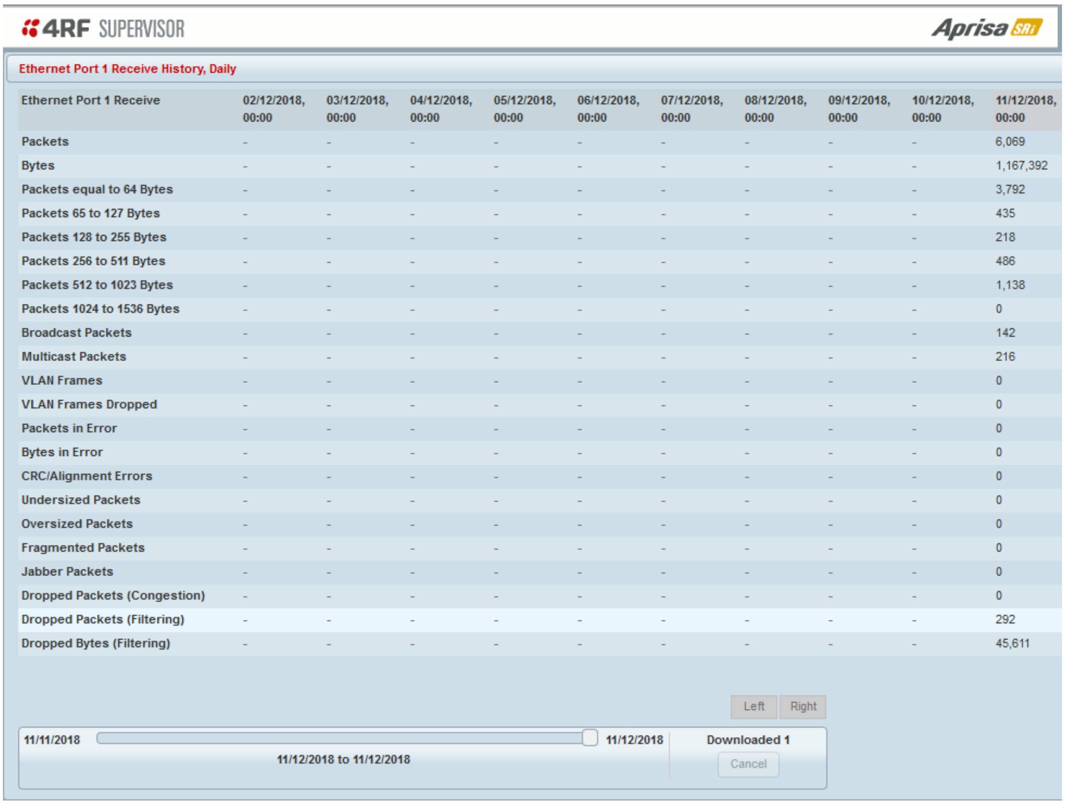
The Reset button clears the current results.

The History Quarter Hourly button presents a log of results every quarter of an hour.



Ethernet Port 1 Receive	12/12/2018, 05:30	12/12/2018, 05:45	12/12/2018, 06:00	12/12/2018, 06:15	12/12/2018, 06:30	12/12/2018, 06:45	12/12/2018, 07:00	12/12/2018, 07:15	12/12/2018, 07:30	12/12/2018, 07:45
Packets	-	-	-	-	-	-	-	-	-	959
Bytes	-	-	-	-	-	-	-	-	-	212,408
Packets equal to 64 Bytes	-	-	-	-	-	-	-	-	-	511
Packets 65 to 127 Bytes	-	-	-	-	-	-	-	-	-	113
Packets 128 to 255 Bytes	-	-	-	-	-	-	-	-	-	55
Packets 256 to 511 Bytes	-	-	-	-	-	-	-	-	-	10
Packets 512 to 1023 Bytes	-	-	-	-	-	-	-	-	-	269
Packets 1024 to 1536 Bytes	-	-	-	-	-	-	-	-	-	1
Broadcast Packets	-	-	-	-	-	-	-	-	-	33
Multicast Packets	-	-	-	-	-	-	-	-	-	29
VLAN Frames	-	-	-	-	-	-	-	-	-	0
VLAN Frames Dropped	-	-	-	-	-	-	-	-	-	0
Packets in Error	-	-	-	-	-	-	-	-	-	0
Bytes in Error	-	-	-	-	-	-	-	-	-	0
CRC/Alignment Errors	-	-	-	-	-	-	-	-	-	0
Undersized Packets	-	-	-	-	-	-	-	-	-	0
Oversized Packets	-	-	-	-	-	-	-	-	-	0
Fragmented Packets	-	-	-	-	-	-	-	-	-	0
Jabber Packets	-	-	-	-	-	-	-	-	-	0
Dropped Packets (Congestion)	-	-	-	-	-	-	-	-	-	0
Dropped Packets (Filtering)	-	-	-	-	-	-	-	-	-	59
Dropped Bytes (Filtering)	-	-	-	-	-	-	-	-	-	10,562

The History Daily button presents a log of results every day.

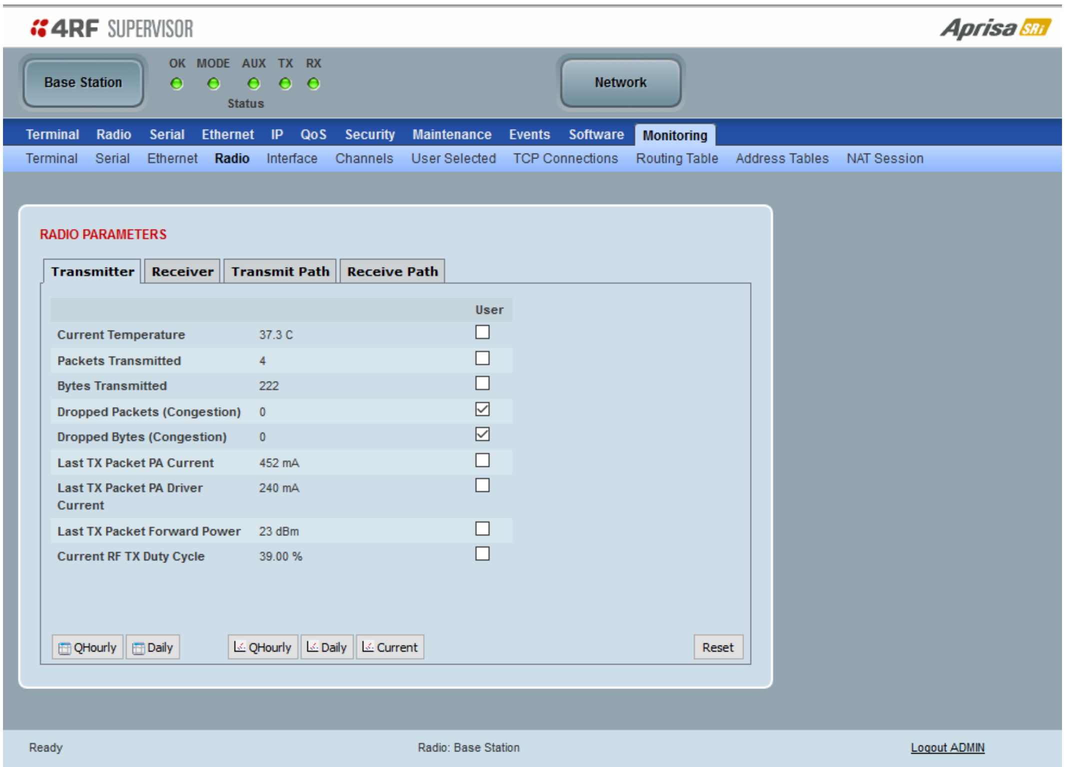


Ethernet Port 1 Receive	02/12/2018, 00:00	03/12/2018, 00:00	04/12/2018, 00:00	05/12/2018, 00:00	06/12/2018, 00:00	07/12/2018, 00:00	08/12/2018, 00:00	09/12/2018, 00:00	10/12/2018, 00:00	11/12/2018, 00:00
Packets	-	-	-	-	-	-	-	-	-	6,069
Bytes	-	-	-	-	-	-	-	-	-	1,167,392
Packets equal to 64 Bytes	-	-	-	-	-	-	-	-	-	3,792
Packets 65 to 127 Bytes	-	-	-	-	-	-	-	-	-	435
Packets 128 to 255 Bytes	-	-	-	-	-	-	-	-	-	218
Packets 256 to 511 Bytes	-	-	-	-	-	-	-	-	-	486
Packets 512 to 1023 Bytes	-	-	-	-	-	-	-	-	-	1,138
Packets 1024 to 1536 Bytes	-	-	-	-	-	-	-	-	-	0
Broadcast Packets	-	-	-	-	-	-	-	-	-	142
Multicast Packets	-	-	-	-	-	-	-	-	-	216
VLAN Frames	-	-	-	-	-	-	-	-	-	0
VLAN Frames Dropped	-	-	-	-	-	-	-	-	-	0
Packets in Error	-	-	-	-	-	-	-	-	-	0
Bytes in Error	-	-	-	-	-	-	-	-	-	0
CRC/Alignment Errors	-	-	-	-	-	-	-	-	-	0
Undersized Packets	-	-	-	-	-	-	-	-	-	0
Oversized Packets	-	-	-	-	-	-	-	-	-	0
Fragmented Packets	-	-	-	-	-	-	-	-	-	0
Jabber Packets	-	-	-	-	-	-	-	-	-	0
Dropped Packets (Congestion)	-	-	-	-	-	-	-	-	-	0
Dropped Packets (Filtering)	-	-	-	-	-	-	-	-	-	292
Dropped Bytes (Filtering)	-	-	-	-	-	-	-	-	-	45,611

Monitoring > Radio

This page displays the current radio diagnostic and performance monitoring parameters of the radio transmitter.

The results shown are since the page was opened and are updated automatically every 12 seconds.



RADIO PARAMETERS

Transmitter

Monitored Parameter	Function	Normal Operating Limits
Current Temperature	Parameter to show the current temperature of the transmitter	0 to 70 °C
Packets Transmitted	Parameter to show the number of packets transmitted over the air	
Bytes Transmitted	Parameter to show the number of bytes transmitted over the air	
Dropped Packets (congestion)	Parameter to show the number of dropped packets not transmitted over the air due to congestion	
Dropped Bytes (congestion)	Parameter to show the number of dropped bytes not transmitted over the air due to congestion	
Last TX Packet PA Current	Parameter to show the current consumed by the transmitter power amplifier in mA. The value is stored from the last time the transmitter was active and transmitted a packet.	This value will change depending on the transmitter power setting, modulation, temperature and the VSWR of the antenna. The alarm limits for this are 50 mA to 2.5 A
Last TX Packet Driver Current	Parameter to show the current consumed by the transmitter power amplifier driver in mA. The value is stored from the last time the transmitter was active and transmitted a packet.	This value will change depending on the transmitter power setting, modulation and temperature. The alarm limits for the PA Driver Current are 10 mA to 500 mA.

Monitored Parameter	Function	Normal Operating Limits
Last TX Packet Forward Power	Parameter to show the actual transmitter power in dBm. The value is stored from the last time the transmitter was active and transmitted a packet.	This value will be dependent on the output power, the ATPC setting, the temperature and the VSWR of the antenna. The alarm limits for the Tx forward power are +/-4 dB.
Last TX Packet Reverse Power (note [1])	Parameter to show the reflected power. The value is stored from the last time the transmitter was active and transmitted a packet.	The value will be dependent on the impedance presented to that antenna port of the radio by the feeder and antenna system. A reflected power of 15 dB below the transmit power shows an acceptable performance.
Last TX Packet VSWR (note [1])	Parameter to show numerically how well the antenna is impedance matched to the radio. The value is stored the last time the transmitter was active and transmitted a packet.	This value will be dependent on the feeder and antenna performance, a value of <1.5:1 shows acceptable performance. A value of >3.0:1 would indicate that most of the power is being reflected to the radio and that there is a fault in the feeder or antenna.
Current RF TX Duty Cycle	Parameter to show the average percentage of the RF channel utilization	Dependent on the amount of TX traffic

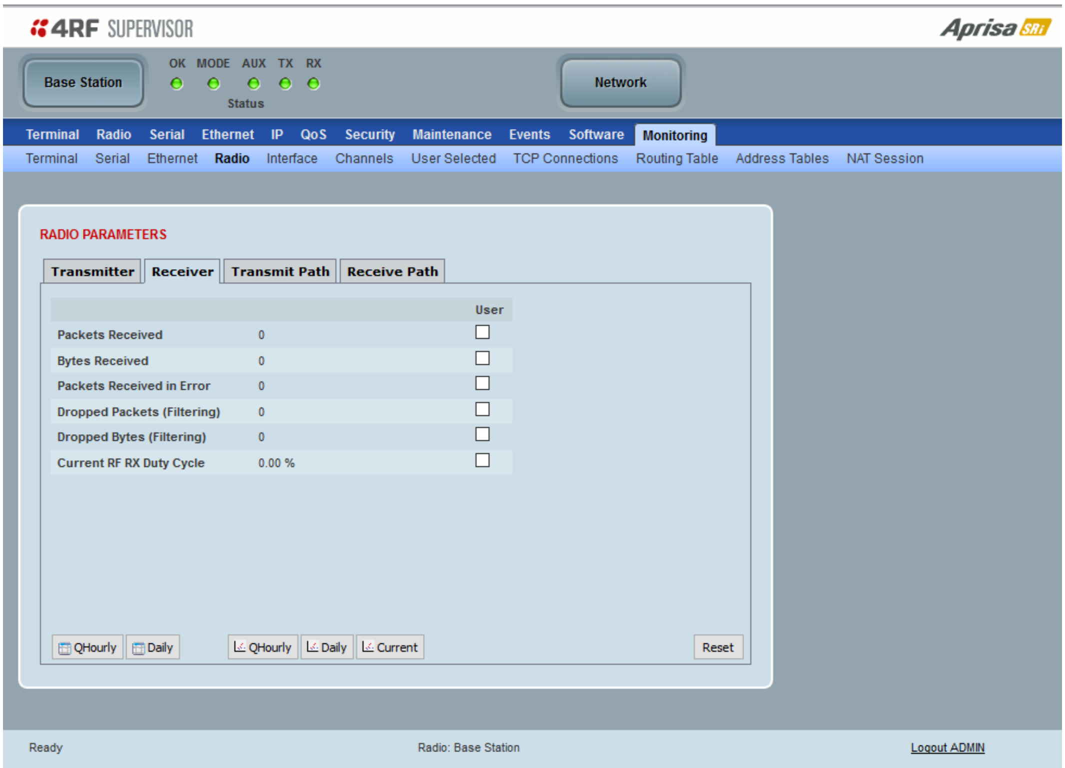
Note 1: Currently only some hardware variants are capable of providing this data. If these parameters are not shown on the Radio Parameters > Transmitter page, the hardware variant is not capable of providing this data.

Controls

The Reset button clears the current results.

This page displays the current radio performance monitoring parameters of radio receiver.

The results shown are since the page was opened and are updated automatically every 12 seconds.



RADIO PARAMETERS

Receiver

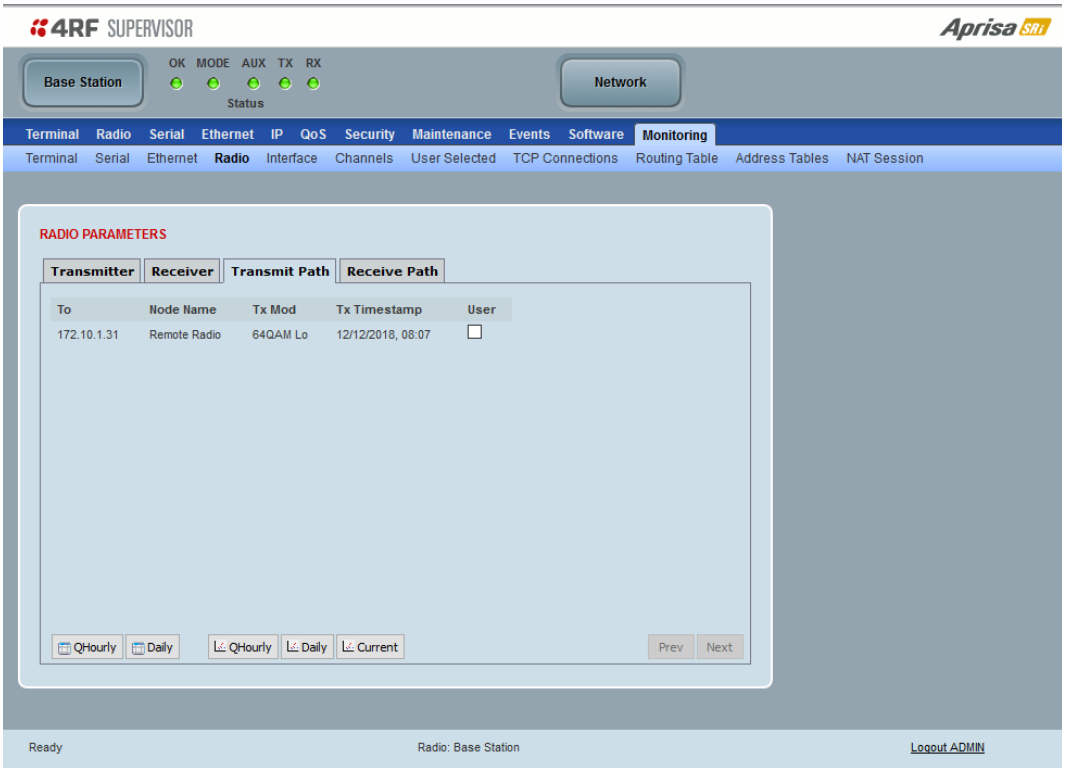
<table>
<tr><th>Monitored Parameter</th><th colspan="2">Function</th></tr>
<tr><td>Packets Received</td><td colspan="2">Parameter to show the number of packets received over the air without errors</td></tr>
<tr><td>Bytes Received</td><td colspan="2">Parameter to show the number of bytes received over the air</td></tr>
<tr><td>Packets Received In Error</td><td colspan="2">Parameter to show the number of packets received over the air that contained errors. It is normal to see this counter increment when ACM is enabled, and a unicast packet is sent to another radio that supports a faster modulation.</td></tr>
<tr><td>Dropped Packets (filtering)</td><td colspan="2">Parameter to show the number of packets dropped because received packets were either destined for another radio or could not be decrypted. It is normal to see this counter increment as radios filter out unicast Ethernet or management packets.</td></tr>
<tr><td>Dropped Bytes (filtering)</td><td colspan="2">Parameter to show the number of bytes dropped because received packets were either destined for another radio or could not be decrypted. It is normal to see this counter increment as radios filter out unicast Ethernet or management packets.</td></tr>
<tr><td>Current RF RX Duty Cycle</td><td>Parameter to show the average percentage of the RF channel utilization</td><td>Dependent on the amount of RX traffic</td></tr>
</table>

Controls

The Reset button clears the current results.

This page displays the current radio RF transmit path modulation setting to single or multiple destination radios that the radio is transmitting to.

The results shown are since the page was opened and are updated automatically every 12 seconds.



RADIO PARAMETERS

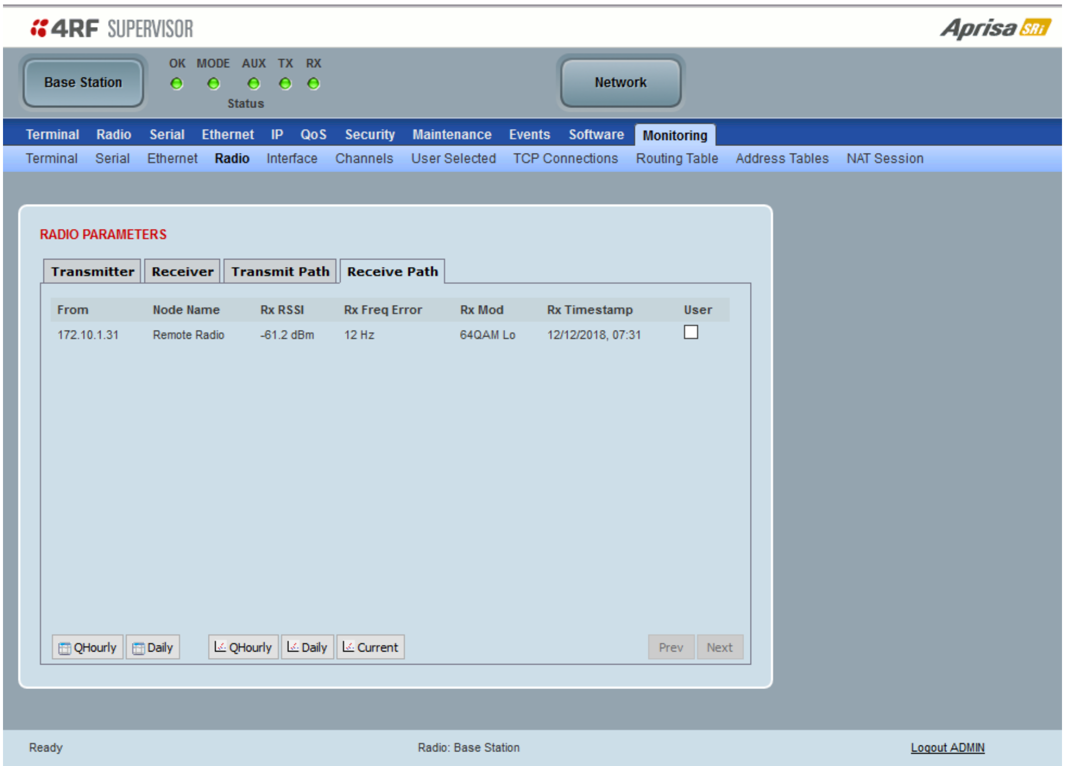
Result	Function
To	The destination Node Address of the radio/s transmitting data to.
Tx Mod	The current radio transmitter modulation being used to communicate with the destination radio/s.
Tx Timestamp	The timestamp of the last transmitted packet to the destination radio/s.

Controls

The Next button will display the next page of 8 radios and the Prev button will display the previous page of 8 radios.

This page displays the current radio RF receive path parameters from single or multiple source radios that the radio is receiving from.

The results shown are since the page was opened and are updated automatically every 12 seconds.



RADIO PARAMETERS

Receive Path

Result	Function
From	The IP Address and Node Name of the radio receiving data from.
Rx RSSI	The RSSI of the RF signal received from the source radio/s. This parameter displays the receiver RSSI reading taken from the last data packet received.
Rx Freq Error	The frequency difference between this radio’s receiver and the frequency of the incoming packet rate from the source radio/s.
Rx Mod	The current radio receive modulation being used to communicate with the source radio/s.
Rx Timestamp	The timestamp of the last received packet from the source radio/s.

Controls

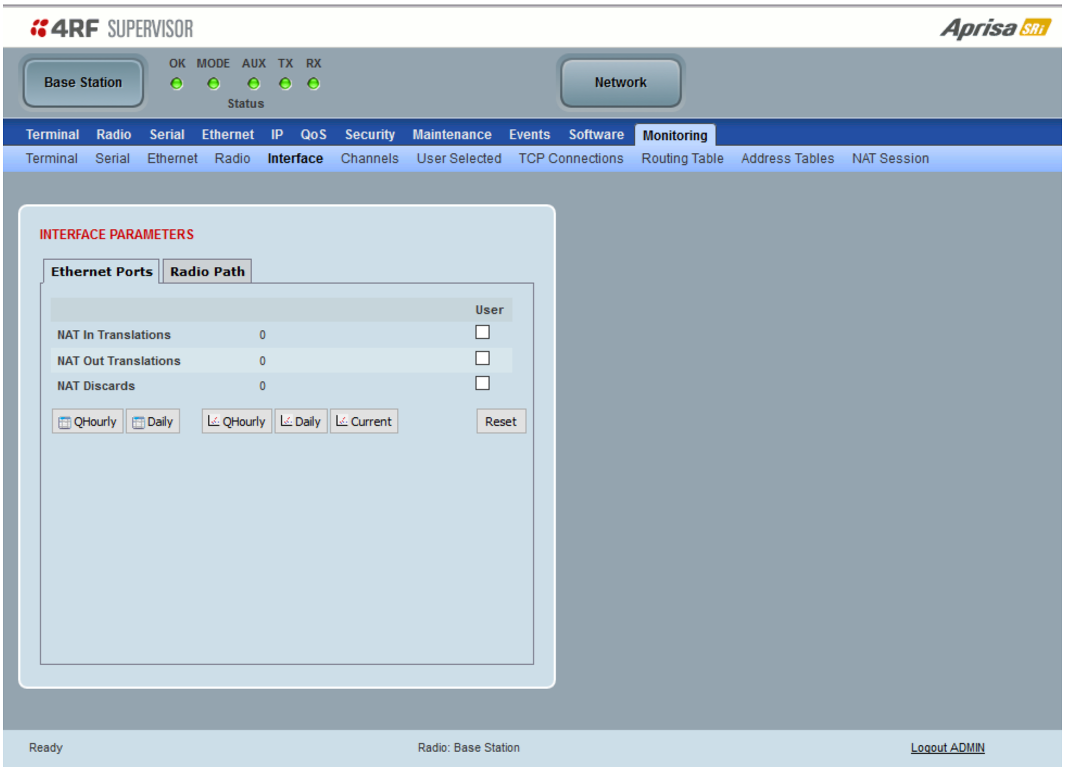
The Next button will display the next page of 8 radios and the Prev button will display the previous page of 8 radios.

Monitoring > Interface

This page displays the current radio Network Address Translation statistics.

The results shown are since the page was opened and are updated automatically every 12 seconds.

Ethernet Ports

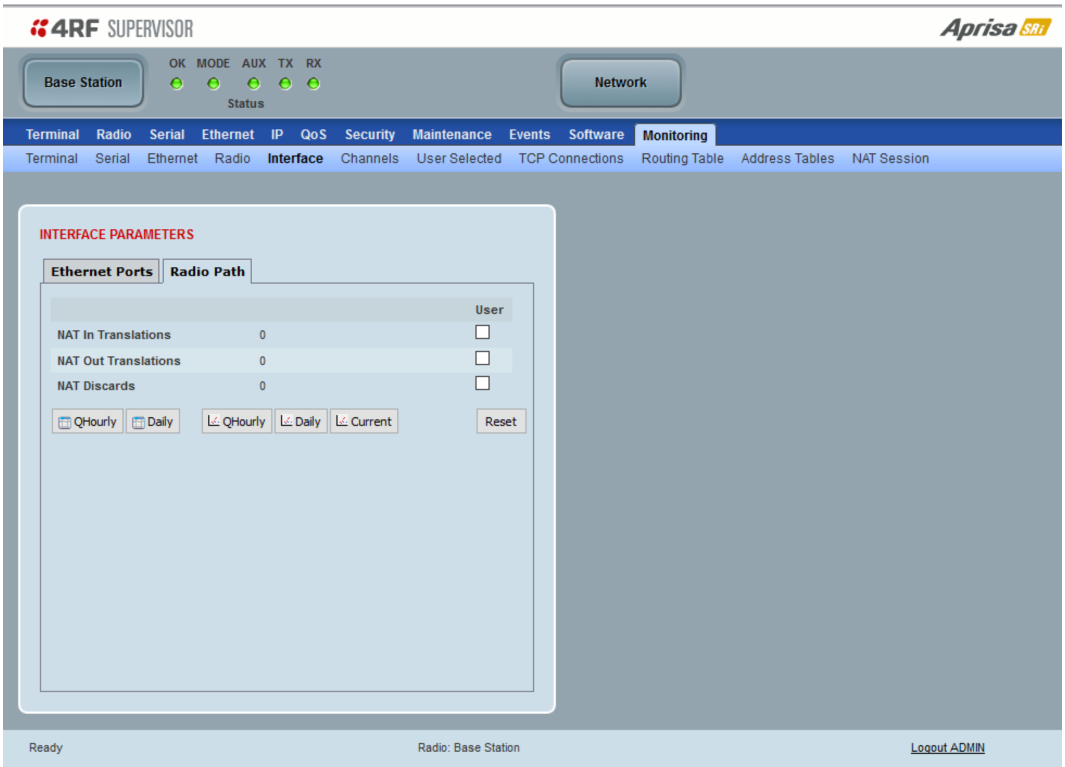


INTERFACE PARAMETERS

Ethernet Ports

Monitored Parameter	Function
NAT In Translations	The number of translated packets received on Ethernet ports
NAT Out Translations	The number of translated packets transmitted on Ethernet ports
NAT Discards	The number of translated packets rejected / discarded on Ethernet ports due to the lack of resource or other reason

Radio Path



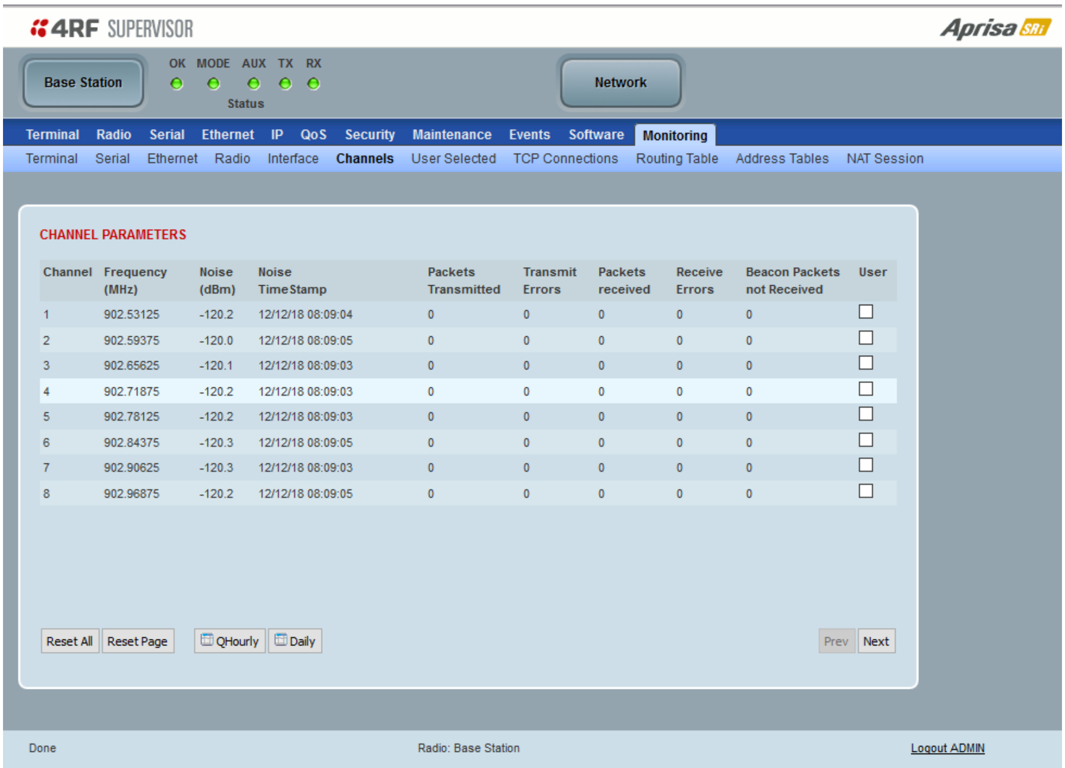
Radio Path

Monitored Parameter	Function
NAT In Translations	The number of translated packets received on the radio interface
NAT Out Translations	The number of translated packets transmitted on the radio interface
NAT Discards	The number of translated packets rejected / discarded on the radio interface due to the lack of resource or other reason

Monitoring > Channels

This page displays the current radio diagnostic and performance monitoring parameters of the channels.

The results shown are since the page was opened and are updated automatically every 12 seconds.



CHANNEL PARAMETERS

Result	Function
Channel	The channel number.
Noise RSSI	The RSSI measured when the channel is clear. It is used to determine if interference is present.
RSSI Timestamp	The timestamp of the last received packet used for RSSI.
Packets Transmitted	The number of packets transmitted from the radio.
Transmit Errors	The number of transmit packets not acknowledged by the base station.
Packets Received	The number of packets received by the radio.
Receive Errors	The number of errored packets received by the radio.
Beacon Packets Not Received	The base station sends broadcast beacon packets to the remotes to sync to the hop channels. This is the number of Beacon Packets not received at the remotes.

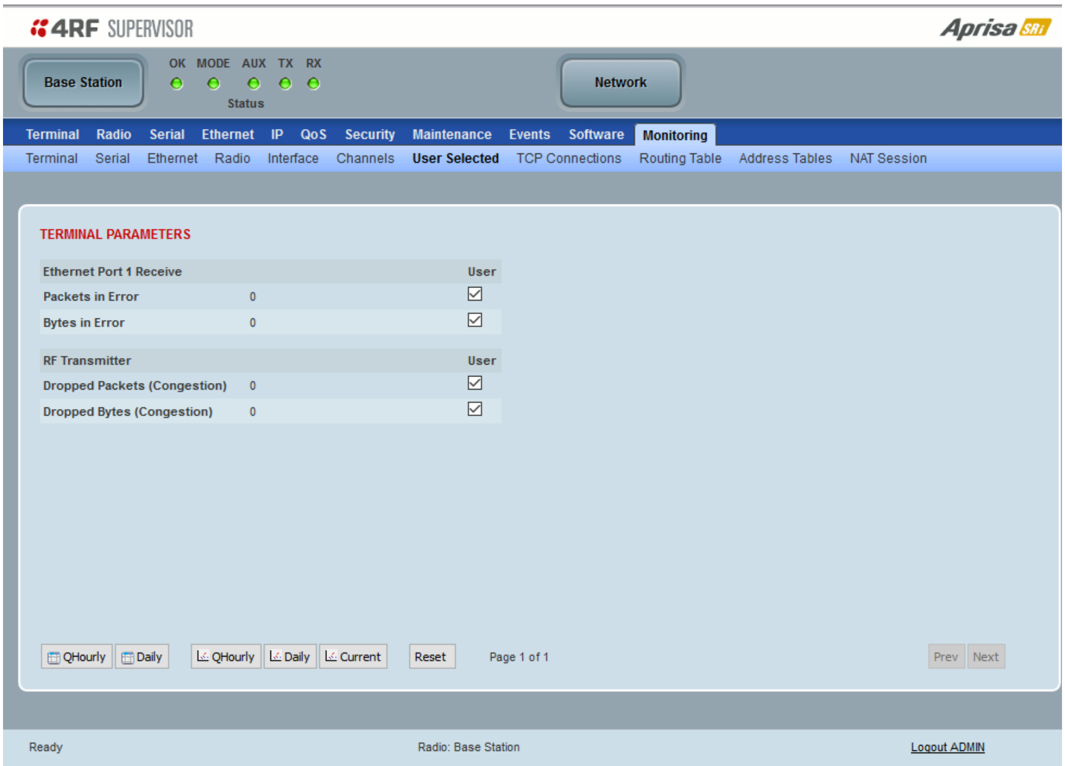
Controls

The Next button will display the next page of 8 connections and the Prev button will display the previous page of 8 connections.

