Sontay® SonNet & Tridium JACE Integration

User Manual

Version 2.0

March 2014

Audience

This manual is intended for specifiers, users and installers of the Sontay® SonNet radio sensor system.

Content

This manual provides a complete reference for the integration of the Sontay® SonNet radio sensor system to Tridium JACE.

Related Documents

The Sontay® SonNet radio sensor system Site Survey Kit Quick Start Guide
The Sontay® SonNet radio sensor system Site Survey Kit Manual
The Sontay® SonNet radio sensor system Quick Start Guide
The Sontay® SonNet radio sensor system product datasheets

Table of Contents:

Overview

The wireless nodes are based on direct-sequence spread spectrum communication in the 2.4 - 2.5GHz band, compliant with IEEE 802.15.4-2006.

All nodes have a unique MAC address, equivalent to a unique serial number.

All nodes have a PCB-mounted on/off switch or jumper.

All nodes retain their configuration properties across a power failure.

Environmental

- Storage temperature range of -10 to +80°C
- Storage relative humidity range of 0 to 90% (non-condensing).
- Ambient (operating) temperature range of -10°C to +50°C
- Ambient (operating) relative humidity range of 0 to 90%, (non-condensing).

Battery Fitting and Replacement

When a battery is installed, or when it is replaced, observing the correct polarity is very important. Fitting the battery incorrectly may result in permanent damage to the device.

Recommended batteries are 3.6Vdc 2.4Ah AA size Lithium-Thionyl Chloride types for space housing sensors, or 3.6Vdc 2.1Ah 2/3 A size Lithium-Thionyl Chloride types for plant housing sensors, and are **not rechargeable**.

This type of battery should be stored in a clean, cool (not exceeding +30°C), dry and ventilated area.

Disposal of Batteries - Warning! Fire, Explosion and Burn Hazard

Do not short-circuit, crush, disassemble, heat above 100°C (212°F), incinerate, or expose the battery contents to water. Do not solder directly to the cell.

NB - All batteries *must* be disposed of in accordance with EC Directive 2006/66/EC, amended by EU Directive 2008/12/EC.

Devices Types

Battery Powered Nodes

Battery powered sensor nodes are used in conjunction with the Sontay® **RF-RX20**, **RF-RX40**, **RF-RXS** and **RF-RXS-N** receiver units, and if required (depending on installation topography), Sontay® **RF-RR** series of routers. Data is transmitted back to the receiver at configurable time intervals, or on a configurable change in measured value. Each sensor retains these configurations if the battery becomes discharged or requires replacement. The sensors automatically find the best path back to the receiver, which may be directly to the receiver or *via* "parent" routers.

To power a battery powered node, jumper J400 must be fitted. To switch off, remove J400.

Battery powered nodes are available in 4 formats:

- Space mounting temperature, with setpoint, momentary switch, fan speed, VFC input and CO_2 options
    - **NB -** setpoint, momentary switch and fan speed options are not available with the CO_2 option
- Space mounting RH&T, with setpoint, momentary switch, fan speed, VFC input and CO_2 options
    - **NB -** setpoint, momentary switch and fan speed options are not available with the CO_2 option
- Plant mounting temperature
- Plant mounting RH&T

Space Mounting Specification:

Radio Output:
      Frequency   2.4GHz
      16 channels, automatically selected, direct-sequence spread spectrum
      Compliance   IEEE 802.15.4-2006
Aerial Characteristics:
      Gain   1.2dBi
      VSWR   1.5:1
Data Encryption: AES 128
Power Output: 0dBm (1mW @ 50Ω)
Accuracy:
      Temperature   ±0.3°C
      Optional RH   ±3% RH
Battery Type: 3.6V AA 2.4Ah Li-SOCl$_2$, non-rechargeable
Battery Life: >3 years (depending on configuration)
Housing:
Material: ABS (flame retardant)
Dimensions: 115 x 85 x 28mm
Environmental:
Operating:
      Temperature: -10°C to +50°C
      RH: 0 to 90%, non-condensing
Storage:
      Temperature: -10°C to +80°C
      RH: 0 to 90%, non-condensing
Country of origin: UK

Refer to product datasheets for installation instructions.

Plant Mounting Specification:

Radio Output:
        Frequency   2.4GHz
        16 channels, automatically selected, direct-sequence spread spectrum
        Compliance   IEEE 802.15.4-2006
Aerial Characteristics:
        Gain   2.0dBi
        VSWR   2:1
Data Encryption: AES 128
Power Output: 0dBm (1mW @ 50Ω)
Accuracy:
        Temperature   ±0.3°C
        Optional RH   ±3% RH
Battery Type: 3.6V AA 2.4Ah Li-SOCl$_2$, non-rechargeable
Battery Life: >3 years (depending on configuration)
Housing:
Material: ABS (flame retardant type VO)
Dimensions: 115 x 85 x 28mm
Mounting: Holes 4mm spaced 85mm apart
Protection: IP65
Environmental:
Operating:
        Temperature: -10°C to +50°C
        RH: 0 to 90%, non-condensing
Storage:
        Temperature: -10°C to +80°C
        RH: 0 to 90%, non-condensing
Country of origin: UK

Temperature Sensor Types:
        Duct
        Outside air
        Outside air with solar radiation shield
        Immersion
        Strap-on
        Flying lead

Refer to product datasheets for installation instructions.

24V Powered Routers

24V powered routers are used in conjunction with the Sontay® **RF-RX20**, **RF-RX40**, **RF-RXS** and **RF-RXS-N** receiver units, **RF-IOM** IO modules and **RF-RS** series of battery powered radio sensors, and are used to route signals from battery powered nodes and other routers to the receiver module, where the signal strength of a direct path is not sufficient for reliable communications. **NB** Each router can support a maximum of 16 "children", which can consist of a maximum of 8 battery powered nodes and 8 routers, *or* up to 16 routers *if* there are no battery powered nodes. Consideration should be given on network planning for redundancy in case of router failure or damage.

