4RF

Aprisa SR+ Aprisa MMS

Aprisa SR+ User Manual Appendix 1

Migration Station

February 2020

Version 2.0.0b

Contents

1. Introduction

About This Document

This document is an appendix 1 to the Aprisa SR+ User Manual for the Aprisa SR+ Migration Station (MMS).

It is recommended that you read the relevant sections of this manual before installing or operating the Aprisa SR+ Migration Station.

2. About the Migration Station

The 4RF Aprisa Migration Station

The Aprisa SR+ Migration Station (MMS) provides migration from legacy radio networks to Aprisa SR+ SCADA radio networks utilizing existing frequencies and antenna infrastructure. The MMS supports network migration of point-to-multipoint legacy network with or without a single repeater.

Master Migration Operation

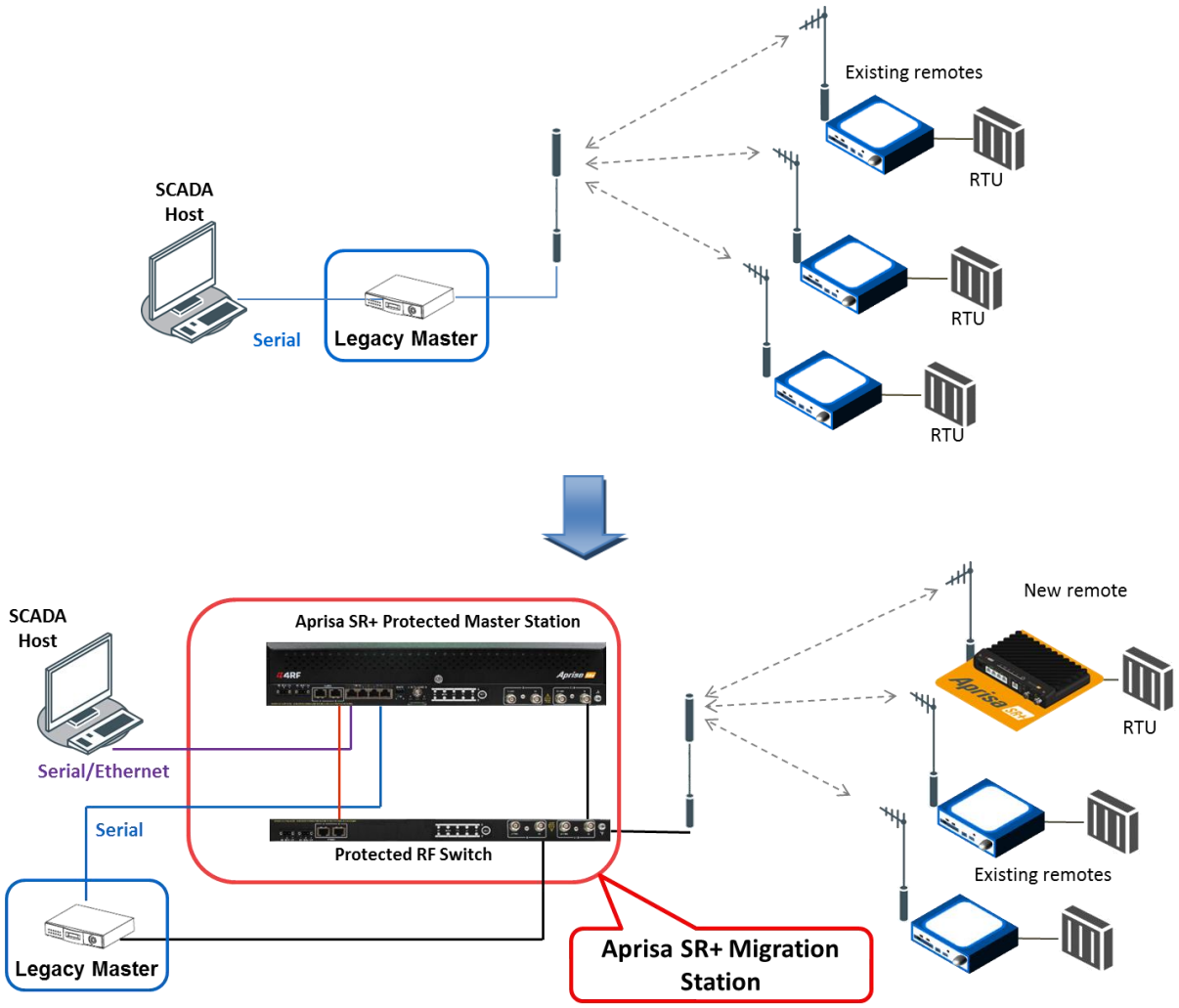
The Aprisa SR+ Master / Base Station MMS inspects the serial SCADA traffic packets to determine the destination address of the RTU or end device.

If a packet destination is supported by an Aprisa SR+ remote radio, the MMS switches to the 4RF network and the packet is sent to the Aprisa SR+ remote radio. A reply packet from the Aprisa SR+ remote site will be received by the Aprisa SR+ Master / Base Station and sent to SCADA host.

If a packet destination is supported by a legacy remote radio, the MMS switches to legacy network. The packet is then serialized from the Aprisa SR+ Master / Base Station to the legacy Master, which in turn will send it Over The Air (OTA) to the legacy remote. A reply packet from a legacy remote site will be received by the legacy master, which will serially send it to Aprisa SR+ Master / Base Station which will forward it to the SCADA host.

Each packet is mapped to either the legacy or the Aprisa SR+ network based on SCADA address learning, utilizing the address / destination ID field of the SCADA protocol. Initially all SCADA protocol addresses will be assumed to exist on the legacy network. If a transaction to a remote address times out or there is no response the packet is resent on the Aprisa SR+ network. If an address is detected as working on the Aprisa SR+ network, it is added to the address map for the Aprisa SR+ network.

This allows you to progressively switch out legacy remote radios without any configuration of the MMS address map or SCADA host. The address map can also be manual defined as an option. When the migration of all the remotes is complete, the legacy master and the migration switch component of the MMS can be removed resulting in a standard Aprisa SR+ master station installation.



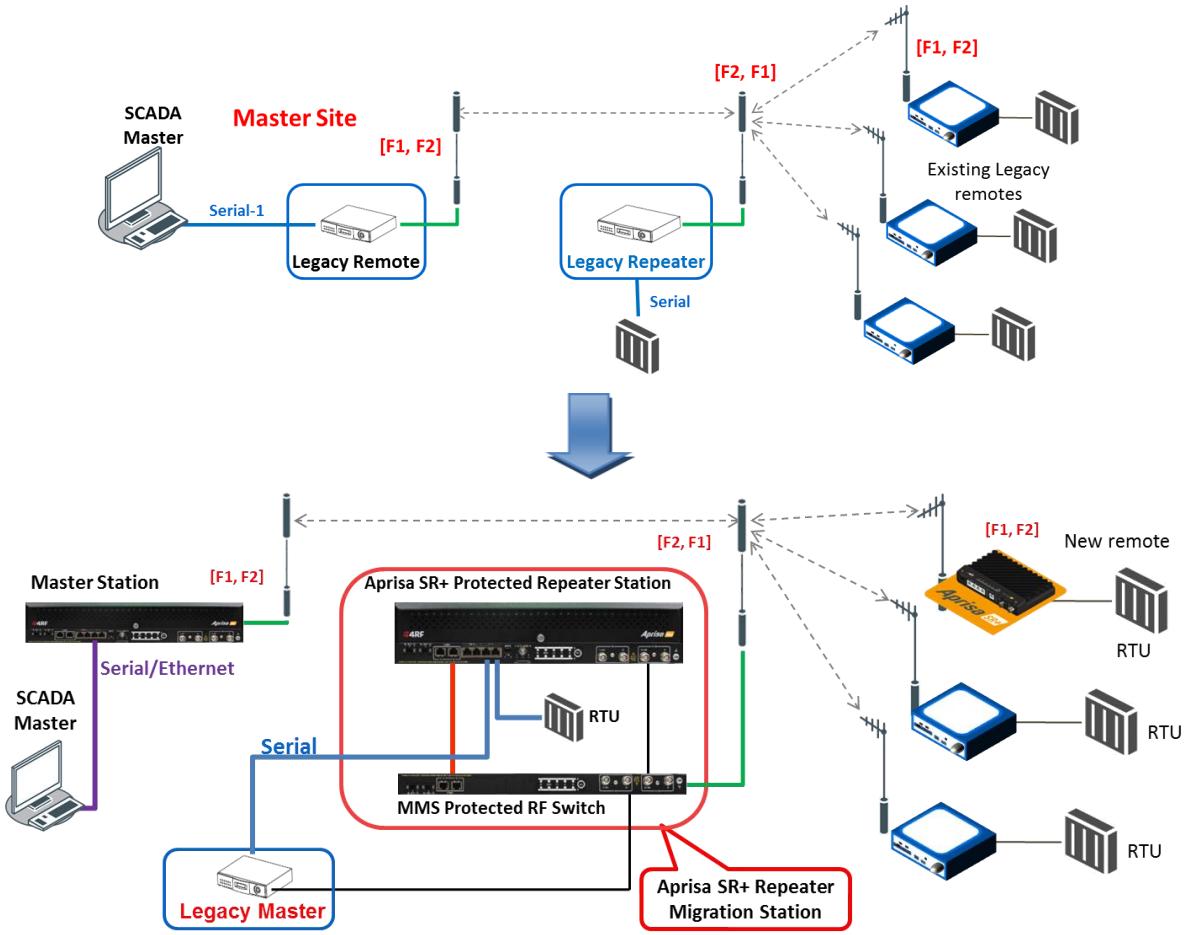
Repeater Migration Operation

The Aprisa SR+ Master / Base Station inspects the serial SCADA traffic packets to determine the destination address. If packet destination is supported by an Aprisa SR+ remote radio, then packet is forwarded via the Aprisa SR+ Repeater MMS and sent to the remote radio. A reply packet from Aprisa SR+ remote site will also be forwarded via the Aprisa SR+ Repeater MMS, sending it to the Aprisa SR+ Master / Base Station and SCADA host. If both the Aprisa SR+ Master/Base and the Repeater station are full duplex, then packets sent to or received from remote radios will be cut-through (repeater starts sending the packet before receiving the whole packet for improve latency). Full duplex Master/base and Repeater is the preferred and recommended option for high performance and low latency.