Monitoring > User Selected

This page displays the ‘User’ parameters setup in all the other Monitoring screens e.g. in the Monitoring > Radio > Transmitter, the User checkbox is ticked for the Dropped Packets (Congestion) and Dropped Bytes (Congestion).

The results shown are since the page was opened and are updated automatically every 12 seconds.

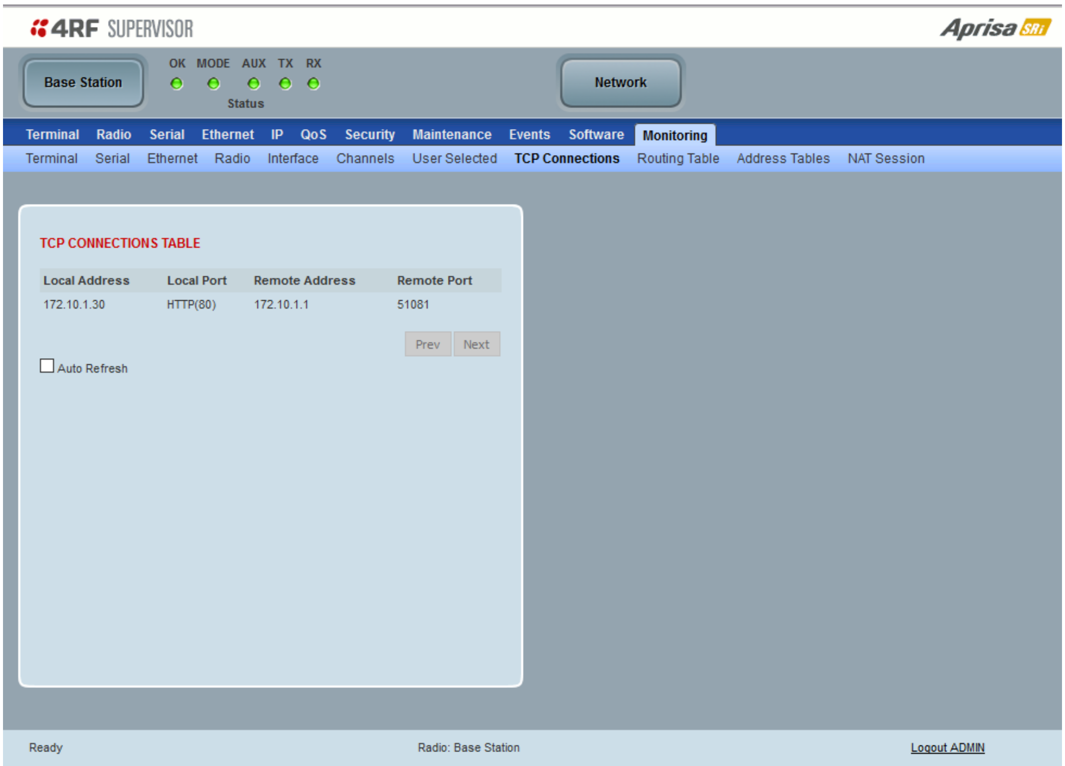


Controls

The Reset button clears the current results.

Monitoring > TCP Connections

This page displays the list of active TCP connections on the radio.



TCP CONNECTIONS TABLE

Result	Function
Local Address	The local radio IP address
Local Port	The local radio TCP port number
Remote Address	The remote host IP address (in most case a host PC connected to radio/network)
Remote Port	The local radio TCP port number (in most case a host PC connected to radio / network)

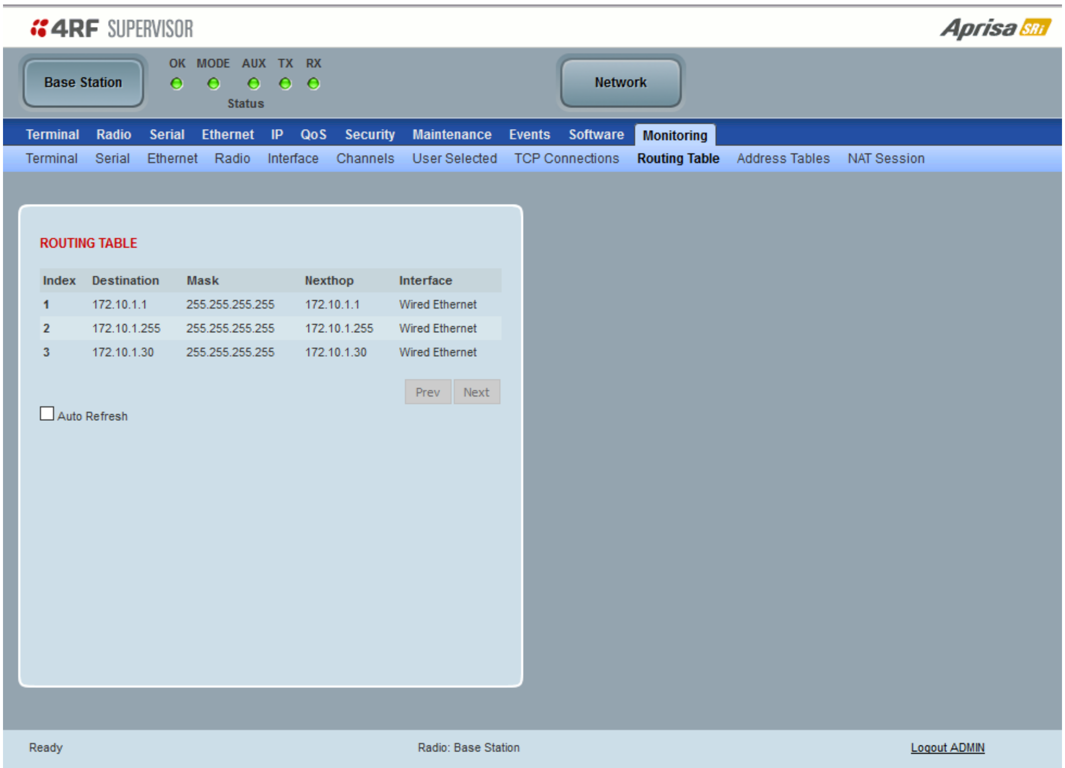
Controls

The Next button will display the next page of 8 connections and the Prev button will display the previous page of 8 connections.

If the Auto Refresh option is ticked, the TCP Connections table will refresh every 12 seconds.

Monitoring > Routing Table

This page displays the list of active routes on the radio.



ROUTING TABLE

Result	Function
Index	The routing table index
Destination	The target destination IP address of the route
Mask	The subnet mask of the destination IP address of the route
Next Hop	The next hop IP address on the path to the destination IP address of the route
Interface	The physical interface output on the path to the destination IP address of the route

Controls

The Next button will display the next page of 8 routes and the Prev button will display the previous page of 8 routes.

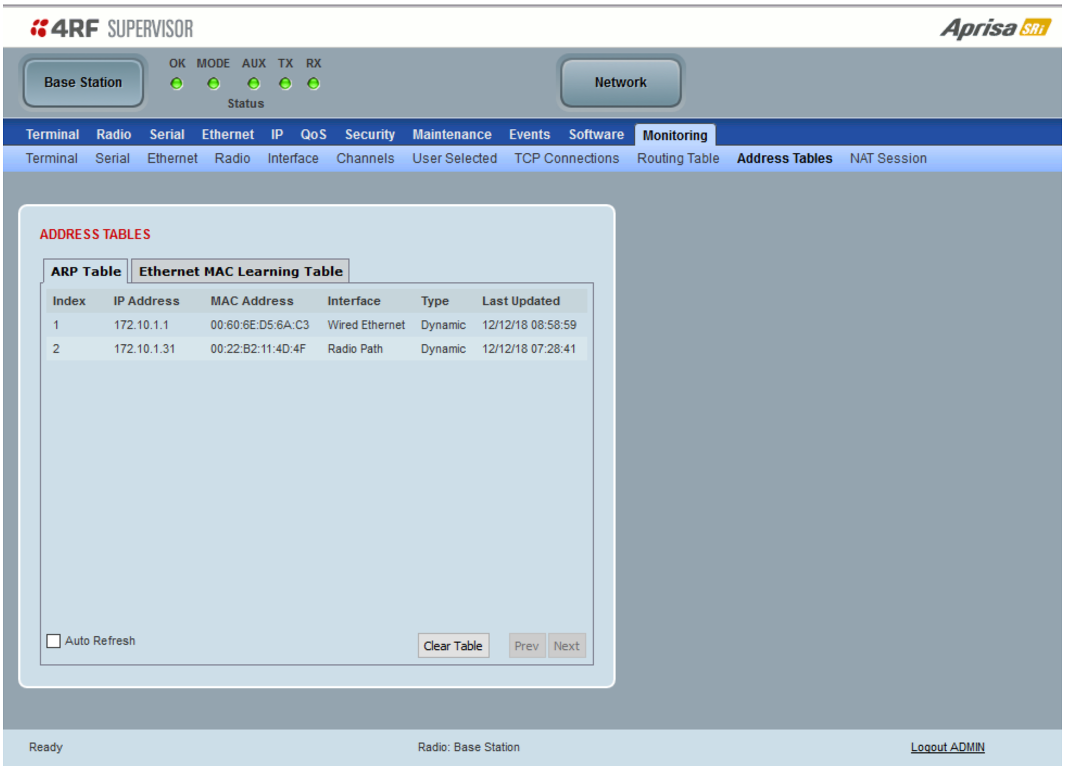
If the Auto Refresh option is ticked, the routing table will refresh every 12 seconds.

Monitoring > Address Tables

ARP Table

This page displays the current Address Resolution Protocols (ARP) on the radio. The radio implemented ARP protocol is used for resolution of network layer addresses into link layer addresses. It is used to map a IPv4 address to an Ethernet MAC address. The ARP table shows the results of the ARP protocol linkage between IPv4 address and Ethernet MAC address of the devices attached to the radio.

In a layer 2 bridge LAN, an upper layer protocol may include the IP address of the destination, but since it is an Ethernet LAN network, it also needs to know the destination MAC address. First, the radio uses a cached ARP table to look up the IPv4 destination address for the matching MAC address records. If the MAC address is found, it sends the IPv4 packet encapsulated in Ethernet frame with the found MAC address. If the ARP cache table did not produce a result for the destination IPv4 address, the radio sends a broadcast ARP message requesting an answer (of MAC address that matches) for IP address. The destination device responds with its MAC address (and IP). The response information is cached in radios' ARP table and the message can now be sent with the appropriate destination MAC address.



ADDRESS TABLES

Title	Function
IP Address	The IPv4 address of a neighboring device in the radio LAN network
MAC Address	The ARP result matching or mapping MAC address from the IPv4 address.
Interface	The Ethernet port interface the ARP results found the matching/mapping
Type	'Dynamic' indicates an ARP result and 'Static' indicates a user static mapping.

Controls

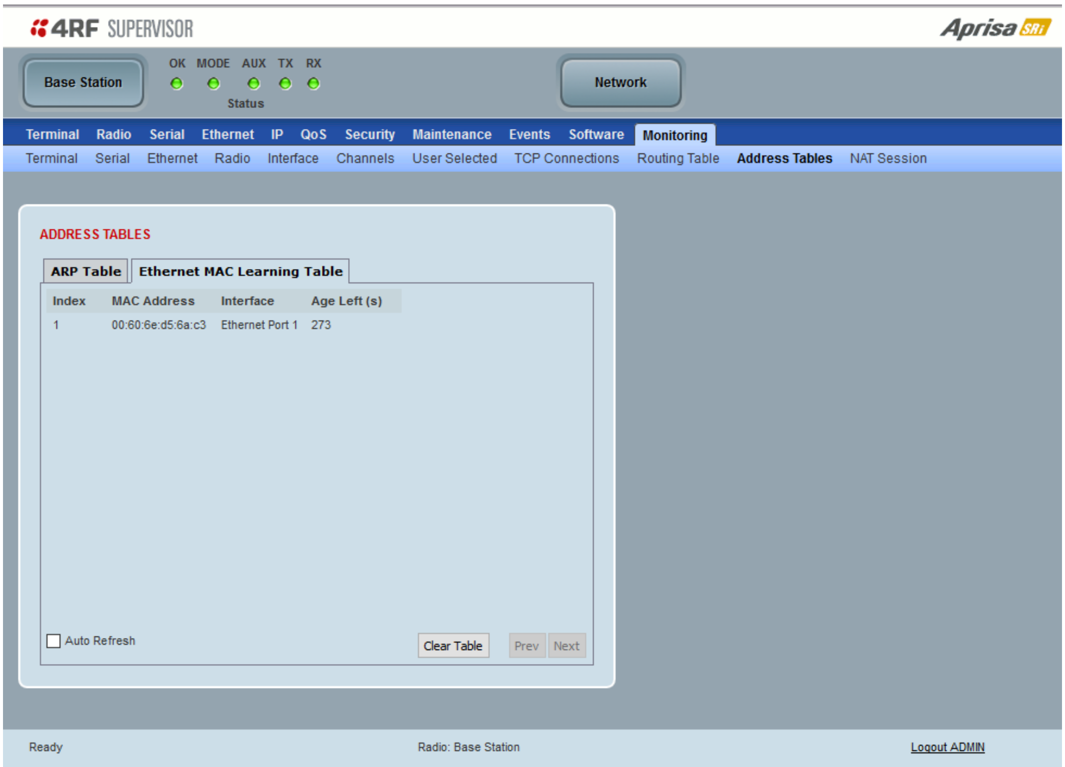
The Next button will display the next page of 8 addresses and the Prev button will display the previous page of 8 addresses.

If the Auto Refresh option is ticked, the ARP table will refresh every 12 seconds.

Ethernet MAC Learning Table

This page displays the current Ethernet Media Access Control (MAC) Address table on the radio LAN network. In order for the radio to switch frames between Ethernet LAN ports efficiently, the radio layer 2 bridge maintains a MAC address table. When the radio bridge receives a frame, it associates the MAC address of the sending network device with the LAN port on which it was received.

The bridge dynamically learns and builds the MAC address table by using the MAC source address of the frames received. When the radio bridge receives a frame for a MAC destination address not listed in its address table, it floods the frame to all LAN ports of the same LAN (or in case of VLAN, to the specific VLAN) except the port that received the frame. When the destination bridge device replies, the radio bridge adds its relevant MAC source address and interface port number to the MAC address table. The switch then forwards subsequent frames to a single LAN port without flooding all LAN ports.



ADDRESS TABLES

Title	Function
MAC Address	The learned MAC address of a neighboring bridge device in the LAN network.
Interface	The Ethernet port interface the MAC address has learned
Age left	The aging time of this MAC entry will stay in the table, even if this MAC address is not used. Every time this MAC address is used, the aging time restarts from its maximum. Default is 300 sec.

Controls

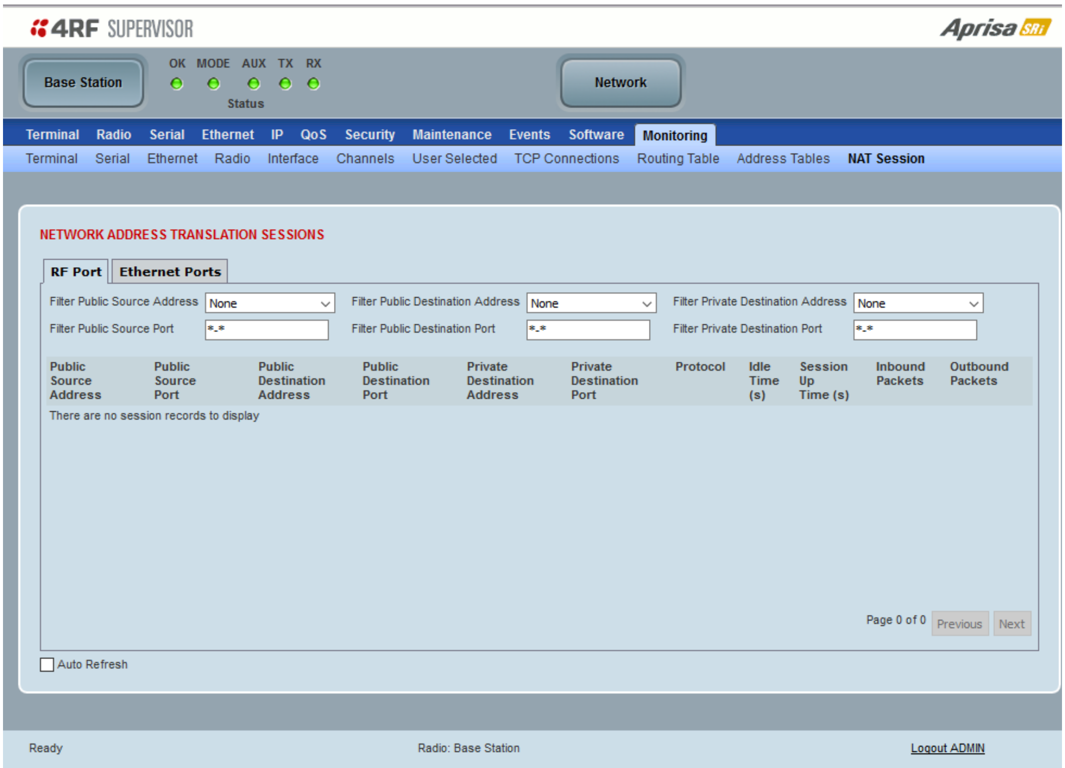
The Next button will display the next page of 8 addresses and the Prev button will display the previous page of 8 addresses.

If the Auto Refresh option is ticked, the routing table will refresh every 12 seconds.

Monitoring > NAT

This page displays the number of NAT sessions. The maximum number of sessions is 250.

RF Port



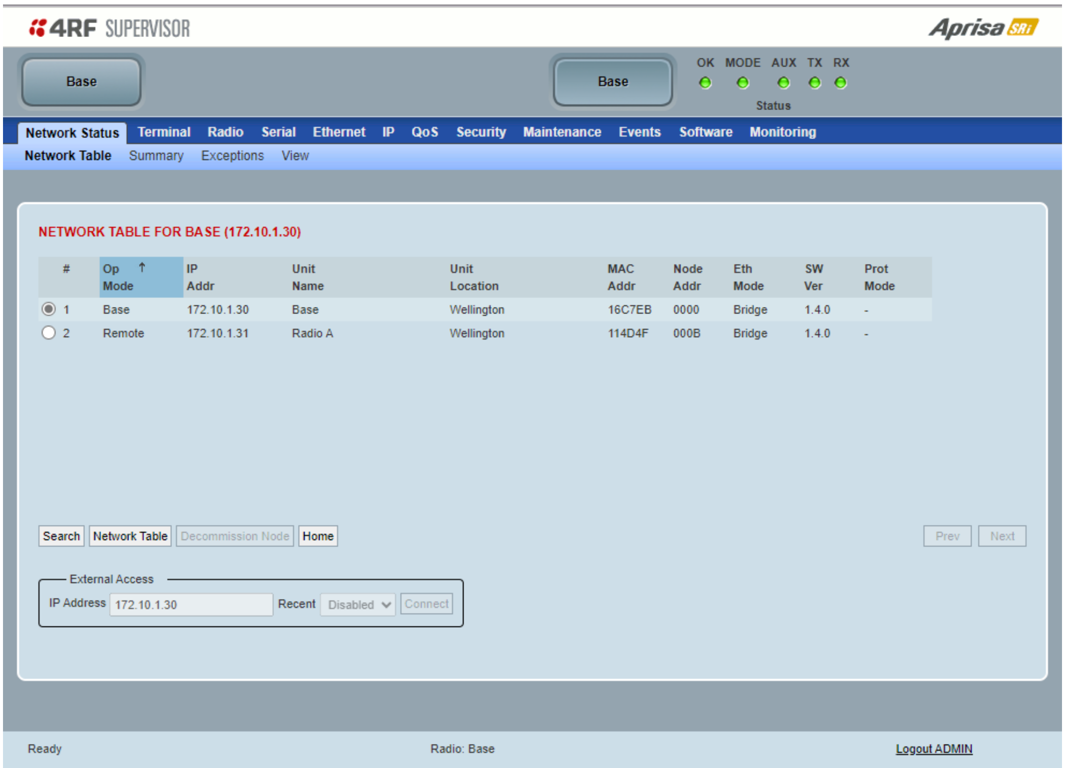
NETWORK ADDRESS TRANSLATION SESSIONS

Title	Function
Idle Time (s)	The total duration where the session has been idle. Traffic on this session will reset the Idle Time to zero.
Session Up Time (s)	The total duration that this session has been shown in the session table.
Inbound Packets	The total number of packets received on the public interface for this session.
Outbound Packets	The total number of packets transmitted from the public interface for this session.

Network Status

Network Status > Network Table

This page displays a list of all the registered remote radios for the base station and provides management access to each of the remote radios.



NETWORK TABLE

This Network Table is only available when the local radio is the base station i.e. SuperVisor is logged into the base station.

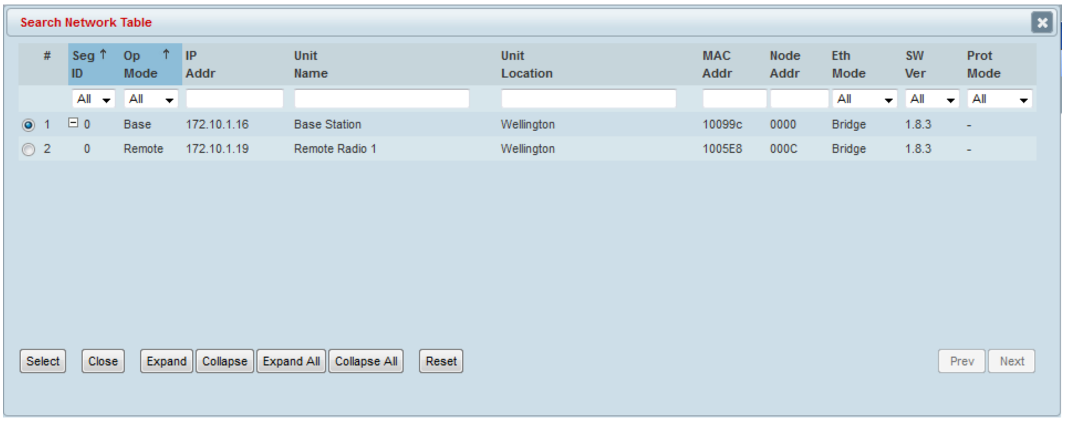
To manage a remote radio with SuperVisor:

Click on the radio button of the required station. The remaining menu items then apply to the selected remote radio.

Controls

Search

The Search button brings up a search form.



Filtering

The first row of the table in the pop up window is the search filter.

There are two types of filters:

1. Drop down lists with a finite set of options to select from
2. Text entry where any text can be entered.

When the filters are applied, the rows in the rest of the table are displayed only if they match all the filters.

Example 1 - one filter; select 'remote' in the 'Op Mode' filter with the other drop down list set to 'All' and the text entry filters blank, will show all the remote radios

Example 2 - two filters; type '98' in the MAC Addr filter and select 'Bridge' for the 'Eth Mode' filter.

Grouping

Entries in the network table can be grouped based on the Segment IDs. The user can expand the groups with the ⊞ and collapse the groups with the ⊟ button to help locate an entry.

Sorting

Clicking on a column header of the table will sort the table by that column.

The Select button closes the popup, updates the selection on the Network Table and saves the search/filter parameters which are reused the next time the search is initiated in the same SuperVisor session.

The Close button closes the Search popup.

The Expand button expands the group of the selected entry and the Expand All button expands all groups.

The Collapse button collapses the group of the selected entry and the Collapse All button collapses all groups.

The Reset button removes all filtering and expands all groups.

Network Table

Refreshes the Network table from the currently selected IP address.

Decommission Node

The selected node is removed from service.

External Access

Sets the IP address of an extended network radio for SuperVisor management.

Recent

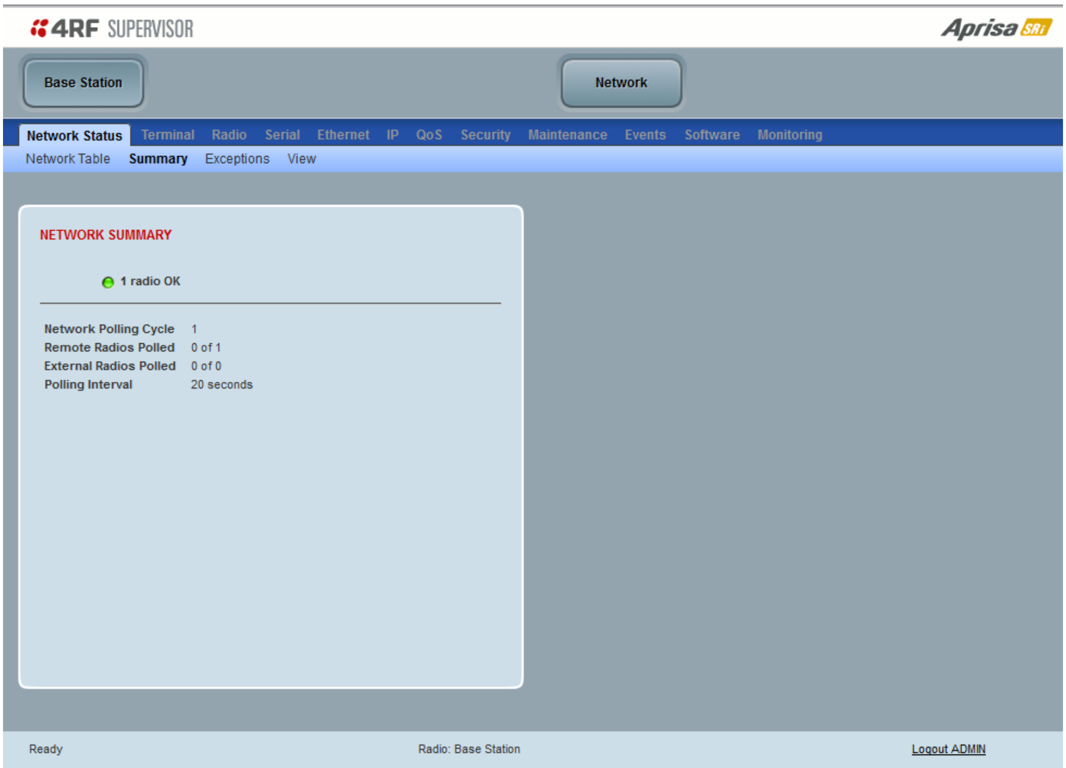
The Recent dropdown list shows the IP addresses that have been managed recently with the extended network radio.

Network Status > Summary

Network View is an overview of the health of the network providing the ability to investigate issues directly within SuperVisor.

This page provides an overall summary view of the alarm status of all registered remote radios for the base station. When open, it provides a continuous monitor of the network.

Depending on the poll period set (20 seconds minimum) and the number of remotes in the network, it will take at least three poll cycles to indicate a failure in the network. Initial results may indicate 'All ok' until at least three poll cycles completed. This could take Number Of Remotes * Poll Period * 3 seconds to complete.



NETWORK SUMMARY

A network poll will start when any of the Network Status pages are opened (Summary, Exceptions or View). The network poll will only continue to poll the remote radios if one of the Network Status pages is open (SuperVisor can lose PC focus). The network poll continues from where it was stopped last time it was polling.

The initial result assumes that all remote radios are operating correctly.

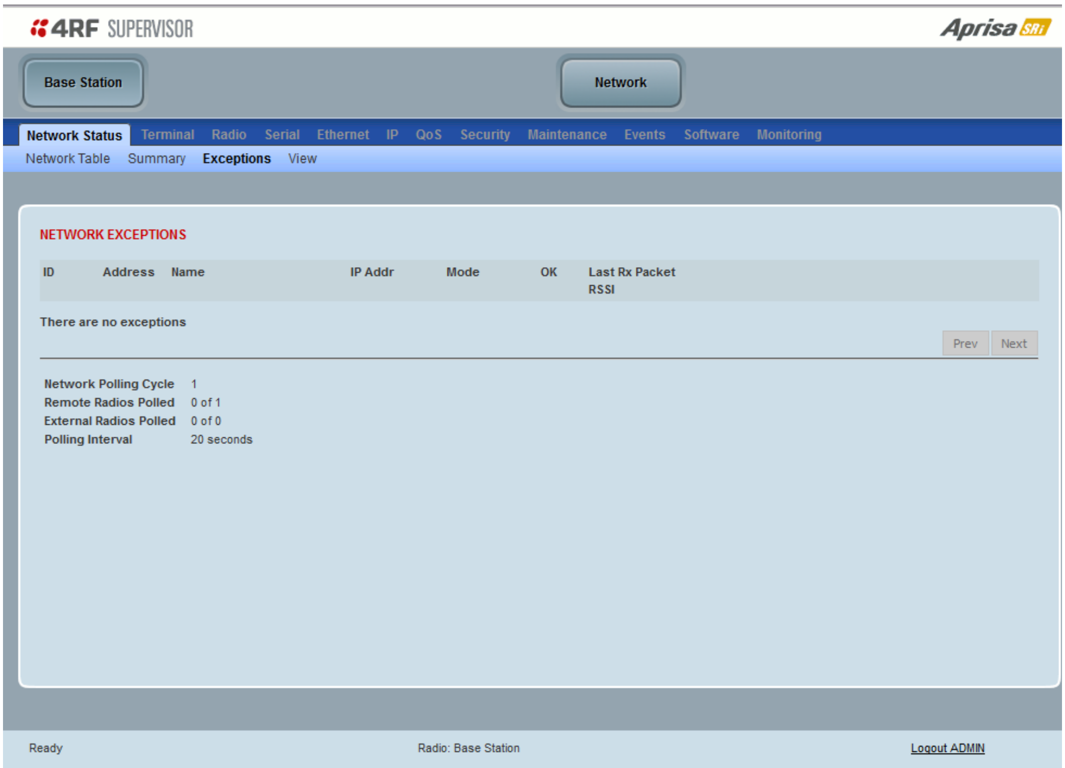
Network Summary Example:

Result	Function
Network Polling Cycle	The number of poll cycles since first opening a Network Status > Summary, Exceptions or View page.
Remote Radios Polled	This shows the number of remote radios polled for the current polling cycle out of the number of remote radios registered with the base station.
Polling Interval	The time interval between the completion of one radio poll and the start of the next radio poll. To set the polling interval, see 'Maintenance > General' on page 235.

If a remote radio does not respond to a poll request within 10 seconds, the previous readings from that radio will be presented. Connectivity to a remote radio will be show as 'lost' if the remote radio has not responded to 3 consecutive poll requests.

Network Status > Exceptions

This page provides a list of all registered remote radios that are in an alarmed state or have stopped responding to the SuperVisor polling. When open, it provides a continuous monitor of the network.



NETWORK EXCEPTIONS

A network poll will start when any of the Network Status pages are opened (Summary, Exceptions or View). The network poll will only continue to poll the remote radios if one of the Network Status pages is open (SuperVisor can lose PC focus). The network poll continues from where it was stopped last time it was polling.

Network Exceptions Example:

Result	Function
Network Polling Cycle	The number of poll cycles since first opening a Network Status > Summary, Exceptions or View page.
Remote Radios Polled	This shows the number of remote radios polled for the current polling cycle out of the number of remote radios registered with the base station.
Polling Interval	The time interval between the completion of one radio poll and the start of the next radio poll. To set the polling interval, see 'Maintenance > General' on page 235.

If a remote radio does not respond to a poll request within 10 seconds, the previous readings from that radio will be presented. Connectivity to a remote radio will be show as 'lost' if the remote radio has not responded to 3 consecutive poll requests.

If a remote radio on the list is detected to be responding to a poll request and no longer be in an alarmed state, the entry for this remote radio will be removed from the list.

View Events

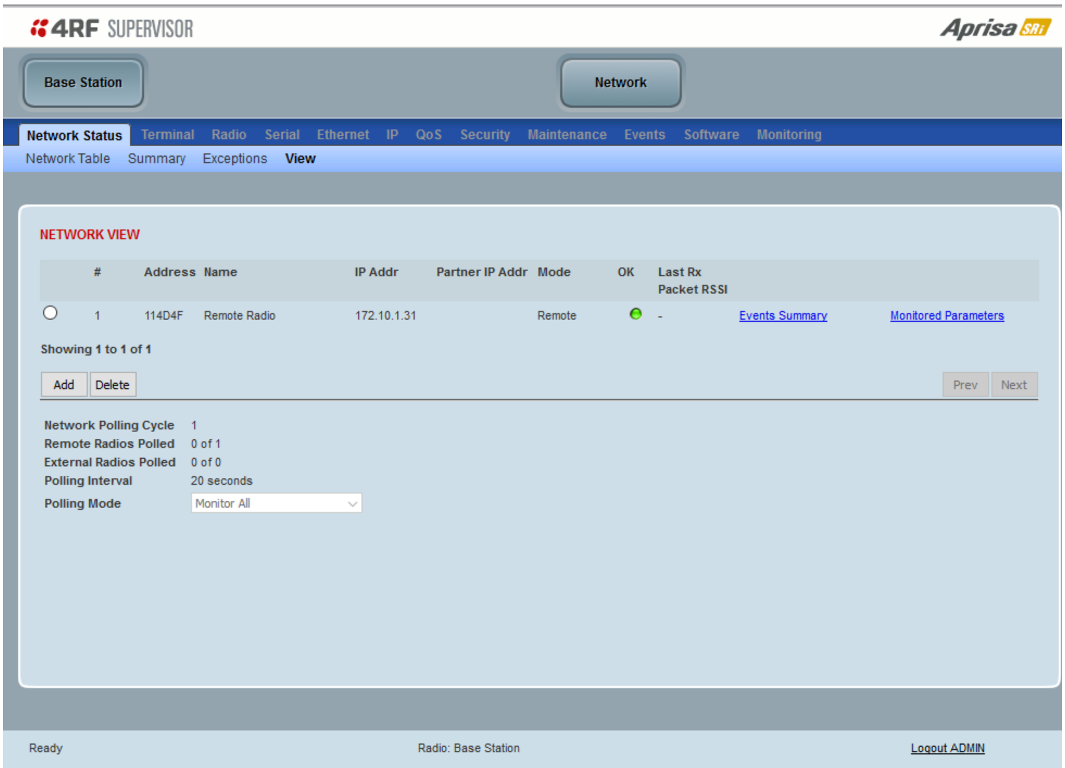
Clicking on View Events navigates to the Events page (see 'Events' on page 249) for the specific remote radio where the radio events will be displayed.