Data is transmitted back to the receiver at configurable time intervals, or on a configurable change in measured value. Each sensor retains these configurations if the battery becomes discharged or requires replacement. Routers automatically find the best path back to the receiver, which may be directly to the receiver or *via* other "parent" routers.

To power a router, jumper J200 must be fitted. To switch off, remove J200.

24V powered nodes are available in 5 formats:

- Space mounting temperature, with setpoint, momentary switch, fan speed, VFC input, PIR and CO_2 options
    - **NB -** setpoint, momentary switch and fan speed options are not available with the CO_2 option
- Space mounting RH&T, with setpoint, momentary switch, fan speed, VFC input, PIR and CO_2 options
    - **NB -** setpoint, momentary switch and fan speed options are not available with the CO_2 option
- Plant mounting with no sensor functions
- Plant mounting temperature
- Plant mounting RH&T

Space Mounting Specification:

Radio Output:
       Frequency   2.4GHz
       16 channels, automatically selected
       Direct-sequence spread spectrum
       Compliance   IEEE 802.15.4-2006
Aerial Characteristics:
       Gain   1.2dBi
       VSWR   1.5:1
Data Encryption: AES 128
Power Output: +10dBm (10mW @ 50Ω)
Accuracy:
       Temperature   ±0.3°C
       Optional RH   ±3% RH
Power Supply: 24Vac/dc
Housing:
Material: ABS (flame retardant)
Dimensions: 115 x 85 x 28mm
Environmental:
Operating:
       Temperature: -10°C to +50°C
       RH: 0 to 90%, non-condensing

Storage:

        Temperature: -10°C to +80°C
        RH: 0 to 90%, non-condensing
Country of origin: UK

Refer to product datasheets for installation instructions.

Plant Mounting Specification:

Radio Output:

        Frequency   2.4GHz
        16 channels, automatically selected, direct-sequence spread spectrum
        Compliance   IEEE 802.15.4-2006
Aerial Characteristics:
        Gain   2.0dBi
        VSWR   2:1
Data Encryption: AES 128
Power Output: +10dBm (10mW @ 50Ω)
Accuracy:
        Temperature   ±0.3°C
        Optional RH   ±3% RH
Power Supply: 24Vac/dc
Housing:
Material: ABS (flame retardant type VO)
Dimensions: 115 x 85 x 28mm
Mounting: Holes 4mm spaced 85mm apart
Protection: IP65
Environmental:
Operating:
        Temperature: -10°C to +50°C
        RH: 0 to 90%, non-condensing
Storage:
        Temperature: -10°C to +80°C
        RH: 0 to 90%, non-condensing
Country of origin: UK

Temperature Sensor Types:
        Duct
        Outside air
        Outside air with solar radiation shield
        Immersion
        Strap-on
        Flying lead

Refer to product datasheets for installation instructions.

230Vac Powered Routers

The 230Vac powered RF-RR-MPR routers can be used in conjunction with the Sontay® **RF-RX20**, **RF-RX40**, **RF-RXS** and **RF-RXS-N** receiver units, **RF-IOM** IO modules, 24V powered **RF-RR** routers and **RF-RS** series of battery powered radio sensors, and are used to route signals from battery powered nodes and other routers to the receiver module, where the signal strength of a direct path is not sufficient for reliable communications. **NB** Each router can support a maximum of 16 "children", which can consist of a maximum of 8 battery powered nodes and 8 routers, *or* up to 16 routers *if* there are no battery powered nodes. Consideration should be given on network planning for redundancy in case of router failure or damage.

NB - the **RF-RR-MPR** 230Vac has no sensor capability.

Specification:
Radio Output:
        Frequency   2.4GHz
        16 channels, automatically selected
        Direct-sequence spread spectrum
        Compliance   IEEE 802.15.4-2006
Aerial Characteristics:
        Gain   2.0dBi
        VSWR   <2:1
Data Encryption: AES 128
Power Output: +10dBm (10mW @ 50Ω)
Power Supply: 85 – 240Vac @ 50/60 Hz
Housing:
        Material: ABS (flame retardant)
        Dimensions: 116 x 106 x 52mm
Environmental:
Ambient:
        Temperature: -30°C to +70°C
        RH: 0 to 90%, non-condensing
Protection: IP30

The System Receiver

The SonNet® receiver collects data from all other devices on the radio network, including measurements from sensors, link quality for all links formed in the network, battery levels for all battery powered devices, hours run for all devices and the current status of all devices. **NB** Each receiver can support a maximum of 16 "children", which can consist of a maximum of 12 battery powered nodes and 4 routers, *or* up to 16 routers *if* there are no battery powered nodes.

*NB - If the USB port of an **RF-RXS** receiver is connected, the 9-way serial port is temporarily disabled until the USB port id disconnected again.*

Receivers are available in 4 formats:

- **RF-RXS** - Serial output and USB port for use with CMS
- **RF-RXS-N** - Option card for Tridium JACE controllers

Receiver Specification:

Radio Output:

   Frequency 2.4GHz

   16 channels, automatically selected

   Direct-sequence spread spectrum

   Compliance IEEE 802.15.4-2006

Aerial Characteristics:

   Gain   2.0dBi

   VSWR   2:1

Data Encryption: AES 128

Power Output: +10dBm (10mW @ 50Ω)

Power Supply: 24Vac/dc

Environmental:

Operating:

   Temperature: -10°C to +50°C

   RH: 0 to 90%, non-condensing

Storage:

   Temperature: -10°C to +80°C

   RH: 0 to 90%, non-condensing

Country of origin: UK

Refer to product datasheets for installation instructions.