If a packet destination is supported by legacy radio, then the Repeater MMS will receive a marked legacy packet, causing to set the repeater MMS switch to legacy. The Repeater MMS will then forward the packet to the serial port of the legacy Master, which will transmit it OTA to the legacy remote. A reply packet from legacy remote site will be received by the legacy master, which is forwarded to the serial port of the Aprisa SR+ Repeater MMS, which in turn will set the repeater MMS switch to 4RF network and send the packet/s to the Aprisa SR+ Master / Base Station and SCADA host.

Each packet is mapped to either the legacy or the Aprisa SR+ network based on SCADA address learning, utilizing the address / destination ID field of the SCADA protocol. Initially all SCADA protocol addresses will be assumed to exist on the legacy network. If a transaction to a remote address times out or there is no response the packet will be resent on the Aprisa SR+ network. If an address is detected as working on the Aprisa SR+ network, it is added to the address map for the Aprisa SR+ network.

This allows you to progressively switch out legacy remote radios without any configuration of the MMS address map or SCADA host. The address map can also be manually defined as an option. When migration of all remotes is complete, the legacy master and the migration switch component of the MMS can be removed resulting in a standard Aprisa SR+ (protected) Repeater station installation.



Migration RF Switch

The Aprisa SR+ Protected Station uses the alarm outputs to control the RF switch. The RF switch controls which radio the antenna is connected to.

In Master Migration operation, the init/default state connects the antenna to the legacy radio.

In Repeater Migration operation the init/default and idle state connects the antenna to the 4RF radio.

Migration Station Redundancy

The MMS switch contains a fully redundant RF switch. When combined with a fully redundant protected station, the migration station is fully protected. Any hardware failure in the migration switch (or master station) results in a switchover and the MMS will continue to operate switching traffic between the legacy and Aprisa SR+ networks.

Connection to SCADA Master / Host Controller

For best performance the existing serial connection to the SCADA host controller should be set to the maximum bit rate (115.2 kbit/s) or replaced by an Ethernet connection, if available, to maximize the performance of the network as remote upgrades progress.

For Base MMS at 19200 or higher, or if the selected protocol relies on interframe gaps for framing (such as Modbus), use the default serial MTU of 512 and serial IFG to 3.5. In all other cases set the serial MTU to 58. If external equipment does not introduce any gaps between characters, IFG may also be reduced to 1.

For Repeater MMS systems, it is usually best to leave the serial MTU at the default of 512. If the SCADA Host to RTU packets are at a slow baud rate and are usually large (>200 bytes at 9600 or >100 bytes at 4800) then it may be faster to set a smaller serial MTU. In this case set the serial MTU at the base to 74, and also ensure that the LEGACY Network Switch Delay Duration is also configured to serial MTU * 10000 / baud + 100.

Connection to Legacy Master (for Base MMS)

If the selected protocol relies on interframe gaps for framing (such as Modbus) AND the SCADA master connection uses terminal server, use default IFG of 3.5 and MTU of 512. In all other cases, set the IFG to 1 and the MTU to the minimum for the selected protocol:

Protocol	Minimum MTU
Generic Legacy Only	Any
ABB Totalflow	16
BSAP or EBSAP	10
DART	30
DF1 Half Duplex BCC	9
DF1 Half Duplex CRC	9
DNP3	10
Harris	3
HSQ	8
IEC60870-5-101	7
Medina	5
MDLC	5
Modbus ASCII	3
Modbus RTU	1
PG&E	2
Proteus	4
ROC	4
Siemens Sinaut ST1 / ST7	5
Telegyr 8979	5
Thermo	9

For combination protocols, use the larger of the two MTU values e.g. for PG&E & DNP3, use an MTU value of 10.

Connection to Legacy Repeater

The legacy repeater should have continuous key disabled and/or be changed to base operating mode.

If the legacy baud rate is 9600 or higher, or the selected protocol relies on interframe gaps for framing (such as Modbus), set the serial MTU to 512, the serial IFG to 3.5, and LEGACY Network Switch Delay Duration to 0. In all other cases set the serial MTU to 58 and LEGACY Network Switch Delay Duration to 50. If external equipment does not introduce any gaps between characters, IFG may also be reduced to 1.

Connection to RTU after Migration

For best performance, the existing serial connection to the RTU should be set to the maximum bit rate (115.2 kbit/s). If using 115 kbit/s or the protocol relies on inter-frame gaps for framing (such as Modbus), the IFG and MTU should be left at default of 3.5 and 512. If other protocols are used and a slower legacy baud rate of 9600 or less is used, then the IFG should be set to 1 and the MTU should be set to 74.

Operating Temperature

With the superior thermal design common across all Aprisa products the MMS operates across the full temperature range without de-rating or the need for fans.

Operating Configurations

The Aprisa SR+ MMS supports standard legacy radio networks, and single repeater based network. The MMS supports integration with legacy networks with the master station operating in non-continuously keyed or switched carrier mode. The legacy network traffic must be serial utilizing a standard poll / response protocol.

Support is protocol specific. Multiple protocols including DNP3, Modbus and a range of others are supported. Additional protocols will be released on customer request.

Changes to the Network Table are automatically synchronized from the active radio to the standby radio.

Migration Plan for Master Migration Operation

1. Establish a new Aprisa SR+ network alongside the existing network (see figure below).

The Aprisa SR+ Migration Station shares your master station infrastructure and frequency assets.

Master Site Connections:

A. Connect the SCADA Master serial connection to Aprisa SR+ Master / Base Station Com port 1 or replace it with Ethernet connection using the Aprisa SR+ IP terminal server.

B. Connect the legacy master serial com port to Aprisa SR+ Master / Base Station Com port 2.

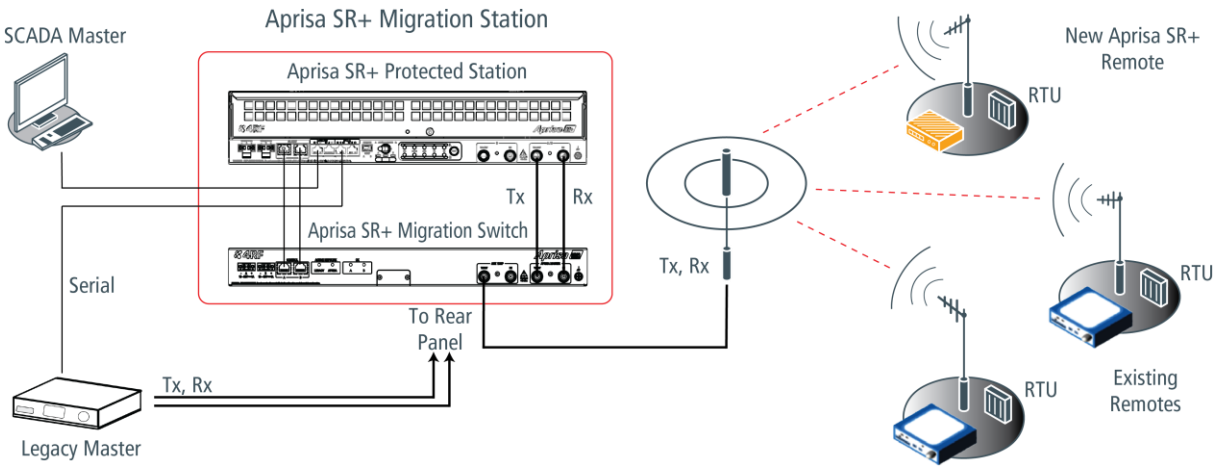
C. Connect the legacy master RF port to the rear panel RF port of the Migration switch.

D. Connect the Aprisa SR+ Master / Base Station RF port and Alarm I/O port as describe in the figure below.

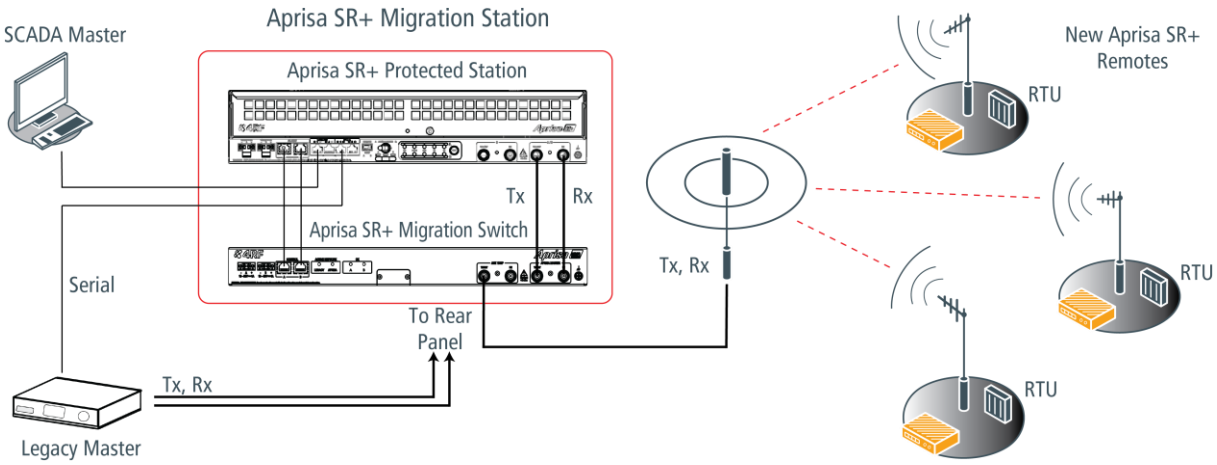
E. Connect the antenna to the front panel ANT/DUP RF port of the Migration switch.