View Parameters

Clicking on View Parameters navigates to the Monitoring page (see 'Monitoring' on page 281) for the specific remote radio where the radio parameters will be displayed.

Network Status > View

This page provides a complete list of all registered remote radios. It is similar to the Exceptions page but it shows all radios, not limited to the radios with alarms. When open, it provides a continuous monitor of the network.



NETWORK VIEW

A network poll will start when any of the Network Status pages are opened (Summary, Exceptions or View). The network poll will only continue to poll the remote radios if one of the Network Status pages is open (SuperVisor can lose PC focus). The network poll continues from where it was stopped last time it was polling.

Network View Example:

Result	Function
Network Polling Cycle	The number of poll cycles since first opening a Network Status > Summary, Exceptions or View page.
Remote Radios Polled	This shows the number of remote radios polled for the current polling cycle out of the number of remote radios registered with the base station.
External Radios Polled	This shows the number of extended network radios polled for the current polling cycle out of the total extended network radios.
Polling Interval	The time interval between the completion of one radio poll and the start of the next radio poll. To set the polling interval, see ‘Maintenance > General’ on page 235. Note: as this polling feature utilizes air time, the polling interval should be selected to suit the network traffic.

If a remote radio does not respond to a poll request within 10 seconds, the previous readings from that radio will be presented. Connectivity to a remote radio will be show as 'lost' if the remote radio has not responded to 3 consecutive poll requests.

Events Summary

Clicking on Events Summary navigates to the Events page (see 'Events > Alarm Summary' on page 249) for the specific remote radio where the radio events will be displayed.

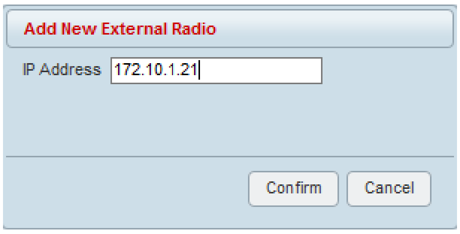
Monitored Parameters

Clicking on Monitored Parameters navigates to the Monitoring page (see 'Monitoring' on page 281) for the specific remote radio where the radio parameters will be displayed.

Controls

Add

The Add button adds a radio to the extended network radio list.



An error message will warn the user if the IP address entered is not a radio in the external network.

A maximum of 480 external radios can be added to the monitoring list but only the first 24 radios will be saved. If the user adds external radios beyond the first 24, an additional informational message will be displayed in the pop up box to inform the user that these entries will not be saved and will be lost when logging out of SuperVisor.

Delete

Deletes the selected radio from the extended network radio list.

Protected Station

The majority of SuperVisor screens are the same for the standard radio and the protected station. The following screens are specific to the protected station.

Logging into a Protected Station

When SuperVisor detects a protected station, it operates in Single Session Management operation mode.

When in Single Session Management mode, SuperVisor will automatically detect the two individual Aprisa SRi radios configured to pair together for protection and manage the two units in a single browser session. To the user, it will appear as managing a single unit, but SuperVisor will interact with the two individual units at a lower level.

The user can login with the IP address of either the Primary or Secondary radio to manage the protected station (don't use the PVIP address as it is not a management IP address). SuperVisor will present all information appropriately where 'Common Parameters' will be presented to the user as a single parameter e.g. TX and RX Frequencies and 'Unit Specific Parameters' will be presented to the user as Primary or Secondary parameters e.g. Events and Alarms.

When saving data, SuperVisor will also validate and ensure that the correct settings are written to both units. The SuperVisor Single Session Management ensures that both units of the protected station are always configured correctly to complement each other as protected partners.

The user can still login with two different sessions to the active and standby radios. If the user opens two session management, one session logged into the active radio and a second session logged into the standby radio, the Multiple Management Sessions pop-up message will show the usernames and IP addresses of the active and standby radio.

Parameter Errors

On protected station screens, parameter values displayed in red indicate discrepancies in common parameter values between the primary and secondary radios (see 'Protected Station: Terminal > Summary' on page 313 for an example of the red display). The value displayed is from the 'addressed radio'.

These value discrepancies can occur if the two protected station radios have been separately configured. The discrepancies can be corrected by re-entering the values in one of the radios. The value will be copied to the partner radio.

Terminal

Protected Station: Terminal > Summary

TERMINAL SUMMARY

This page displays the current settings for the Terminal parameters.

PROTECTION INFORMATION

Protection Type

This parameter shows the type of protection:

Option	Function
Redundant (Protected Station)	The RF ports and interface ports from two standard Aprisa SRi radios are switched to the standby radio if there is a failure in the active radio

Active Unit

This parameter shows the radio which is currently active (Primary or Secondary).

Switch Count

This parameter shows the number of protection switchovers since the last radio reboot (volatile).

Primary Address

This parameter shows the IP address of the primary radio (usually the left side radio A).

Secondary Address

This parameter shows the IP address of the secondary radio (usually the right side radio B).

OPERATING SUMMARY

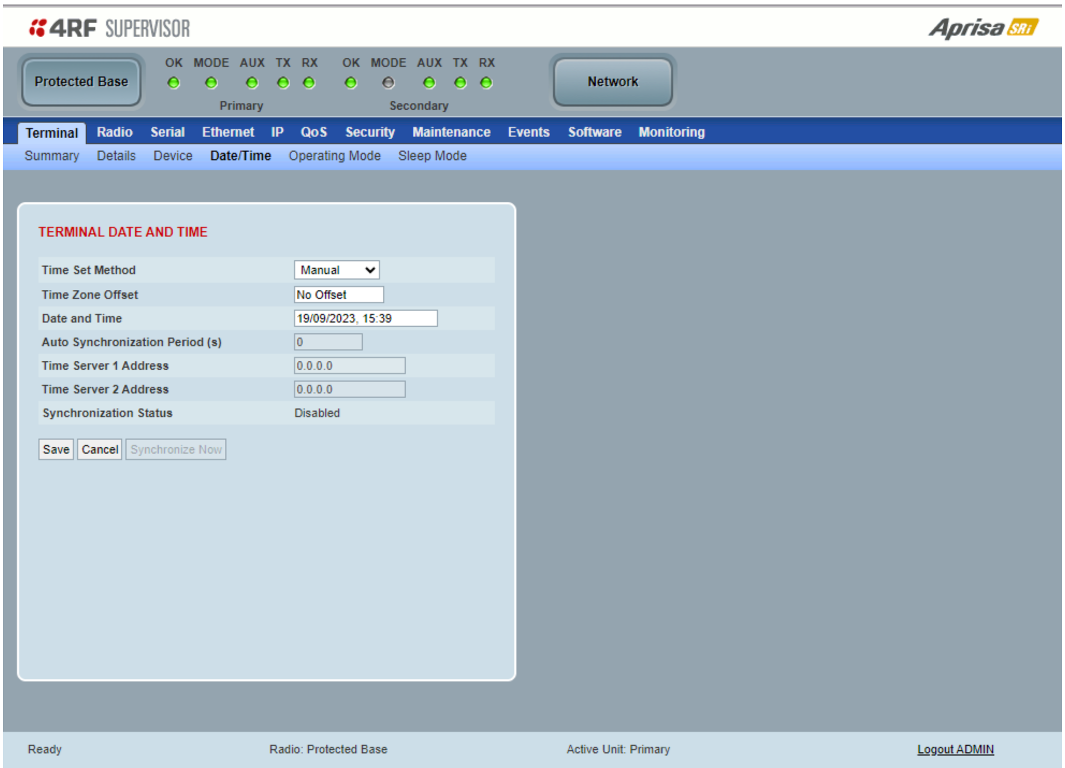
See ‘Terminal > Summary’ on page 96 for parameter details.

Protected Station: Terminal > Details

PRIMARY UNIT / SECONDARY UNIT MANUFACTURING DETAILS

See ‘Terminal > Details’ on page 98 for parameter settings.

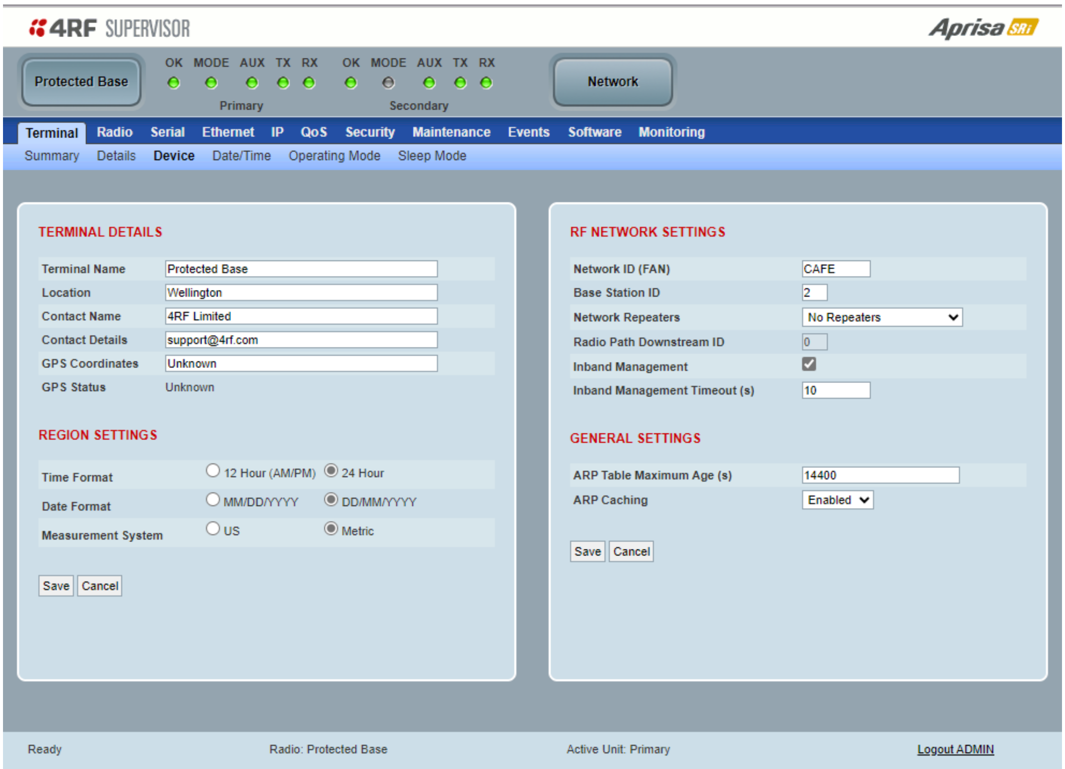
Terminal > Date / Time



TERMINAL DATE AND TIME

See ‘Terminal > Date / Time’ on page 104 for details.

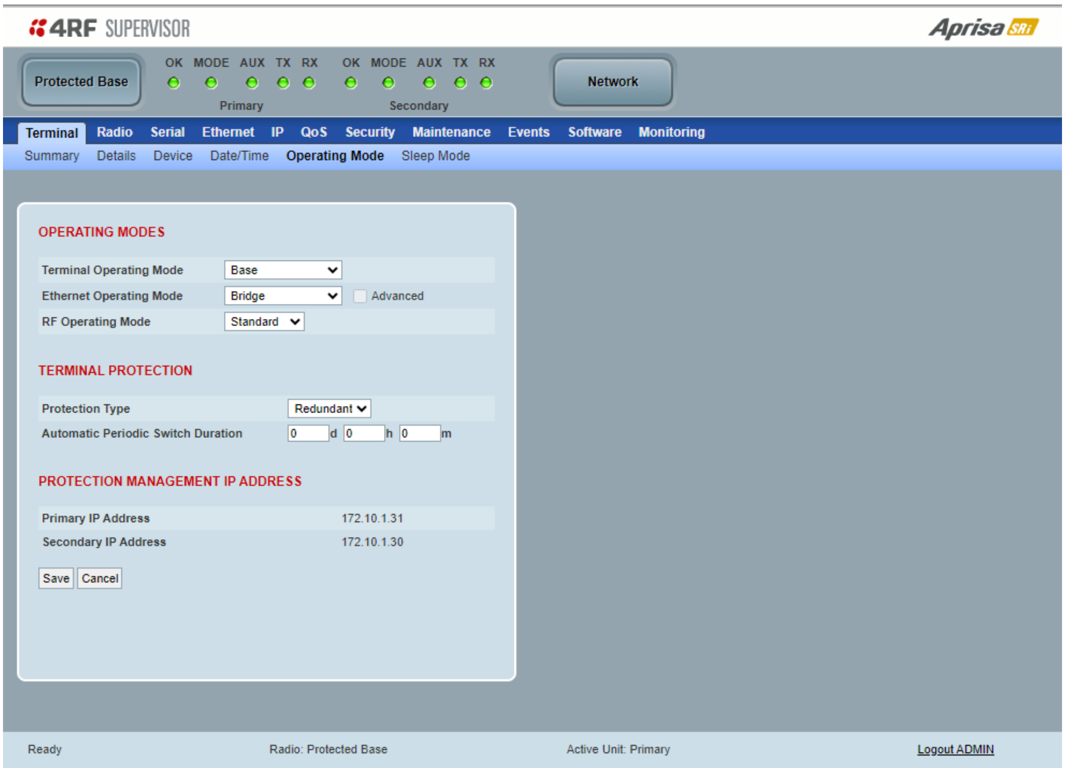
Terminal > Device



TERMINAL DETAILS

See ‘Terminal > Device’ on page 100 for details.

Protected Station: Terminal > Operating Mode



OPERATING MODES

Terminal Operating Mode

The Terminal Operating Mode defines the radio mode of operation. The default setting is Remote.

Option	Function
Base	The Base operating mode manages all traffic activity between itself, repeaters, and remotes. It is the center-point of network where in most cases will be connected to a SCADA master.
Base Repeater	The Base Repeater operating mode has the same function as the base (and repeater station) but used when peer to peer connections between remotes is required via the base station.
Repeater	The Repeater operating mode forwards packets coming from base station and other repeaters e.g. in daisy chain LBS mode and /or remote radios.
Remote	The Remote operating mode in most cases is used as the end-point of the SCADA network connected to an RTU or PLC device for SCADA network control and monitoring.

Ethernet Operating Mode

The Ethernet Operating Mode defines how Ethernet / IP traffic is processed in the radio. The default setting is Bridge.

Option	Function
Bridge	Bridge mode inspects each incoming Ethernet frame source and destination MAC addresses to determine if the frame is forwarded over the radio link or discarded.
Gateway Router	Gateway Router mode inspects each incoming IP source and destination IP addresses to determine if the packet is forwarded over the radio link or discarded. In this mode, all Ethernet interfaces have the same IP address and subnet.
Router	Router mode inspects each incoming IP source and destination IP addresses to determine if the packet is forwarded over the radio link or discarded. In this mode, each Ethernet interface has a different IP address and subnet.

Advanced

Enabled for Gateway Router and Router modes only. The default setting is unticked.

To enable Advanced routing, select the operating mode; Router or Gateway Router and tick the Advanced checkbox.

Advanced Gateway Router mode (AGRM) or Advanced Router mode (ARM) act like a true router between the Ethernet ports and RF interface port where the next hop is one of these ports. This means that the RF interface is a public interface exposed to the user with IP and MAC address like the Ethernet interface.

In AGRM mode, all Ethernet interfaces have the same IP address and subnet.

In ARM mode, each Ethernet interface has a different IP address and subnet.

See 'Advanced Gateway Router Mode (AGRM) and Advanced Router Mode (ARM)' on page 37 for a detailed explanation of advanced router modes.

Note: The Network Address Translation feature works only in Advanced Router or Advanced Gateway Router operating mode (see 'IP > NAT' on page 171).

TERMINAL PROTECTION

Protection Type

The Protection Type defines if a radio is a stand-alone radio or part of an Aprisa SRi Protected Station. The default setting is None.

Option	Function
None	The SRi radio is a stand-alone radio (not part of an Aprisa SRi Protected Station).
Redundant (Protected Station)	The SRi radio is part of an Aprisa SRi Protected Station. The RF ports and interface ports from two standard Aprisa SRi radios are switched to the standby radio if there is a failure in the active radio

Automatic Periodic Switch Duration

The Automatic Periodic Switch Duration sets the time interval for automatic switchover from the active radio to the standby radio.

This feature will automatically switchover from the active radio to the standby radio if there are no alarms preventing the switchover to the standby radio. It can be used to provide confidence that the standby radio is still operational, maybe after many days of standby operation.

The maximum number of days that can be set is 49 days.

The default setting is 0 which disables the automatic switchover feature.

PROTECTION MANAGEMENT IP ADDRESS

Primary Address

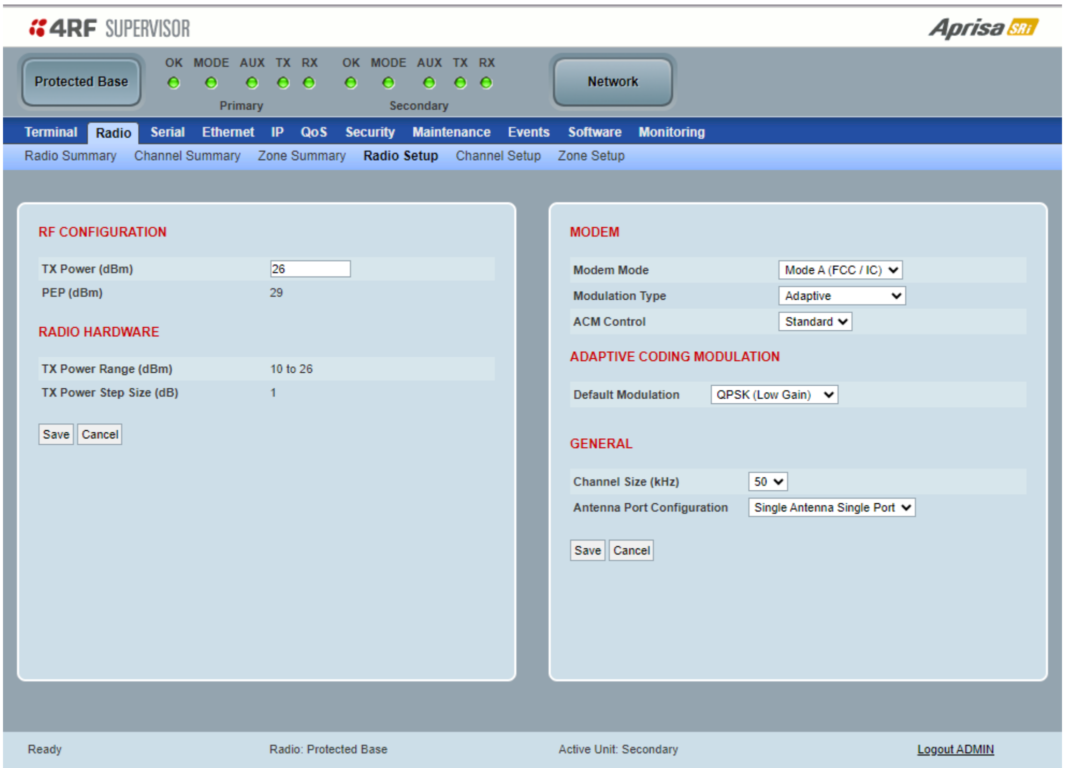
This parameter shows the IP address of the primary radio (usually the left side radio A).

Secondary Address

This parameter shows the IP address of the secondary radio (usually the right side radio B).

Radio

Protected Station: Radio > Radio Setup



Antenna Port Configuration

This parameter sets the Antenna Port Configuration for the radio. For more information on single and dual antenna port part numbers and cabling options, see 'Cabling' on page 380.

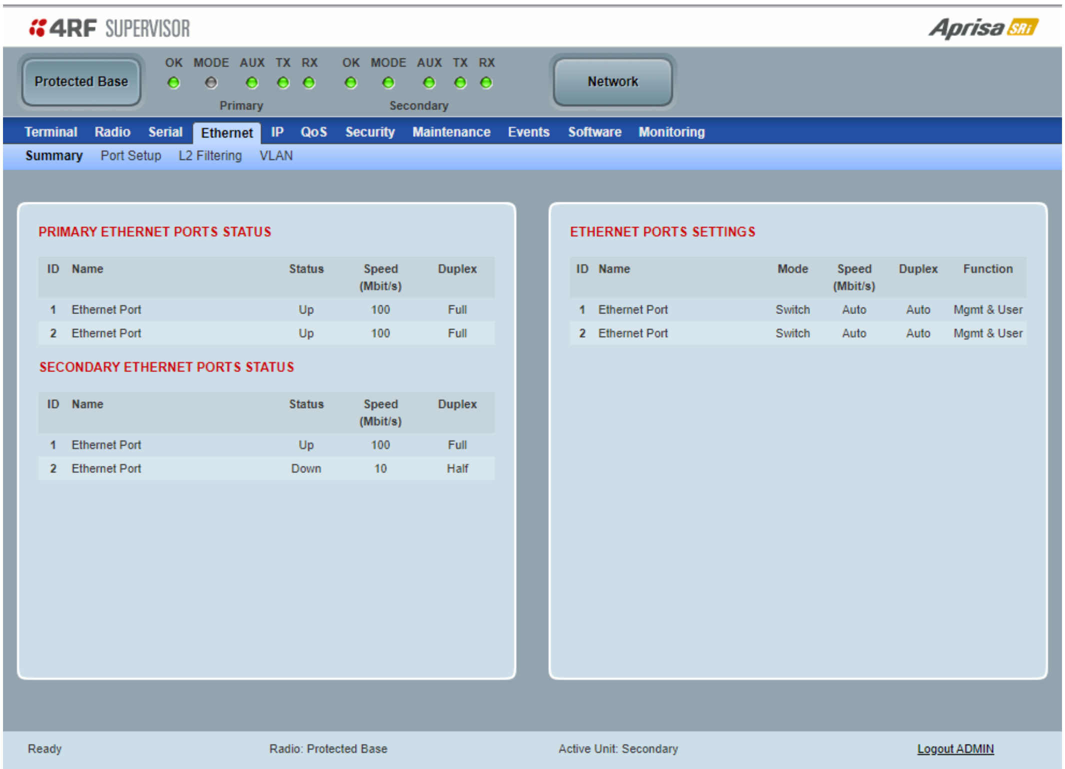
Option	Function
Single Antenna Single Port	Select Single Antenna Single Port for a single antenna protected station using one or two frequency half duplex transmission. The antenna is connected to the ANT port.
Dual Antenna Single Port	Select Dual Antenna Single Port for a dual antenna protected station using one or two frequency half duplex transmission. The antenna is connected to the A and B TX/ANT ports.

The default setting is Single Antenna Single Port.

Ethernet

Protected Station: Ethernet > Summary

This page displays the current settings for the Protected Station Ethernet port parameters.

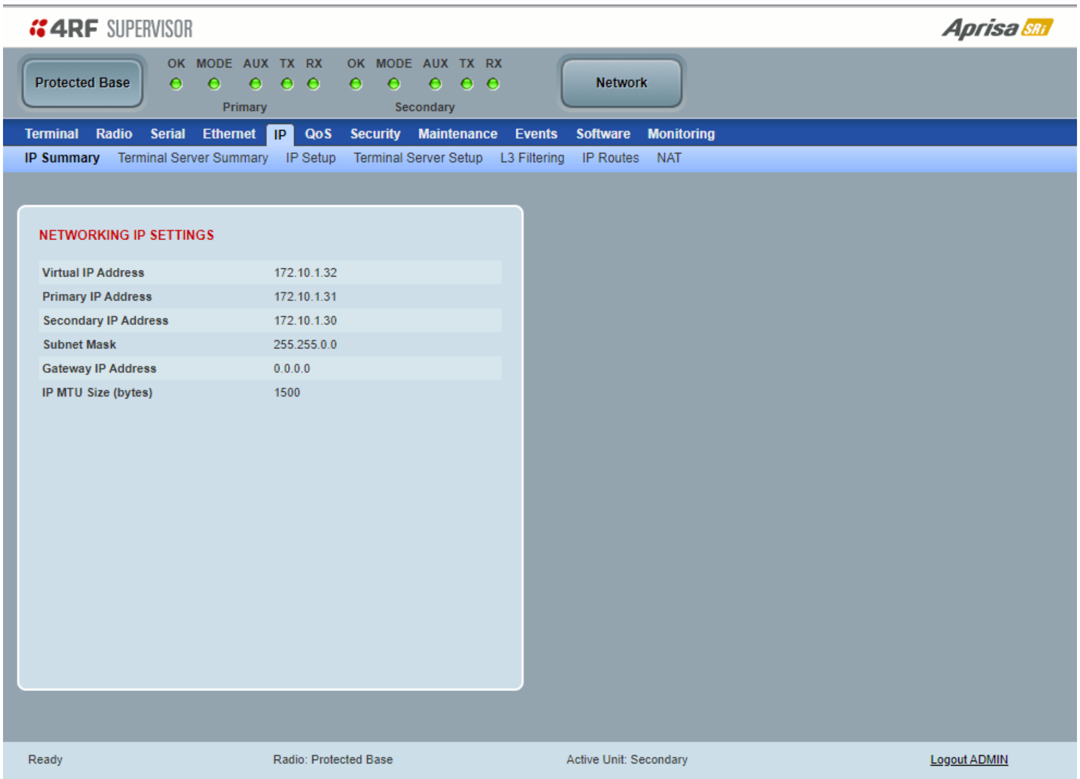


See ‘Ethernet > Port Setup’ for configuration options.

IP

Protected Station: IP > IP Summary

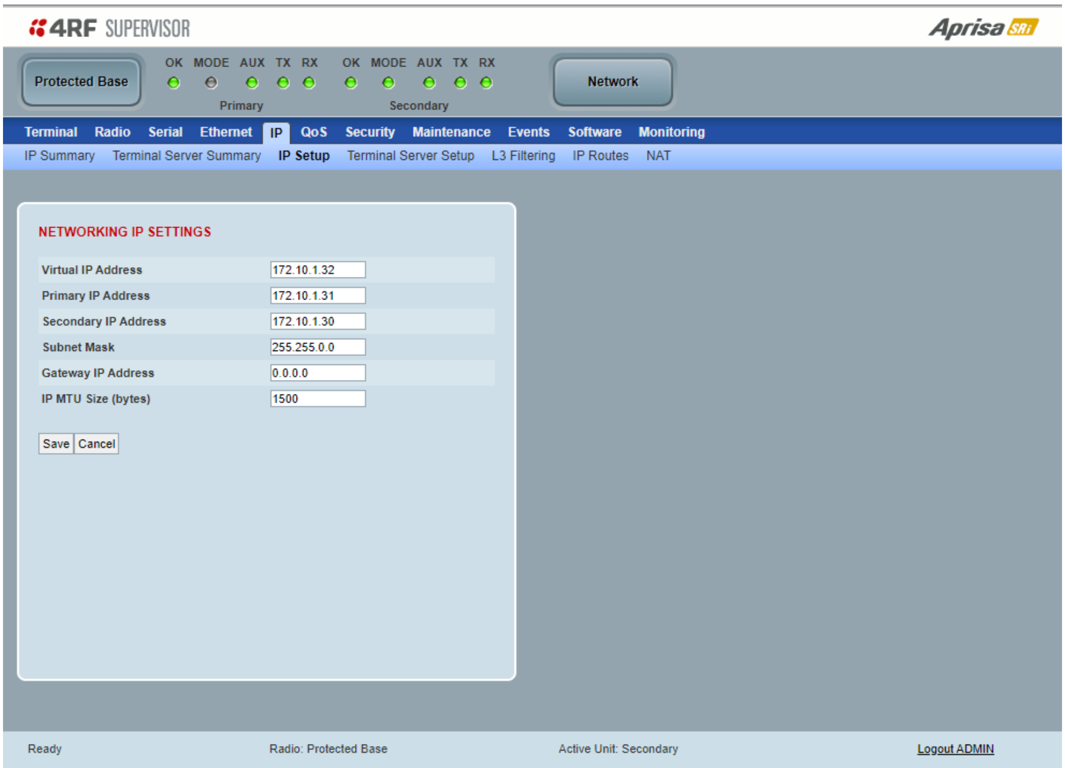
This page displays the current settings for the Protected Station Networking IP settings.



See 'IP > IP Summary > Bridge / Gateway Router Modes' on page 158 for configuration options.

Protected Station: IP > IP Setup

This page provides the setup for the Protected Station Networking IP setup.



NETWORKING IP SETTINGS

Changes in these parameters are automatically changed in the partner radio.

Virtual IP Address (PVIP)

The Protected Station Virtual IP Address (PVIP) is the IP Address of the active radio whether it is the primary radio or the secondary radio.

The PVIP is available in both bridge and router modes.

In router mode, the PVIP can be used as 'next hop' IP address by external routers to reach the protected station so the protection station switch will always be transparent to the external devices and routers.

In both bridge and router modes, the PVIP is used in terminal server mode in remote protected stations. The PVIP is used to reach the protected remote radio from the SCADA master connected to base station in terminal server mode.

Note: The radio IP address should be used for SNMP management as using the PVIP for SNMP management will result in undefined behaviour if a switchover occurs during an SNMP transaction. Thus, using PVIP for SNMP network management is not recommended.

After a switchover, new active radio owns the PVIP and will send out a gratuitous ARP to clear the MAC learning tables of upstream switches/routers.

Set the static IP Address of the PVIP using the standard format xxx.xxx.xxx.xxx. The default IP address is 0.0.0.0.

Primary IP Address

Set the static IP Address of the primary radio assigned by your site network administrator using the standard format xxx.xxx.xxx.xxx. The default IP address is in the range 169.254.50.10.

Secondary IP Address

Set the static IP Address of the secondary radio assigned by your site network administrator using the standard format xxx.xxx.xxx.xxx. The default IP address is in the range 169.254.50.20.

Subnet Mask

Set the Subnet Mask of the radio using the standard format xxx.xxx.xxx.xxx. The default subnet mask is 255.255.0.0.

Gateway

Set the Gateway address of the radio, if required, using the standard format xxx.xxx.xxx.xxx. The default Gateway is 0.0.0.0.

RADIO INTERFACE IP SETTINGS

The RF interface IP address is the address that traffic is routed to for transport over the radio link. This IP address is only used when Router Mode is selected i.e. not used in Bridge Mode.

Radio Interface IP Address

Set the IP Address of the RF interface using the standard format xxx.xxx.xxx.xxx. The default IP address is in the range 10.0.0.0.

Radio Interface Subnet Mask

Set the Subnet Mask of the RF interface using the standard format xxx.xxx.xxx.xxx. The default subnet mask is 255.255.254.0 (/23) (see Note 2 below).

Note 1: If the base station RF interface IP address is a network IP address, and if the remote radio is also using a network IP address within the same subnet or different subnet, then the base radio will assign an automatic RF interface IP address from its own subnet.

When the base radio has a host specific RF interface IP address, then all the remotes must have a host specific RF interface IP address from the same subnet.

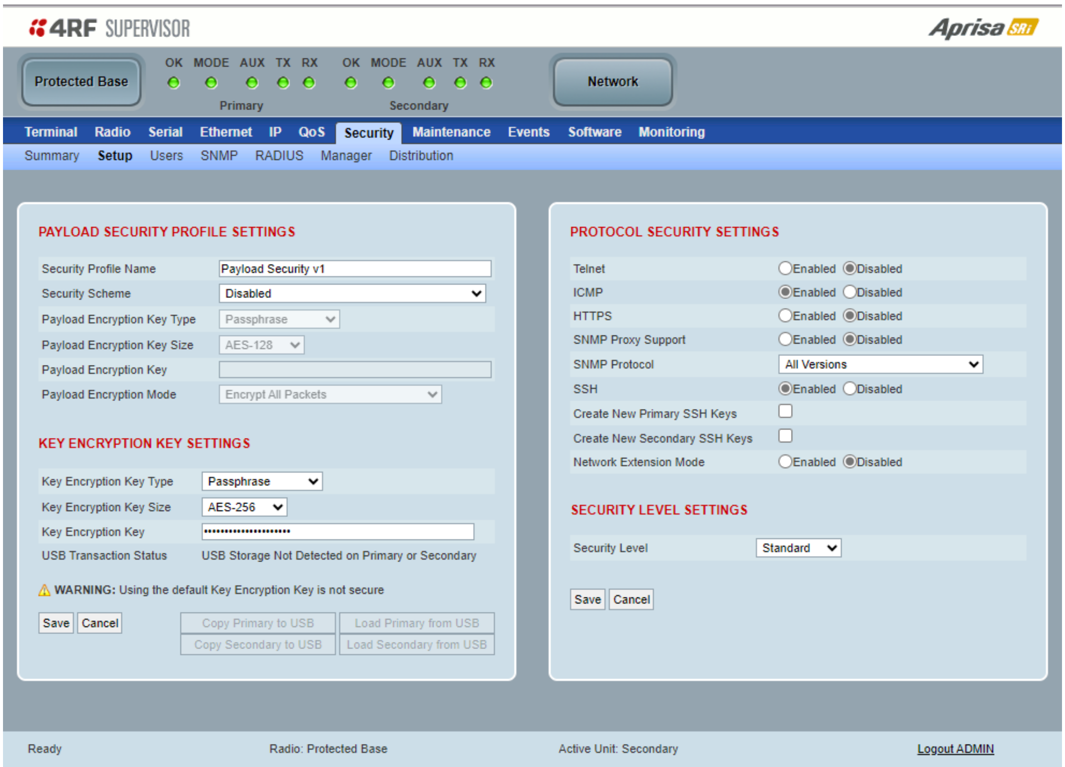
Note 2: If the user sets the RF interface IP address to a network IP address for Auto IP assignment, then the radio will ignore the Radio Interface Subnet Mask setting and use a /23 network subnet ignoring the last two octets.