The RF-IOM

The **RF-IOM** has no "intelligence", but merely acts as local I/O with connectivity to typical HVAC equipment such as fan coil units (FCUs) and variable air volume (VAV) boxes. The **RF-IOM** reads its digital and analogue inputs and transmits the values wirelessly to a BMS controller *via* either a SonNet V2 serial receiver or a SonNet option card receiver. The **RF-IOM** receives its output values wirelessly from a BMS controller *via* either a SonNet V2 serial receiver or a SonNet option card receiver.

Additionally, the **RF-IOM** has full router functionality.

Typically, a simple system will consist of;

- Battery powered EDs

- Powered routers (if required)
- SonNet V2 serial receiver or a SonNet option card receiver
- RF-IOMs

The EDs (and routers, where applicable) operate in the normal way. Data from the receiver is made available to the controller via a serial link. The SonNet data points are then used by the controller as part of a control strategy, which will typically calculate heating and cooling demands, damper positions etc. These calculated control values will then be passed back to the receiver via the serial link and passed from the receiver over the wireless network to the **RF-IOM**.

The **RF-IOM** _outputs_ are defined as points in the JACE so that their values can be set by the control strategy via the receiver. Note that the **RF-IOM** cannot be used with the **RF-RX20** or **RF-RX40** receivers.

RF-IOM Specification:

Radio Output:
Frequency   2.4GHz
16 channels, automatically selected
Direct-sequence spread spectrum
Compliance   IEEE 802.15.4-2006
Aerial Characteristics:
Gain   2.0dBi
VSWR   2:1
Data Encryption: AES 128
Power Output: +10dBm (10mW @ 50Ω)
Power Supply: 24Vac/dc
Inputs:
          4 x universal inputs;
                                   4-20mA (loop or externally powered), into 750Ω maximum impedance
                                   0-10Vdc, into 4k7Ω minimum impedance
                                   Resistive, 1.5kΩ min to 60kΩ max
                                   Digital, VFC
Outputs: 4 x 0-10Vdc linear, @ 20mA per output
LED Indication:
          Network
          Data
          Digital input
Housing: DIN Rail H86mm x W58mm x L104mm (excluding aerial)
Environmental:
Operating:
Temperature: -10°C to +50°C
RH: 0 to 90%, non-condensing
Storage:
Temperature: -10°C to +80°C
RH: 0 to 90%, non-condensing
Country of origin: UK

The Radio Network

A Sontay® SonNet radio system is comprised of a receiver, battery powered sensors, RF-IOMs and permanently powered routers.

Routers, though permanently powered, can also have sensing elements, accomplishing both router and sensors functions. Routers, RF-IOMs and sensors can either communicate directly with the receiver or *via* other routers. RF-IOMs and routers are required to be permanently powered as they need to stay "awake" at all times to allow signals from "child" nodes to be instantly forwarded to their "parent" nodes. Battery powered sensors only "wake" for very short periods to send data.
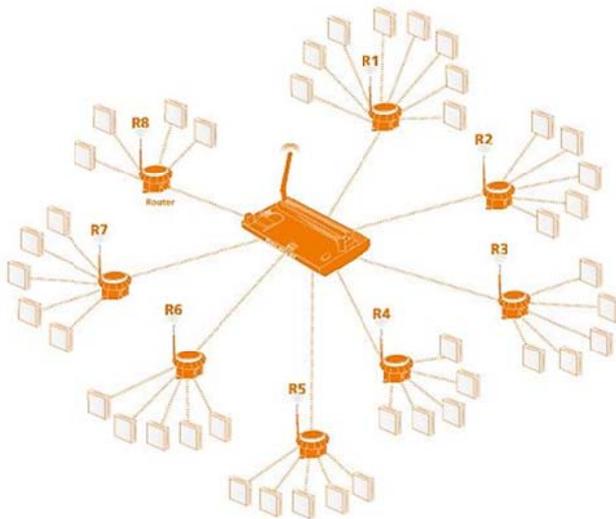
In the schematic above, routers **R2 to R7** have 5 children each, all battery powered sensors. Their parent is the receiver. Router **R1** has 6 children and **R8** has 4 children, giving a total number of network devices of 50, including the receiver.

The receiver can support a **maximum** of 16 directly connected "child" devices, of which only 12 can be battery powered nodes, plus up to 4 routers.

RF-IOMs and routers can support a **maximum** of 16 directly connected "child" devices, of which only 8 can be battery powered nodes, plus up to 8 routers.
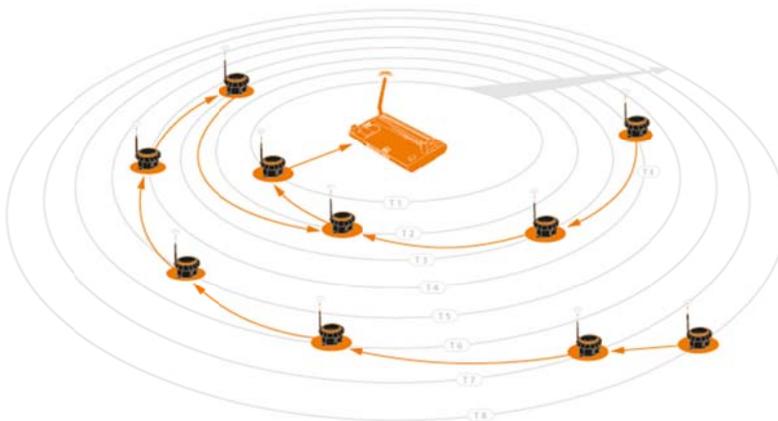
There can be a maximum depth of 8 layers of routers in a network and a maximum of 150 nodes per network with the **RF-RX** series of receivers.

Note that battery powered devices can only route their signals to the receiver directly or through RF-IOMs and routers, and **not through other battery powered devices**.