Notes and recommendations:

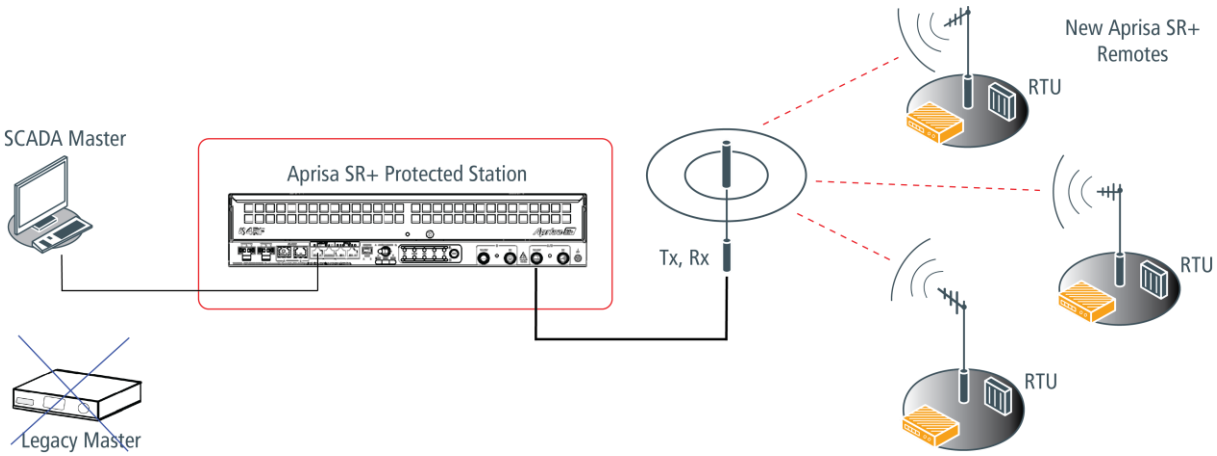
- The traffic on the legacy network must be serial poll / response
- The serial connection to the SCADA server should be increased to the maximum rate or replaced by an Ethernet connection to terminal server setting in the Aprisa SR+ Protected Station to gain full speed benefit of Aprisa SR+.
- The serial connection between the RTU/PLC and Aprisa SR+ remote radio should be increased to the maximum rate to gain full speed benefit of Aprisa SR+.
- Wide selection of serial SCADA protocols can be supported (check with 4RF)



2. Migrate the legacy remote radios to the new Aprisa SR+ remote radios.



3. When the migration is complete, the standard Aprisa SR+ Protected Master Station remains. Removal of the redundant equipment can be done to suit maintenance schedule windows.
   - Change the Aprisa SR+ Protected Station operating mode to Base MMS operation (see 'Terminal > Operating Mode' on page 26').
   - Reconnect the antenna to the front panel A/B TX/ANT RF port of the Aprisa SR+ Protected Master Station.
   - Remove the legacy master station and remove the Migration Switch. This can be redeployed to form another Migration Station.



Migration Plan for Repeater Migration Operation

1. Establish a new Aprisa SR+ network alongside the existing network.

The Aprisa SR+ Master / Base Station and Repeater Migration Station shares your master and repeater station infrastructure and frequency assets. Both Aprisa SR+ Master / Base Station and Repeater station should use the preferred / recommended full duplex hardware option radio type for high performance and low latency.

Master Site Connections:

A. Remove the legacy radio at the master site and replace it with Aprisa SR+ Master / Base Station.
B. Connect the antenna to the front panel A/B TX/ANT RF port of the Aprisa SR+ Master / Base Station.
C. Reconnect the SCADA Master serial connection to Aprisa SR+ Master / Base Station Com port 1 or replace it with Ethernet connection using the Aprisa SR+ IP terminal server.

Repeater Site Connections:

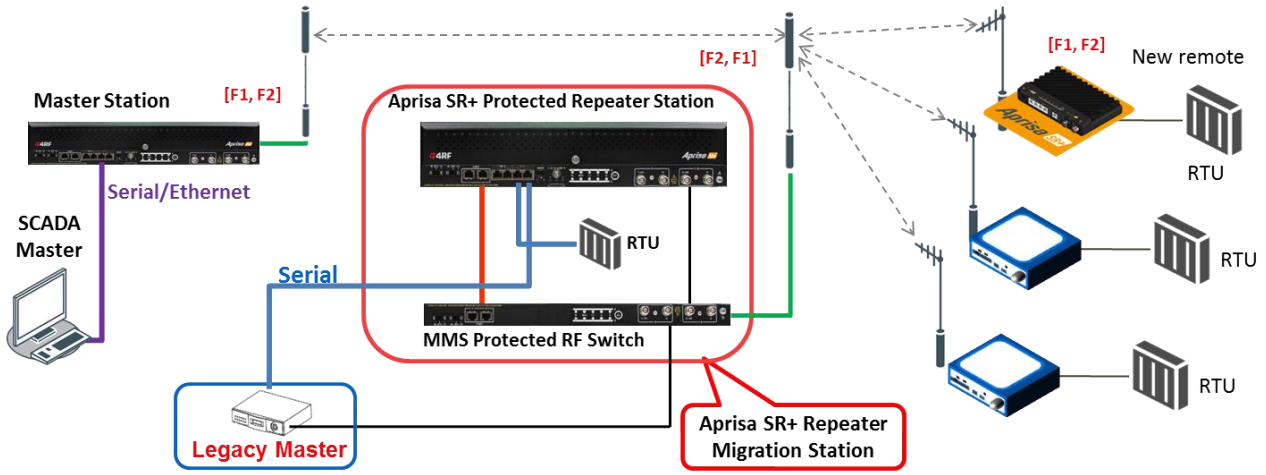
A. Reconnect legacy master RF port to the rear panel RF port of the Migration switch.
B. Reconnect legacy master serial Com port to Aprisa SR+ repeater MMS Com port 2.
C. If RTU was connected to the legacy repeater radio, then reconnect it to Aprisa SR+ repeater MMS Com port 1.
D. Reconnect the antenna to the front panel ANT/DUP RF port of the Migration switch.
E. Connect Aprisa SR+ Repeater station A/B RF port to the front panel APRISA MASTER RF port of the migration switch as describe in the figure below.
F. Connect Aprisa SR+ Repeater station ALARMS A & B alarm I/O ports to the front panel CONTROL A & B alarm I/O ports of the migration switch, respectively, as describe in the figure below.

Special Configuration:

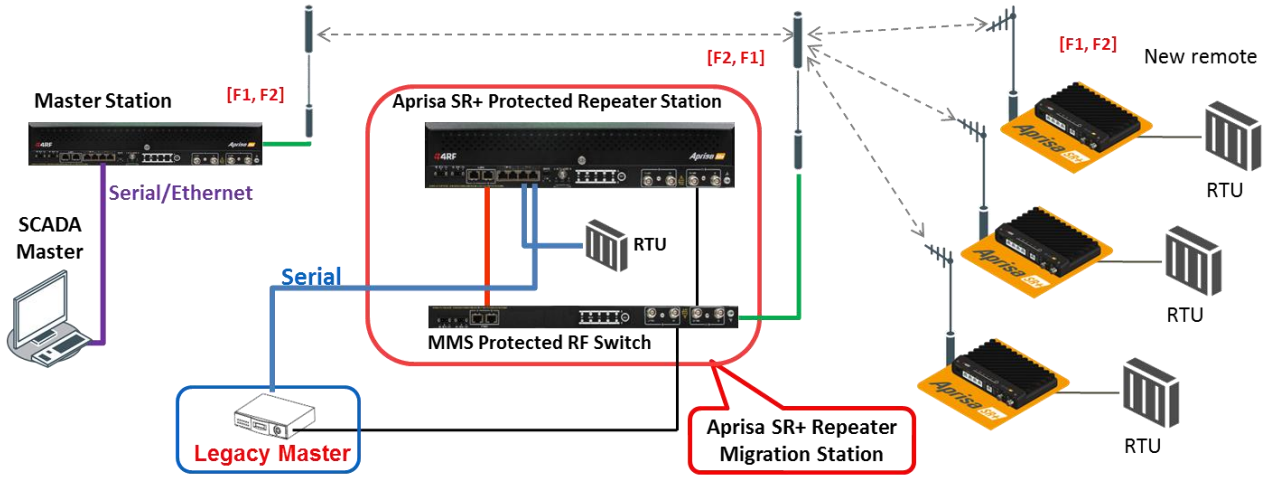
A. Reconfigure the legacy repeater to a legacy Master / Base Station.
B. The Aprisa SR+ Master / Base Station must be configured to 'Base MMS' operating mode (see ‘Terminal > Operating Mode’ on page 26’).
C. The Aprisa SR+ Repeater station must be configured to ‘Repeater MMS’ operating mode (see ‘Terminal > Operating Mode’ on page 26’).
D. The ‘Network Repeaters Proximity’ setting must be set to ‘Single Repeater Only’ option on all Aprisa SR+ radios in the network (see ‘Terminal > Operating Mode’ on page 26’).
E. The Aprisa SR+ Master / Base and Repeater station must configure the parameters ‘Serial Data Stream Mode’ to ‘Segregate’ mode (see ‘Radio > Channel Setup’ on page 29).
F. SCADA master time out setting shall be greater than Repeater MMS timeout setting. If remote doesn’t respond, the Master Station will need to wait for Repeater MMS timeout and then respond back to SCADA master

Notes and recommendations:

- The traffic on the legacy network must be serial poll / response.
- The serial connection to the SCADA server should be increased to the maximum rate or replaced by an Ethernet connection to terminal server setting in the Aprisa SR+ master station to gain full speed benefit of Aprisa SR+.
- The serial connection between the RTU/PLC and Aprisa SR+ remote radio should be increased to the maximum rate to gain full speed benefit of Aprisa SR+.
- Wide selection of serial SCADA protocols can be supported (check with 4RF).



2. Migrate the legacy remote radios to the new Aprisa SR+ remote radios.



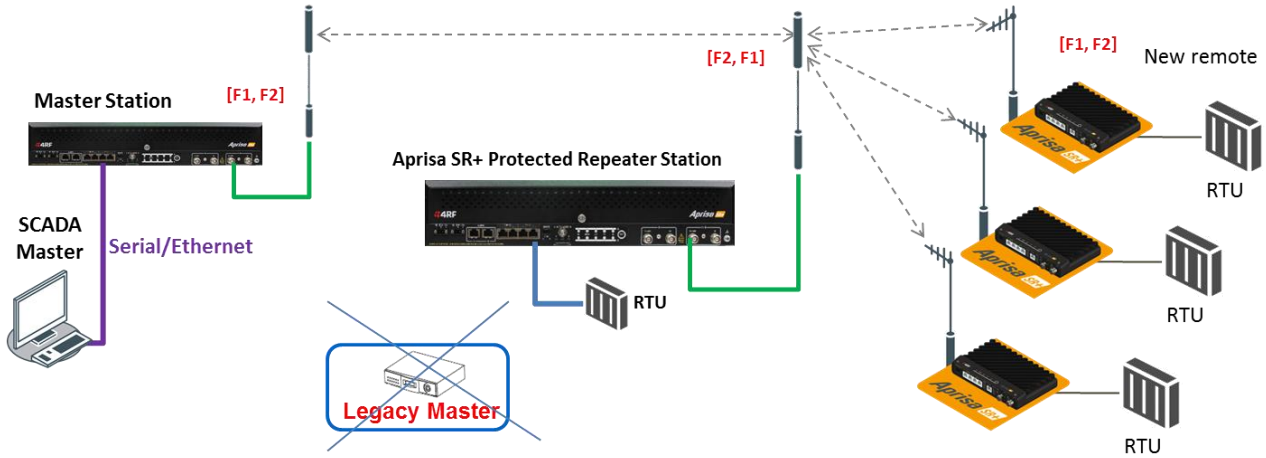
3. When the migration is complete, the standard Aprisa SR+ Protected Repeater Station remains. Removal of the redundant equipment can be done to suit maintenance schedule windows.