Note 3: When a remote radio is configured for Router Mode and the base radio is changed from Bridge Mode to Router Mode and the RF interface IP address is set to AUTO IP configuration (at least the last octet of the RF interface IP address is zero), it is mandatory to configure the network topology by using the 'Decommission Node' and 'Discover Nodes' (see 'Maintenance > Advanced' on page 247).

Security

Protected Station: Security > Setup

This page displays the current settings for the Security parameters.



KEY ENCRYPTION KEY SETTINGS

USB Transaction Status

This parameter shows if a USB flash drive is plugged into the radio host port.

Option	Function
USB Storage Disconnected	A USB flash drive is not plugged into the radio host port.
USB Storage Connected	A USB flash drive is plugged into the radio host port.

Controls

These buttons are grayed out if a USB flash drive is not plugged into the radio host port.

The 'Load Primary From USB' button loads the Key Encryption Key settings from the primary radio USB flash drive into the primary radio.

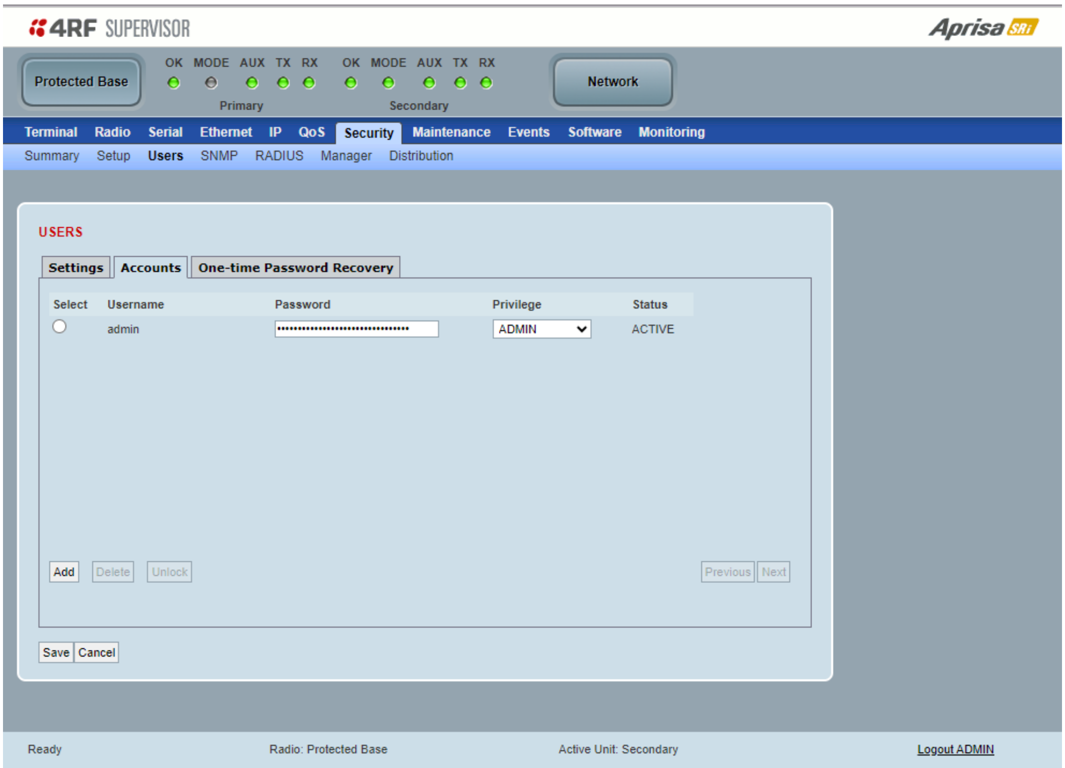
The 'Copy To Primary USB' button copies the Key Encryption Key settings from the primary radio to the primary radio USB flash drive.

The 'Load Secondary From USB' button loads the Key Encryption Key settings from the secondary radio USB flash drive into the secondary radio.

The 'Copy To Secondary USB' button copies the Key Encryption Key settings from the secondary radio to the secondary radio USB flash drive.

Protected Station: Security > Users

This page provides the management and control of the Protected Station Security Users accounts.



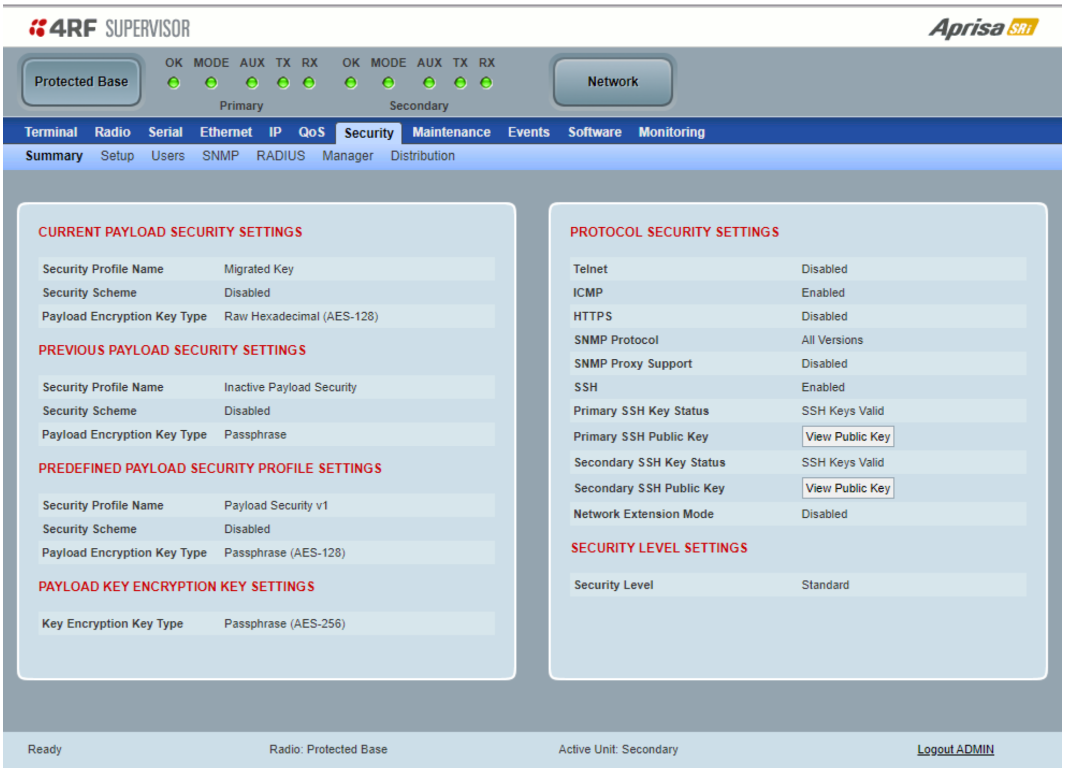
In a protected station, the 'Accounts' tab will indicate any differences between the user account configuration of the primary radio and the secondary radio.

- If the user account is only configured for one of the radios, the username will appear in red text, the password field of that account will be displayed blank.
- If the user account is configured on both radios, but the privilege settings are different, then the privilege configuration dropdown list will be surrounded by two red borders.
- If the user account is configured on both radios, but the current status of user account is different, then the status field will be displayed in red text.

When there are empty password fields on the page, the user will be required to enter a new password for each of the empty fields before saving the user configuration. Validation on this is performed and a pop up will be displayed if a password has not been entered.

Protected Station: Security > Manager

This page provides the management and control of the Protected Station Networking Security manager.



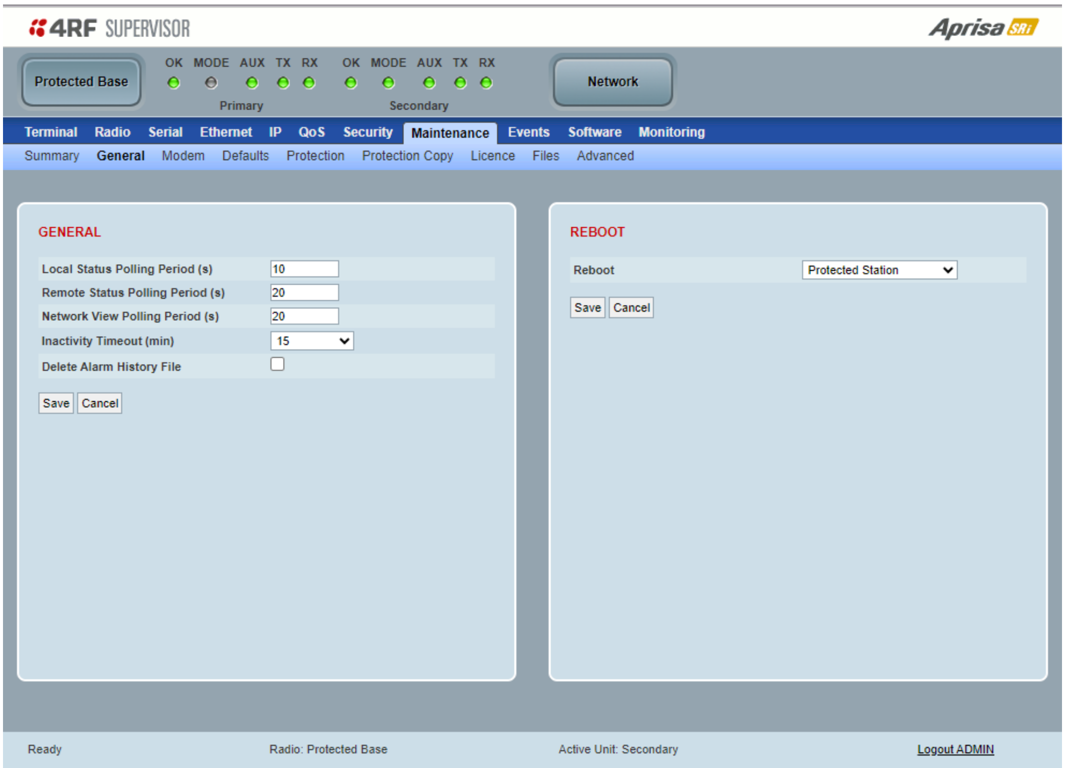
PRIMARY / SECONDARY SECURITY PROFILE

See ‘Security > Manager’ on page 228 for parameter details.

Maintenance

Protected Station: Maintenance > General

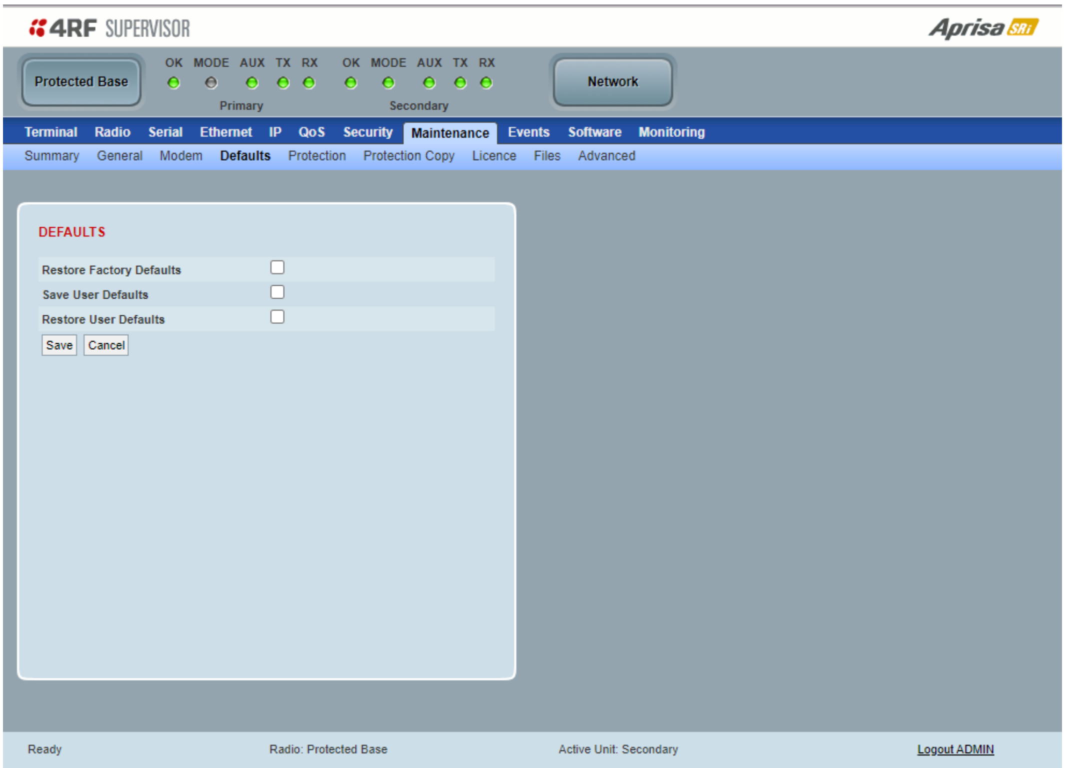
This page provides the management and control of the Protected Station Maintenance General settings.



See 'Maintenance > General' on page 235 for parameter details.

Protected Station: Maintenance > Defaults

This page provides the management and control of the Protected Station Maintenance Default settings.



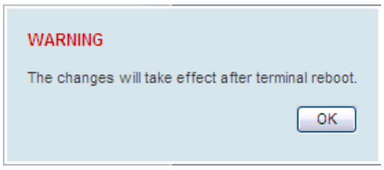
DEFAULTS

The Maintenance Defaults page is only available for the local terminal.

Restore Factory Defaults

When a radio is restored to factory defaults while installed in a protected station, the radio will default to its preconfigured protection configuration. This includes resetting the radio IP address to the default value depending on the location of the radio.

Radio Location	Protection Type	Protection Unit	Primary IP Address	Secondary IP Address	Virtual IP Address
Not in a protected station	None	Primary	169.254.50.10	0.0.0.0	0.0.0.0
Protected station radio A	Redundant	Primary	169.254.50.10	169.254.50.20	169.254.50.30
Protected station radio B	Redundant	Secondary	169.254.50.20	169.254.50.10	169.254.50.30



Note: Take care using this command.

Save User Defaults

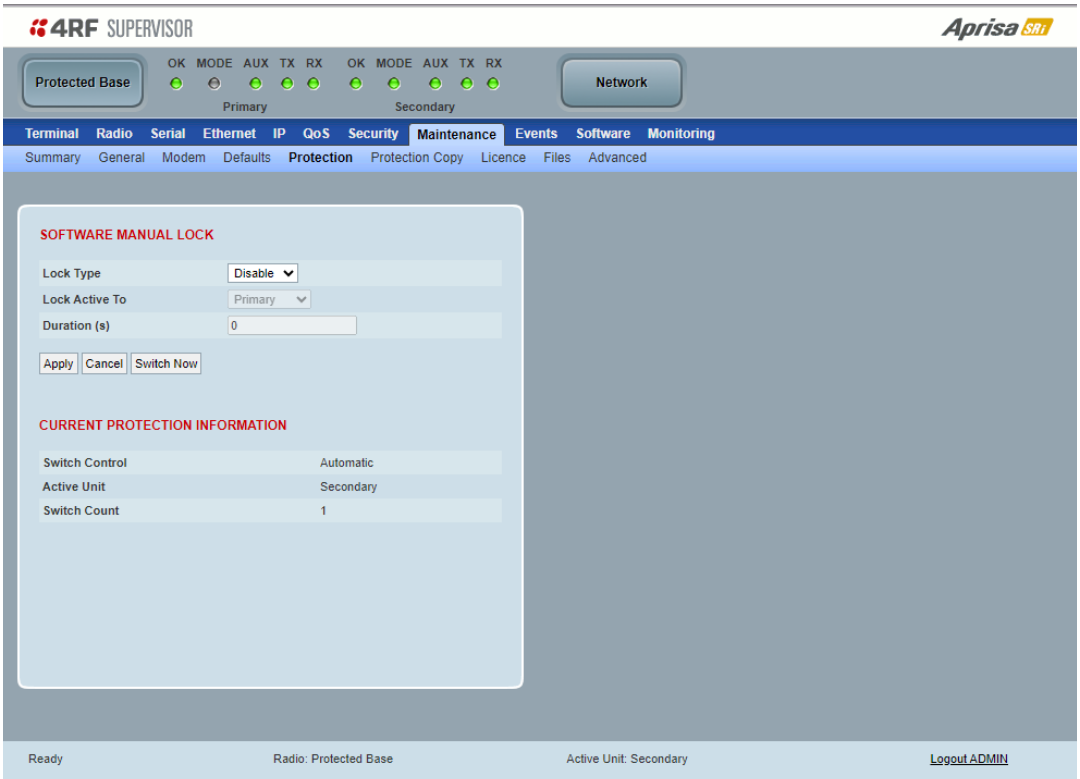
When activated, all current radio parameter settings will be saved to non-volatile memory within the radio.

Restore User Defaults

When activated, all radio parameters will be set to the settings previously saved using ‘Save User Defaults’.

Protected Station: Maintenance > Protection

This page provides the management and control of the Protected Station Maintenance Protection settings.



SOFTWARE MANUAL LOCK

The software Manual Lock is a software implementation of the Hardware Manual Lock switch on the Protection Switch.

Lock Active To

This parameter sets the Protection Switch Software Manual Lock. The Software Manual Lock only operates if the Hardware Manual Lock is deactivated (set to the Auto position).

Option	Function
Automatic	The protection is automatic and switching will be governed by normal switching and blocking criteria.
Primary	The primary radio will become active i.e. traffic will be switched to the primary radio.
Secondary	The secondary radio will become active i.e. traffic will be switched to the secondary radio.

Duration (s)

This parameter defines the period required for manually locking to the primary or secondary radios. When this period elapses, the Lock To becomes automatic.

Switch Now Button

This button forces a switchover independent of the state of Lock Type.

CURRENT PROTECTION INFORMATION

Switch Control

This parameter shows the status of the switch control i.e. which mechanism is in control of the protection switch.

Option	Function
Automatic	The protection is automatic and switching will be governed by normal switching and blocking criteria.
Software Manual Lock	The Software Manual Lock has control of the protection switch.
Hardware Manual Lock	The Hardware Manual Lock has control of the protection switch.

Active Unit

This parameter shows the radio which is currently active (Primary or Secondary).

Switch Count

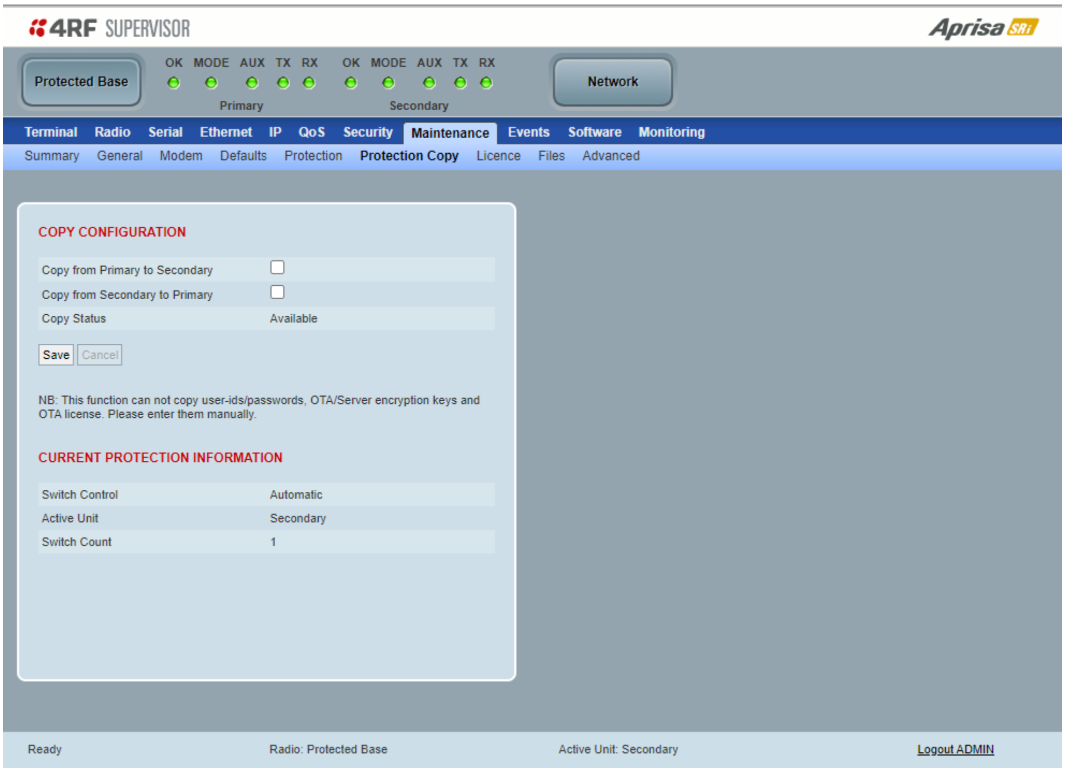
This parameter shows the number of protection switchovers since the last radio reboot (volatile).

Automatic Periodic Switch will occur in

If this parameter is visible, the Automatic Periodic Switch feature has been enabled and will show the period before the next automatic switchover.

Protected Station: Maintenance > Protection Copy

This page provides the management and control of the Protected Station Maintenance Protection Copy.



COPY CONFIGURATION

When common parameters are changed in one radio, they are automatically changed in the partner radio but if one radio has been replaced in the protected station, common parameters will need to be updated in the new radio.

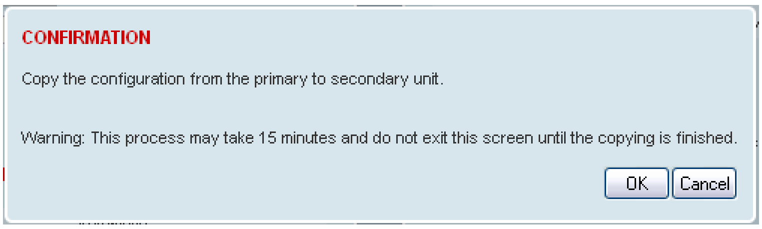
Note: This function does not copy user IDs, passwords, encryption keys or licenses. These must be entered manually.

Copy from Primary to Secondary

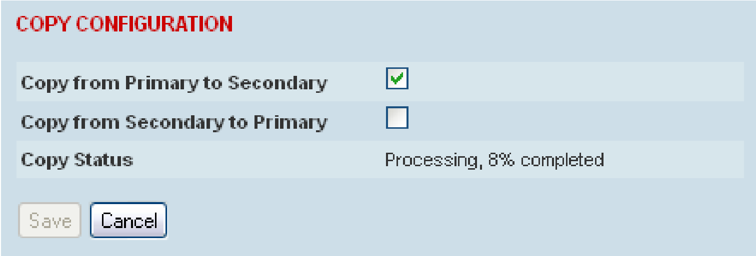
This parameter copies all common parameters from the primary to the secondary radio.

To activate copy configuration:

1. Tick the Copy from Primary to Secondary and click Save.



2. To continue, click OK.



Copy from Secondary to Primary

This parameter copies all common parameters from the secondary to the primary radio.

Copy Status

This parameter displays the status of the Copy Configuration.

Option	Function
Available	The Copy Configuration feature can be used (but not necessarily required).
Processing	The Copy Configuration feature is running and the % completed.

CURRENT PROTECTION INFORMATION

Switch Control

This parameter shows the status of the switch control i.e. which mechanism is in control of the protection switch.

Option	Function
Automatic	The protection is automatic and switching will be governed by normal switching and blocking criteria.
Software Manual Lock	The Software Manual Lock has control of the protection switch.
Hardware Manual Lock	The Hardware Manual Lock has control of the protection switch.

Active Unit

This parameter shows the radio which is currently active (Primary or Secondary).

Switch Count

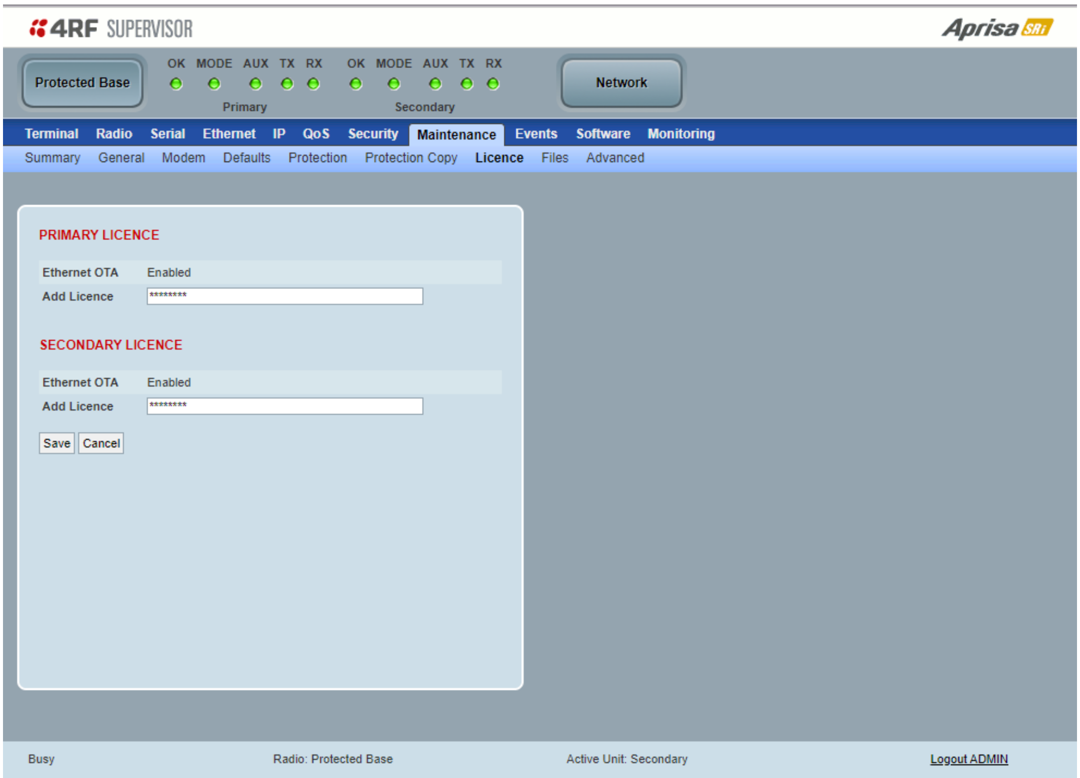
This parameter shows the number of protection switchovers since the last radio reboot (volatile).

Automatic Periodic Switch will occur in

If this parameter is visible, the Automatic Periodic Switch feature has been enabled and will show the period before the next automatic switchover.

Protected Station: Maintenance > Licence

This page provides the management and control of the Protected Station Maintenance Licence settings.

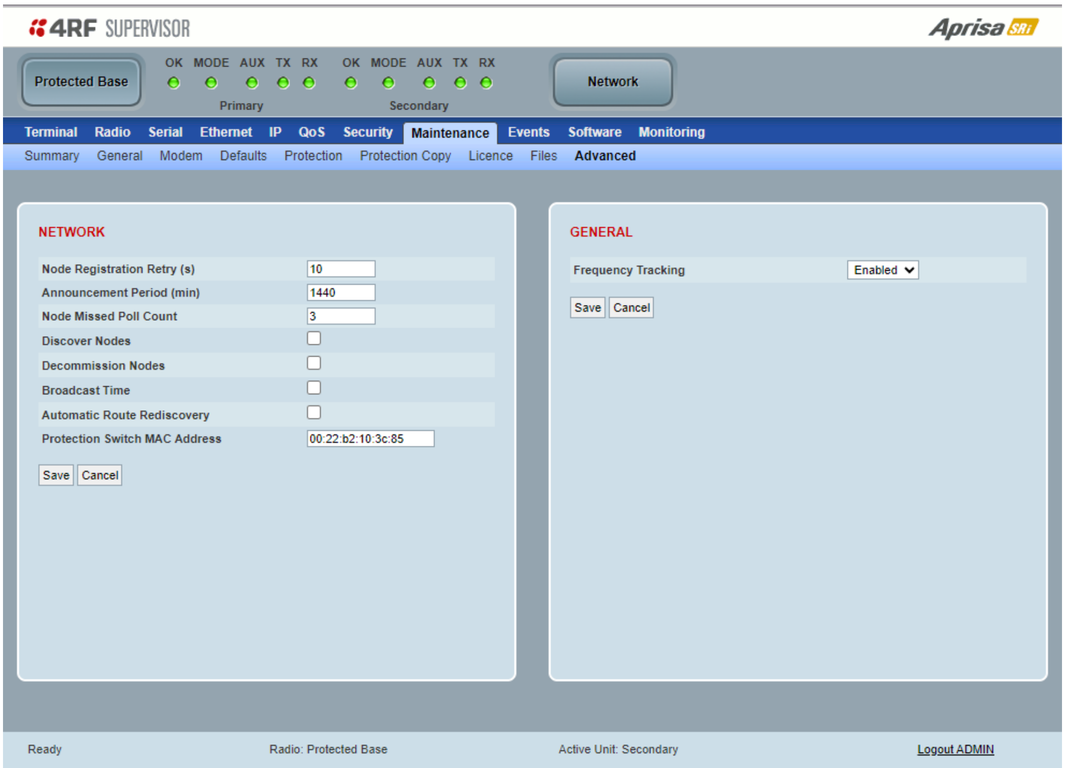


PRIMARY / SECONDARY LICENCE

See 'Maintenance > Licence' on page 241 for parameter details.

Protected Station: Maintenance > Advanced

This page provides the management and control of the Protected Station Maintenance Advanced settings.



NETWORK

See 'Maintenance > Files' on page 242 for parameter details.

Discover Nodes

This parameter, when activated triggers the base station to poll the network with Node Missed Poll Count and Node Registration Retry values.

This command only needs to be carried out on the Protected Station Active radio. This will update the network table which is shared by the Standby radio.

Decommission Node(s)

This parameter, when activated resets the network registrations to remove the entire network from service.

This command only needs to be carried out on the Protected Station Active radio. This will update the network table which is shared by the Standby radio.

Note: Take care using this option.

Protection Switch MAC address

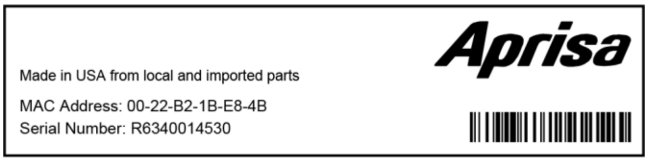
This parameter is only applicable when the radio is part of a Protected Station.

This Protection Switch MAC address is used to define the MAC address of the Protection Switch. This address is entered in the factory. Both Protected Station radios read and use this MAC address.

This MAC address entry will only be used by the software if it detects that the factory MAC address set in the internal EPROM of the protected switch is corrupted for some reason, otherwise the software will ignore the MAC address entered by the user.

The Protection Switch MAC address is used for registration process only. For example, in a remote Protected Station, both radios share the same RF MAC address, and a single entry of the remote Protected Station will be presented in network table (Network Status > Network Table).

The Protection Switch MAC address is shown on the Protection Switch label:



PRIMARY / SECONDARY CONFIGURATION

See ‘Maintenance > Advanced’ on page 247 for parameter details.

PRIMARY / SECONDARY MAINTENANCE FILES

See ‘Maintenance > Advanced’ on page 247 for parameter details.

Events

The Events menu contains the setup and management of the alarms, alarm events and traps.

Protected Station: Events > Alarm Summary

There are two types of events that can be generated on the Aprisa SRi radio. These are:

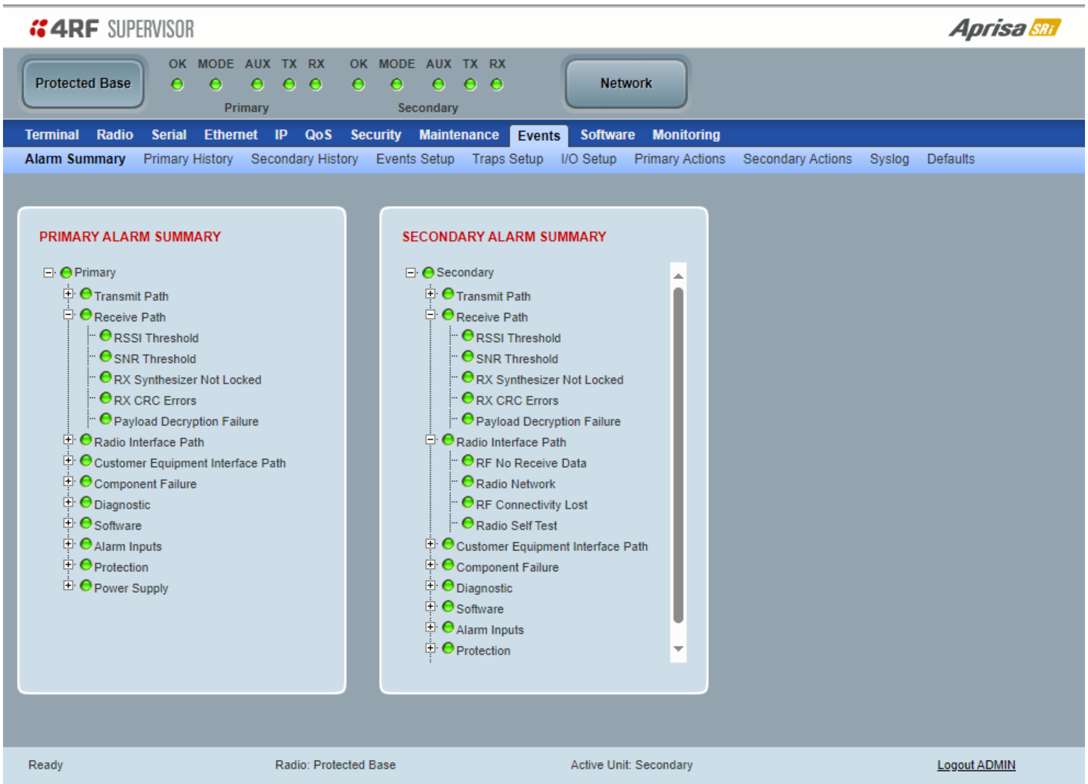
1. Alarm Events

Alarm Events are generated to indicate a problem on the radio.