When planning a SonNet radio network, it is recommended that the Sontay® SonNet Site Survey Kit be used. This easy-to-use package allows installers to test signal strengths between locations required for battery powered sensors and the receiver prior to installing the full system. It can also identify whether routers are needed to ensure reliable communications between all devices on the network back to the receiver. This removes any guesswork from planning a system and allows the installer to order exactly and only the devices required.

See the Sontay® SonNet radio sensor system Site Survey Kit Quick Start Guide and The Sontay® SonNet radio sensor system Site Survey Kit Manual for full details.

Network Planning Considerations

When planning a SonNet radio system, it is always worth considering the placement of routers, and should be capable of handling the consequences of a router failing or being damaged.

Example:

Consider a network with a requirement for 16 EDs:
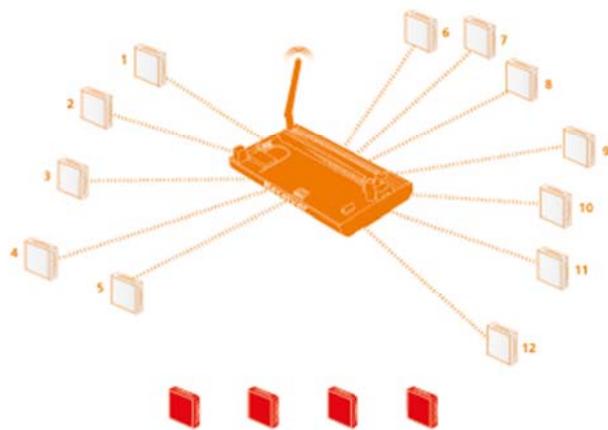
1. At least one router is required, as 16 directly connected EDs will exceed the maximum limit of 12. Four EDs will be orphaned.
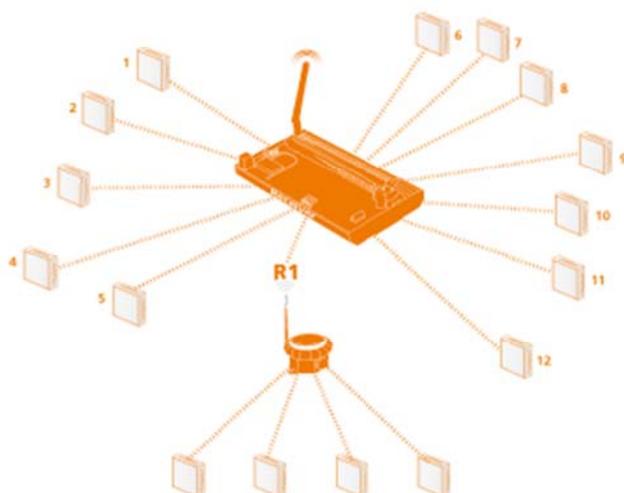
2. A single router (R1) will work, but gives no redundancy if the router should fail.
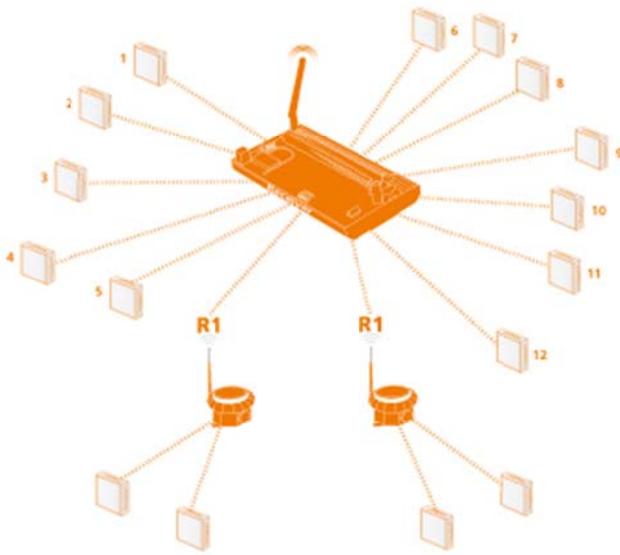
3. Optimal network uses 2 routers, R1 and R2.
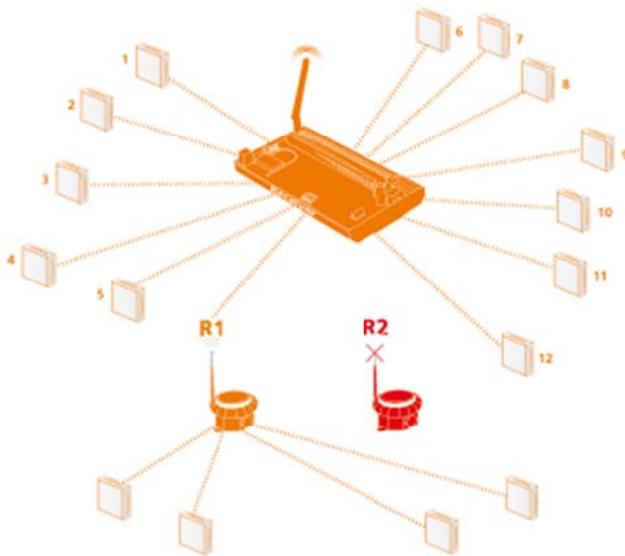
4. If either of the routers fail, the network can still be maintained, as the 2 orphaned EDs can re-route via the other router.

The Radio System

The radio system used by the Sontay SonNet devices is divided into 3 sections or 'layers'.

1. The radio layer is where physical control of the radio signal is done. This conforms to international standard 802.15.4, and determines the frequency of the radio signals, the number of 'channels' available for use, the bandwidth and power level of the signal etc. There are 16 channels available, and the best one is automatically selected by the receiver. The frequencies used are in the ISM (Industrial, Scientific and Medical) 2.4GHz band, with a maximum data rate of 250kb/s.
2. The network management layer is where the self-healing tree functionality is run, which controls network topology. 'ZigBee' is an example of a network management MESH protocol. SonNet does not use ZigBee, but instead uses a 'self-healing tree' protocol to control network topology.
3. The application layer determines what the device does – i.e. makes it a temperature sensing device, a router or a receiver. SonNet devices use specific applications, and include features such as configuration properties.