Master Site:

- Change the Aprisa SR+ Protected Station operating mode to Base operation (see 'Terminal > Operating Mode' on page 26').

Repeater Site:

- Change the Aprisa SR+ Protected Station operating mode to Repeater MMS operation (see 'Terminal > Operating Mode' on page 26').
- Reconnect the antenna to the front panel A/B TX/ANT RF port of the Aprisa SR+ Protected Repeater Station.
- Remove the legacy master station and remove the migration switch. This can be redeployed to form another migration station.



Hardware Configurations

The Migration Station can be realized with two possible hardware configurations; Non-Protected Migration Station and Protected Migration Station.

Non-Protected Migration Station

The Non-Protected Aprisa SR+ Migration Station is comprised of a standard Aprisa SR+ Radio and an Aprisa SR+ Migration Switch.

The Migration Switch is available in three frequency band options:

- VHF 135 – 240 MHz (covers 135 and 220 MHz bands)
- 320 – 520 MHz (covers the 300, 400, 450 MHz bands)
- 896 – 960 MHz (covers the 896 and 928 MHz bands)

The solution is available with 2E2S (two Ethernet and two Serial) data port option.

Example Part Numbers:

A complete Non-Protected Aprisa SR+ Migration Station requires two parts to be ordered.

The Aprisa SR+ Radio (13.8 VDC):

Part Number	Part Description
APSQ-N896-SSC-FD-22-ENAA	4RF SR+, BR, 896-902 MHz, SSC, Full Dup, 2E2S, EN, STD

The Aprisa SR+ Migration Switch frequency compatible with the radio:

Part Number	Part Description
APSB-XMSW-900	4RF SR+ Acc, Migration Switch, 896-960 MHz

Power

The Aprisa SR+ radio operates from a power supply input of 13.8 VDC nominal (+10 to +30 VDC).

The Migration Switch operates from a power supply input of 48 VDC nominal (10 to 60 VDC floating) so it can operate with a standard 13.8 VDC Aprisa SR+ radio, 13.8 VDC Aprisa SR+ protected station or 48 VDC Aprisa SR+ protected station.

The Migration Switch power consumption is < 6.0 W so the maximum combined power consumption of the non-protected MMS is 41.0 W for 13.8 VDC power input and 10 W transmit peak power.

The external power source must be connected to the Aprisa SR+ radio and the Migration Switch A Phoenix Contact 2 pin male power connector.

Mounting

The Aprisa SR+ radio / duplexer mounts on a 1U 19” rack shelf and the Aprisa SR+ Migration Switch mounts in a standard 19” rack (total of 2RU).

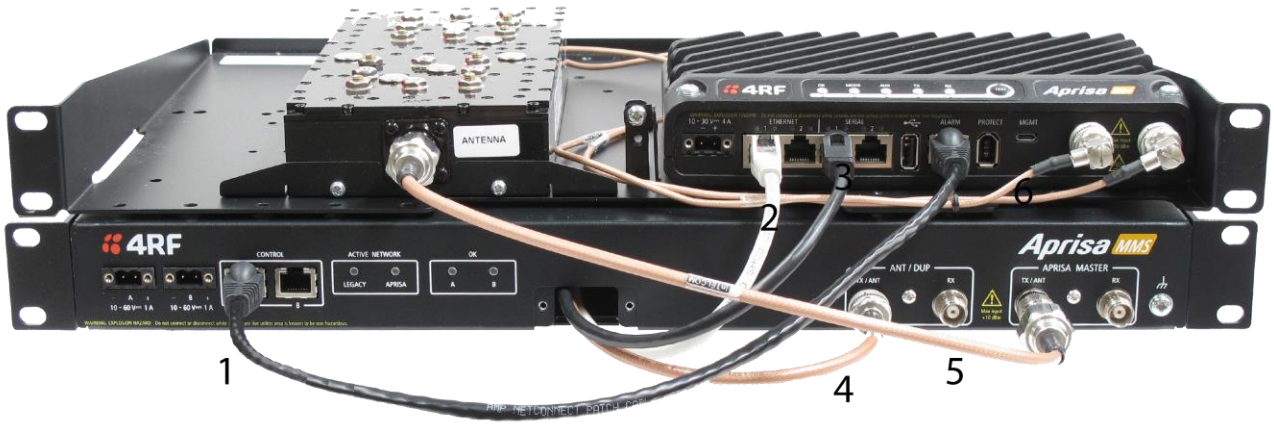
The Aprisa SR+ Migration Switch is delivered with rack mounting hardware.

Cabling

The Aprisa SR+ Migration Switch is delivered with a set of interconnect cables and adaptors. This includes:

1x 4G0200-4053A01	cable TNC to TNC 160 mm RG142
1x 4G0200-4054A02	cable N-male to N-male 360 mm RG142
1x 4G0200-4055A00	cable N-female to TNC 800 mm RG142
1x 4G0200-4004A02	cable RJ45 to RJ45 flat 185 mm black
1x 4G0200-0122	cable RJ45 to RJ45 360 mm black
1x 4G0200-0117	cable RJ45 to RJ45 1.5 m grey
1x 4G0400-0043A01	adaptor RJ45 to DB25 female (MMS wired)
1x 4G0400-0044A00	adaptor RJ45 to DB25 male (MMS wired)

1+0 Radio Full Duplex Migration Station



The 1+0 Radio Full Duplex Migration Station cabling is as follows:

1. The RJ45 to RJ45 360 mm black cable connects the Alarm port from the Aprisa SR+ radio to the Migration Switch.
2. The RJ45 to RJ45 1.5 m grey cable connects the serial traffic interface from the SCADA master and the legacy master via the Migration Switch cable channel.
3. The RJ45 to RJ45 1.5 m white cable connects the Ethernet traffic interface from the SCADA master and the legacy master via the Migration Switch cable channel.
4. The N-female to TNC 800 mm RF cable connects the antenna to the Migration Switch ANT / DUP > TX / ANT TNC connector.
5. The N-male to N-male 800 mm RF cable connects the external duplexer antenna to the Migration Switch TX / ANT TNC connector via a N female to TNC cable.
6. The two right-angle TNC to SMA right angle 640mm cables connect the radio TX / ANT TNC connectors to the external duplexer SMA TX / RX.

1+0 Radio Half Duplex Migration Station

The 1+0 Radio Half Duplex Migration Station cabling is as follows:

1. The RJ45 to RJ45 360 mm black cable connects the Alarm port from the Aprisa SR+ radio to the Migration Switch.
2. The RJ45 to RJ45 1.5 m grey cable connects the serial traffic interface from the SCADA master and the legacy master via the Migration Switch cable channel.
3. The RJ45 to RJ45 1.5 m white cable connects the Ethernet traffic interface from the SCADA master and the legacy master via the Migration Switch cable channel.
4. The N-female to TNC 800 mm RF cable connects the antenna to the Migration Switch ANT / DUP > TX / ANT TNC connector.
5. The TNC to TNC 160 mm RF cable connects the RF port between the Aprisa SR+ Radio TX / ANT TNC connector and the Migration Switch APRISA MASTER TX / ANT TNC connector.

Protected Migration Station

The protected Aprisa SR+ Migration Station is comprised of a standard Aprisa SR+ Protected Station and a Aprisa SR+ Migration Switch, a fully redundant RF switch.

The Migration Switch is available in three frequency band options:

- VHF 135 – 240 MHz (covers 135 and 220 MHz bands)
- 320 – 520 MHz (covers the 300, 400, 450 MHz bands)
- 896 – 960 MHz (covers the 896 and 928 MHz bands)

The solution is available with 2E2S (two Ethernet and two Serial) data port option.

Example Part Numbers:

A complete protected Aprisa SR+ Migration Station requires two parts to be ordered.

The Aprisa SR+ Protected Station (48 VDC):

Part Number	Part Description
APSQ-R896-SSC-FD-22-ENAB	4RF SR+, PS, 896-902 MHz, SSC, Full Dup, 2E2S, EN, 48VDC

The Aprisa SR+ Migration Switch frequency compatible with the protected station:

Part Number	Part Description
APSB-XMSW-900	4RF SR+ Acc, Migration Switch, 896-960 MHz

Power

The Aprisa SR+ Migration Station supports redundant power supply inputs. The Aprisa SR+ Protected Station has two power supply options of 13.8 VDC and 48 VDC nominal.

The Aprisa SR+ Migration Switch operates from a power supply input of 48 VDC nominal (10 to 60 VDC floating) so it can operate with a standard 13.8 VDC Aprisa SR+ radio, 13.8 VDC Aprisa SR+ protected station or 48 VDC Aprisa SR+ protected station.

The Migration Switch power consumption is < 6.0 W so the maximum combined power consumption of the protected MMS is 54.0 W for 48 VDC power input and 10 W transmit peak power.

The external power source must be connected to both the A and B Phoenix Contact 2 pin male power connectors of the Aprisa SR+ Protected Station and both the A and B Phoenix Contact 2 pin male power connectors of the Aprisa SR+ Migration Switch.