2. Informational Events

Informational Events are generated to provide information on key activities that are occurring on the radio. These events do not indicate an alarm on the radio and are used to provide information only.

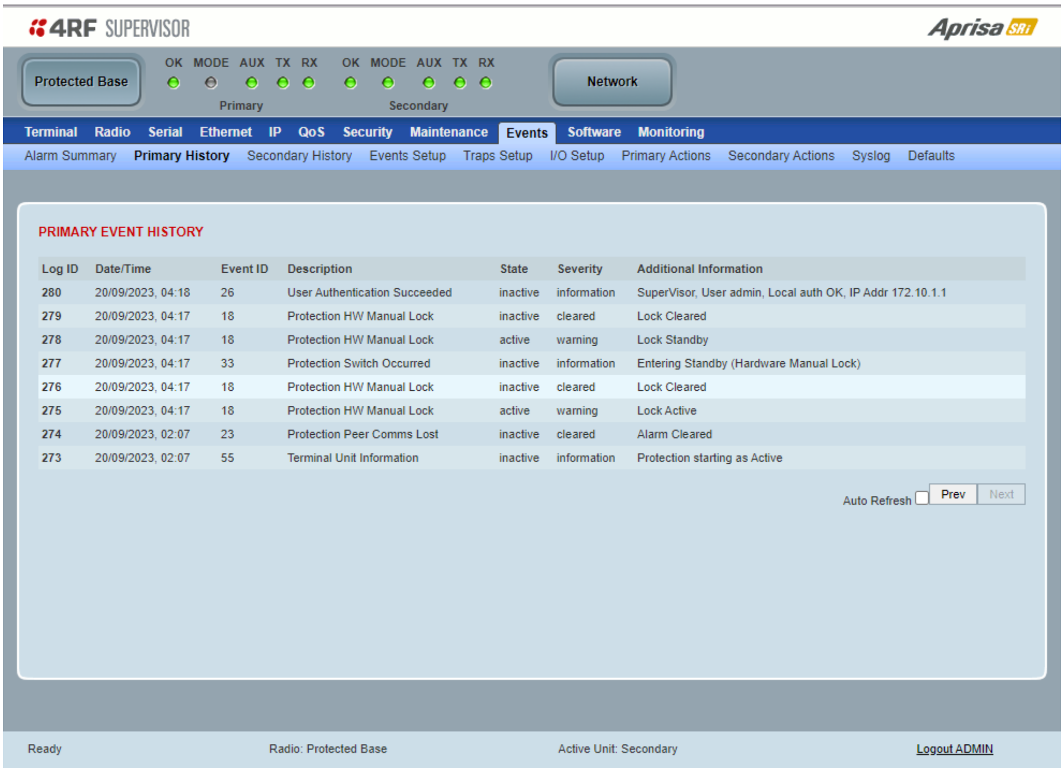
See 'Alarm Types and Sources' on page 402 for a complete list of events.



PRIMARY / SECONDARY ALARM SUMMARY

See 'Events > Alarm Summary' on page 249 for parameter details.

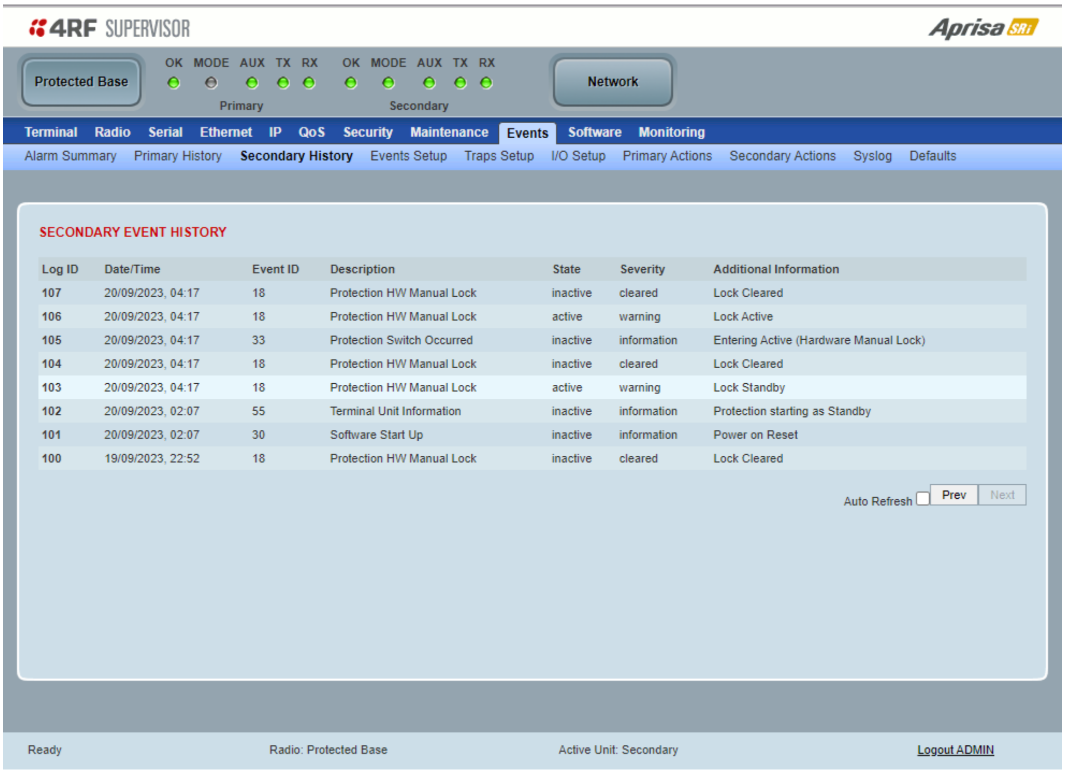
Protected Station: Events > Primary History



PRIMARY EVENT HISTORY

See 'Events > Event History' on page 250 for parameter details.

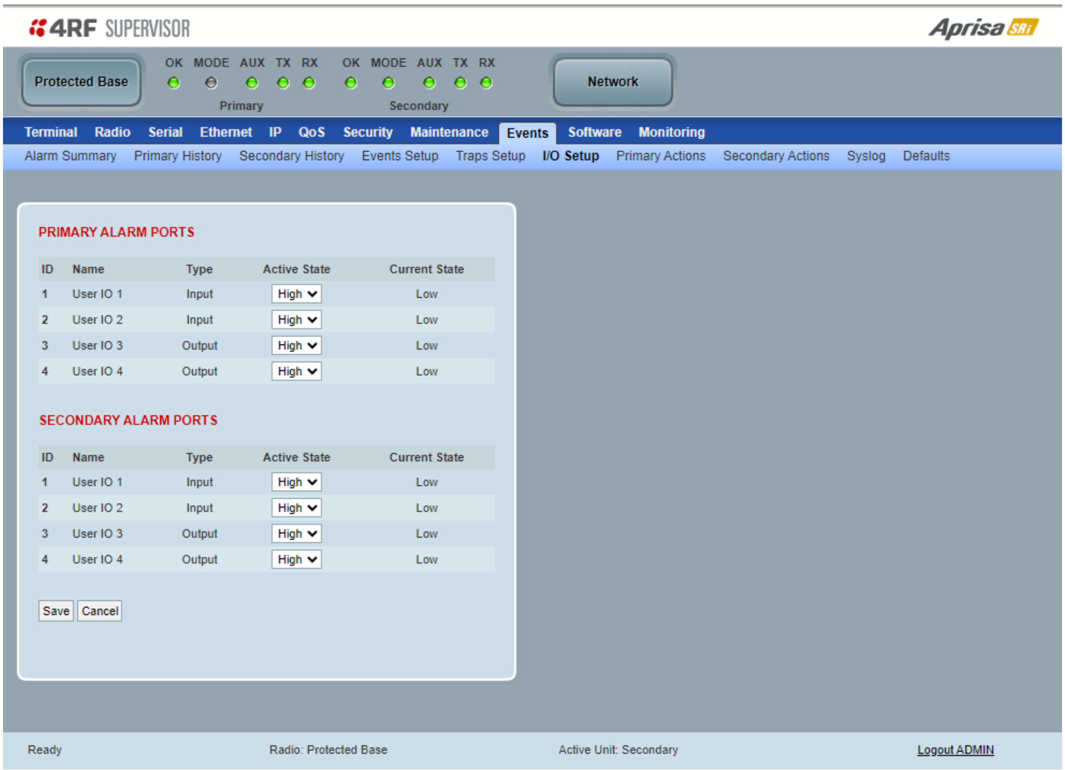
Protected Station: Events > Secondary History



SECONDARY EVENT HISTORY

See 'Events > Event History' on page 250 for parameter details.

Protected Station: Events > I/O Setup



PRIMARY / SECONDARY ALARM PORTS

The alarm ports on a protected station are not switched. Each individual Alarm I/O goes directly to each radio. Both the Primary Alarm Ports and a Secondary Alarm Ports need to be configured.

See 'Events > Alarm I/O Setup' on page 255 for parameter details.

Software

The Software menu contains the setup and management of the system software including network software distribution and activation on a protected station.

Single Radio Software Upgrade

The radio software can be upgraded on a single radio single Aprisa SRi radio (see ‘Single Radio Software Upgrade’ on page 397). This process would only be used if the radio was a replacement or a new station in an existing network.

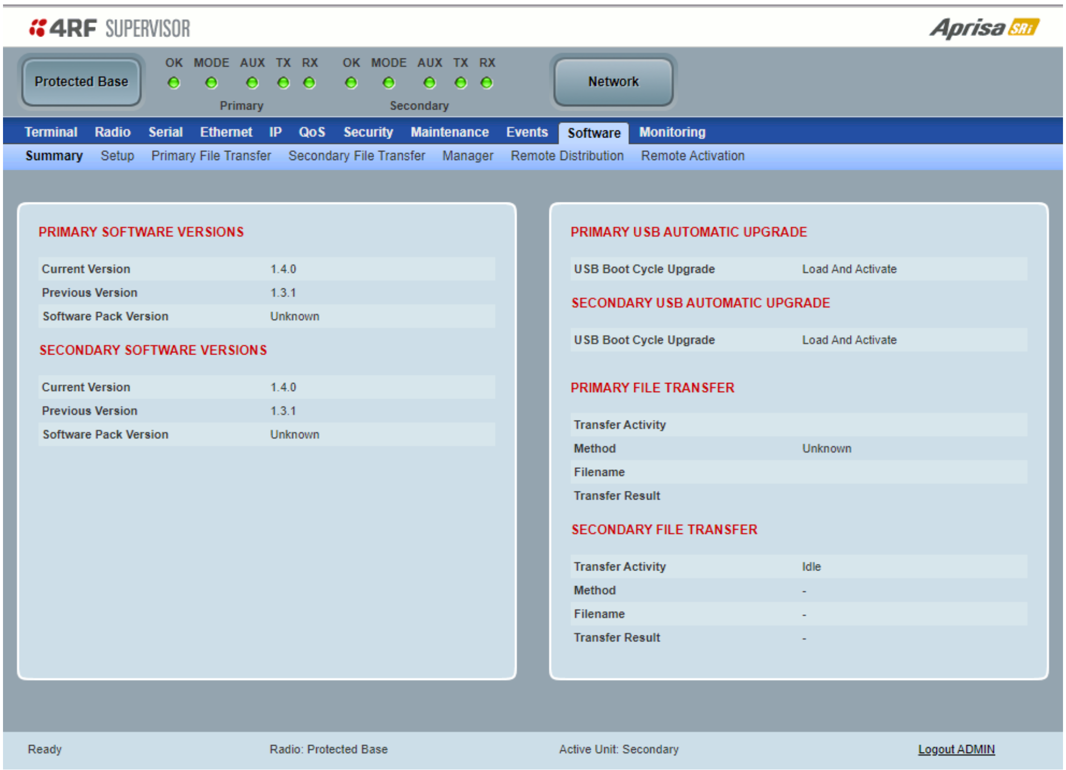
Network Software Upgrade

The radio software can be upgraded on an entire Aprisa SRi radio network remotely over the radio link (see ‘Network Software Upgrade’ on page 393). This process involves the following steps:

1. Transfer the new software to base station primary radio with ‘Protected Station: Software > Primary File Transfer’.
2. File Transfer the new software to base station secondary radio with ‘Protected Station: Software > Secondary File Transfer’.
3. Using the Software Manual Lock, manually lock all protected remotes to the currently active radio (this is necessary to prevent automatic switching during the distribution and activation process).
4. Distribute the new software to all remote radios with ‘Protected Station: Software > Remote Distribution’. Note: The software pack in the base station active radio is used for distribution.
5. Activate of the new software on remote radios with ‘Protected Station: Software > Remote Activation’.
6. Finally, activate the new software on the base station primary and secondary radios. Note: activating the software will reboot the radio which will reset the Software Manual Lock to Automatic.

Protected Station: Software > Summary

This page provides a summary of the software versions installed on the radio, the setup options and the status of the File Transfers.

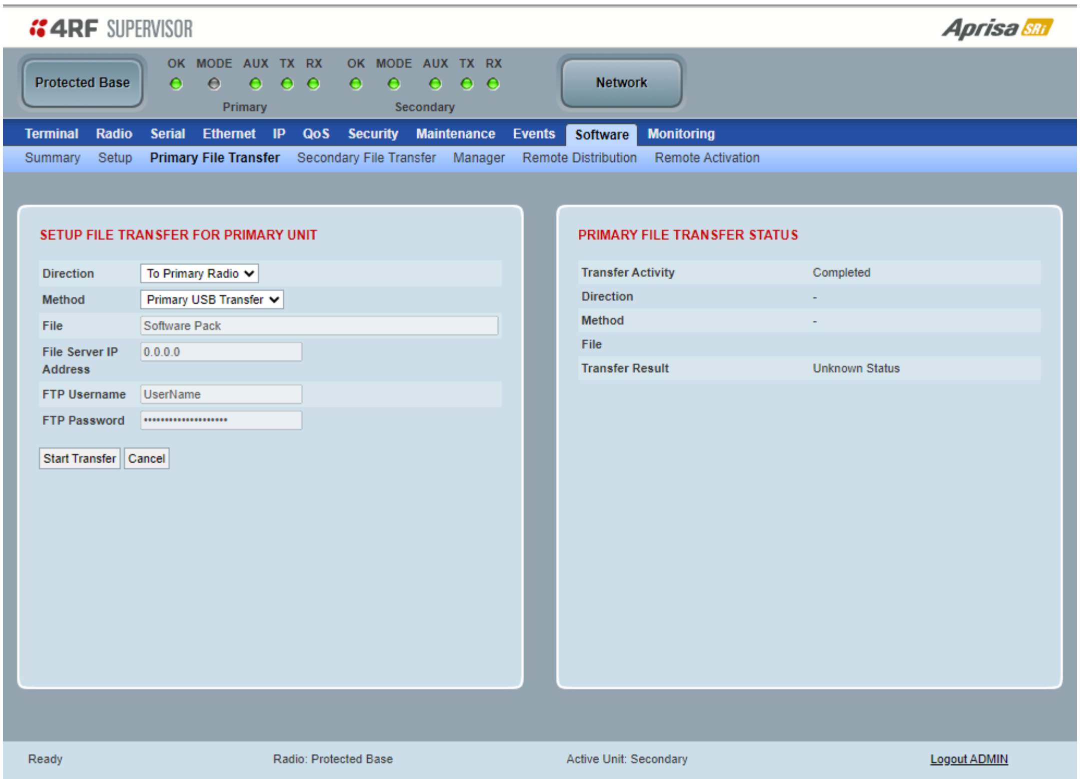


PRIMARY / SECONDARY SOFTWARE VERSIONS

See ‘Protected Station: Software > Primary File Transfer’ and ‘Protected Station: Software > Secondary File Transfer’ for parameter details.

Protected Station: Software > Primary File Transfer

This page provides the mechanism to transfer new software from a file source into the primary radio.



SETUP FILE TRANSFER FOR PRIMARY UNIT

Direction

This parameter sets the direction of file transfer. In this software version, the only choice is 'To Primary Radio'.

Method

This parameter sets the method of file transfer.

Option	Function
Primary USB Transfer	Transfers the software from the USB flash drive to the primary radio.
FTP	Transfers the software from an FTP server to the primary radio.
HTTP	Transfers the software from a PC to the primary radio.
Transfer from Secondary Unit	Transfers the software from the secondary radio to the primary radio. This function is only available when the Protected Station is not a Base Station.

PRIMARY FILE TRANSFER STATUS

See 'Software > File Transfer' on page 266 for parameter details.

To transfer software into the Aprisa SRi primary radio:

Primary USB Transfer Method

1. Unzip the software release files into the root directory of a USB flash drive.
2. Insert the USB flash drive into the primary radio host port .
3. Click on 'Start Transfer'.

FILE TRANSFER STATUS	
Transfer Activity	In Progress
Direction	To This Radio
Method	USB Transfer
File	Software Pack
Transfer Result	In Progress (30%)

4. When the transfer is completed, remove the USB flash drive from the primary radio host port. If the SuperVisor 'USB Boot Upgrade' setting is set to 'Disabled' (see 'USB Boot Upgrade' on page 265), the USB flash drive doesn't need to be removed as the radio won't try to load from it.
5. Go to 'Protected Station: Software > Manager' on page 352 to activate the Software Pack. The radio will reboot automatically.

FTP Method

1. Unzip the software release files into a temporary directory.
2. Open the FTP server and point it to the temporary directory.
3. Enter the FTP server IP address, username, and password into SuperVisor.
4. Click on 'Start Transfer'.

FILE TRANSFER STATUS	
Transfer Activity	In Progress
Direction	To This Radio
Method	FTP (172.17.10.11)
File	Software Pack
Transfer Result	In Progress (1%)

5. Go to 'Protected Station: Software > Manager' on page 352 to activate the Software Pack. The radio will reboot automatically.

Transfer from Secondary Unit

1. Select Transfer from Secondary Unit.
2. Click on ‘Start Transfer’.

SECONDARY FILE TRANSFER STATUS

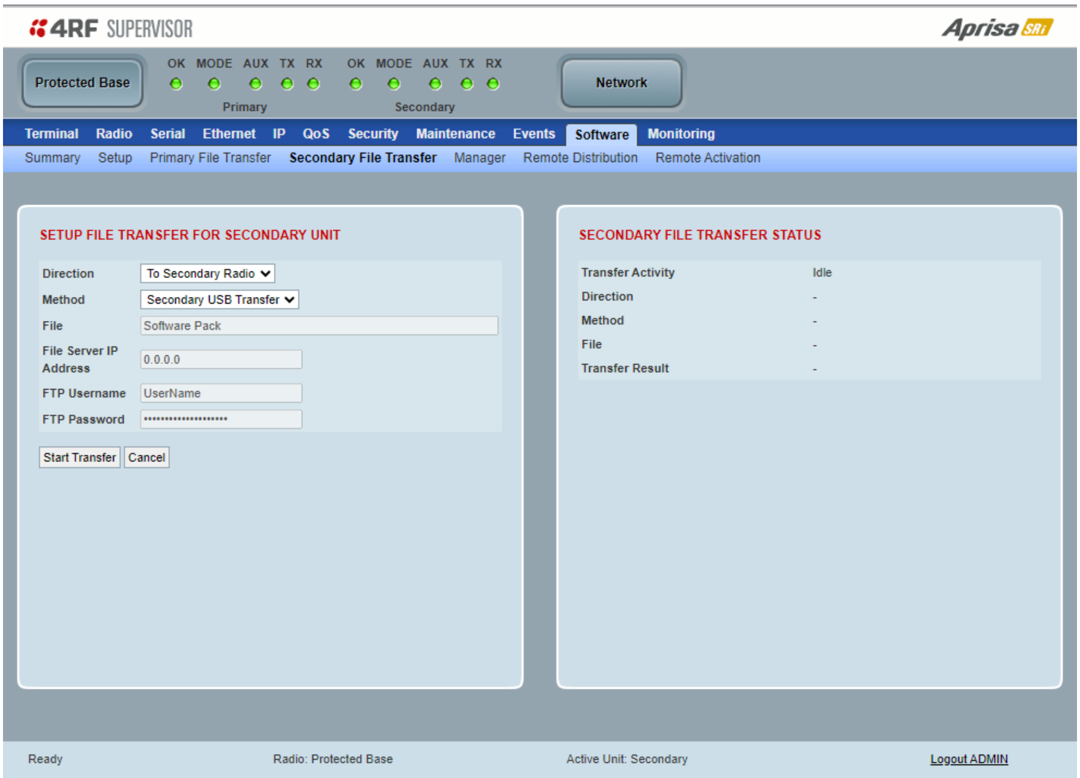
Transfer Activity	In Progress
Direction	To This Radio
Method	Protected Partner Transfer
File	Software Pack
Transfer Result	Starting Transfer

3. Go to ‘Protected Station: Software > Manager’ on page 352 to activate the Software Pack. The radio will reboot automatically.

If the file transfer fails, check the Event History page (see ‘Protected Station: Events > Secondary History’ on page 342) for more details of the transfer.

Protected Station: Software > Secondary File Transfer

This page provides the mechanism to transfer new software from a file source into the secondary radio.



SETUP FILE TRANSFER FOR SECONDARY UNIT

Direction

This parameter sets the direction of file transfer. In this software version, the only choice is ‘To Secondary Radio’.

Method

This parameter sets the method of file transfer.

Option	Function
Secondary USB Transfer	Transfers the software from the USB flash drive to the secondary radio.
FTP	Transfers the software from an FTP server to the secondary radio.
HTTP	Transfers the software from a PC to the secondary radio.
Transfer from Primary Unit	Transfers the software from the primary radio to the secondary radio. This function is only available when the Protected Station is not a Base Station.

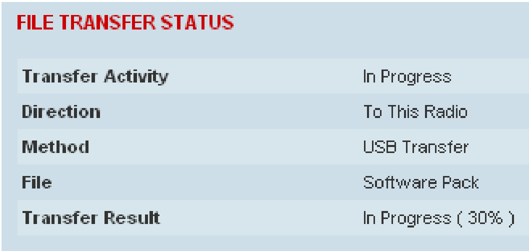
SECONDARY FILE TRANSFER STATUS

See ‘Software > File Transfer’ on page 266 for parameter details.

To transfer software into the Aprisa SRi secondary radio:

Secondary USB Transfer Method

1. Unzip the software release files in to the root directory of a USB flash drive.
2. Insert the USB flash drive into the secondary radio host port .
3. Click on 'Start Transfer'.



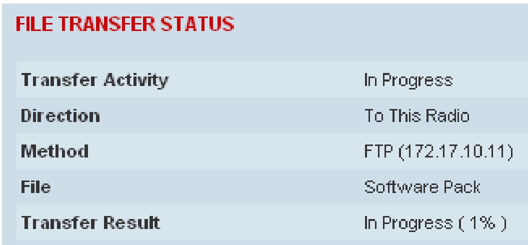
FILE TRANSFER STATUS

Transfer Activity	In Progress
Direction	To This Radio
Method	USB Transfer
File	Software Pack
Transfer Result	In Progress (30%)

4. When the transfer is completed, remove the USB flash drive from the secondary radio host port. If the SuperVisor 'USB Boot Upgrade' setting is set to 'Disabled' (see 'USB Boot Upgrade' on page 265), the USB flash drive doesn't need to be removed as the radio won't try to load from it.
5. Go to 'Protected Station: Software > Manager' on page 352 to activate the Software Pack. The radio will reboot automatically.

FTP Method

1. Unzip the software release files in to a temporary directory.
2. Open the FTP server and point it to the temporary directory.
3. Enter the FTP server IP address, Username and password into SuperVisor.
3. Click on 'Start Transfer'.



FILE TRANSFER STATUS

Transfer Activity	In Progress
Direction	To This Radio
Method	FTP (172.17.10.11)
File	Software Pack
Transfer Result	In Progress (1%)

4. Go to 'Protected Station: Software > Manager' on page 352 to activate the Software Pack. The radio will reboot automatically.

Transfer from Primary Unit

1. Select Transfer from Primary Unit.
2. Click on 'Start Transfer'.

SECONDARY FILE TRANSFER STATUS

Transfer Activity	In Progress
Direction	To This Radio
Method	Protected Partner Transfer
File	Software Pack
Transfer Result	Starting Transfer

3. Go to 'Protected Station: Software > Manager' on page 352 to activate the Software Pack. The radio will reboot automatically.

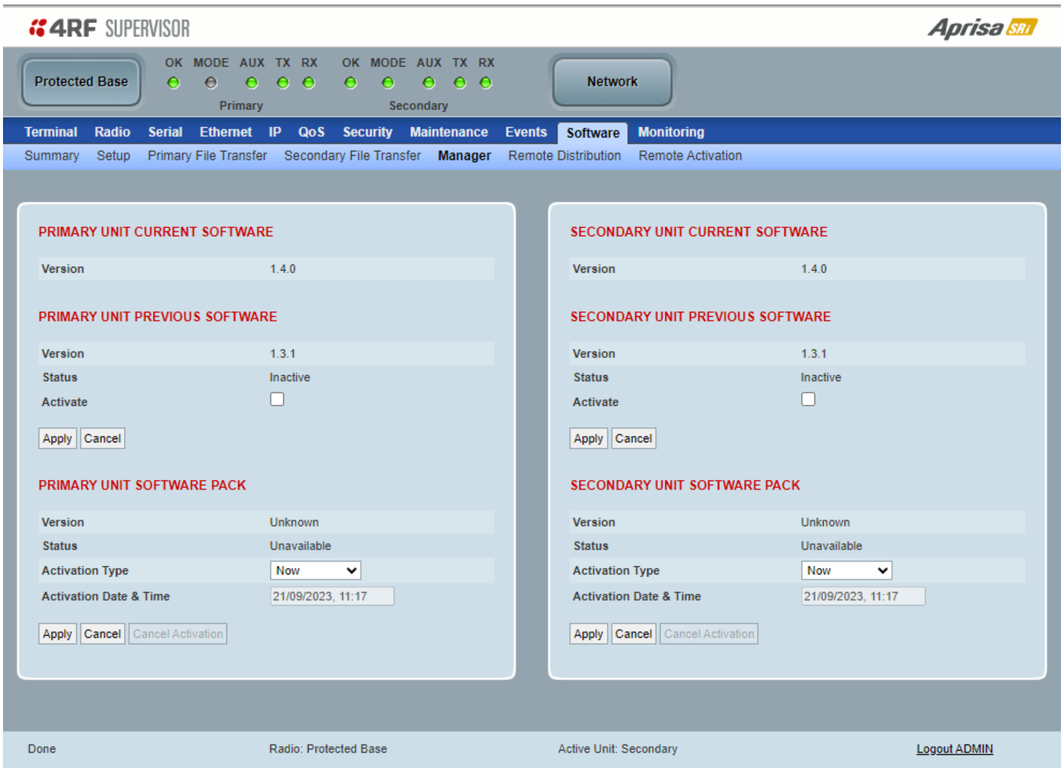
If the file transfer fails, check the Event History page (see 'Protected Station: Events > Primary History' on page 341) for more details of the transfer.

Protected Station: Software > Manager

This page summaries and manages the software versions available in the primary and secondary radios.

The manager is predominantly used to activate new software on single radios. Network activation is performed with ‘Protected Station: Software > Remote Activation’.

Both the previous software (if available) and Software Pack versions can be activated on each radio from this page.



PRIMARY / SECONDARY CURRENT SOFTWARE

Version

This parameter displays the software version running on the radio.

PRIMARY / SECONDARY PREVIOUS SOFTWARE

Version

This parameter displays the software version that was running on the radio prior to the current software being activated.

Status

This parameter displays the status of the software version running on the radio.

Option	Function
Active	The software is operating the radio.
Inactive	The software is not operating the radio but could be re-activated if required.

PRIMARY / SECONDARY SOFTWARE PACK

Version

This parameter displays the software pack version available for distribution on base station and activate on all stations.

Status

This parameter displays the status of the software pack version.

Option	Function
Available	On the base station, the software pack is available for distribution. On all stations, the software pack is available for activation.
Activating	The software pack is activating in the radio.
Unavailable	There is no software pack loaded into the radio.

Activate

See ‘Software > Manager’ on page 270 for the activation options.

Protected Station: Software > Remote Distribution

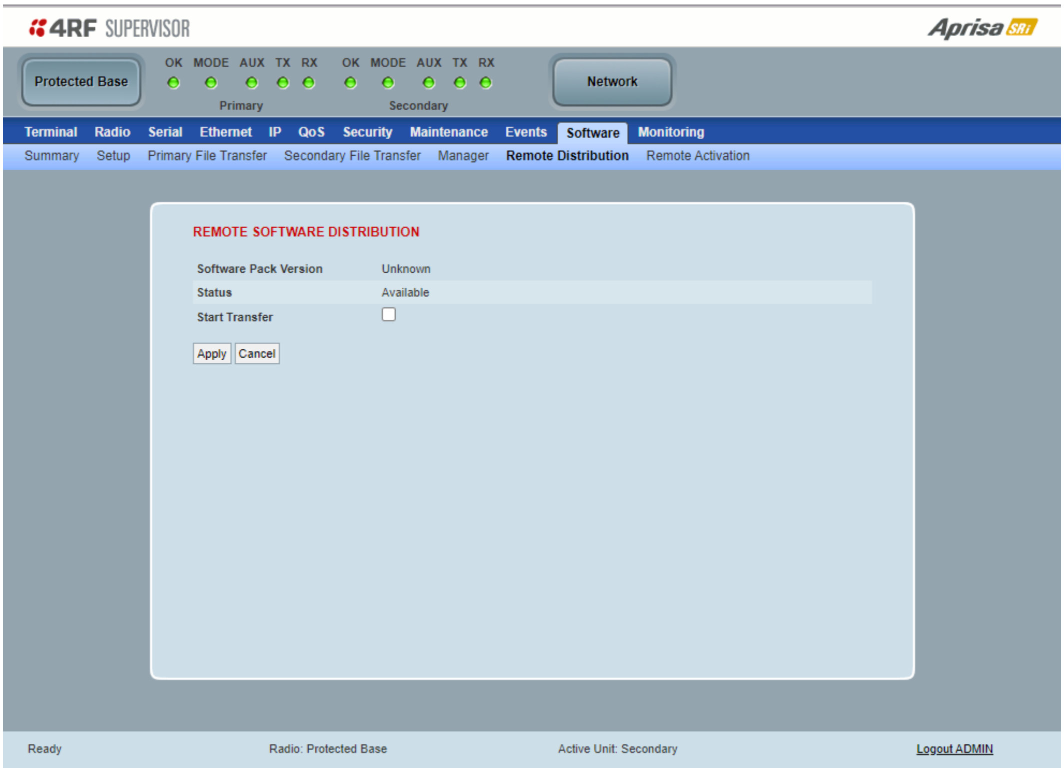
This page provides the mechanism to distribute software to all remote protected stations into the Aprisa SRi network (network) and then activate it.

The Software Pack loaded into the base station with the file transfer process (see 'Protected Station: Software > Primary File Transfer' on page 346) is distributed via the radio link to all remote radios from the active radio.

The distribution process is monitored from this page.

When all remote radios receive the Software Pack version, the software can be remotely activated on all remote radios.

This page is only available when the radio is configured as a Base Station.



REMOTE SOFTWARE DISTRIBUTION

Software Pack Version

This parameter displays the software pack version available for distribution on base station and activate on all stations.

Status

This parameter displays the status of the software pack version.

If a Software Pack is not available, the status will display 'Unavailable' and the software distribution mechanism will not work.

Start Transfer

This parameter when activated distributes (broadcasts) the new Software Pack to all remote radios in the network.

Note: The distribution of software to remote radios does not stop customer traffic from being transferred. However, due to the volume of traffic, the software distribution process may affect customer traffic.

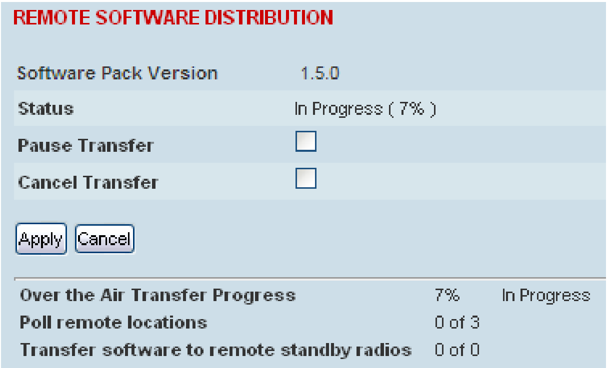
The impact of software distribution traffic upon customer traffic is controlled by two settings. The traffic uses the ‘Default Management Data Priority’ QoS setting, and the rate of packets at this priority is controlled with the ‘Background Bulk Data Transfer Rate’ setting in Radio > Channel Setup.

To distribute software to remote radios:

This process assumes that a Software Pack has been loaded into the base station with the file transfer process (see ‘Protected Station: Software > Primary File Transfer’ on page 346).

1. Distribution is performed only to the radios listed in the Network Table and powered on. If a radio is listed in the network table, but cannot be contacted, it will slow down the distribution of software.

   To ensure that the Network Table is up to date, it is recommended running the node discover function (see ‘Discover Nodes’ on page 247).
2. Click on ‘Start Transfer’.



Note: This process could take anywhere between 40 minutes and several hours depending on channel size, Ethernet Management Priority setting and the amount of customer traffic on the network.

Result	Function
Over the Air Transfer Progress	The percentage of the software pack that has been broadcast to the remote radios.
Poll Remote Locations	X is the number of radios polled to determine the number of standby radios. Y is the number of remote radios registered with the base station.
Transfer software to remote standby radios	X is the number of standby radios with the new software version. Y is the number of standby radios requiring the new software version.

3. When the distribution is completed, activate the software with the Remote Software Activation.

Pause Transfer

This parameter when activated, pauses the Over the Air Transfer Process and shows the distribution status. The distribution process will continue from where it was paused with Resume Transfer.

Cancel Transfer

This parameter when activated, cancels the Over the Air Transfer Process immediately.