Security

All SonNet system devices have the same, unique network identifier. Only devices with the correct ID will be allowed to join the network. The ID used by system devices is different from the ID used for site survey kit (SSK) devices. Hence, SSK devices cannot join a system network and vice versa. When a SonNet system network has been formed, it can be 'locked' to prevent any unauthorised devices joining, even if they are SonNet devices. Niagara WorkPlace AX can be used to subsequently authorise extra SonNet system devices if required.

All data transmitted by SonNet devices is encrypted.

How the Self-Healing Tree Network is Formed

The network is formed based on 3 rules, and in a specific order of priority.

1. *How many 'tiers' a device is away from the receiver.*

If a device can communicate directly with the receiver, it will, even if the link quality is poorer than if it went through a router. If a device has a choice of more than one router, it will *always* choose the router closest to the receiver (the least number of tiers away), *even if the link quality is poor*.

2. *The number of 'child' devices a router already has.*

A RF-IOM or router can have a maximum of 16 'children'. If a device has a choice of more than one router of the same tier level, it will *always* choose the router with the least number of children, *even if the link quality is poor*.

3. *Signal Strength (link quality).*

Finally, if a device has a choice of more than one RF-IOM or router of the same tier level and the same number of children, it will choose the router with the best link quality.

If, for any reason, a device (ED, RF-IOM or router), loses its preferred path back to the receiver, it will automatically search for an alternative – still obeying the 3 rules above in sequence. If, despite employing Direct Sequence Spread Spectrum (DSSS) techniques, interference on the currently occupied channel prevents communications, the receiver will automatically look for another channel which is clear. All other devices, having lost their links to the receiver, will then also automatically scan the 16 channels until they find the receiver again, and the network will re-form without user intervention.

Propagation of Radio Signals in Buildings

The propagation of microwave radio signals in a building can be affected in several ways:

Attenuation
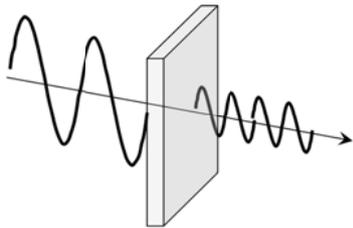
Radio signal strength is attenuated when it passes through air. Signals are attenuated much more when passing through other media, such as materials typically used in construction, such as brick, stone, wood and especially steel.

Reflection
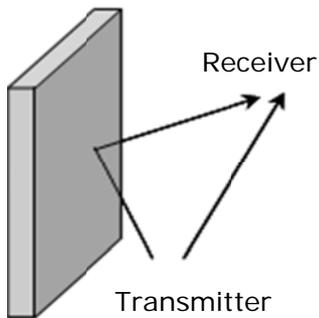
Depending on the building, radio signals can take many paths from the transmitter to the receiver, rather than just one single path.

'Multipath' signals can have the effect of cancelling each other out, reducing overall received signal strength.

Scattering
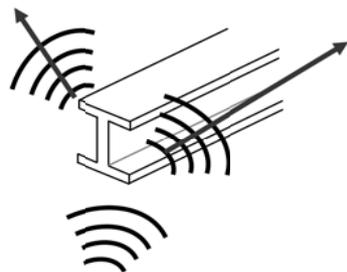
Scattering the radio signal can also reduce its signal strength.

Extension Aerials

When using the **RF-AERIAL-PM2** or **RF-AERIAL-PM5** extension aerials, it is important to observe some basic rules for siting and mounting.

1. Always ensure there is a much clear space around the aerial as possible.
2. Generally speaking, where possible mount the aerial as high as possible on the same floor as the routers and EDs
3. Don't mount between metal surfaces (for example steel I-beams) in ceiling spaces
4. Wherever possible, mount the aerial on a metal ground plane (such as the top of a metal panel)
5. The coaxial cable used for the **RF-AERIAL-PM2** or **RF-AERIAL-PM5** extension aerials is semi-rigid and should not be bent at too sharp an angle or too tight a radius. It is recommended that the minimum bending radius is 5cms
6. Always mount the aerial vertically. This produces the optimum radiation pattern and signal strength
7. Extension aerials can be used with receivers and RF-IOM modules.
8. Aerial extensions should not exceed 5m to prevent excessive loss of signal.

SonNet-Tridium JACE Driver Action Menus

Network Action Menu

i. Set System Lock – This command determines whether the driver can only find nodes if the receiver is placed in auto-commissioning mode
   a. FALSE = The driver will find nodes already commissioned to a receiver *without* having to put the receiver into auto commissioning mode.
   b. TRUE = The driver will **not** find nodes already commissioned to a receiver without having to put the receiver into auto commissioning mode.

ii. Assert Serial Card Communications – This command automatically sets up serial communications parameters for the **RF-RXS** receiver

iii. Assert Option Card Slot1 Communications – This command automatically sets up serial communications parameters for the **RF-RXS-N** option card receiver connected to slot 1 on the JACE (COM3)

iv. Assert Option Card Slot2 Communications – This command automatically sets up serial communications parameters for the **RF-RXS-N** option card receiver connected to slot 2 on the JACE (COM4)