13.8 VDC Nominal

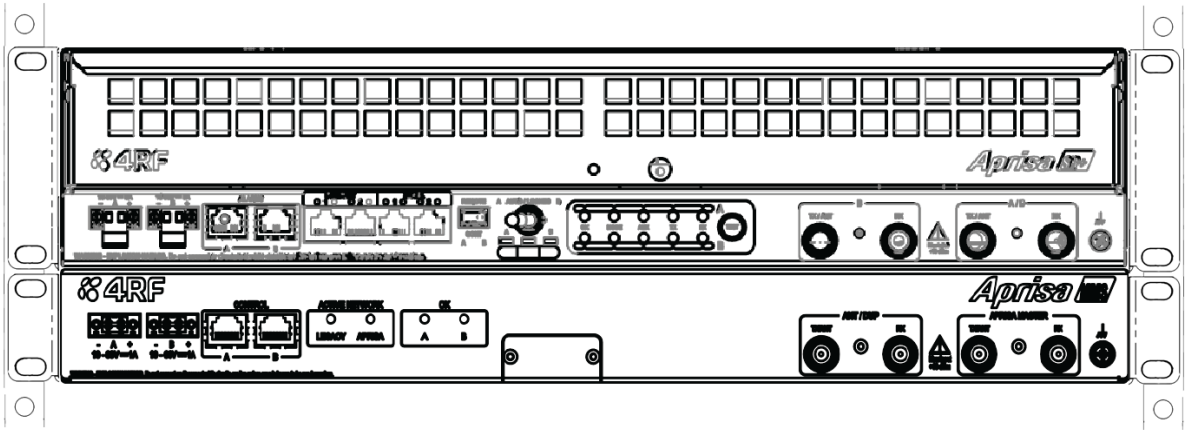
Part Number	Part Description
APSQ-R896-SSC-HD-22-ENAA	4RF SR+, PS, 896-902 MHz, SSC, Half Dup, 2E2S, EN, STD
APSB-XMSW-900	4RF SR+ Acc, Migration Switch, 896-960 MHz

48 VDC Nominal

Part Number	Part Description
APSQ-R896-SSC-HD-22-ENAB	4RF SR+, PS, 896-902 MHz, SSC, Half Dup, 2E2S, EN, 48VDC
APSB-XMSW-900	4RF SR+ Acc, Migration Switch, 896-960 MHz

Mounting

Both the Aprisa SR+ Protected Station and the Aprisa SR+ Migration Switch mount in a standard 19” rack (total of 3RU) and are delivered with rack mounting hardware.



Cabling

The Aprisa SR+ Migration Switch is delivered with a set of interconnect cables and adaptors. This includes:

2x 4G0200-4053A01	cable TNC to TNC 160 mm RG142
2x 4G0200-4054A02	cable N-male to N-male 360 mm RG142
2x 4G0200-4055A00	cable N-female to TNC 800 mm RG142
2x 4G0200-4004A02	cable RJ45 to RJ45 flat 185 mm black
1x 4G0200-0122	cable RJ45 to RJ45 1.5 m black
1x 4G0200-0117	cable RJ45 to RJ45 1.5 m grey
1x 4G0400-0043A01	adaptor RJ45 to DB25 female (MMS wired)
1x 4G0400-0044A00	adaptor RJ45 to DB25 male (MMS wired)

Protected Station Single Antenna Dual Port Migration Station

This cabling option is used when an external duplexer is used, for both half and full duplex operation.

The Protected Station Single Antenna Dual Port Migration Station cabling is as follows:

1. The two RJ45 to RJ45 flat 185 mm black cables connect the Alarms ports from the Aprisa SR+ Protected Station to the Migration Switch.
2. The RJ45 to RJ45 1.5 m black cable connects the Ethernet traffic interface from the SCADA master and the legacy master via the Migration Switch cable channel.
3. The RJ45 to RJ45 1.5 m grey cable connects the serial traffic interface from the SCADA master and the legacy master via the Migration Switch cable channel.
4. The two N-female to TNC 800 mm RF cables connect the external duplexer TX to the Migration Switch ANT / DUP > TX / ANT TNC connector and the external duplexer RX to the Migration Switch ANT / DUP > RX TNC connectors.
5. The two TNC to TNC 160 mm RF cables connect the RF ports between the Aprisa SR+ Protected Station A / B TNC connectors and the Migration Switch APRISA MASTER TNC connectors.
6. The N-male to N-male 360 mm RF cables connect the antenna ports between the legacy master and the Migration Switch (rear panel connectors).

Protected Station Single Antenna Single Port Migration Station

This cabling option is used when half duplex operation is used, and an external duplexer is not required.

The Protected Station Single Antenna Single Port Migration Station cabling is as follows:

1. The two RJ45 to RJ45 flat 185 mm black cables connect the Alarms ports from the Aprisa SR+ Protected Station to the Migration Switch.
2. The RJ45 to RJ45 1.5 m black cable connects the Ethernet traffic interface from the SCADA master and the legacy master via the Migration Switch cable channel.
3. The RJ45 to RJ45 1.5 m grey cable connects the serial traffic interface from the SCADA master and the legacy master via the Migration Switch cable channel.
4. The N-female to TNC 800 mm RF cable connects the antenna to the Migration Switch ANT / DUP > TX / ANT TNC connector.
5. The TNC to TNC 160 mm RF cable connects the RF ports between the Aprisa SR+ Protected Station A / B > TX / ANT connector and the Migration Switch APRISA MASTER TX / ANT connector.
6. The N-male to N-male 360 mm RF cable connects the antenna between the legacy master and the Migration Switch (rear panel connectors).

Protected Station Dual Antenna Single Port Migration Station

This cabling option is used when half duplex operation is used with dual antennas, and external duplexers are not required.

The Protected Station Dual Antenna Single Port Migration Station cabling is as follows:

1. The two RJ45 to RJ45 flat 185 mm black cables connect the Alarms ports from the Aprisa SR+ Protected Station to the Migration Switch.
2. The RJ45 to RJ45 1.5 m black cable connects the Ethernet traffic interface from the SCADA master and the legacy master via the Migration Switch cable channel.
3. The RJ45 to RJ45 1.5 m grey cable connects the serial traffic interface from the SCADA master and the legacy master via the Migration Switch cable channel.
4. One N-female to TNC 800 mm RF cable connects the primary antenna to the Migration Switch ANT / DUP > TX / ANT TNC connector.
5. Another N-female to TNC 800 mm RF cable connects the secondary antenna to the Migration Switch ANT / DUP > RX TNC connector.
6. One TNC to TNC 160 mm RF cable connects the RF ports between the Aprisa SR+ Protected Station B > TX / ANT connector and the Migration Switch APRISA MASTER > RX connector.
7. Another TNC to TNC 160 mm RF cable connects the RF ports between the Aprisa SR+ Protected Station A / B > TX / ANT connector and the Migration Switch APRISA MASTER > TX / ANT connector.
8. One N-male to N-male 360 mm RF cable connects between the legacy master primary antenna port and the Migration Switch LEGACY > TX / ANT (rear panel connectors).
9. If legacy radio has dual antenna protection, then:

   Another N-male to N-male 360 mm RF cable connects between the legacy master secondary antenna port and the Migration Switch LEGACY > RX (rear panel connectors).

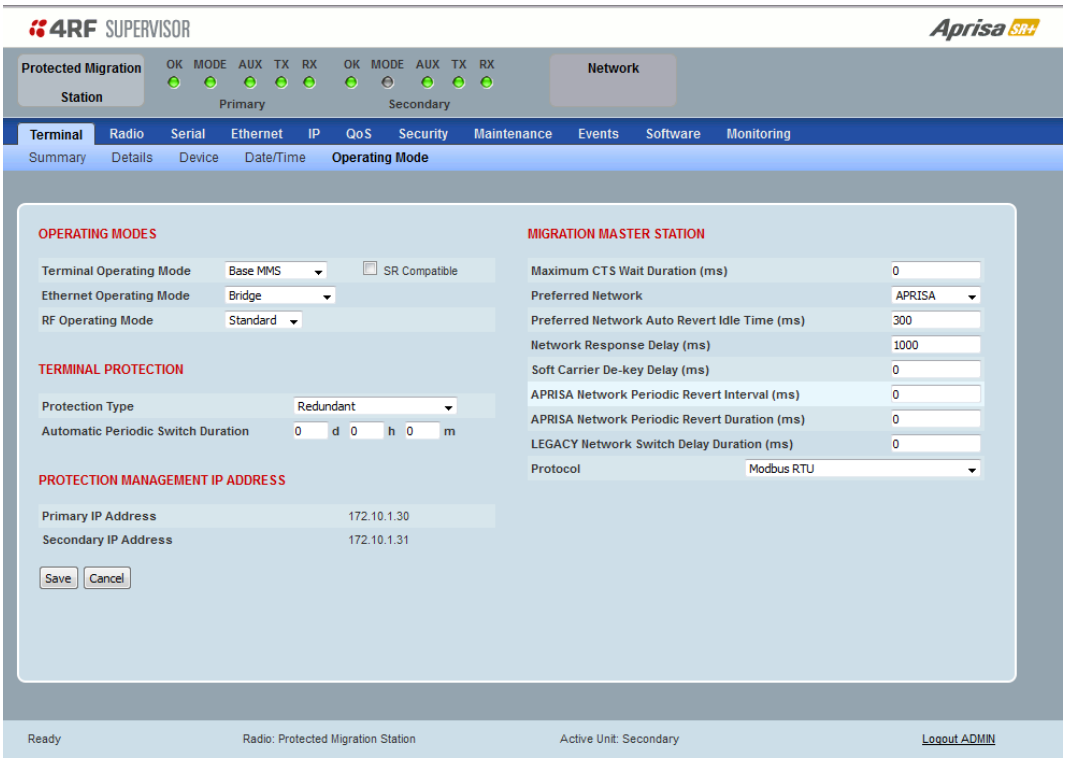
   Otherwise:

   Place a dummy load on the Migration Switch LEGACY > RX (rear panel connectors)

Management

The Aprisa SR+ Migration Station is managed with the embedded web-based management tool, SuperVisor. The following are the SuperVisor screens relevant to a Protected Migration Station.

Terminal > Operating Mode



OPERATING MODES

Terminal Operating Mode

For Migration Station operation, the Terminal Operating Mode must be set to Base MMS or Repeater MMS.

Option	Function
Base MMS	The Base-MMS has the same function as the base station but used for Migration Station operation.
Repeater MMS	The Repeater-MMS has the same function as the repeater station but used for Migration Station operation.

MIGRATION STATION

Maximum CTS Wait Duration (ms)

This parameter sets the maximum delay between the MMS asserting its CTS signal and sending serial data to the legacy radio. If RTS signal is detected by the MMS before the delay expires, then the serial data is sent immediately. If the legacy radio provides a ready signal, then this setting should be set to longer than this signal takes to appear. If the legacy radio requires an externally measured delay, then set this here and do not connect the RTS pin. If the legacy radio does not require key-up delay, then leave this as 0ms. Note that both the MMS and legacy radios are likely wired DCE – so the CTS of MMS will usually be connected to the RTS of the legacy radio and vice-versa. The default setting is 0 ms.

Preferred Network

This parameter sets the Preferred Network to Legacy or Aprisa. The network will be switched to this selection when the Preferred Network Auto Revert Idle time expires i.e. it is the rest state for the switch. Setting this parameter to the predominant network can reduce latency. If Aprisa network is to be shared with IP or management traffic, or the system is repeater MMS, then this setting must be Aprisa. The default setting is Aprisa.