During the distribution process, it is possible to navigate away from this page and come back to it to check progress. The SuperVisor session will not timeout.

Protected Station: Software > Remote Activation

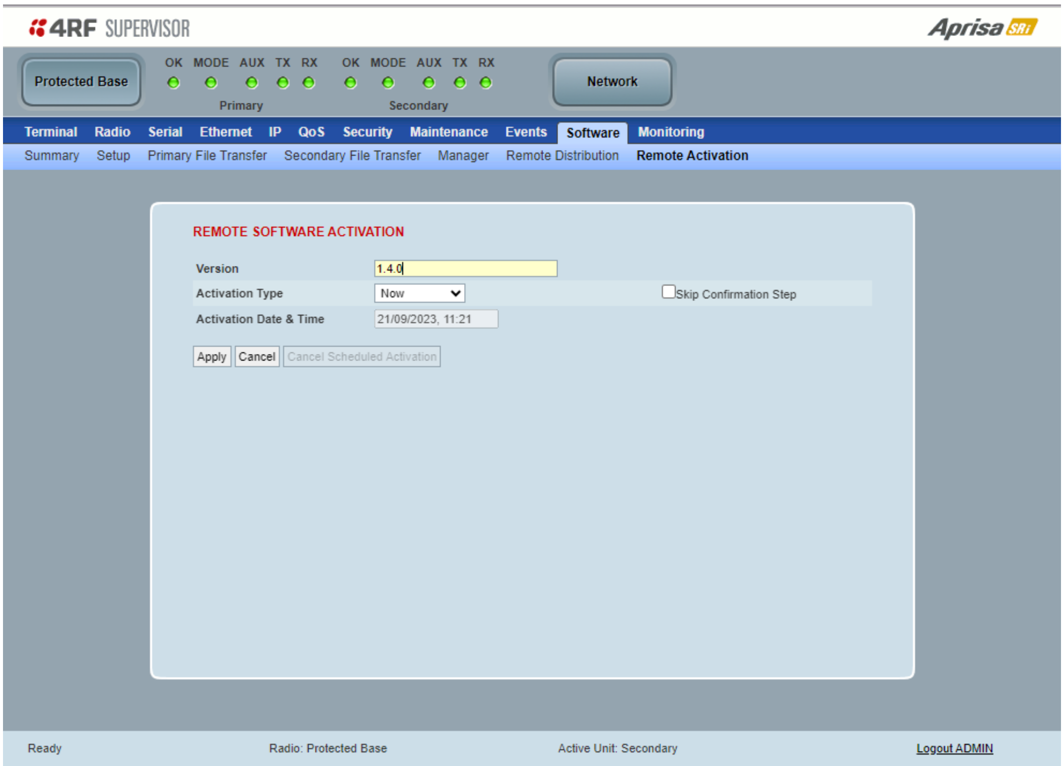
This page provides the mechanism to activate software on all remote protected stations.

The Software Pack has been loaded into the base station with the file transfer process (see 'Protected Station: Software > Primary File Transfer' on page 346) and distributed via the radio link to all remote radios from the active radio.

When all remote radios receive the Software Pack version, the software can be remotely activated on all remote radios.

The activation process is monitored by this page.

This page is only available when the radio is configured as a Base Station.



REMOTE SOFTWARE ACTIVATION

When the software pack version has been distributed to all the remote radios, the software is then activated in all the remote radios with this command. If successful, then activate the software pack in the base station to complete the network upgrade.

Version

This parameter displays the software version for activation. The default version is the software pack version but any valid software version can be entered in the format 'n.n.n'.

Activation Type

This parameter sets when the software pack activation will occur.

Option	Function
Now	Activates the software pack now.
Date & Time	Activates the software pack at the Date & Time set in the following parameter.

Activation Date & Time

This parameter sets the Date & Time when the software pack activation will occur.

This setting can be any future date and 24 hour time.

Skip Confirmation Step

This parameter when enabled skips the confirmation step during the activation process.

Normally, the confirmation step will require use intervention to accept the confirmation which will halt the activation process. Skipping the confirmation will enable the activation process to continue without use intervention.

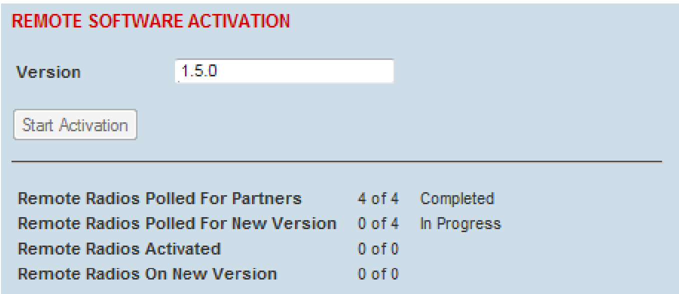
To activate software in remote radios:

This process assumes that a Software Pack has been loaded into the base station with the file transfer process (see 'Software > File Transfer' on page 266) and that distributed to all remote radios in the network.

Note: Do not navigate SuperVisor away from this page during the activation process (SuperVisor can lose PC focus).

---

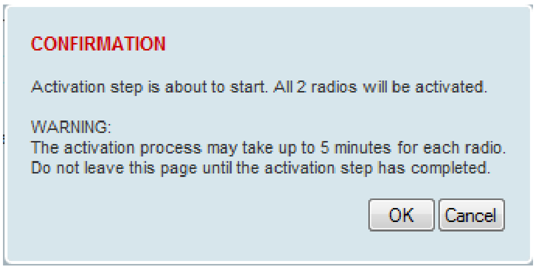
1. Enter the Software Pack version (if different from displayed version).
2. See 'Software > Manager' on page 270 for the activation options.



The remote radios will be polled to determine which radios require activation:

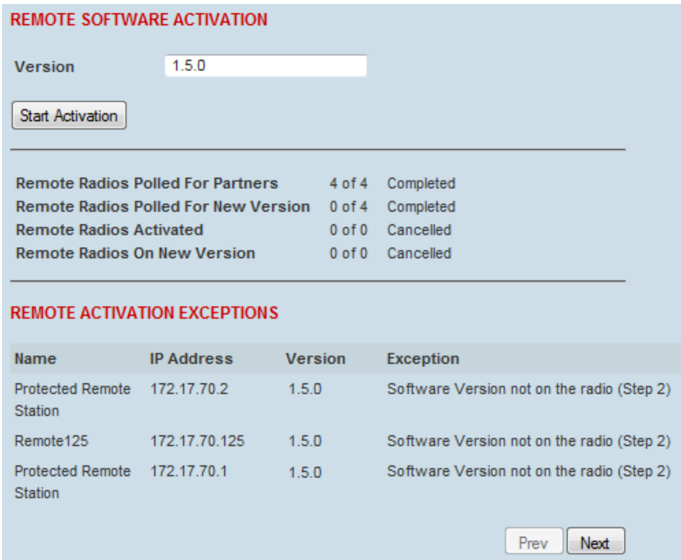
Result	Function (X of Y)
Remote Radios Polled for Partners	X is the number of radios polled to determine the number of protected stations in the network. Y is the number of remote radios registered with the base station.
Remote Radios Polled for New Version	X is the number of radios polled to determine the number of radios that contain the new software version. Y is the number of remote radios registered with the base station.
Remote Radios Activated	X is the number of radios that contain the new software version and have been activated. Y is the number of radios that contain the new software version and can be activated.
Remote Radios On New Version	X is the number of radios that has been successfully activated and now running the new version of software. Y is the number of radios that the activation command was executed on.

When the activation is ready to start:



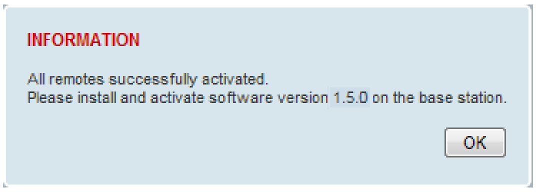
3. Click on ‘OK’ to start the activation process or Cancel to quit.

The page will display the progress of the activation.



The example shows that during the activation process there were exceptions that may need to be investigated.

When all the remote radios have been activated, the base station radio must now be activated with (see ‘Software > Manager’ on page 270).



4. Click on ‘OK’ to start the activation on the base station.

Command Line Interface

The Aprisa radio has a Command Line Interface (CLI) which provides basic product setup and configuration. This can be useful if you need to confirm the radio's IP address, for example.

You can password-protect the Command Line Interface to prevent unauthorized users from modifying radio settings.

This interface can be accessed via;

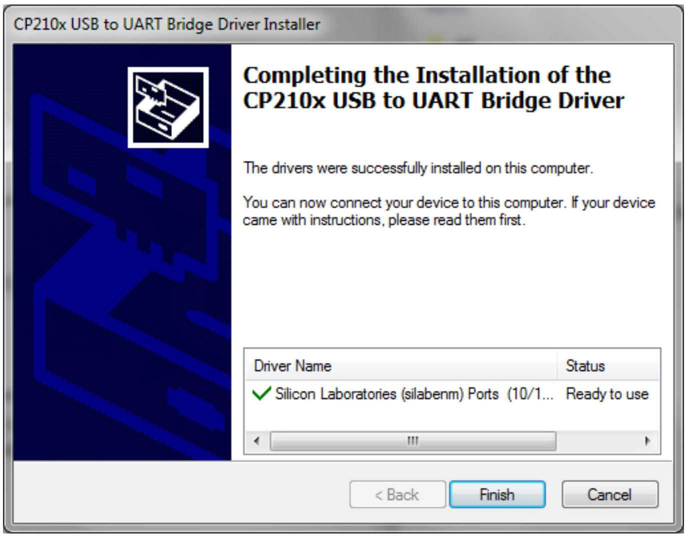
- USB via the Management Port (MGMT USB micro type B) or the USB host port (USB type A) with a USB converter to RS-232 convertor.
- Telnet via the Ethernet Port (RJ45) using standard TCP/UDP port 23.
- Secure Shell (SSH) application via the Ethernet Port (RJ45) using standard TCP/UDP port 22.

Connecting to the CLI via the Management Port (MGMT)

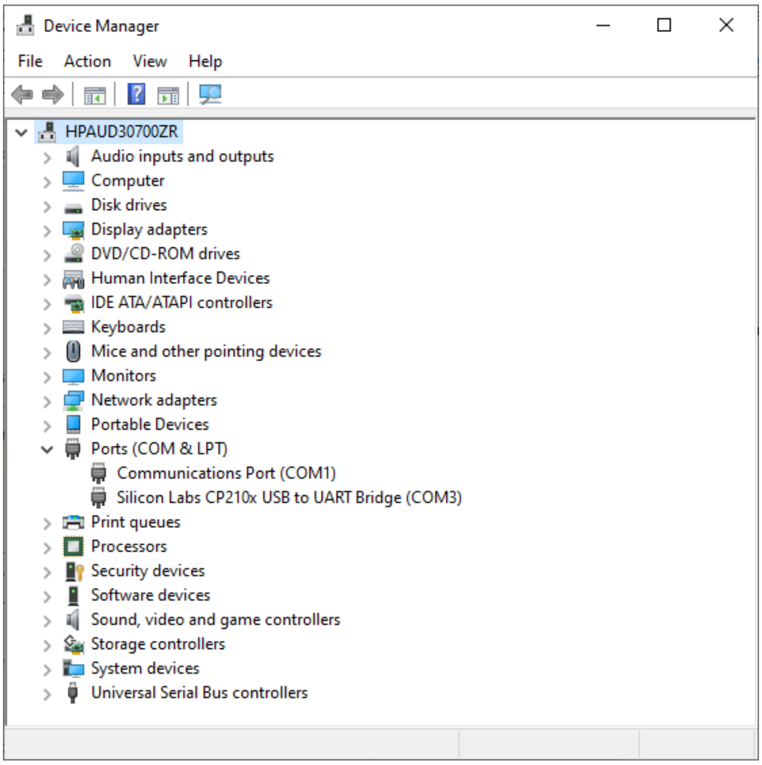
1. Connect the USB A to your computer USB port and the USB micro B to the management port of the Aprisa radio (MGMT).
2. USB to UART Bridge VCP Drivers are required to connect the radio USB port to your PC. You can download and install the relevant driver from;

   https://www.silabs.com/products/development-tools/software/usb-to-uart-bridge-vcp-drivers

   Unzip the USB serial driver to a temporary location and install the appropriate driver on your computer.



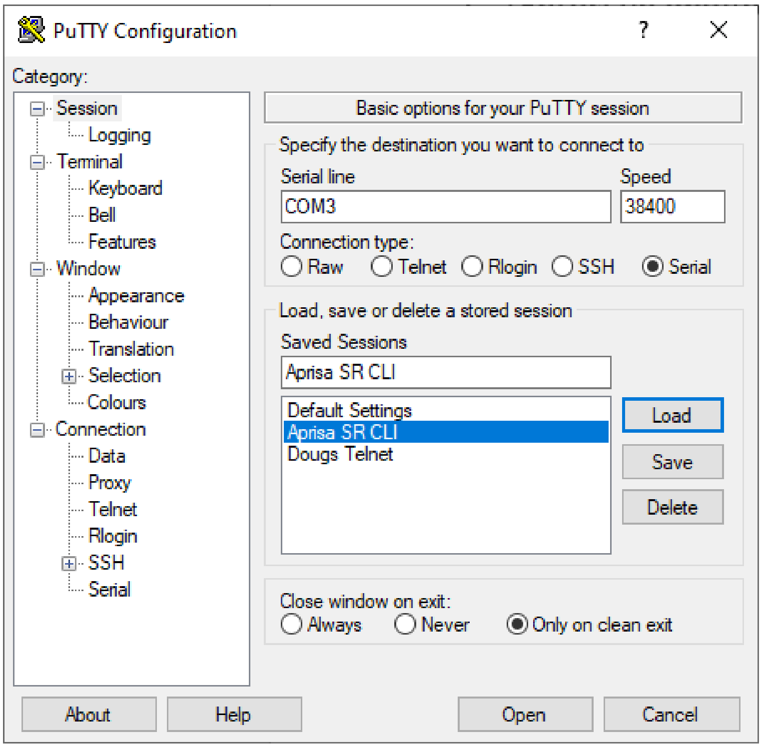
3. Go to your computer device manager (Windows > Control Panel > Device Manager)
4. Click on 'Ports (COM & LPT)'
5. Make a note of the COM port which has been allocated to the 'Silicon Labs CP210x USB to UART Bridge' (COM3 in the example below)



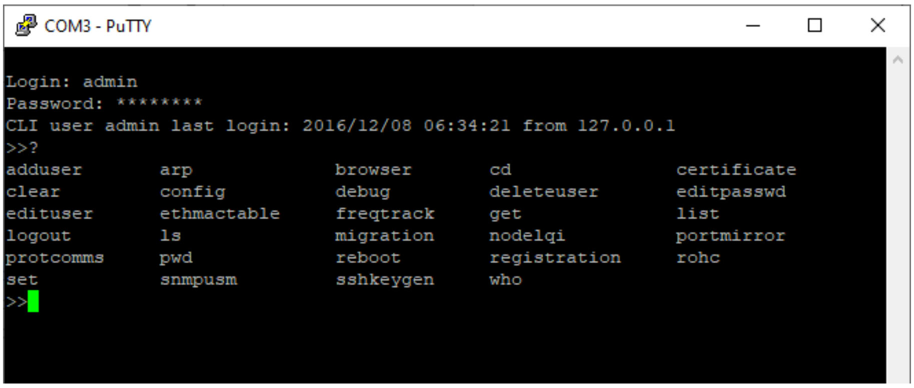
6. Open terminal emulator program e.g. Putty.

Putty Example

7. Enter a name for the connection e.g. Aprisa SR CLI and save for future use.



8. Click Open and the terminal window will open.
9. Press the enter key to initiate the session.
10. Login to the CLI with a default username ‘admin’ and password ‘admin’.
11. Type ? enter and the Aprisa SRi CLI top level menu is shown:



Connecting to the CLI via Telnet

1. Connect the PC Ethernet to the radio Ethernet port (assuming a compatible IP address range).
2. Open the PC Command Prompt.
3. Type Telnet and the IP address of the radio 'Telnet xx.xx.xx.xx'.
4. Login to the CLI with a default username 'admin' and password 'admin'.

Connecting to the CLI via SSH

Secure Shell (SSH) is a cryptographic network protocol for operating network services securely over an unsecured network. It is used in the Aprisa radio to provide a secure CLI remote access connection to the radio. SSH is operated in server client mode, where the radio is acting as the SSH server. The communication between the client and radio (server) is encrypted in SSHv2 (where SSHv2 vs SSHv1 uses a more enhanced security encryption algorithm).

The SSHv2 protocol consists of three major components:

- The Transport Layer Protocol provides server authentication, confidentiality, and integrity with perfect forward secrecy.
- The User Authentication Protocol which authenticates the client to the server.
- The Connection Protocol which multiplexes the encrypted tunnel into several logical channels.

The SSHv2 protocol has the following advantages:

- Allows secure CLI connection over the internet.
- Provides an alternate secure CLI connection to the un-secure CLI Telnet connection.
- RADIUS, retype password change, user privilege and user account lockout are also applied over SSHv2.

The Aprisa radio supports the following SSH features capabilities:

- SSH is operated over Ethernet ports. It is also operated over the RF port when the radio is in Advanced Router or Gateway router modes. SSH is not operated over USB or micro USB CLI.
- The radio SSH supports 'key re-exchange' which is initiated after 1 hour or 1GB data but only if client initiates this process.
- The radio supports simultaneous sessions of CLI / USB-CLI / Telnet / SSH.
- SSH is supported OTA to repeater/remotes using the RF IP Address in advanced router mode.
- Current SSH is supported OTA to repeater/remotes using the RF IP Address in advanced router mode.
- Regenerates a new random SSH public/private key-pairs, using the CLI command 'sshkeygen'. This command will delete current key pairs and on next reboot the radio will create a new pair.
- Factory reset doesn't clear the public / private key pairs.
- Supervisor 'Inactivity timeout' in Maintenance > General is also used for SSH to expire idle sessions.
- Supervisor Maintenance > Advanced configuration save/restore does not save/restore the SSH public / private keys pairs.
- A maximum 5 simultaneous SSH sessions can be supported.

The Aprisa radio SSH server uses the following algorithms to secure the connection:

- Key exchange: diffie-hellman-group14-sha1, diffie-hellman-group1-sha1
- Data Integrity: hmac-sha2-256, hmac-sha1-96, hmac-sha1
- Encryption: aes128-cbc
- Host key: RSA

1. Connect the PC Ethernet to the radio Ethernet port (assuming a compatible IP address range).
2. Install one of the following tested SSH clients on your PC.
   - PuTTY - Windows / Ubuntu
   - TeraTerm
   - Secure CRT
   - MobaXterm
   - OpenSSH
   - Linux Terminal (Ubuntu)
   - Kitty portal
   - DameWare
   - smartTTY
   - Terminals (https://terminals.codeplex.com/)
   - mRemoteng - Multi-Remote Next Generation
3. Open the SSH client.
4. Login to the CLI with a default username ‘admin’ and password ‘admin’.

CLI Commands

The cd and ls commands can be used to navigate the MIBs in the CLI however, 4RF recommends the use of the get and set commands in conjunction with the distributed MIB files.

The MIB files are provided as part of the software pack available on the 4RF website http://www.4rf.com/secure.

Contact support@4rf.com if you are not familiar with the use of MIB files.

To enter a CLI command:

1. Type the first few characters of the command and hit Tab. This auto completes the command.
2. Enter the command string and enter.

Note: All CLI commands are case sensitive.

The top level CLI command list is displayed by typing a ? at the command prompt.

The following is a list of the top level CLI commands and their usage:

CLI Command	Usage
get	Read the value of a MIB object The MIB object name can be obtained in the MIB files. It can be a scalar object or a table object. If the MIB object is a scalar, then the CLI command needs to be 'get ObjectName' If the MIB object name is a table, then the CLI command needs to be 'get ObjectName ObjectIndex' Examples: get termName get unitConfigOperatingMode 1
set	Set the value of a MIB object The MIB object name can be obtained in the MIB files. It can be a scalar object or a table object. If the MIB object is a scalar, then the CLI command needs to be 'set ObjectName ObjectValue' If the MIB object name is a table, then the CLI command needs to be 'set ObjectName ObjectValue ObjectIndex' Examples: set termName MyRadio set unitConfigOperatingMode 1 1
cd	Change directory
ls	Displays the next level menu items
pwd	Displays the current working directory
clear	Clear the screen
logout	Logs out from the CLI
adduser	adduser [-i <role>] <user name> <password> <password confirmation> Notes: - The role parameter must be ALL CAPS - Neither password nor account aging are being used by the radio
deleteuser	deleteuser <userName>

CLI Command	Usage
edituser	edituser [-p <password>] [-c <password confirmation>] [-i <role>] <userName>
editpasswd	editpasswd <old password> <new password> <password confirmation>
who	Shows the users currently logged into the radio
debug	Used by 4RF for detailed debug
list	list <tablename> Example: list user
reboot	Reboots the radio
snmpusm reset	To reset SNMPv3 users to Default
snmpusm reset	To reset SNMPv3 users to Default

Viewing the CLI Terminal Summary

At the command prompt, type:

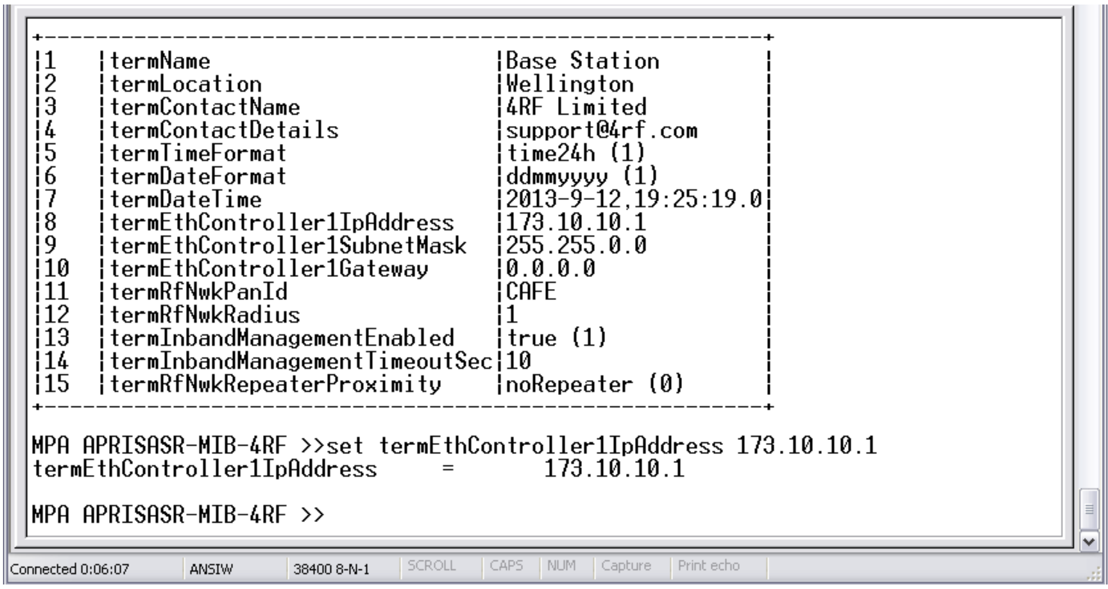
cd APRISASR-MIB-4RF

MPA APRISASR-MIB-4RF >>ls TerminalDetails

```
>>cd APRISASR-MIB-4RF
MPA APRISASR-MIB-4RF >>ls Terminal
+----------------------------------------------------------+
|S.NO|ATTRIBUTE NAME                   |ATTRIBUTE VALUE     |
+----------------------------------------------------------+
|1   |termName                         |Base Station        |
|2   |termLocation                     |Wellington          |
|3   |termContactName                  |4RF Limited         |
|4   |termContactDetails               |support@4rf.com     |
|5   |termTimeFormat                   |time24h (1)         |
|6   |termDateFormat                   |ddmmyyyy (1)        |
|7   |termDateTime                     |2013-9-12,19:22:43.0|
|8   |termEthController1IpAddress      |173.10.10.1         |
|9   |termEthController1SubnetMask     |255.255.0.0         |
|10  |termEthController1Gateway        |0.0.0.0             |
|11  |termRfNwkPanId                   |CAFE                |
|12  |termRfNwkRadius                  |1                   |
|13  |termInbandManagementEnabled      |true (1)            |
|14  |termInbandManagementTimeoutSec|10                     |
|15  |termRfNwkRepeaterProximity       |noRepeater (0)      |
+----------------------------------------------------------+
```

Changing the Radio IP Address with the CLI

At the command prompt, type ‘set termEthController1IpAddress xxx.xxx.xxx.xxx’



Wireshark Debug Access

These commands are provided for diagnosing problems using Wireshark. By enabling this function, you can connect a computer running Wireshark to the second port of a base station or remote radio to monitor the traffic of the primary port.

The command for port mirroring (on the CLI) is as follows:

CLI Command	Usage
portmirror enable ETH1 ETH2	This will enable monitoring of ETH1 on ETH2
portmirror disable ETH1	This will disable monitoring of ETH1

Transmitter Test Modes

Transmitter test modes is available on the CLI for

- PRBS
- Deviation
- CW

It uses the lowest frequency currently enabled and will be stay on that channel and not hop.

Note: FCC rules does not allow to transmit constantly on the same channel, thus this test mode should never be used when connected to antenna and should be used only when connected to test equipment, for example power meter.

At the command prompt, type:

>> cd APRISASR-MIB-4RF

MPA APRISASR-MIB-4RF >>cd MaintenanceTestmode

MPA MaintenanceTestmode >>ls

```
MPA APRISASR-MIB-4RF >>cd MaintenanceTestmode
MPA MaintenanceTestmode >>ls
+----------------------------------------------------+
|S.NO|ATTRIBUTE NAME               |ATTRIBUTE VALUE   |
+----------------------------------------------------+
|1   |testmodeResponseTimeoutMsec|3000               |
|2   |testmodeTransmitPeriodSec  |5                  |
|3   |testmodeTimeoutSec         |600                |
|4   |testmodeTxPRBS             |false (2)          |
|5   |testmodeTxDeviation        |false (2)          |
|6   |testmodeTxCW               |cwTestDisabled (2)|
|7   |testmodeTxTimeoutSec       |10                 |
+----------------------------------------------------+
```

8. In-Service Commissioning

Before You Start

When you have finished installing the hardware, RF and the traffic interface cabling, the system is ready to be commissioned. Commissioning the radio is a simple process and consists of:

1. Powering up the radios.
2. Configuring all radios in the network using SuperVisor.
3. Aligning the antennas.
4. Testing that the links are operating correctly.
5. Connecting up the client or user interfaces.

What You Will Need

- Appropriately qualified commissioning staff at both ends of each link.
- Safety equipment appropriate for the antenna location at both ends of each link.
- Communication equipment, that is, mobile phones or two-way radios.
- SuperVisor software running on an appropriate laptop, computer, or workstation at the base station radio.
- Tools to facilitate loosening and re-tightening the antenna pan and tilt adjusters.
- Predicted receiver input levels and fade margin figures from the radio link budget.

Antenna Alignment

A base station omni-directional collinear antenna has a vertical polarization. The remote radio yagi antennas must also have vertical polarization.

Aligning the Antennas

Align the remote radio yagi antennas by making small adjustments while monitoring the RSSI. The Aprisa SRi has a Test Mode which presents a real time visual display of the RSSI on the front panel LEDs. This can be used to adjust the antenna for optimum signal strength (see 'Test Mode' on page 59).

Note: Low gain antennas need less adjustment in elevation as they are simply aimed at the horizon. They should always be panned horizontally to find the peak signal.

1. Press and hold the TEST button on the radio LED panel until all the LEDs flash green (about 3 - 5 seconds).

   Note: The time for the LEDs to display the RSSI result is variable, depending on the network traffic, and can be up to 5 seconds. Small antenna adjustments should be made and then wait for the display to refresh.

2. Move the antenna through a complete sweep horizontally (pan). Note down the RSSI reading for all the peaks in RSSI that you discover in the pan.
3. Move the antenna to the position corresponding to the maximum RSSI value obtained during the pan. Move the antenna horizontally slightly to each side of this maximum to find the two points where the RSSI drops slightly.
4. Move the antenna halfway between these two points and tighten the clamp.
5. If the antenna has an elevation adjustment, move the antenna through a complete sweep (tilt) vertically. Note down the RSSI reading for all the peaks in RSSI that you discover in the tilt.
6. Move the antenna to the position corresponding to the maximum RSSI value obtained during the tilt. Move the antenna slightly up and then down from the maximum to find the two points where the RSSI drops slightly.
7. Move the antenna halfway between these two points and tighten the clamp.
8. Recheck the pan (steps 2-4) and tighten all the clamps firmly.
9. To exit Test Mode, press and hold the TEST button until all the LEDs flash red (about 3 – 5 seconds).

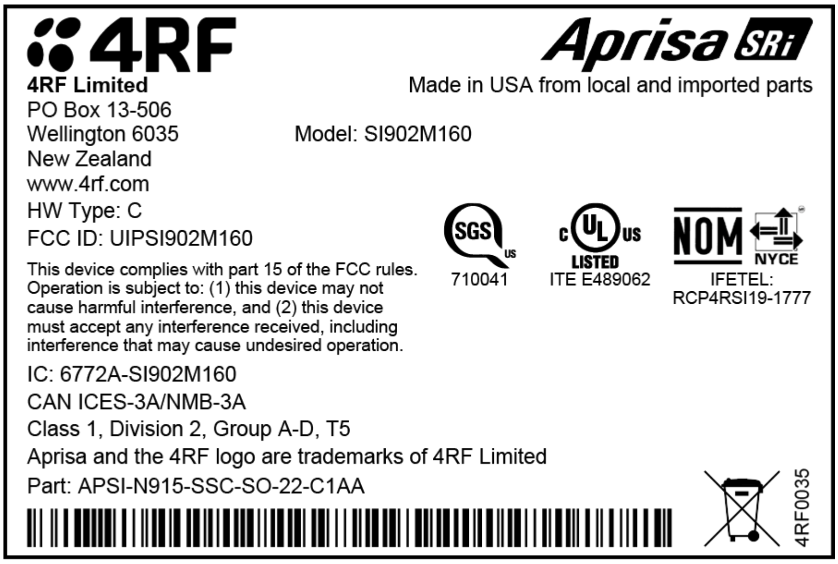
9. Product Options

Radio Hardware Types

The hardware variants of the Aprisa SRi radio.

Option	Function
HW Type A, HW Type A1	Standard Aprisa SRi radio
HW Type B, HW Type B1	Power optimized radio including Sleep Modes
HW Type C, HW Type C1	

The Aprisa SRi hardware type can be identified from SuperVisor (see 'HW Type' on page 99) or from the Compliance label on the radio bottom.



Country Specific Products

The standard Aprisa SRi provides product option part numbers for the following country compliance bodies;

APSI-N915-SSC-SO-22-C1AA

Country	Compliance Body
United States Of America	FCC
Canada	ISED

APSI-N915-SSC-SO-22-C2AA

Country	Compliance Body
Australia	ACMA
New Zealand	R-NZ

Protected Station

The Aprisa SRi Protected Station is a hot-swappable product providing radio and user interface protection for Aprisa SRi radios. The RF ports and interface ports from the active radio are switched to the standby radio if there is a failure in the active radio.

The Aprisa SRi Protected Station has an operating input voltage of 10-60 VDC floating.

Option Example

Part Number	Part Description
APSI-R915-SSC-SO-22-C1AE	4RF SRi, PS, 902-928 MHz, SSC, S Ant, 2E2S, FCC / IC, 10-60 VDC

The Aprisa SRi Protected Station is comprised of an Aprisa SRi Protection Switch and two standard Aprisa SRi radios mounted in a 2U rack mounting chassis.

All interfaces (RF, data, etc.) are continually monitored on both the active and standby radio to ensure correct operation. The standby radio can be replaced without impacting traffic flow on the active radio.

The Aprisa SRi radios can be any of the currently available Aprisa SRi radio frequency bands, interface port options or compliance options.

The Aprisa SRi Protected Station can operate as a base station, repeater station or remote radio. The protection behaviour and switching criteria between the active and standby radios is identical for the three configurations.

By default, the Aprisa SRi Protected Station is configured with the left hand radio (A) designated as the primary radio and the right hand radio (B) designated as the secondary radio.

Each radio is configured with its own unique IP and MAC address and the address of the partner radio.

On power-up, the primary radio will assume the active role and the secondary radio will assume the standby role. If, for some reason, only one radio is powered on it will automatically assume the active role.

Both the Aprisa SRi Protected Station primary radio and secondary radio must be operating on the same software version.

Protected Ports

The protected ports are located on the protected station front panel. Switching occurs between the active radio ports and the standby radio ports based on the switching criteria described below.

The protected ports include:

- Antenna port ANT/TX
- Ethernet ports (depending on interface port option purchased)
- Serial ports (depending on interface port option purchased)

Operation

In normal operation, the active radio carries all RS-232 serial and Ethernet traffic over the radio link and the standby radio transmit is on with its transmitter connected to an internal load. Both radios are continually monitored for correct operation including the transmitter and receiver and alarms are raised if an event occurs.

The active radio sends regular ‘keep alive’ messages to the standby radio to indicate it is operating correctly. In the event of a failure on the active radio, the RF link and user interface traffic is automatically switched to the standby radio.

The failed radio can then be replaced in the field without interrupting user traffic.

Switchover

The switchover to the standby radio can be initiated automatically, on fault detection, or manually via the Hardware Manual Lock switch on the Protection Switch or the Software Manual Lock from SuperVisor.

Additionally, it is possible to switch over the radios remotely without visiting the station site, via the remote control connector on the front of the Protection Switch.

On detection of an alarm fault, the switchover time is less than 0.5 seconds. Some alarms may take up to 30 seconds to be detected depending on the configuration options selected.

The Protection Switch has a switch guard mechanism to prevent protection switch oscillation. If a switchover has occurred, subsequent switchover triggers will be blocked if the guard time has not elapsed.

The guard time starts at 20 seconds and doubles each switchover to a maximum of 320 seconds and halves after a period of two times the last guard time with no protection switchovers.