Receiver Action Menu
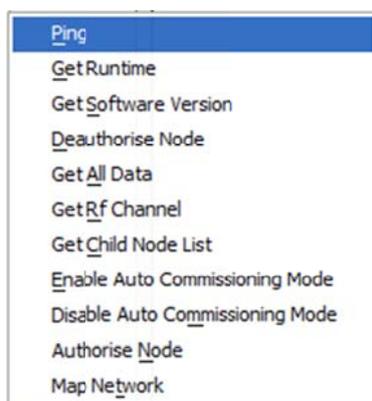
i. Ping – This command requests the receiver runtime, as a method on checking comms, but doesn't update the receiver runtime field

ii. Get Runtime – This command requests the receiver runtime and updates the receiver runtime field

iii. Get Software Version – This command gets the major and minor versions of the receiver firmware and stores the result as properties

iv. De-authorise Node – This command de-authorises and removes the receiver from the network (**NB** Only works when auto commissioning is **off**)

v. Get All Data – This command refreshes all data, excluding the "parent" property

vi. Get RF Channel – This command gets the current 2.4GHz RF channel (valid channels are 11 – 26 inclusive)

vii. Enable Auto Commissioning Mode – This command sends a request to enable auto commissioning

viii. Disable Auto Commissioning Mode – This command sends a request to disable auto commissioning

ix. Authorise Node – This command is used to manually authorise a node or nodes (as opposed to using auto commissioning)

x. Map Network – This command is used to discover and update the parent node of all devices on the network

Router Action Menu
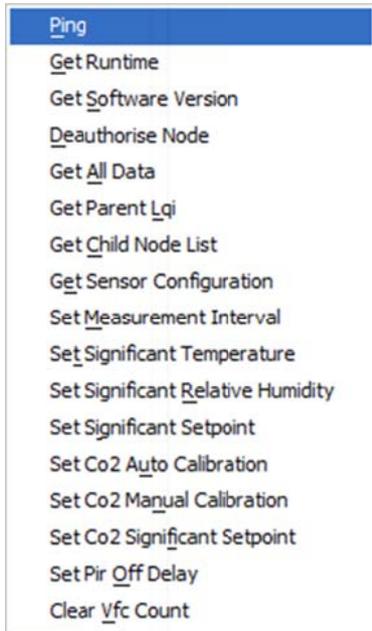
i. Ping – This command requests the router runtime, as a method on checking comms, but doesn't update the router's runtime field

ii. Get Runtime – This command requests the router's runtime and updates the runtime field

iii. Get Software Version – This command gets the major and minor versions of the router firmware and stores the result as properties

iv. De-authorise Node – This command de-authorises and removes the router from the network (**NB** Only works when auto commissioning is **off**)

v. Get All Data – This command refreshes all the data specific to the selected router, excluding "parent" property

vi. Get Parent LQI – This command gets radio link strength (LQI = Link Quality Index) to the node's parent

vii. Get Sensor Configuration – This command requests the following configuration properties;
    a. Has Temp – Whether the node has a temperature sensor fitted
    b. Has RH – Whether the node has an RH sensor fitted
    c. Has Setpoint – Whether the node has a setpoint adjustment pot fitted
    d. Has Switch – Whether the node has a momentary switch fitted
    e. Meas Interval – The time between transmission of measurement values
    f. Sig Temp – The significant change in temperature which results in the measured value being transmitted immediately
    g. Sig RH – The significant change in RH which results in the measured value being transmitted immediately
    h. Sig Setpoint – The significant change in setpoint which results in the measured value being transmitted immediately

viii. Set Measurement Interval – This command sets the normal time between transmission of measurement values *[Limits: 10 to 900 seconds]*

ix. Set Significant Temperature – This command sets the significant change in temperature which results in the measured value being transmitted immediately *[Limits: 0.1°C to 1.0°C]*

x. Set Significant RH – This command sets the significant change in RH which results in the measured value being transmitted immediately *[Limits: 3% to 10%]*

xi. Set Significant Setpoint – This command sets the significant change in setpoint which results in the measured value being transmitted immediately *[Limits: 1% to 25%]*

xii. Set CO2 Auto Calibration – This command enables automatic baseline calibration (ABC) for the CO2 sensor element. Over a period of 24 hours, the sensor system records CO2 levels, and once per 24 hours, the lowest level (which is assumed to be during a period of no occupancy) is used to calibrate the sensor output at 400ppm.

xiii. Set CO2 Manual Calibration – This command performs a manual calibration of the CO2 sensor. Ensure ambient CO2 is at 400ppm before performing this command.

xiv. Set CO2 Significant Setpoint – This command sets the significant change in CO2 which results in the measured value being transmitted immediately *[Limits: 100ppm to 800ppm, 20ppm steps, default = 400ppm]*

xv. Set PIR Off Delay – This command sets the off delay, which starts counting when the PIR element detects no occupancy. *[Limits: 10 seconds to 30 minutes, 10 second steps steps, default = 30 seconds]*

xvi. Clear VFC Count – This command clears the VFC input counter. *See also The VFC Activation count Point on page 66.*

RF-IOM Action Menu

Ping
Get Runtime
Get Software Version
Deauthorise Node
Get All Data
Get Input Configuration
Get Output Configuration
Get Output Settings
Set Input Configuration
Set Output Configuration
Get Child Node List
Get Parent Lqi
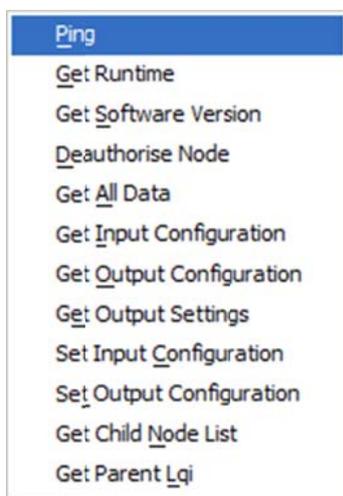
i. Ping – This command requests the RF-IOM runtime, as a method on checking comms, but doesn't update the RF-IOM's runtime field

ii. Get Runtime – This command requests the RF-IOM's runtime and updates the runtime field

iii. Get Software Version – This command gets the major and minor versions of the RF-IOM firmware and stores the result as properties

iv. De-authorise Node – This command de-authorises and removes the RF-IOM from the network (**NB** Only works when auto commissioning is **off**)

v. Get All Data – This command refreshes all the data specific to the selected router, excluding "parent" property

vi. Get Input Configuration – This command refreshes all the data specific to the RF-IOM input configuration

vii. Get Output Configuration – This command refreshes all the data specific to the RF-IOM output configuration

viii. Set Input Configuration – This command sends any changes made to the RF-IOM input configuration

ix. Set Output Configuration – This command sends any changes made to the RF-IOM output configuration

x. Get Parent LQI – This command gets radio link strength (LQI = Link Quality Index) to the node's parent