Preferred Network Auto Revert Idle (ms)

This parameter sets the amount of time after the previous serial poll response or timeout to wait before switching to the preferred network. This allows the RTU to send multiple response packets. Many protocols only ever have one response packet to each poll packet. If this is the case, then this can be set to 0 to allow improved management or IP traffic on Aprisa network. The default is 300ms.

Network Response Delay (ms)

This parameter sets the maximum amount of time after a transmit is completed before the first byte of a response packet is expected. This setting should be half the response timeout setting configured in the SCADA polling software. The default setting is 1000 ms.

Soft Carrier De-key Delay (ms)

This parameter is used to account for the length of time the legacy transmitter stays active after data transfer is complete. This should be set to the same as the Soft Carrier De-key Delay (or equivalent parameter) on the legacy master/repeater station. The setting should be the same as the legacy master/repeater station setting. The default setting is 0 ms.

APRISA Network Periodic Revert Interval (ms)

This parameter sets the maximum amount of time the Migration Switch can be set to legacy causing Ethernet and management traffic on the Aprisa network to be blocked. This blocking can occur because the preferred network is legacy or continuous legacy polls are being performed. This forced switch will not occur in the middle of legacy serial polls and will not occur if Migration Switch has been locked to legacy. This setting is only relevant for Base MMS, and should be left as 0 for Repeater MMS. The default setting is 0 ms.

APRISA Network Periodic Revert Duration (ms)

This parameter sets the amount of time spent on the Aprisa network when a forced switch to Aprisa occurs. Together with the Aprisa network Periodic Revert Interval, this sets the guaranteed percentage of time given to traffic on the Aprisa network. This setting is only relevant for Base MMS and should be left as 0 for Repeater MMS. The default setting is 0 ms.

LEGACY Network Switch Delay Duration (ms)

This parameter sets the amount of time the repeater MMS delays forwarding packets to legacy network. On Master MMS this parameter is ignored. This setting should be used if the configured protocol sends multiple packets in a single polling cycle (or MTU is set smaller than packet size to reduce buffering latency), to prevent the MMS waiting for the Network Response Delay between each packet.

In the above described case, the recommended setting is 150ms. Most systems do not need this to be set, but this is known to be required for ABB totalflow and DNP3 (when link layer confirms are used) and may also be required for other protocols in some configurations. The default setting is 0ms.

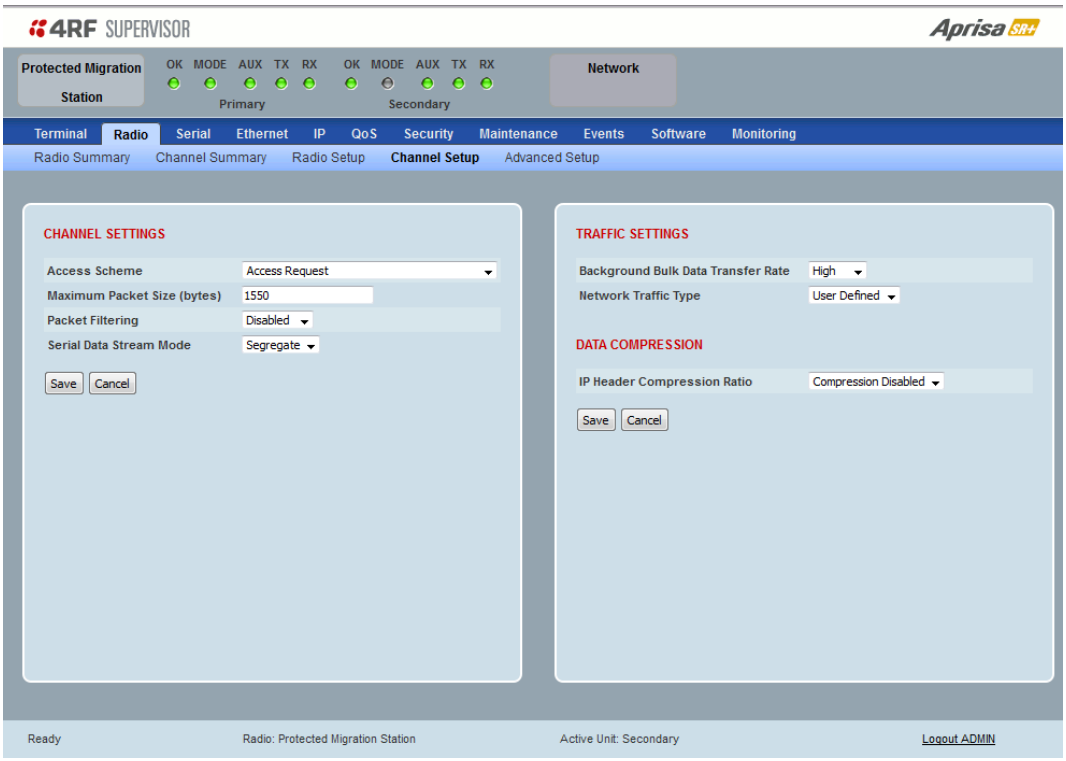
This parameter is only visible / applicable when there are repeaters in the network i.e. Network Radius > 1.

Protocol

This parameter sets the SCADA polling packets protocol. The default setting is Modbus RTU.

When the protocol is set to an option with multiple types, the polling protocol will be automatically determined from within the types specified. Multiple options with dual protocols are supported.

Radio > Channel Setup



CHANNEL SETTINGS

Access Scheme

This parameter sets the Media Access Control (MAC) used by the radio for over the air communication.

Option	Function
Access Request	Channel access scheme where 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. This mode is a general purpose access method for high and low load networks.
Access Request (full duplex)	Used on a network with full duplex base or repeater station hardware and half duplex remotes. A full duplex version of Access Request channel access scheme where 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. If no repeaters are present, this allows the base station to send traffic during remote transmission and when used in a repeater network, this allows repeaters to forward traffic while it is being received.
Listen Before Send without Acknowledgement	Channel access scheme where network elements listen to ensure the channel is clear, before trying to access the channel. This mode is optimized for low load networks and repeated networks. Acknowledgements are disabled.

Listen Before Send with Acknowledgement	Channel access scheme where network elements listen to ensure the channel is clear, before trying to access the channel. This mode is optimized for low load networks and repeated networks. With Acknowledgement, unicast requests from the remote station are acknowledged by the base station to ensure that the transmission has been successful. If the remote station does not receive an acknowledgement, then random back-offs are used to reschedule the next transmission. Enabling acknowledgments increases reliability of transport but reduces available channel capacity so if application has the capability to handle lost or duplicate messages, the Access Scheme should be set to Listen Before Send without Acknowledgement.
Point To Point (Half Duplex)	Channel access scheme for Point-to-point links using half duplex radios. This is the preferred access scheme for mirrored bits ®.

The default setting is Access Request.

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 stations or repeater stations 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 1550 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 security setting is 0, 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 SR+. This is not encrypted.

Packet Filtering

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

In an Aprisa SR+ network, all communication from remote stations is destined for the base station in the Aprisa SR+ network communication protocol. In a repeater or base-repeater network, a remote station will send a message to the base station. The repeater station will receive this and then repeat the message. The repeated message will then be received by the base station. Other remote stations connected to the repeater station will receive this message and depending on the Packet Filtering parameter, either forward this packet or discard it.

This filtering capability can provide the ability for remote stations to communicate with each other (peer to peer communication) when connected to a repeater station or to a base-repeater station, particularly useful in the event of losing communication with a SCADA Master, assuming the Aprisa SR+ network is still operational. For example, to create peer to peer communication between two remotes in a network with a base-repeater, the base-repeater packet filtering setting is set to 'Automatic' and the two remotes packet filtering setting is set to 'Disabled'.

Note: For correct PTP link operation, the Packet Filtering parameter should not be changed from the default setting of 'automatic'.

Note: Packet filtering will remain enabled for IP packets regardless of this setting unless IP Header Compression is disabled.

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 SR+ traffic protocols

The default setting is Automatic.

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

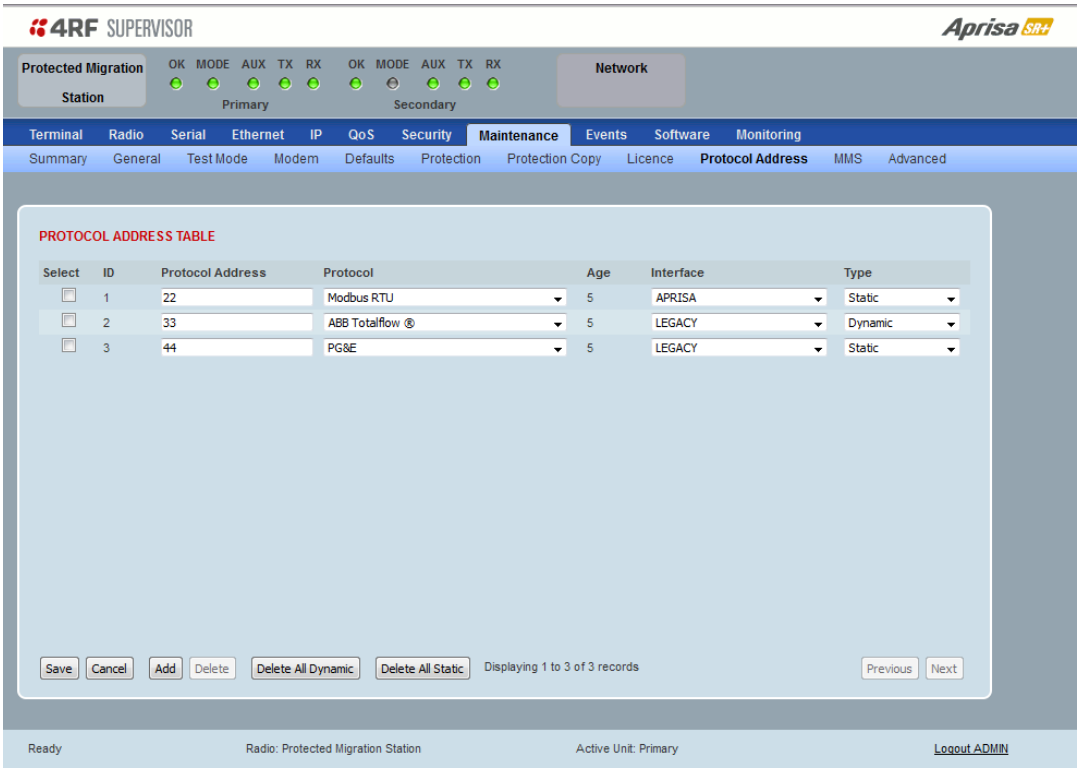
Serial Data Stream Mode

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

For Migration Station operation, the Serial Data Stream Mode must be set to Segregate.