Switching Criteria

The Protected Station will switchover operation from the active to the standby radio if any of the configurable alarm events occur, or if there is a loss of the ‘keep alive’ signal from the active radio.

It is possible to configure the alarm events which will trigger the switchover. It is also possible to prevent an alarm event triggering a switchover through the configuration of blocking criteria.

Any of the following alarm events can be set to trigger or prevent switching from the active radio to the standby radio (see ‘Events > Events Setup’ on page 251).

PA current	
Tx reverse power	Tx AGC
Temperature threshold	Thermal shutdown
RSSI Threshold	RX Synthesizer Not Locked
Rx CRC errors	RF no receive data
Port 1 Eth no receive data	Port 2 Eth no receive data
Port 1 Eth data receive errors	Port 2 Eth data receive errors
Port 1 Eth data transmit errors	Port 2 Eth data transmit errors
Port 3 Serial Data No RX Data	Port 4 Serial Data RX Data
Port 3 Serial Data RX Errors	Port 4 Serial Data RX Errors
USB Port Serial Data No RX Data	USB Port Serial Data RX Errors
Component failure	Calibration failure
Configuration not supported	Protection Hardware Failure
Alarm Input 1	Alarm Input 2

It will not attempt to switchover to a standby radio which has power failure.

It will also not switch over to a standby radio with an active alarm event which has been configured as a ‘blocking criteria’.

Switchover will be initiated once either of these conditions is rectified, i.e. power is restored, or the alarm is cleared.

Monitored Alarms

The following alarms are monitored by default on the active / standby radio. The monitored alarms are dependent on the Protection Type selected.

Protection Type	**All Protection Types**	**Redundant**
Alarm Type	Monitored on Active Radio	Monitored on Standby Radio
PA Current	☑	
PA Driver Current	☑	
PA Stability	☑	
TX AGC	☑	
TX Forward Power	☑	
TX Reverse Power	☑	
Temperature Threshold	☑	☑
TX Synthesizer Not Locked	☑	
Thermal Shutdown	☑	
RSSI Threshold	☑	
RX Synthesizer Not Locked	☑	
RX CRC Errors	☑	
RF No Receive Data	☑	
Port1 ETH No Receive Data	☑	
Port1 ETH Data Receive Errors	☑	
Port1 ETH Data Transmit Errors	☑	
Port2 ETH No Receive Data	☑	
Port2 ETH Data Receive Errors	☑	
Port2 ETH Data Transmit Errors	☑	
Port3 Serial Data No RX Data	☑	
Port3 Serial Data RX Errors	☑	
Port4 Serial Data No RX Data	☑	
Port4 Serial Data RX Errors	☑	
USB Port Serial Data No RX Data	☑	
USB Port Serial Data No RX Errors	☑	
Component Failure	☑	☑
Protection SW Manual Lock	☑	
Protection HW Manual Lock	☑	
Modem FEC Disable	☑	
Modem ACM Lock	☑	
Alarm Input 1	☑	☑
Alarm Input 2	☑	☑
Protection Peer Comms Lost	☑	
Protection Hardware Failure	☑	
VDC Power Supply	☑	☑

Protection Type	All Protection Types	Redundant
Alarm Type	Monitored on Active Radio	Monitored on Standby Radio
3.3 Volts Power Supply	☑	☑
5.0 Volts Power Supply	☑	☑
7.2 Volts Power Supply	☑	
15.0 Volts Power Supply	☑	☑

Configuration Management

The Primary and Secondary radios are managed with the embedded web-based management tool, SuperVisor, by using either the Primary or Secondary IP address. Configuration changes in one of the radios will automatically be reflected in the partner radio.

To ensure all remote radios are registered to the correct (active) base station, changes to the Network Table are automatically synchronized from the active radio to the standby radio. The Network Table is only visible on the active radio. This synchronization does not occur if the Hardware Manual Lock is active.

Hardware Manual Lock

The Hardware Manual Lock switch on the Protection Switch provides a manual override of the active / standby radio.

When this lock is activated, the selected radio (A or B) becomes the active radio regardless of the Software Manual Lock and the current switching or block criteria.

When the lock is deactivated (set to the Auto position), the protection will become automatic and switching will be governed by normal switching and blocking criteria.

The state of the switch is indicated by the three LEDs on the Protection Switch:

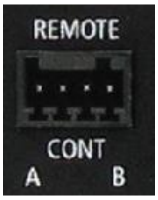
A LED	B LED	Locked LED	State
Green	Off	Off	Auto - Radio A is active
Off	Green	Off	Auto - Radio B is active
Green	Off	Orange	Manual Lock to radio A
Off	Green	Orange	Manual Lock to radio B

The Protection Switch also has a Software Manual Lock. The Hardware Manual Lock takes precedence over Software Manual Lock if both diagnostic functions are activated i.e. if the Software Manual Lock is set to ‘Primary’ and the Hardware Manual Lock set to ‘Secondary’, the system will set the Secondary radio to Active.

When a Hardware Manual Lock is deactivated (set to the Auto position), the Software Manual Lock is re-evaluated, and locks set appropriately.

Remote Control

The switchover to the standby radio can be initiated via the Remote Control Phoenix 1963447 connector on the front of the Protection Switch. This control will only operate if the Hardware Manual Lock switch is set to the Auto position.



The inputs are logic inputs with 4700 Ω pullup to +3.3 VDC. They require a pull down to ground to activate the control. The ground potential is available on the connector (see ‘Protection Switch Remote Control Connections’ on page 401).

L2 / L3 Protection Operation

The Aprisa SRi Protected Station has selectable L2 Bridge or L3 Router modes, with VLAN, QoS and L2/3/4 address filtering attributes. Each Radio is configured with its own unique IP and MAC address and partner radio address. On switchover failure, the new active radio sends out a gratuitous ARP to update the MAC learning tables / ARP tables of the upstream bridge / router for the appropriate traffic flow.

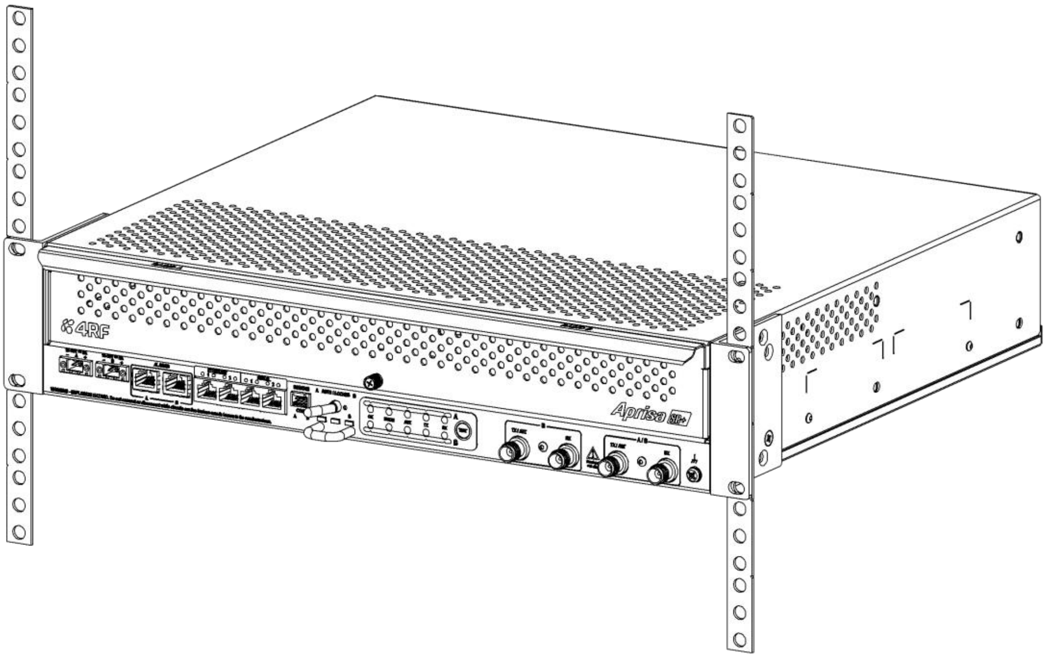
Hot-Swappable

The two Aprisa SRi radios are mounted on a pull-out tray to making it possible to replace a failed radio without interrupting user traffic.

Installation

Mounting

The Aprisa SRi Protected Station is designed to mount in a standard 19 inch rack.



Cabling

The Aprisa SRi Protected Station is delivered pre-cabled with power, interface, management and RF cables.

Protected Station Wiring	Internal pre-cabled Protected Station wiring setting	
	Radio / TNC Port	**RF Switch Port**
Standard Protected Station (single antenna operation)	Radio A TX/ANT	TX/ANTA
	Radio B TX/ANT	TX/ANTB

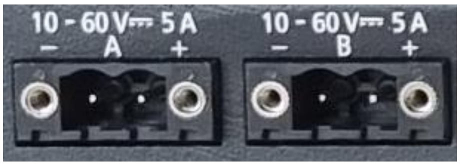
Power

The external power source must be connected to both the A and B Molex 2 pin male power connectors located on the protected station front panel. The A power input powers the A radio and the B power input powers the B radio.

The protection switch is powered from the A power input or the B power input (whichever is available).

The maximum combined power consumption is 42 Watts for 10 W transmit peak power.

The Aprisa SRi Protected station has one DC power option which operates over the voltage range of 10 to 60 VDC floating.

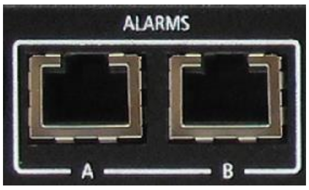


An example of the 10-60 VDC option part number is:

Part Number	Part Description
APSI-R915-SSC-SO-22-C1AE	4RF SRi, PS, 902-928 MHz, SSC, S Ant, 2E2S, FCC / IC, 10-60 VDC

Alarms

The protection switch provides access to both the A radio and B radio Alarm Interfaces (see 'Alarm Interface Connections' on page 400 for the connector pinout).



Maintenance

Changing the Protected Station IP Addresses

To change the IP address of a Protected Station radio:

1. Change the IP address of either or both the Primary Radio and Secondary radio (see ‘Protected Station: IP > IP Setup’ on page 324). Changes in these parameters are automatically changed in the partner radio.

Creating a Protected Station

When a Protected Station is ordered from 4RF, it will be delivered complete with radios installed, pre-cabled and pre-configured for Redundant operation. The following process will not be required.

This process is to create a protected station from two individual SRI radios and a new spare Aprisa SRi Protection Switch. It assumes that the SRI radios are currently setup for non-protected operation.

1. Set the protection type and partner IP address of the SRI radio A with SuperVisor 'Terminal > Operating Mode'. Set this radio Protection Unit to primary.
2. Set the protection type and partner IP address of the secondary SRI radio B with SuperVisor Terminal > Operating Mode'. Set this radio Protection Unit to secondary.
3. Switch off the radios and place the two radios in the new spare Aprisa SRi Protection Switch.
4. Ensuring that the cables are not crossed over, plug in the interface port cables, the Alarm and Protect port cables and the power connector to both the radios. Secure the power connectors with the two screws.
5. Power on the Protected Station.
6. Connect to either one of the radios via SuperVisor. This will start up SuperVisor in Single Session Management mode.
7. The user can now configure the Protected Station as required.

Replacing a Protected Station Faulty Radio

Replacing a faulty radio in a Protected Station can be achieved without disruption to traffic.

Assuming that the primary radio is active, and the secondary radio is faulty and needs replacement:

1. Ensure the replacement radio has the same version of software installed as the primary radio. If necessary, upgrade the software in the replacement radio.
2. Set the Protection Switch MAC address (see ‘Protected Station: Maintenance > Advanced’ on page 338). This MAC address is present on the chassis label.
3. Using SuperVisor > Maintenance > Advanced ‘Save Configuration to USB’ and ‘Restore Configuration from USB’ operation, clone the primary radio’s configuration to the replacement radio.
4. Configure the replacement radio as the secondary radio and setup the IP address and other protection parameters (see ‘Terminal > Operating Mode’ on page 107).
5. Set the Hardware Manual Lock switch to set the primary radio active.
6. Unplug the interface port cables, the Alarm and Protect port cables and the power connector from the faulty radio being replaced. The two screws securing the power connector will need to be undone.
7. Carefully remove the faulty radio from the protection switch.
8. Install the replacement radio into the protection switch.
9. Ensuring that the cables are not crossed over, plug in the interface port cables, the Alarm and Protect port cables and the power connector to the replacement radio. Secure the power connector with the two screws.
10. Power on the replacement radio and wait for it to become standby.
11. Set the Hardware Manual Lock switch to the Auto position.

Replacing a Faulty Power Supply

Replacing one of the power supplies can be achieved without disruption to traffic.

If a power supply has failed, the associated radio will have failed which will have caused the protection switch to switchover to the other radio. It will not have switched back unless the power was restored and another problem occurred which caused a switchover.

1. If the A power supply is faulty, ensure that the B radio is active (whether it be the primary or secondary radio).

   If the B power supply is faulty, ensure that the A radio is active (whether it be the primary or secondary radio).
2. Replace the faulty power supply.

Replacing a Faulty Protection Switch

Note: Replacing a faulty Protection Switch will disrupt traffic.

Move the radios, the interface cables and the power cables to the replacement Protection Switch.

On both Protected Station radios:

1. Power on the radio and wait for it to become ready.
2. Using SuperVisor > Maintenance > Advanced, enter the Protection Switch MAC address shown on the Protection Switch label (see 'Protected Station: Maintenance > Advanced' on page 338).
3. Using SuperVisor > Maintenance > Advanced, Decommission the node (see 'Decommission Node' on page 247) and then Discover the Nodes (see 'Discover Nodes' on page 247).

Ensure that the Hardware Manual Lock switch is set to the Auto position.

The Aprisa SRi Protected Station is now ready to operate.

Spares

The Aprisa SRi Protection Switch is available as spare parts for the radio interface port options:

Part Number	Part Description
APGS-XPSW-X22-FR-SA	4RF Spare, Protection Switch, 2E2S, 10-60VDC, Single Ant

Duplexer Kits

The Aprisa SRi product range contains Duplexer Kit accessories for use with Aprisa SRi radios.

Radio Duplexer Kits

Example of part number: APIB-KDUP-915-G5-BR

Part Number	Description
APIB-KDUP-915-G5-BR	Aprisa SRi Duplexer Kit for an Aprisa SRi radio containing: 1x 1U 19" rack front mount shelf with mounting brackets and screws to mount 2x Aprisa SRi radios and 1x APIT-DUPL-915-G5 duplexer 1x G5 Duplexer 900 MHz, split 26 MHz, passband 7 MHz 2x TNC to SMA right angle 640mm cables Fixed tuning - does not require factory tuning Used for overlapping coverage - two Aprisa SRi base stations coupling to a single antenna (base station 1 zones 1&2, base station 2 zones 7&8) Note: cannot be used with ACMA / RSM radios

USB Serial Ports

USB RS-232 / RS-485 Serial Port

The Aprisa SRi USB host port is predominantly used for software upgrade and diagnostic reporting. However, it can also be used to provide an additional RS-232 DCE or RS-485 serial port for customer traffic.

This is accomplished with a USB to RS-232 / RS-485 serial converter cable. This plugs into the USB host port connector and can be terminated with the required customer connector.

This additional RS-232 / RS-485serial port is enabled with the SuperVisor mode setting in Serial Port Settings (see 'Serial > Port Setup' on page 132).

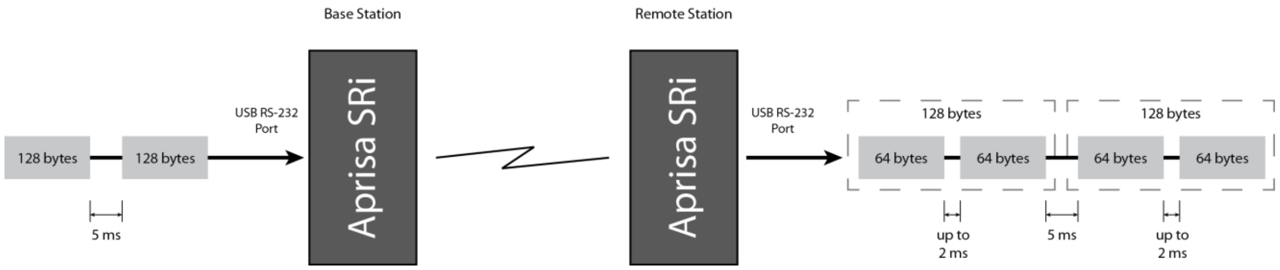
The Aprisa SRi USB port has driver support for these USB serial converters. Other USB serial converters may not operate correctly.

USB RS-232 / RS-485 operation

The USB serial converter buffers the received data frames into 64 byte blocks separated by a small inter-frame gap.

For the majority of applications, this fragmentation of egress frames is not an issue. However, there are some applications that may be sensitive to the inter-frame gap, therefore, these applications need consideration.

A 5 ms inter-frame is recommended for the applications that are sensitive to inter-frame gap timings.



On a USB RS-232 port, Modbus RTU can operate up to 9600 bit/s with all packet sizes and up to 115200 bit/s if the packet size is less than 64 bytes. The standard RS-232 port is fully compatible with Modbus RTU at all baud rates.

USB RS-232 Cabling Options

The following converter cables are available as Aprisa SRi accessories to provide the customer interface. The kit contains a USB connector retention clip (see 'USB Retention Clip' on page 388).

1. USB Converter to 1.8 metre multi-strand cable 6 wire for termination of customer connector

Part Number	Part Description
APSB-KFCA-USB-23-MS-18	4RF SRi Acc, Kit, Interface, USB Conv, RS-232, Multi-strand, 1.8m

2. USB converter to RJ45 female kit for USB to RS-232 DCE conversion.

Part Number	Part Description
APSB-KFCA-USB-23-45-MF18	4RF SRi Acc, Kit, Interface, USB Conv, RS-232, RJ45, Female, 1.8m

3. USB converter to DB9 female kit for USB to RS-232 DCE conversion.

Part Number	Part Description
APSB-KFCA-USB-23-D9-MF18	4RF SRi Acc, Kit, Interface, USB Conv, RS-232, DB9, Female, 1.8m

USB RS-485 Cabling Options

The following converter cable is available as an Aprisa SRi accessory to provide the customer interface RS-485 2 wire. The kit contains a USB connector retention clip (see 'USB Retention Clip' on page 388).

1. USB Converter to 1.8 metre multi-strand cable 6 wire for termination of customer interface

Part Number	Part Description
APSB-KFCA-USB-48-MS-18	4RF SRi Acc, Kit, Interface, USB Conv, RS-485, Multi-strand, 1.8m

USB Retention Clip

The USB Retention Clip attaches to the underside of the Aprisa SRi enclosure adjacent to the USB connector.

To attach the USB Retention Clip:

1. Clean the enclosure surface where the retention clip will attach with an alcohol based cleaner e.g. Isopropanol.
2. Peel off the retention clip protective backing.
3. Stick the clip onto the Aprisa SRi enclosure ensuring that it aligns to the middle of the radio USB connector.

10. Maintenance

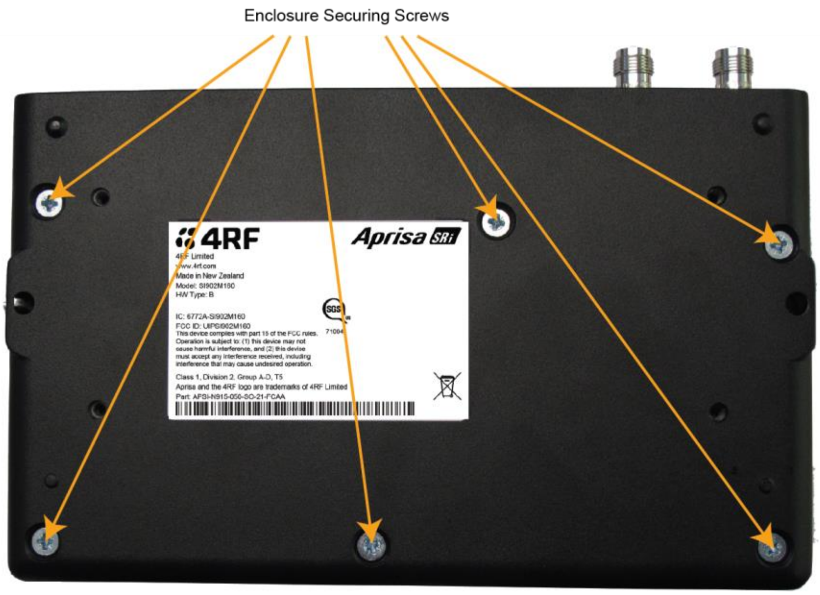
Spare Fuses

Radio Spare Fuses

The Aprisa SRi PBA contains two fuses in the power input with designators F1 and F2. Both the positive and negative power connections are fused. The fuse type is a Littelfuse 0454007 NANO Slo-Blo with a rating of 7 A. Two spare fuses are located inside the enclosure.

To replace the fuses:

1. Remove the input power and antenna cable.
2. Unscrew the enclosure securing screws (posi 2).



2. Separate the enclosure halves.

CAUTION: Antistatic precautions must be taken as the internal components are static sensitive.

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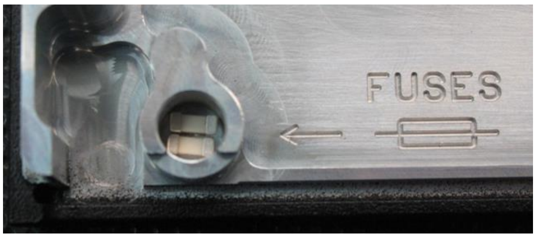
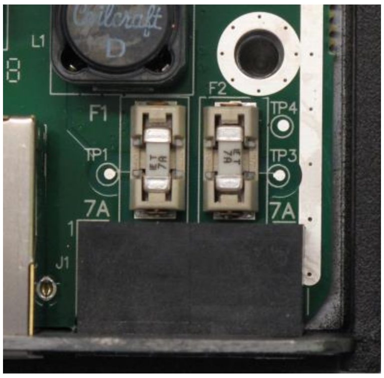
3. Access the enclosure spare fuses under the plastic cap.



4. Replace the two fuses.



5. Close the enclosure and tighten the screws.

Note: Is it critical that the screws are re-tightened to 1.2 Nm. The transmitter adjacent channel performance can be degraded if the screws are not tightened correctly.

Additional Spare Fuses

Additional spare fuses can be ordered from 4RF:

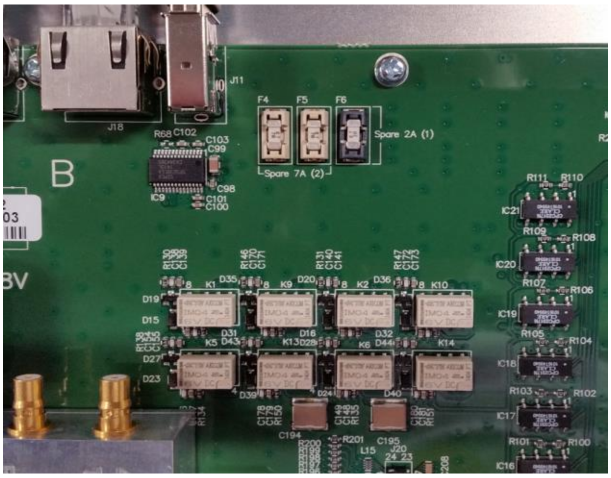
Part Number	Part Description
APGS-FNAN-454-07-02	4RF Spare, Fuse, Nano SMF, 454 Series, 7A, 2 items

Protected Station Spare Fuses

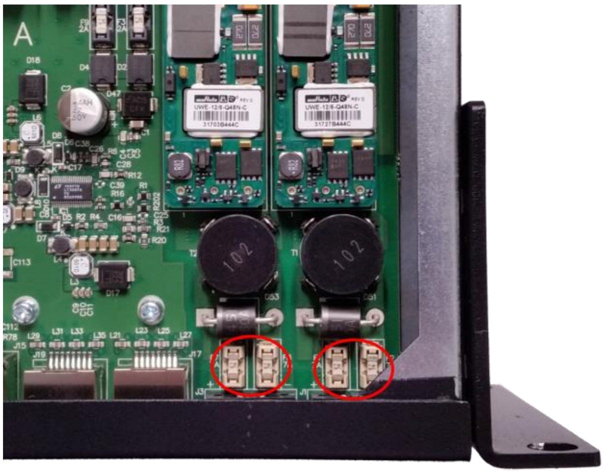
The Aprisa SRi Protected Station contains two fuses in the power inputs to the Protection Switch. If the protected station power supplies are connected and operating but the radios are not operating, it may be that a power supply input fuse is blown. Spare fuses are located on the Protection Switch board.

To replace Protection Switch fuses:

1. Disconnect the power supply, antenna, interface cables and any other connections.
2. Remove the Protected Station shelf from the rack.
3. Turn the Protected Station shelf upside down.
4. Remove the rear securing screws and remove the bottom panel.
5. Locate the spare fuses.



6. Determine which fuse is blown and replace it with the spare.



The 7A fuses are the main power supply input fuses

7. Refit the bottom panel and tighten the two screws.
8. Replace the shelf in the rack and re-connect all the cables

No User-Serviceable Components

Except for fuse replacement, there are no user-serviceable components within the radio.

All hardware maintenance must be completed by 4RF or an authorized service centre.

Do not attempt to carry out repairs to any boards or parts.

Return all faulty radios to 4RF or an authorized service centre.

For more information on maintenance and training, please contact 4RF Customer Services at support@4rf.com.

CAUTION: Electro Static Discharge (ESD) can damage or destroy the sensitive electrical components in the radio.

Software Upgrade

A software upgrade can be performed on a single Aprisa SRi radio or an entire Aprisa SRi network.

Network Software Upgrade

This process allows customers to upgrade their Aprisa SRi network from the central base station location without need for visiting remote sites.

The Software Pack is loaded into the base station with the file transfer process (see 'Software > File Transfer' on page 266) and distributed via the radio link to all remote radios.

When all remote radios receive the Software Pack version, the software can be remotely activated on all remote radios.

To upgrade the entire Aprisa SRi network software:

1. Using File Transfer, load the software pack into the base station (see 'Software > File Transfer' on page 266). The software can be transferred to the radio via an FTP transfer or from a USB flash drive.

   The Aprisa SRi network file transfer operation is indicated in base station and remote radios by a flashing orange AUX LED.

2. Distribute the software to the entire network of remote radios (see 'Software > Remote Distribution' on page 274). Note that the distribution process over the air will take some time, depending on RF and Transfer rate settings.

   The Aprisa SRi network software distribution operation is indicated in base station and remote radios by a flashing orange MODE LED.

   Note: The distribution of software to remote radios does not stop customer traffic from being transferred. However, due to the volume of traffic, the software distribution process may affect customer traffic.

   The impact of software distribution traffic upon customer traffic is controlled by two settings. The traffic uses the 'Default Management Data Priority' QoS setting, and the rate of packets at this priority is controlled with the 'Background Bulk Data Transfer Rate' setting in Radio > Channel Setup.

3. Activate the software on the entire network of remote radios (see 'Software > Remote Activation' on page 276).

   Note: When the new software activates on the remote radios, all link communication from the base station to the remote will be lost. The base station will attempt to re-establish connectivity to the remote radios for the new version verification but this will fail. However, when the new software activates on the remote radios, the remote radio will reboot automatically and link communication will restore when the base station software is activated.

   When the Remote Activation process gets to the 'Remote Radios On New Version' step, don't wait for this to complete but proceed to step 4.

4. Activate the software on the base station radio (see 'Software > Manager' on page 270).

5. When the new software has been activated, remote radios will re-register with the base station. The remote radios software version can be verified with 'Network Status > Network Table' on page 303.

6. When the base station restarts with the new software, rediscover the nodes (see 'Discover Nodes' on page 247).

7. Check that all remote radios are now running on the new software (see 'Network Status > Network Table' on page 303).

Note: The following steps will only be necessary if for some reason steps 1-7 did not operate correctly or if software activation is attempted before the distribution process ends or the remote radio was off during steps 1-7 and turns on later. Thus, the following steps will most likely not be required.

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8. If step 7 shows that not all remote radios are running the latest software version, restore the base / master station to the previous software version (see 'Software > Manager' on page 270).
9. Attempt to re-establish connectivity to the remote radios that have failed to upgrade by navigating to and remotely managing the remote radios individually.
10. Navigate to the remote radio history log and review the logs to determine the reason for the failure to activate the new software version.
11. Take appropriate actions to address the reported issue. If connectivity restores with the failed remotes, repeat steps 2-7 if required.

Protected Network Upgrade Process

This upgrade process is for upgrading the software on an entire Aprisa SRI network from a protected base station. This software upgrade can be achieved without disruption to traffic.

Transferring the new software to the radios

The software can be transferred to the radio via an FTP transfer, HTTP transfer or from a USB flash drive.

1. Using the Hardware Manual Lock switch (see 'Hardware Manual Lock' on page 378), or the Software Manual Lock (see 'Lock Active To' on page 333), force the secondary radio to active
2. Using File Transfer, load the software pack into the secondary radio (see 'Protected Station: Software > Secondary File Transfer' on page 349).
3. Confirm that the transfer is successful (see 'Protected Station: Software > Manager' on page 352).
4. Using the Hardware Manual Lock switch (see 'Hardware Manual Lock' on page 378), or the Software Manual Lock (see 'Lock Active To' on page 333), force the primary radio to active.
5. Using File Transfer, load the software pack into the primary radio (see 'Protected Station: Software > Primary File Transfer' on page 346).
6. Confirm that the transfer is successful (see 'Protected Station: Software > Manager' on page 352).
7. Distribute the software to the entire network of remote radios (see 'Protected Station: Software > Remote Distribution' on page 354). If there are protected remotes in the network, they must be locked to the current active radio.

   Note that the distribution process over the air will take some time, depending on RF and Transfer rate settings.

Activating the new software on the radios

1. Activate the software on the entire network of remote radios (see 'Protected Station: Software > Remote Activation' on page 357).
2. Monitor the progress of the activation process until the stage where activation of all remote radios has been confirmed.

   When the new software has been activated, remote radios will re-register with the base station. The remote radios software version can verified with 'Network Status > Network Table' on page 303.
3. If the new software version is not over the air compatible with the version currently operating on the radio, there is no need to wait as all link communication from the base station to the remote will be lost so the verification of the new version on the remote radio will fail.
4. Activate the new version software pack of the secondary radio (see 'Protected Station: Software > Manager' on page 352).
5. Immediately after that, activate the new version software pack of the primary radio (see 'Protected Station: Software > Manager' on page 352).

   Note that the activation process will take a few minutes.

Confirm that the new software version is now running on the radios

1. Re-login into the Protection Station and navigate to SuperVisor > Software>Summary.
2. Confirm that the Primary and Secondary radio current software version is now up to date
3. Confirm that the list of remote radios are now running the latest software version with ‘Network Status > Network Table’ on page 303.
4. When the upgrade process is complete, if the Hardware Manual Lock switch has been used, set it to the Auto position. The software manual lock will release automatically.

Single Radio Software Upgrade

This upgrade process is for upgrading the software on a single Aprisa SRi radio.

File Transfer Method

The Software Pack is loaded into the radio with the file transfer process (see ‘Software > File Transfer’ on page 266) and activated (see ‘Software > Manager’ on page 270).

The Aprisa SRi upgrade operation is indicated by a flashing orange AUX LED.

To upgrade the Aprisa SRi radio software:

1. Unzip the software release files in to the root directory of a USB flash drive.
2. Insert the USB flash drive into the host port .
3. Using File Transfer, load the software pack into the radio (see ‘Software > File Transfer’ on page 266).
4. Remove the USB flash drive from the host port .
5. Activate the software on the radio (see ‘Software > Manager’ on page 270).

USB Boot Upgrade Method

A single Aprisa SRi radio can also be upgraded simply by plugging a USB flash drive containing the new software into the USB A host port on the Aprisa SRi front panel and power cycling the radio.

To upgrade the Aprisa SRi radio software:

1. Unzip the software release files in to the root directory of a USB flash drive.
2. Check that the SuperVisor USB Boot Upgrade setting is set to 'Load and Activate' (see 'Software > Setup' on page 265) if you require the new software to load and automatically activate following the radio power cycle on step 7.
3. Power off the Aprisa SRi and insert the USB flash drive into the host port .
4. Power on the Aprisa SRi.
5. The software upgrade process is complete when the OK LED flashes green. This can take about 2 minutes.

   The software will have loaded in to the radio current software version.
6. Remove the USB flash drive from the host port .
7. Power cycle the Aprisa SRi.

Login to the radio being upgraded and go to SuperVisor 'Software > Manager' on page 270.

The version of the uploaded software will be displayed in the Software Pack 'Version' field and the current software version.

If the upgrade process did not start, the Aprisa SRi could already be operating on the version of software on the USB flash drive. This will be indicated by flashing OK LED and then the OK, MODE and AUX will light steady green.

If the radio is not operating on the new software (after the power cycle), it could be caused by the SuperVisor 'USB Boot Upgrade' setting set to 'Load Only' (see 'Software > Setup' on page 265).

In this case, go to SuperVisor see 'Software > Manager' on page 270 and tick the Software Pack 'Activate' checkbox and click 'Apply'.

If any Display Panel LED flashes red or is steady red during the upgrade process, it indicates that the upgrade has failed. This could be caused by incorrect files on the USB flash drive or a radio hardware failure.

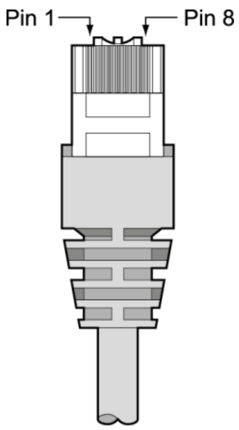
Software Downgrade

Radio software can also be downgraded if required. This may be required if a new radio is purchased for an existing network which is operating on an earlier software release.

The downgrade process is the same as the upgrade process.

11. Interface Connections

RJ45 Connector Pin Assignments



RJ45 pin numbering

Ethernet Interface Connections

Pin Number	Pin Function	Direction	TIA-568A Wire Colour	TIA-568B Wire Colour
1	Transmit	Output	Green/white	Orange/white
2	Transmit	Output	Green	Orange
3	Receive	Input	Orange/white	Green/white
4	Not used		Blue	Blue
5	Not used		Blue/white	Blue/white
6	Receive	Input	Orange	Green
7	Not used		Brown/white	Brown/white
8	Not used		Brown	Brown

Note: The TIA-568B wiring is the most commonly used and matches the cables we supply.