Sensor Action Menu

```
Ping
Get Runtime
Get Software Version
Deauthorise Node
Get All Data
Get Sensor Configuration
Set Measurement Interval
Set Significant Temperature
Set Significant Relative Humidity
Set Significant Setpoint
Get Battery Level
Get Battery Runtime
Get Parent Lqi
Set Co2 Auto Calibration
Set Co2 Manual Calibration
Set Co2 Significant Setpoint
Set Pir Off Delay
Clear Vfc Count
```
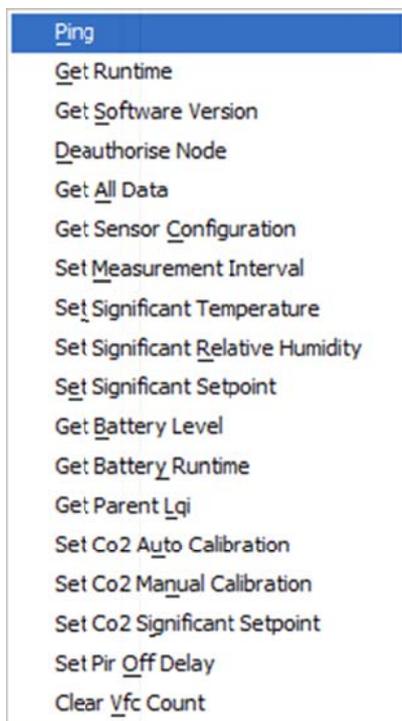
i. Ping – This command requests the ED's runtime, as a method on checking comms, but doesn't update the router's runtime field

ii. Get Runtime – This command requests the ED's runtime and updates the runtime field

iii. Get Software Version – This command gets the major and minor version of the ED's firmware and stores the result as properties

iv. De-authorise Node – This command de-authorises and removes the ED (**NB** Only works when auto commissioning is **off**)

v. Get All Data – This command refreshes all the data specific to the selected ED, excluding "parent" property

vi. Get Sensor Configuration – This command requests the following configuration properties;

    a. Has Temp – Whether the node has a temperature sensor fitted

    b. Has RH – Whether the node has an RH sensor fitted

    c. Has Setpoint – Whether the node has a setpoint adjustment pot fitted

    d. Has Switch – Whether the node has a momentary switch fitted

    e. Meas Interval – The time between transmission of measurement values

    f. Sig Temp – The significant change in temperature which results in the measured value being transmitted immediately

    g. Sig RH – The significant change in RH which results in the measured value being transmitted immediately

    h. Sig Setpoint – The significant change in setpoint which results in the measured value being transmitted immediately

vii. Set Measurement Interval – This command sets the normal time between transmission of measurement values *[Limits: 10 to 900 seconds]*

viii. Set Significant Temperature – This command sets the significant change in temperature which results in the measured value being transmitted immediately *[Limits: 0.1℃ to 1.0℃]*

ix. Set Significant RH – This command sets the significant change in RH which results in the measured value being transmitted immediately *[Limits: 3% to 10%]*

x. Set Significant Setpoint – This command sets the significant change in setpoint which results in the measured value being transmitted immediately *[Limits: 1% to 25%]*

xi.   Get Battery Level – This command requests the battery status

xii.   Get Battery Runtime – This command requests the ED's battery runtime

xiii.   Get Parent LQI – This command get link strength (LQI = Link Quality Index) to the node's parent

xiv.   Set CO_2 Auto Calibration – This command enables automatic baseline calibration (ABC) for the CO_2 sensor element. Over a period of 24 hours, the sensor system records CO_2 levels, and once per 24 hours, the lowest level (which is assumed to be during a period of no occupancy) is used to calibrate the sensor output at 400ppm.

xv.   Set CO_2 Manual Calibration – This command performs a manual calibration of the CO_2 sensor. Ensure ambient CO_2 is at 400ppm before performing this command.

xvi.   Set CO_2 Significant Setpoint – This command sets the significant change in CO_2 which results in the measured value being transmitted immediately *[Limits: 100ppm to 800ppm, 20ppm steps, default = 400ppm]*

xvii.   Set PIR Off Delay – This command sets the off delay, which starts counting when the PIR element detects no occupancy. *[Limits: 10 seconds to 30 minutes, 10 second steps steps, default = 30 seconds]*

xviii.   Clear VFC Count – This command clears the VFC input counter. *See also The VFC Activation count Point on page 66.*

Managing a Tridium JACE SonNet Wireless Network

Requirements

1. Tridium JACE 2xx series or 6xx series
2. Niagara AX Workbench
   a. **RF-RXS** - V3.5.34 or later
   b. **RF-RXS-N** - V3.6.43 or later

Installing the SonNet Driver to a Tridium JACE

If not pre-installed, download a copy the SonNet driver file "sonnet.jar" from www.sontay.com and copy it to the <Modules> folder on the PC running Niagara Workbench. For example;