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).

Maintenance > Protocol Address



PROTOCOL ADDRESS TABLE

The MMS protocol address table controls the mappings between protocol address and the network location of the RTU using that address. The address of each packet is checked against this list to determine if it should be sent on the legacy radio network or sent on the Aprisa radio network.

If a SCADA RTU address that is not present in the list is encountered, the Aprisa SR+ will automatically learn which interface to use for this address by trying each interface in turn. A user may choose to create static entries (or change existing dynamic entries to static) to remove this learning step and ensure that the network always has consistent response times.

Protocol Address

This parameter sets the address of the RTU.

Protocol

This parameter sets the protocol used by the RTU. The following protocols are currently supported by the Aprisa SR+ MMS. New protocols can be added based on customer request.

Protocol
Generic Legacy Only
ABB Totalflow
BSAP
BSAP & ABB Totalflow
DF1 Half Duplex BCC
DF1 Half Duplex CRC
DART
DART & Modbus ASCII
DNP3
DNP3 & Harris
EBSAP
Fisher ROC
Harris
HSQ
HSQ & DNP3
IEC 60870-5-101-1 byte address
IEC 60870-5-101-2 byte address
Medina
MDLC
Modbus ASCII
Modbus RTU
Modbus RTU & Thermo
Modbus RTU & Fisher ROC
PG&E
PG&E & DNP3
Proteus
Proteus & DNP3
ROC
Siemens Sinaut ST1 / ST7
Telegyr 8979
Thermo

Age

This parameter shows the Age of this address. For each SCADA request sent to an RTU address, this counter is reduced by one. If a response is received from the RTU, then the counter is reset to 5. When the counter reaches 0 and the address is a dynamic address type, the entry is deleted and subsequent packets to that SCADA address will be relearnt by trying each interface in turn.

Interface

This parameter sets the location of the RTU.

If set to Radio Path, the RTU is located on the Aprisa network.

If set to Serial Port 2, the RTU is located on the legacy network.

Type

This parameter controls if this entry is allowed to be deleted when its age reaches 0.

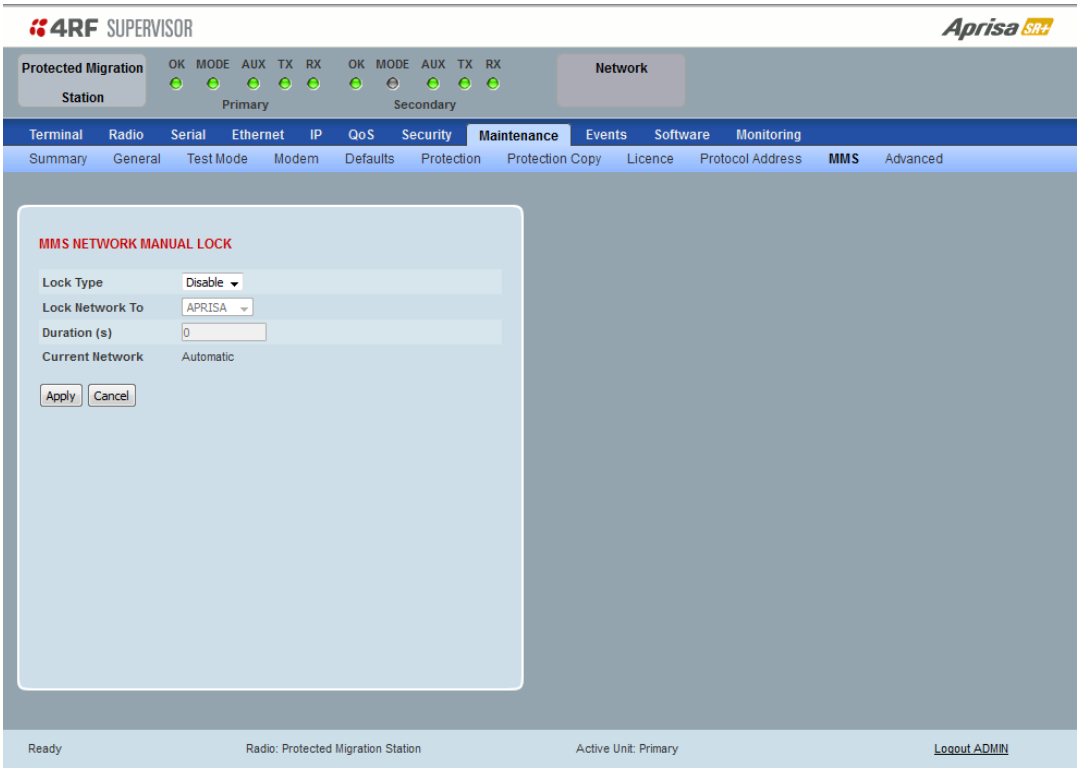
Option	Function
Static	This is a permanent address and will never be deleted.
Dynamic	This is an automatically added address and may be deleted when its age reaches 0.

Controls

The ‘Delete All Dynamic’ button deletes all entries with the Type set to Dynamic.

The ‘Delete All Static’ button deletes all entries with the Type set to Static.

Maintenance > MMS



MMS NETWORK MANUAL LOCK

The MMS network manual lock controls the switching of the Migration Station.

Lock Type

This parameter sets the Migration Station manual lock.

Option	Function
Disable	Disables manual locking of the Migration Switch i.e. allows for automatic switching.
Enable	Allows the Migration Switch to be manually locked i.e. disables automatic switching.
Timer	Allows the Migration Switch to be manually locked but only for a predetermined period.

Lock Network To

This parameter sets the manual lock state.

Option	Function
Aprisa	Manually switches the Migration Switch to the Aprisa network.
Legacy	Manually switches the Migration Switch to the Legacy network.

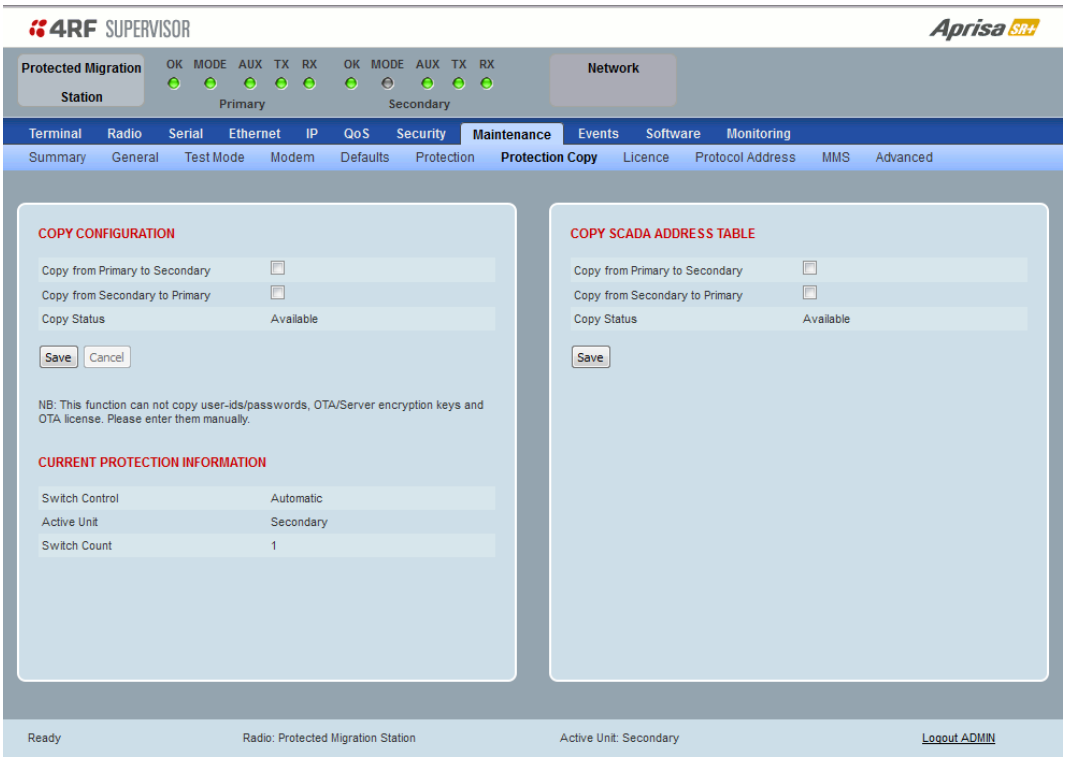
Duration (s)

This parameter defines the period required for manually locking the Migration Switch. When this period elapses, the Lock Type becomes Disable (automatic switching).

Current Network

This parameter shows the network that is currently active (Automatic or Aprisa or Legacy).

Maintenance > Protection Copy



COPY SCADA ADDRESS TABLE

When the SCADA Address Table is changed in one radio, it is automatically changed in the partner radio but if one radio has been replaced in the protected station, the SCADA Address Table will need to be copied to the new radio.

Copy from Primary to Secondary

This parameter copies the SCADA Address Table from the primary to the secondary radio.