RJ45 connector LED indicators		
LED	**Status**	**Explanation**
Green	On	Ethernet signal received
Orange	Flashing	Data traffic present on the interface

Note: Do not connect Power over Ethernet (PoE) connections to the Aprisa SRi Ethernet ports as this will damage the port.

RS-232 Serial Interface Connections

RS-232 Pinout

The Aprisa RS-232 Serial Interface is always configured as a DCE:

RJ45 Pin Number	Pin Function	Direction	TIA-568A Wire Colour	TIA-568B Wire Colour
1	RTS	Input	Green / white	Orange/white
2	DTR / Sleep Mode	Input	Green	Orange
3	TXD	Input	Orange / white	Green/white
4	Ground		Blue	Blue
5	DCD	Output	Blue / white	Blue/white
6	RXD	Output	Orange	Green
7	DSR	Output	Brown / white	Brown/white
8	CTS	Output	Brown	Brown

Note: The TIA-568B wiring is the most commonly used and matches the cables we supply.

RS-232 Customer Cable Wiring

Aprisa RS-232 Interface - DCE			DTE Customer Interface		DCE Customer Interface	
RJ45 Pin Number	Pin Function	Direction	Pin Function	DB9 Male Pinout	Pin Function	DB9 Female Pinout
1	RTS	Input	RTS	7	CTS	8
2	DTR / Sleep Mode	Input	DTR	4	DSR	6
3	TXD	Input	TXD	3	RXD	2
4	Ground		Ground	5	Ground	5
5	DCD	Output	DCD	1		
6	RXD	Output	RXD	2	TXD	3
7	DSR	Output	DSR	6	DTR	4
8	CTS	Output	CTS	8	RTS	7

RS-232 RJ45 LED Indicators

LED	Status	Explanation
Green	On	RS-232 device connected
Orange	Flashing	Data present on the interface

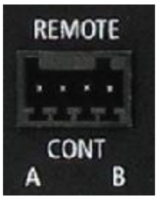
Alarm Interface Connections

RJ45 Pin Number	Pin Function	Direction	TIA-568A Wire Colour	TIA-568B Wire Colour
1	Alarm 1 Input / sleep control	Input	Green / white	Orange/white
2	Ground		Green	Orange
3	Alarm 2 Input	Input	Orange / white	Green/white
4	Ground		Blue	Blue
5	Alarm 1 Output	Output	Blue / white	Blue/white
6	Ground		Orange	Green
7	Alarm 2 Output	Output	Brown / white	Brown/white
8	Ground		Brown	Brown

Note: The TIA-568B wiring is the most commonly used and matches the cables we supply.

Protection Switch Remote Control Connections

1 2 3 4



Pin Number	1	2	3	4
Function	Ground	A radio active	Ground	B radio active

12. Alarm Types and Sources

Alarm Types

There are three types of alarm event configuration types:

1. Threshold Type

These alarm events have lower and upper limits. An alarm is raised if current reading is outside the limits.

Note: the limits for PA Current, TX AGC, TX Reverse Power and Thermal shutdown are not user configurable.

2. Error Ratio Type

This is the ratio of bad packets vs total packets in the defined sample duration.

For Serial, it is the ratio of bad characters vs total characters in the duration seconds. An alarm is raised if current error ratio is greater than the configured ratio. The error ratio is configured in ‘Upper Limit’ field and accepts value between 0 and 1. Monitoring of these events can be disabled by setting the duration parameter to 0.

3. Sample Duration Type

Used for No Receive data events type. An alarm is raised if no data is received in the defined sample duration. Monitoring of these events can be disabled by setting the duration parameter to 0.

See ‘Events > Events Setup’ on page 251 for setup of alarm thresholds / sample durations etc.

Alarm Events

Transmit Path Alarm Events

Event ID	Event Display Text	Default Severity	Configuration Type	Function	Recommended Actions
1	PA Current	critical(1)	Threshold Type	Alarm to indicate that the current drawn by the transmitter power amplifier is outside defined limits.	Check antenna is not open or shorted, check duplexer correctly connected and tuned, if OK replace radio.
61	PA Driver Current	critical(1)	Threshold Type	Alarm to indicate that the current drawn by the transmitter power amplifier driver is outside defined limits.	Check antenna is not open or shorted, check duplexer correctly connected and tuned, if OK replace radio.
62	PA Stability	warning(4)	Threshold Type	Alarm to indicate that the power amplifier is oscillating which may cause corruption of the TX signal	Check antenna is not open or shorted, check duplexer correctly connected and tuned, if OK replace radio.
2	TX AGC	critical(1)	Threshold Type	Alarm to indicate that the variable gain control of the transmitter is outside defined limits.	Check antenna is not open or shorted, check duplexer correctly connected and tuned, if OK replace radio.
3	TX Reverse Power	warning(4)	Threshold Type	Alarm to indicate that the antenna is not connected to the radio	Check antenna is not open or shorted, check duplexer correctly connected and tuned, and confirm VSWR at TX port is less than 2:1. If OK replace radio.
60	TX Forward Power	warning(4)	Threshold Type	Alarm to indicate that the transmitter power is outside the selected TX power setting.	Check antenna is not open or shorted, check duplexer correctly connected and tuned, and confirm VSWR at TX port is less than 2:1. If OK replace radio.
4	Temperature Threshold	warning(4)	Threshold Type	Alarm to indicate that the transmitter temperature is outside defined limits.	Check ambient temperature and for airflow obstructions.
5	TX Synthesizer Not Locked	critical(1)	Threshold Type	Alarm to indicate that the transmitter synthesizer is not locked.	Power off radio and restart. If condition persists replace radio.
31	Thermal Shutdown	critical(1)	Threshold Type	Alarm to indicate that the transmitter has shutdown due to excessively high temperature.	Check ambient temperature and for airflow obstructions.
90	VSWR Threshold	warning(4)	Threshold Type	Alarm to indicate that there is a high SWR on the antenna port.	Check antenna is not open or shorted, check duplexer correctly connected and tuned.

Receive Path Alarm Events

Event ID	Event Display Text	Default Severity	Configuration Type	Function	Recommended Actions
7	RSSI Threshold	warning(4)	Threshold Type	Alarm to indicate that the receiver RSSI reading taken on the last packet received is outside defined limits.	Check antenna is not open or shorted. If the antenna is directional check for off-pointing.
88	SNR Threshold	warning(4)	Threshold Type	Alarm to indicate that the monitored SNR has exceeded its configured threshold limits	Check antenna is not open or shorted. If the antenna is directional check for off-pointing.
8	RX Synthesizer Not Locked	critical(1)	Not Configurable	Alarm to indicate that the receiver Synthesizer is not locked on the RF received signal.	Power off radio and restart. If condition persists replace radio.
9	RX CRC Errors	warning(4)	Error Ratio Type	Alarm to indicate that the data received on the RF path contains errors at a higher rate than the defined error rate threshold.	Check antenna is not open or shorted. Check duplexer is correctly tuned. If the antenna is directional check for off-pointing. Power off radio and restart. If condition persists replace radio.
87	Payload Decryption Failure	warning(4)	Sample Duration Type	Alarm to indicate that packets have been received over the air where the radio has failed to decrypt the content.	Check the event history log for more details. If the decryption failure is solely due to security setting mismatch, then the security settings of the radios involved needs to be checked and corrected. If the decryption failure is also possibly due to a security key mismatch, then this indicates that another unauthorized radio is attempting to connect to the radio network, or an authorized radio has got an invalid key that needs updating.

Radio Interface Path Alarm Events

Event ID	Event Display Text	Default Severity	Configuration Type	Function	Recommended Actions
34	RF No Receive Data	warning(4)	Sample Duration Type	Alarm to indicate that there is no data received on the RF path in the defined duration period.	Check master is operational. If new deployment check set-up, frequencies, and duplexer (if used). Check antenna is not open or shorted. If the antenna is directional check for off-pointing. Power off radio and restart. If condition persists replace radio.
86	RF Profile Manual Lock	warning(4)	Not Configurable	Alarm to indicate that the diagnostics function to lock the radio to a specific RF profile has been activated. This is only relevant when the radio has been configured with more than one RF profile.	No action required. This indicates that the diagnostic function is active.

Modem Alarm Events

Event ID	Event Display Text	Default Severity	Configuration Type	Function	Recommended Actions
68	Modem FEC disable	warning(4)	Not Configurable	Alarm to indicate that FEC has been disabled. This could be a permanent event or a timed event.	Alarm to indicate that FEC has been disabled. This could be a permanent event or a timed event.
70	Modem ACM locked	warning(4)	Not Configurable	Alarm to indicate that the ACM has been locked to a fixed coding and modulation. This could be a permanent event or a timed event.	Alarm to indicate that the ACM has been locked to a fixed coding and modulation. This could be a permanent event or a timed event.

Customer Equipment Interface Path Alarm Events

Event ID	Event Display Text	Default Severity	Configuration Type	Function	Recommended Actions
10	Port 1 Eth No Receive Data	warning(4)	Sample Duration Type	Alarm to indicate that Ethernet port 1 has no received input signal in the defined duration period.	Check Ethernet cable and connector. Check switch port or RTU is active. Check IP and VLAN configuration.
11	Port 1 Eth Data Receive Errors	warning(4)	Error Ratio Type	Alarm to indicate that Ethernet port 1 received input signal contains errors at a higher rate than the defined error rate threshold.	Check Ethernet cable and connector. Check switch port or RTU is active. Check IP and VLAN configuration.
12	Port 1 Eth Data Transmit Errors	warning(4)	Error Ratio Type	Alarm to indicate that Ethernet port 1 transmitted output signal contains errors at a higher rate than the defined error rate threshold.	Check Ethernet cable and connector. Check switch port or RTU is active. Check IP and VLAN configuration.
15	Port 1 Eth Port Down	critical(1)	Sample Duration Type	Alarm to indicate that Ethernet port 1 has no detected connection during the defined duration period.	Check the cable and connector. Check switch port or RTU is active. Check Ethernet Port speed/duplex configuration.
35	Port 2 Eth No Receive Data	warning(4)	Sample Duration Type	Alarm to indicate that Ethernet port 2 has no received input signal in the defined duration period.	Check Ethernet cable and connector. Check switch port or RTU is active. Check IP and VLAN configuration.
36	Port 2 Eth Data Receive Errors	warning(4)	Error Ratio Type	Alarm to indicate that Ethernet port 2 received input signal contains errors at a higher rate than the defined error rate threshold.	Check Ethernet cable and connector. Check switch port or RTU is active. Check IP and VLAN configuration.
37	Port 2 Eth Data Transmit Errors	warning(4)	Error Ratio Type	Alarm to indicate that Ethernet port 2 transmitted output signal contains errors at a higher rate than the defined error rate threshold.	Check Ethernet cable and connector. Check switch port or RTU is active. Check IP and VLAN configuration.
38	Port 2 Eth Port Down	critical(1)	Sample Duration Type	Alarm to indicate that Ethernet port 2 has no detected connection during the defined duration period.	Check the cable and connector. Check switch port or RTU is active. Check Ethernet Port speed/duplex configuration.
44	Port 3 Eth No Receive Data	warning(4)	Sample Duration Type	Alarm to indicate that Ethernet port 3 has no received input signal in the defined duration period.	Check Ethernet cable and connector. Check switch port or RTU is active. Check IP and VLAN configuration.
45	Port 3 Eth Data Receive Errors	warning(4)	Error Ratio Type	Alarm to indicate that Ethernet port 3 received input signal contains errors at a higher rate than the defined error rate threshold.	Check Ethernet cable and connector. Check switch port or RTU is active. Check IP and VLAN configuration.

Event ID	Event Display Text	Default Severity	Configuration Type	Function	Recommended Actions
46	Port 3 Eth Data Transmit Errors	warning(4)	Error Ratio Type	Alarm to indicate that Ethernet port 3 transmitted output signal contains errors at a higher rate than the defined error rate threshold.	Check Ethernet cable and connector. Check switch port or RTU is active. Check IP and VLAN configuration.
47	Port 3 Eth Port Down	critical(1)	Sample Duration Type	Alarm to indicate that Ethernet port 3 has no detected connection during the defined duration period.	Check the cable and connector. Check switch port or RTU is active. Check Ethernet Port speed/duplex configuration.
48	Port 4 Eth No Receive Data	warning(4)	Sample Duration Type	Alarm to indicate that Ethernet port 4 has no received input signal in the defined duration period.	Check Ethernet cable and connector. Check switch port or RTU is active. Check IP and VLAN configuration.
49	Port 4 Eth Data Receive Errors	warning(4)	Error Ratio Type	Alarm to indicate that Ethernet port 4 received input signal contains errors at a higher rate than the defined error rate threshold.	Check Ethernet cable and connector. Check switch port or RTU is active. Check IP and VLAN configuration.
50	Port 4 Eth Data Transmit Errors	warning(4)	Error Ratio Type	Alarm to indicate that Ethernet port 4 transmitted output signal contains errors at a higher rate than the defined error rate threshold.	Check Ethernet cable and connector. Check switch port or RTU is active. Check IP and VLAN configuration.
51	Port 4 Eth Port Down	critical(1)	Sample Duration Type	Alarm to indicate that Ethernet port 4 has no detected connection during the defined duration period.	Check the cable and connector. Check switch port or RTU is active. Check Ethernet Port speed/duplex configuration.
13	Port 1 Serial Data No Receive Data	warning(4)	Sample Duration Type	Alarm to indicate that the RS-232 port 1 has no received input signal in the defined duration period.	Check serial ports settings, check serial cable and connector.
14	Port 1 Serial Data Receive Errors	warning(4)	Error Ratio Type	Alarm to indicate that the RS-232 port 1 received input signal contains errors at a higher rate than the defined error rate threshold.	Check serial ports settings, check serial cable and connector.
52	Port 2 Serial Data No Receive Data	warning(4)	Sample Duration Type	Alarm to indicate that the RS-232 port 2 has no received input signal in the defined duration period.	Check serial ports settings, check serial cable and connector.
53	Port 2 Serial Data Receive Errors	warning(4)	Error Ratio Type	Alarm to indicate that the RS-232 port 2 received input signal contains errors at a higher rate than the defined error rate threshold.	Check serial ports settings, check serial cable and connector.
63	USB Port Serial Data No Receive Data	warning(4)	Sample Duration Type	Alarm to indicate that the USB port has no received input signal in the defined duration period.	Check serial ports settings, check USB serial cable and adapter, check serial connector.
64	USB Port Serial Data Receive Errors	warning(4)	Error Ratio Type	Alarm to indicate that the USB port received input signal contains errors at a higher rate than the defined error rate threshold.	Check serial ports settings, check USB serial cable and adapter, check serial connector.

Component Failure Alarm Events

Event ID	Event Display Text	Default Severity	Configuration Type	Function	Recommended Actions
16	Component Failure	major(2)	Not Configurable	Alarm to indicate that a hardware component has failed.	Power off and restart radio. If fault persists replace radio.

Hardware Alarm Events

Event ID	Event Display Text	Default Severity	Configuration Type	Function	Recommended Actions
56	VDC Power Supply	warning(4)	Not Configurable	Alarm to indicate that the input power source is outside the operating limits of 10 to 30 VDC	Check DC connection to radio. Replace power supply.
57	3.3 Volts Power Supply	warning(4)	Not Configurable	Alarm to indicate that the 3.3 volt power rail is outside defined limits.	Power off and restart radio. If fault persists replace radio.
58	5.0 Volts Power Supply	warning(4)	Not Configurable	Alarm to indicate that the 5.0 volt power rail is outside defined limits.	Power off and restart radio. If fault persists replace radio.
59	7.2 Volts Power Supply	warning(4)	Not Configurable	Alarm to indicate that the 7.2 volt power rail is outside defined limits.	Power off and restart radio. If fault persists replace radio.
71	15 Volts Power Supply	warning(4)	Not Configurable	Alarm to indicate that the 15 volt power rail is outside defined limits.	Power off and restart radio. If fault persists replace radio.

Software Alarm Events

Event ID	Event Display Text	Default Severity	Configuration Type	Function	Recommended Actions
20	Calibration Failure	major(2)	Not Configurable	Alarm to indicate that the RF calibration has failed.	Power off and restart radio. If fault persists replace radio.
21	Configuration Not Supported	major(2)	Not Configurable	Alarm to indicate that a configuration has entered that is invalid.	Restore previous configuration, remove out of range or invalid parameters, updated software.
22	Remote Communications Lost	major(2)	Not Configurable	Alarm to indicate that a remote radio is not receiving packets from the base station.	Check RF configuration settings.
32	Network Configuration Warning	warning(4)	Not Configurable	Alarm to indicate a network configuration problem e.g. remote not registered.	Check for invalid parameters. Audit network settings.
73	Radio Network	warning(4)	Not Configurable	Alarm to indicate that there is an alarm in the radio network e.g. a remote radio has not registered or duplicate IP address.	Check for duplicate or invalid parameters. Audit network settings.
39	Software Restart Required	warning(4)	Not Configurable	Alarm to indicate that a configuration has changed that requires a software reboot.	Reboot radio.
74	Software Activation Pending	warning(4)	Not Configurable	Alarm to indicate that a software activation is about to occur. The activation can be on a software pack, configuration pack or security profile.	No action required. This is a warning to indicate that a type of software activation is about to happen. The information in the event history log will describe the type of activation

Hardware Alarm Input Alarm Events

Event ID	Event Display Text	Default Severity	Configuration Type	Function	Recommended Actions
24	Alarm Input 1	warning(4)	Not Configurable	Alarm to indicate that there is an active alarm on hardware alarm input 1	Action depends on nature of third-party alarm.
25	Alarm Input 2	warning(4)	Not Configurable	Alarm to indicate that there is an active alarm on hardware alarm input 2	Action depends on nature of third-party alarm.

Informational Events

Event ID	Event Display Text	Default Severity	Function	Recommended Actions
26	User authentication succeeded	information(5)	Event to indicate that a user is successfully authenticated on the radio during login. The information on the user that was successfully authenticated is provided in the eventHistoryInfo object of the Event History Log.	Information No action required unless unexpected
27	User authentication failed	information(5)	Event to indicate that a user has failed to be authenticated on the radio during login. The information on the user that was unsuccessfully authenticated is provided in the eventHistoryInfo object of the Event History Log.	Check for possible intrusion attempt. If unexpected follow cyber incident report procedure.
29	Software System Check	information(5)	Event to indicate that the software has done a system check on the radio. Any information relevant to the cause of the event is provided in the eventHistoryInfo object of the Event History Log.	Information No action required unless unexpected
30	Software Start Up	information(5)	Event to indicate that the radio software has started. Any information relevant to the software start up is provided in the eventHistoryInfo object of the Event History Log.	Information No action required unless unexpected
41	File Transfer Activity	information(5)	Event to indicate that a data file is being transferred to or from the radio.	Information No action required unless unexpected
42	Software Management Activity	information(5)	Event to indicate that software is being distributed to remote radios.	Information No action required unless unexpected
43	Terminal Server TCP Activity	information(5)	Event to indicate TCP packets are being transferred from the terminal server.	Information No action required unless unexpected
55	Terminal Unit Information	information(5)	Event to indicate a miscellaneous activity occurring on the radio	Information no action required unless unexpected.
65	Event Action Activity	information(5)	Event to indicate an event action occurring on the radio	Information No action required unless unexpected
72	User SuperVisor Session Logout	information(5)	Event to indicate that a user has logged out or the user session has timed out	Information No action required unless unexpected
75	Config Management Activity	information(5)	Event to indicate that there has been some management activity related to the configuration of the radio. As an example, the configuration of the radio has been changed via SNMP, or a new configuration script has been loaded into the radio. This event records: • When the change was made • The management interface that was used; SuperVisor, CLI or SNMP • The IP address and username of the person that made the change • The IP address of the destination radio The category of the change as per SuperVisor menus e.g. Terminal parameters, Radio parameters	Information No action required unless unexpected

Event ID	Event Display Text	Default Severity	Function	Recommended Actions
78	Security Information	information(5)	Security related events that occur on the radio. This may include events that report that a user account has been locked or recovered. Or events related to RADIUS authentication.	Refer to the event history logs for details of the events.
81	Date And Time Activity	information(5)	Events related to the date and time settings of the radio. This may include user changes to the date and time or SNTP related events.	Refer to the event history logs for details of the events.
85	GPS Activity	information(5)	Events related to GPS coordinates of the radio. This includes updates to the GPS coordinates of the radio	Refer to the event history logs for details of the events.
89	User Account Activity	information(5)	Events related to the management of User Accounts of the radio. This includes adding or deleting user accounts, or updates to existing accounts.	Refer to the event history logs for details of the events.

13. Specifications

RF Specifications

Blocking (desensitization), intermodulation, spurious response rejection, and adjacent channel selectivity values determined according to the methods introduced in V1.7.1 of ETSI standards EN 300 113-1.

Frequency Bands

Compliance Body	Frequency Band	Frequency Range	Synthesizer Step Size
FCC	915 MHz	902-928 MHz	6.250 kHz
ISED	915 MHz	902-928 MHz	6.250 kHz
ACMA	915 MHz	915-928 MHz	6.250 kHz
RSM	915 MHz	915-928 MHz	6.250 kHz
ANATEL	915 MHz	902-907.5 and 915-928 MHz	6.250 kHz
PERU	915 MHz	915-928 MHz	6.250 kHz

Channel Sizes

Minimum Coded Forward Error Correction

Channel Size	Gross Radio Capacity less FEC			
	64 QAM	16 QAM	QPSK	
50 kHz	240 kbit/s	160 kbit/s	80 kbit/s	

Receiver

Receiver Sensitivity

		50 kHz
BER < 10^{-2}	64 QAM	-100 dBm
BER < 10^{-2}	16 QAM	-108 dBm
BER < 10^{-2}	QPSK	-113 dBm
BER < 10^{-6}	64 QAM	-96 dBm
BER < 10^{-6}	16 QAM	-104 dBm
BER < 10^{-6}	QPSK	-109 dBm

Adjacent Channel Selectivity

		50 kHz
Adjacent channel selectivity		> -37 dBm
BER < 10^{-2}	64 QAM	> 53 dB
BER < 10^{-2}	16 QAM	> 53 dB
BER < 10^{-2}	QPSK	> 58 dB

Co-Channel Rejection

		50 kHz
BER < 10^{-2}	64 QAM	> -23 dB
BER < 10^{-2}	16 QAM	> -19 dB
BER < 10^{-2}	QPSK	> -12 dB

Intermodulation Response Rejection

		50 kHz
Intermodulation response rejection		> -35 dBm
BER < 10^{-2}	64 QAM	> 55 dB
BER < 10^{-2}	16 QAM	> 55 dB
BER < 10^{-2}	QPSK	> 60 dB

Blocking or Desensitization

		50 kHz
Blocking or desensitization		> -17 dBm
BER < 10^{-2}	64 QAM	> 73 dB
BER < 10^{-2}	16 QAM	> 73 dB
BER < 10^{-2}	QPSK	> 78 dB

Spurious Response Rejection

		50 kHz
Spurious response rejection		> -32 dBm
BER < 10^{-2}	64 QAM	> 58 dB
BER < 10^{-2}	16 QAM	> 58 dB
BER < 10^{-2}	QPSK	> 63 dB

Receiver Spurious Radiation

	50 kHz
Receiver spurious radiation	> -57 dBm

Transmitter

Average Power output Note: The Peak Envelope Power (PEP) at maximum set power level is 1.0 W (+30 dBm).	64 QAM	0.01 to 0.2 W (+10 to +23 dBm, in 1 dB steps)
	16 QAM	0.01 to 0.25 W (+10 to +24 dBm, in 1 dB steps)
	QPSK	0.01 to 0.4 W (+10 to +26 dBm, in 1 dB steps)

Note: The Aprisa SRi transmitter contains power amplifier protection which allows the antenna to be disconnected from the antenna port without product damage.

Adjacent channel power	< - 60 dBc
Transient adjacent channel power	< - 60 dBc
Spurious emissions	< -20 dBc < -49 dBm 800 MHz to 915 MHz < -33 dBm 928 MHz to 1 GHz
Attack time	< 1.5 ms
Release time	< 0.5 ms
Data turnaround time	< 2 ms
Frequency stability	± 0.5 ppm
Frequency aging	< 1 ppm / annum

Spread Spectrum

Number of standard hop zones	8 (non-overlapping)
Zone / channel selection	Zone selection list and channel blacklist
Hop Frequency	62.5 kHz
Minimum number of channels	50

FCC / ISED

Number of channels per hop zone	50
Full band option	400 channels full band single zone

ACMA / RSM

Number of channels per hop zone	25
Full band option	200 channels full band single zone

ANATEL

Number of channels per hop zone	35
Full band option	280 channels full band single zone

PERU

Number of standard hop zones	8 (non-overlapping)
Number of channels per hop zone	25
Full band option	200 channels full band single zone

Modem

Forward Error Correction	Variable length concatenated Reed Solomon plus convolutional code
Adaptive Burst Support	Adaptive FEC Adaptive Coding and Modulation

Data Payload Security

Data payload security	CCM* Counter with CBC-MAC
Data encryption	Counter Mode Encryption (CTR) using Advanced Encryption Standard (AES) 128, 192 or 256
Data authentication	Cipher Block Chaining Message Authentication Code (CBC-MAC) using Advanced Encryption Standard (AES) 128, 192 or 256

Interface Specifications

Ethernet Interface

The Aprisa SRi radio features an integrated 10Base-T/100Base-TX layer-2 Ethernet switch.

To simplify network setup, each port supports auto-negotiation and auto-sensing MDI/MDIX. Operators can select from the following preset modes:

- Auto negotiate
- 10Base-T half or full duplex
- 100Base-TX half or full duplex

The Ethernet ports are IEEE 802.3-compatible. The L2 Bridge (Switch) is IEEE 802.1d/q/p compatible, and supports VLANs and VLAN manipulation of add/remove VLANs.

General	Interface	RJ45 x 2 (Integrated 2-port switch)
	Cabling	CAT-5/6 UTP, supports auto MDIX (Standard Ethernet)
	Maximum line length	100 metres on cat-5 or better
	Bandwidth allocation	The Ethernet capacity maximum is determined by the available radio link capacity.
	Maximum transmission unit	Option setting of 1522 or 1536 octets
	Address table size	1024 MAC addresses
	Ethernet mode	10Base-T or 100Base-TX Full duplex or half duplex (Auto-negotiating and auto-sensing)
Diagnostics	Left Green LED	Off: no Ethernet signal received On: Ethernet signal received
	Right Orange LED	Off: no data present on the interface Flashing: data present on the interface

Note: Do not connect Power over Ethernet (PoE) connections to the Aprisa SRi Ethernet ports as this will damage the port.

RS-232 Asynchronous Interface

The Aprisa SRi radio's ITU-T V.24 compliant RS-232 interface is configured as a Cisco® pinout DCE. The interface terminates to a DTE using a straight-through cable or to a DCE with a crossover cable (null modem).

The interface uses two handshaking control lines between the DTE and the DCE.

General	Interface	ITU-T V.24 / EIA/TIA RS-232E
	Interface direction	DCE only
	Maximum line length	10 metres (dependent on baud rate)
Async parameters	Standard mode data bits	7 or 8 bits
	Standard mode parity	Configurable for None, Even or Odd
	Standard mode stop bits	1 or 2 bits
	Interface baud rates	300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600 and 115200 bit/s
Control signals	DCE to DTE	CTS, RTS, DSR, DTR
Diagnostics	Left Green LED	Off: no RS-232 device connected On: RS-232 device connected
	Right Orange LED	Off: no data present on the interface Flashing: data present on the interface

Hardware Alarms Interface

The hardware alarms interface supports two alarm inputs and two alarms outputs.

Alarm Inputs

The alarm connector provides two hardware alarm inputs for alarm transmission to the other radios in the network.

Interface	RJ45 connector
Detector type	Non-isolated ground referenced voltage detector
Detection voltage - on	> +10 VDC
Detection voltage - off	< +4 VDC
Maximum applied input voltage	30 VDC
Maximum input current limit	10 mA

Alarm Outputs

The alarm connector provides two hardware alarm outputs for alarm reception from other radios in the network.

Interface	RJ45 connector
Output type	Non-isolated ground referenced open collector output
Maximum applied voltage	30 VDC
Maximum drive current	100 mA
Overload protection	Thermally resettable fuse

Protect Interface

The Protect interface is used to connect the radios to the protection switch within a Protected Station. It is not a customer interface.

Protection Switch Specifications

RF Insertion Loss	< 0.5 dB (switch and connecting cables)
Remote Control inputs	Logic 4700 ohms pullup to +3.3 VDC

Power Specifications

Power Supply

Aprisa SRi Radio

Input Voltage Range	+10 to +30 VDC
Ground Reference	Negative Earth
Maximum Power Input	20 W
Connector	Molex 2 pin male screw fitting 39526-4002

Aprisa SRi Protected Station

Protected Station Type	Version 2
Input Voltage Range	10 to 60 VDC
Ground Reference	Floating
Maximum Power Input	42 W
Connector	2x Molex 2 pin male screw fitting 39524-0002

Power Consumption

Note: The radio power consumption is dependent on transmitter power, the type of traffic and network activity.

Aprisa SRi Radio

Mode	Transmit Peak Power	**Power Consumption**
Transmit / Receive	1.0 W	< 15 W
Receive only		< 4.5 W

Aprisa SRi Protected Station

Mode	Transmit Peak Power	**Power Consumption**
Transmit / Receive	1.0 W	< 30 W
Receive only		< 25 W

Power Dissipation

Aprisa SRi Radio

Mode	Transmit Peak Power	Power Dissipation
Transmit / Receive	1.0 W	< 14 W
Receive only		< 4.5 W

Aprisa SRi Protected Station

Mode	Transmit Peak Power	Power Dissipation
Transmit / Receive	1.0 W	< 29 W
Receive only		< 25 W

General Specifications

Environmental

Operating temperature range	-40 to +70˚ C (-40 to +158˚ F)
Storage temperature range	-40 to +85˚ C (-40 to +185˚ F)
Operating humidity	Maximum 95% non-condensing
Acoustic noise emission	No audible noise emission

Mechanical

Aprisa SRi Radio

Dimensions	Width 210 mm (8.27”) Depth 130 mm (5.12”) and 146 mm (5.748”) with TNC connector Height 41.5 mm (1.63”)
Weight	1.25 kg (2.81 lbs)
Colour	Matt black
Mounting	Wall (2 x M5 screws) Rack shelf (4 x M4 screws) DIN rail bracket

Aprisa SRi Protected Station

Dimensions	Width 432.6 mm (17”) Depth 372 mm (14.6”) and 388 mm (15.276”) with TNC connectors Height 2U plus external duplexer (if used)
Weight	10.0 kg (22 lbs) (includes the 2 radios)
Colour	Matt black
Mounting	Rack mount (4 x M6 screws)

Compliance

FCC

Radio	FCC CFR47 Part 15.247
EMC	47CFR part 15 Radio Frequency Devices
Safety	EN 60950-1:2006 Class 1 division 2 for hazardous locations
Environmental	ETS 300 019 Class 3.4 Ingress Protection IP51

Innovation, Science and Economic Development (ISED)

Radio	RSS-247
EMC	This Class A digital apparatus complies with Canadian standard ICES-003. Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.
Safety	EN 60950-1:2006 Class 1 division 2 for hazardous locations
Environmental	ETS 300 019 Class 3.4 Ingress Protection IP51

ACMA

Radio	Radio Communications (Short Range Devices) Standard 2004
EMC	AS/NZS 4268
Safety	EN 60950-1:2006 Class 1 division 2 for hazardous locations
Environmental	ETS 300 019 Class 3.4 Ingress Protection IP51

RSM

Radio / EMC	AS/NZS 4268
Safety	EN 60950-1:2006 Class 1 division 2 for hazardous locations
Environmental	ETS 300 019 Class 3.4 Ingress Protection IP51

ANATEL (compliance pending)

Radio / EMC	Resolution No. 680
Safety	EN 60950-1:2006 Class 1 division 2 for hazardous locations
Environmental	ETS 300 019 Class 3.4 Ingress Protection IP51

PERU

Radio / EMC	NOM-208-SCFI-2016
EMC	AS/NZS 4268
Safety	EN 60950-1:2006 Class 1 division 2 for hazardous locations
Environmental	ETS 300 019 Class 3.4 Ingress Protection IP51

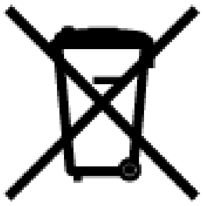
14. Product End Of Life

End-of-Life Recycling Programme (WEEE)

The WEEE Directive concerns the recovery, reuse, and recycling of electronic and electrical equipment. Under the Directive, used equipment must be marked, collected separately, and disposed of properly.

4RF has implemented an end-of-life recycling programme to manage the reuse, recycling, and recovery of waste in an environmentally safe manner using processes that comply with the WEEE Directive (EU Waste Electrical and Electronic Equipment 2002/96/EC).

The WEEE Symbol Explained



This symbol appears on Electrical and Electronic Equipment (EEE) as part of the WEEE (Waste EEE) directive. It means that the EEE may contain hazardous substances and must not be thrown away with municipal or other waste.

WEEE Must Be Collected Separately

You must not dispose of electrical and electronic waste with municipal and other waste. You must separate it from other waste and recycling so that it can be easily collected by the proper regional WEEE collection system in your area.

YOUR ROLE in the Recovery of WEEE

By separately collecting and properly disposing of WEEE, you are helping to reduce the amount of WEEE that enters the waste stream.

One of the aims of the WEEE directive is to divert EEE away from landfill and encourage recycling. Recycling EEE means that valuable resources such as metals and other materials (which require energy to source and manufacture) are not wasted. Also, the pollution associated with accessing new materials and manufacturing new products is reduced.

EEE Waste Impacts the Environment and Health

Electrical and electronic equipment (EEE) contains hazardous substances which have potential effects on the environment and human health. If you want environmental information on the Aprisa SRi radio, contact us (see page 19).

15. Copyrights

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