Copy from Secondary to Primary

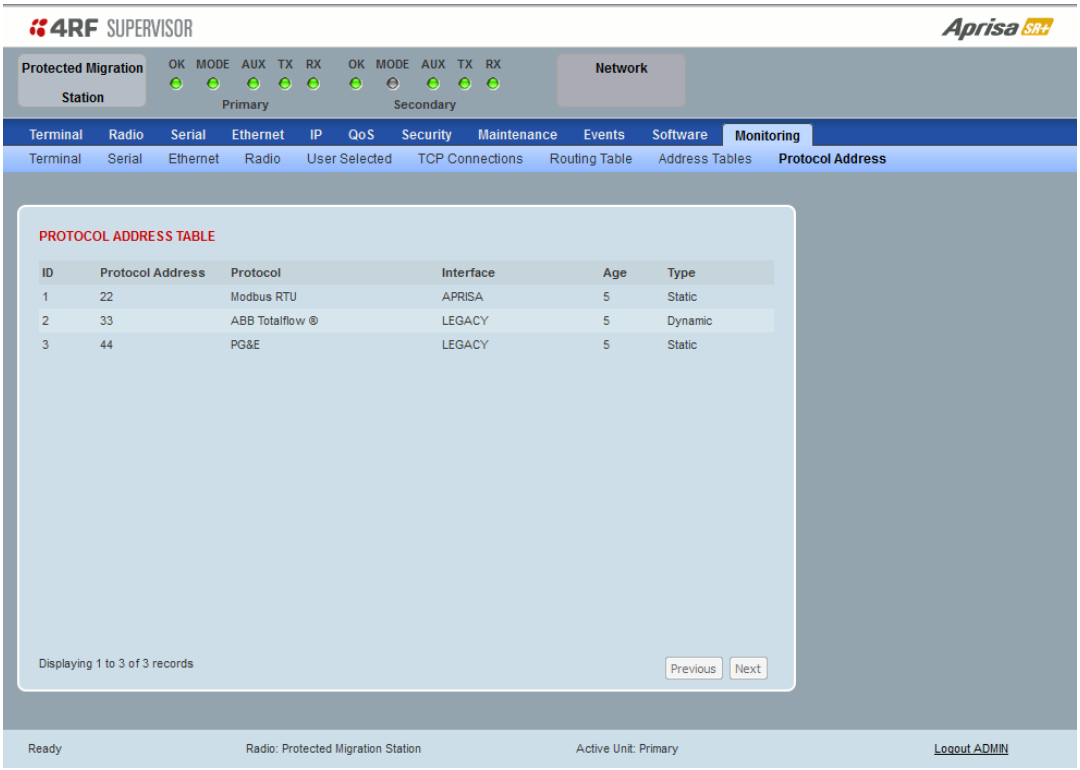
This parameter copies the SCADA Address Table from the secondary to the primary radio.

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).
Copying	The Copy Configuration feature is running.

Monitoring > Protocol Address



PROTOCOL TABLE

The MMS protocol address table shows the current mappings between protocol address and the network location of the RTU using that address.

Protocol Address

This parameter sets the address of the RTU.

Protocol

This parameter sets the SCADA protocol used by the RTU

Age

This parameter shows the Age of this address. For each SCADA request sent to an RTU address, this counter is reduced by one. If a response is received from the RTU, then the counter is reset to 5. When the counter reaches 0 and the address is a dynamic address type, the entry is deleted and subsequent packets to that SCADA address will be relearnt by trying each interface in turn.

Interface

This parameter sets the location of the RTU.

If set to Radio Path, the RTU is located on the Aprisa network.

If set to Serial Port 2, the RTU is located on the legacy network.

Type

This parameter controls if this entry is allowed to be deleted when its age reaches 0.

Accessories

The following accessories are available for the Aprisa SR+ Migration Station:

Part Number	Part Description
APSB-KADP-RMS	4RF SR+ Acc, Kit, Adaptor, Remote MMS Conversion

This adaptor kit allows the replacement of a 3rd party radio with an Aprisa SR+ radio. It includes:

- 1x 4G0400-0045A00 adaptor TNC male To N female
- 1x 4G0400-0047A01 adaptor RJ45 to DB9 female - MMS wired
- 1x 4G0400-0043A01 adaptor RJ45 to DB25 female - MMS wired
- 1x 4G0200-0122 cable RJ45 to RJ45 1.5 m black

The Aprisa SR+ Migration Switch is available for the three frequency band options:

Part Number	Part Description
APSB-XMSW-VHF	4RF SR+ Acc, Migration Switch, 135-240 MHz
APSB-XMSW-450	4RF SR+ Acc, Migration Switch, 320-520 MHz
APSB-XMSW-900	4RF SR+ Acc, Migration Switch, 896-960 MHz

A Migration Switch part includes:

- A Migration Switch 10 to 60 VDC Input Power
- 2x 4G0200-4053A01 cable TNC to TNC 160 mm RG142
- 2x 4G0200-4054A02 cable N-male to N-male 360 mm RG142
- 2x 4G0200-4055A00 cable N-female to TNC 800 mm RG142
- 2x 4G0200-4004A02 cable RJ45 to RJ45 flat 185 mm black
- 1x 4G0200-0122 cable RJ45 to RJ45 1.5 m black
- 1x 4G0200-0117 cable RJ45 to RJ45 1.5 m grey
- 1x 4G0400-0043A01 adaptor RJ45 to DB25 female
- 1x 4G0400-0044A00 adaptor RJ45 to DB25 male

Alarm Events

Migration Station Alarm Events

Event ID	Event Display Text	Default Severity	Configuration Type	Function	Recommended Actions
76	MMS Hardware Failure	major(2)		Alarm to indicate that the radio has detected an error / unexpected state in the MMS hardware.	Check the event history log for more details of the detected error. • Check cable connections? • Replace MMS hardware?
77	MMS Configuration	warning(4)		Alarm to indicate that a MMS related configuration parameter is incorrect.	Check the event history log for more details of the error and correct the configuration setting as required.
79	MMS Manual Lock	warning(4)		Alarm to indicate that the diagnostics function to lock the MMS system to a specific MMS path has been activated. This is only relevant when the radio has been configured for MMS.	No action required. This indicates that the diagnostic function is active.

Maintenance

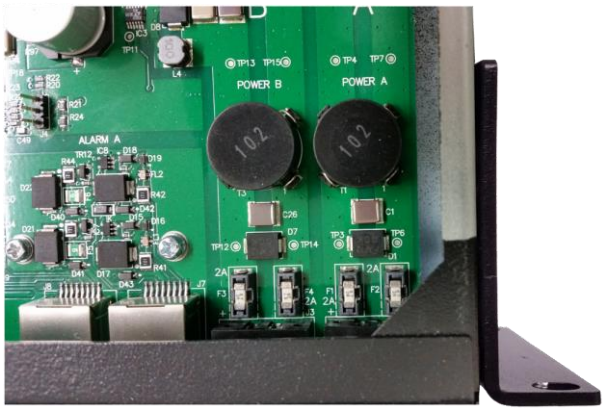
Replacing Migration Switch Fuses

There are fuses on the power supply inputs to the Migration Switch. If the Migration Switch power supplies are connected but it is not operating, it may be that a power supply input fuse is blown.

The fuse required is a Littelfuse 454 Series 2A NANO Surface Mount Fuse.

To replace a Migration Switch fuse:

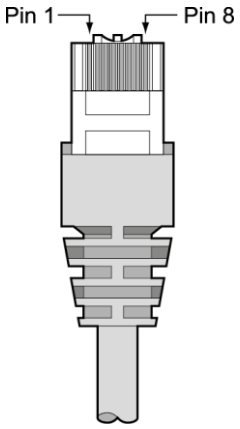
1. Disconnect the power supply, antenna/s, interface cables and any other connections.
2. Remove the Migration Switch shelf from the rack.
3. Turn the Migration Switch shelf upside down.
4. Remove the rear securing screws and remove the bottom panel.



5. Determine which fuse is blown and replace it.
6. Refit the bottom panel and tighten the two screws.
7. Replace the shelf in the rack and re-connect all the cables.

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 SR+ 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	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	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

Adaptors

Adaptor RJ45 to DB25 Female (DCE)- MMS Wired

Part Number: 4G0400-0043A01

RJ45 Pin Number	Pin Function	Wire Color	DB25 Female Pin Number
1	RTS	Blue	4
2	DTR	Orange	12
3	TX	Black	2
4	GND	Red	7
5	DCD	Green	8
6	RX	Yellow	3
7	DSR	Brown	6
8	CTS	White	5

Adaptor RJ45 to DB25 Male (DTE)- MMS Wired

Part Number: 4G0400-0044A01

RJ45 Pin Number	Pin Function	Wire Color	DB25 Male Pin Number
1	CTS	Blue	5
2	DSR	Orange	6
3	RX	Black	3
4	GND	Red	7
5	DCD	Green	NC
6	TX	Yellow	2
7	DTR	Brown	20
8	RTS	White	4

3. Specifications

Power Specifications

Power Supply

Non-Protected Aprisa SR+ Migration Station

Nominal voltage	+13.8 VDC (negative earth)
Absolute input voltage range	+10 to +30 VDC
Maximum power input	41 W
Connector	Molex 2 pin male screw fitting 39526-4002

Protected Aprisa SR+ Migration Station

Power Input	13.8 VDC	48 VDC
Nominal voltage	+13.8 VDC (negative earth)	48 VDC (floating)
Absolute input voltage range	+10 to +30 VDC	18 to 60 VDC
Maximum power input	48 W	54 W
Connector	4x Molex 2 pin male screw fitting 39526-4002	

Power Consumption

Note: The radio power consumption is very dependent on transmitter power, the type of traffic and network activity.

Non-Protected Aprisa SR+ Migration Station

Mode	Transmit Peak Power	13.8 VDC	
Transmit / Receive	10 W	< 41 W	
	1 W	< 31 W	
Receive only		< 13 W	

Protected Aprisa SR+ Migration Station

Mode	Transmit Peak Power	13.8 VDC	48 VDC
Transmit / Receive	10 W	< 48 W	< 54 W
	1 W	< 38 W	< 44 W
Receive only		< 21 W	< 23 W

Power Dissipation

Non-Protected Aprisa SR+ Migration Station

Mode	Transmit Peak Power	13.8 VDC	
Transmit / Receive	10 W	< 31 W	
	1 W	< 30 W	
Receive only		< 13 W	

Protected Aprisa SR+ Migration Station

Mode	Transmit Peak Power	13.8 VDC	48 VDC
Transmit / Receive	10 W	< 38 W	< 44 W
	1 W	< 37 W	< 36 W
Receive only		< 21 W	< 23 W

General Specifications

Environmental

Operating temperature range	-40 to +70˚ C (-40 to +158˚ F)
Storage temperature range	-40 to +80˚ C (-40 to +176˚ F)
Operating humidity	Maximum 95% non-condensing
Acoustic noise emission	No audible noise emission

Mechanical

Non-Protected Aprisa SR+ Migration 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	6.2 kg (31 lbs) (includes 1 radio on a shelf and a migration switch)
Colour	Matt black
Mounting	Rack mount (8 x M6 screws)

Protected Aprisa SR+ Migration Station

Dimensions	Width 432.6 mm (17”) Depth 372 mm (14.6”) and 388 mm (15.276”) with TNC connectors Height 3U plus external duplexer (if used)
Weight	13.8 kg (31 lbs) (includes protected station with 2 radios and a migration switch)
Colour	Matt black
Mounting	Rack mount (8 x M6 screws)