 <C:\Niagara\Niagara-3.5.34\modules>

1. Start Niagara Workbench and log into the JACE platform
2. From the platform tree, open <Software Manager>

File	Installed Version	Avail. Version	
rdb	-	Tridium 3.6.36	Not Installed
rdbDb2	-	Tridium 3.6.36	Not Installed
rdbHsqlDb	-	Tridium 3.6.36	Not Installed
rdbMySQL	-	Tridium 3.6.36	Not Installed
rdbOracle	-	Tridium 3.6.36	Not Installed
rdbSqlServer	-	Tridium 3.6.36	Not Installed
remoteVideo	-	Tridium 3.6.36	Not Installed
report	-	Tridium 3.6.36	Not Installed
sedonaInstaller	-	Tridium 3.6.36	Not Installed
silk	-	Tridium 3.6.36	Not Installed
smartTableHx	-	Tridium 3.6.36	Not Installed
sms	-	Tridium 3.6.36	Not Installed
snmp	-	Tridium 3.6.36	Not Installed
sonnet	-	Sontay 13.14	Install Sontay 13.14
test	-	Tridium 3.6.36	Not Installed
timesync	-	Tridium 3.6.36	Not Installed
tls	-	Tridium 3.6.36	Not Installed
tomcat	-	Tridium 3.6.36	Not Installed
touchscreen	-	Tridium 3.6.36	Not Installed
tunnel	-	Tridium 3.6.36	Not Installed
usbmon	-	Tridium 3.6.36	Not Installed
videoDriver	-	Tridium 3.6.36	Not Installed
weather	-	Tridium 3.6.36	Not Installed
zwave	-	Tridium 3.6.36	Not Installed

Current free space 25,366 KB   To be installed 106 KB   Estimated free space after install 25,260 KB

3. From the list of modules and drivers, locate and select <sonnet>
4. Click the <Commit> button. The driver will be installed. **NB** - this action will cause the JACE to reboot.
5. After the JACE has rebooted, log into the JACE station. Expand the station tree and expand the <Config> branch to show the <Drivers> branch.
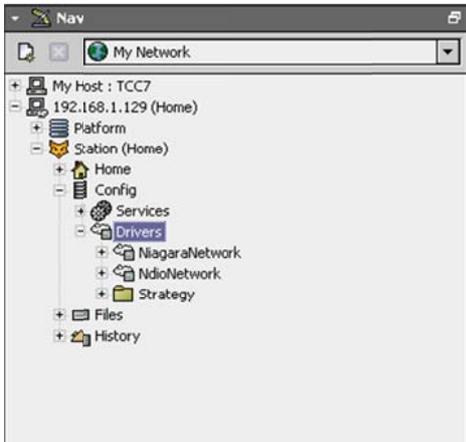
Adding a SonNet Network

Prerequisites:

- The **RF-RXS** must be connected to COM1 of the JACE by a serial cable (9-pin D male to 9-pin D female). Do not use a null modem serial cable.
  - *NB The RS-232 port of the RF-RXS will not communicate if the USB port on the RF-RXS is connected.*
- The **RF-RXS-N** should be installed in either Slot1 (COM3) or Slot2 (COM4) of the JACE. See "Installing the SonNet option card"
- Observing power supply polarity, switch on the **RF-RXS**, or power up the JACE with the option card fitted.
  - Observe the red network LED. If it is blinking on and off it means the receiver has no child devices yet, if it is on steadily then the receiver already has at least one child node.

1. Double-click the <Drivers> folder in the <Station\Config > navigation tree to open the Driver Manager window. Click the <New> button.
2. From the <Type to Add> drop-down box, scroll down and select <SonNet Network>
3. Click the <OK> button, ensure the new driver is enabled and then click the <OK> button to add the network driver.
   a. At this point, the new SonNet network may be shown in orange in the Driver Manager window.
4. To set the default communications parameters for the receiver, right-click on the <SonNetNetwork> folder in the <Station\Config\Drivers> navigation tree, then select <Actions>

 The Network System right-click <Action> menu

   a. If an **RF-RXS** serial receiver is being used, select <Assert Serial Card Communications>
   b. If an **RF-RXS-N** option card receiver is being used, select <Assert Option Card Slot1 Communications> or <Assert Option Card Slot2 Communications>, depending on which option card slot is used.
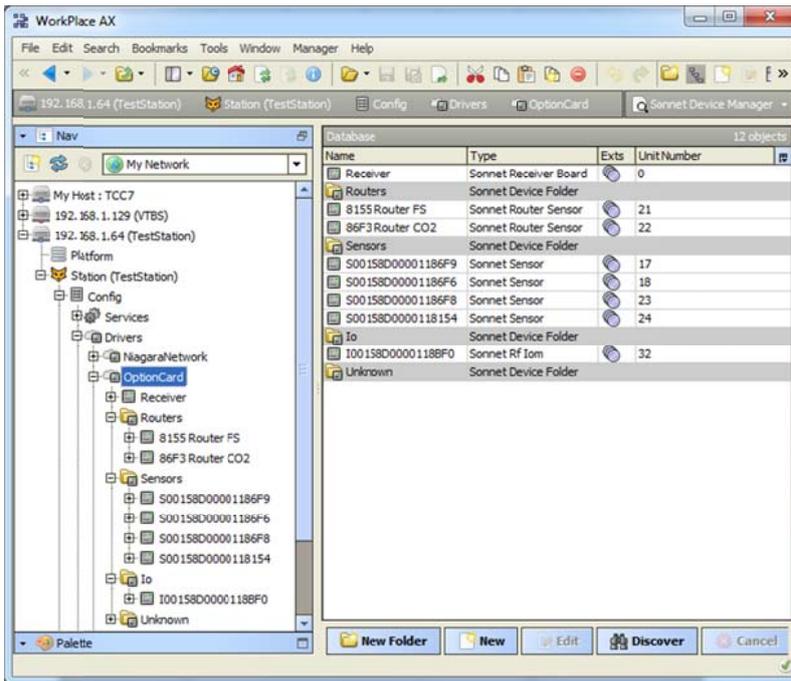
When the communications parameters have been set, the new SonNet network should look similar to this. In the SonNet Device Manager window, the receiver should be shown in white.

The default folders "Receiver", "Routers", "Sensors" and "Unknown" are created automatically. Note that the "Discover" button has no functionality in the SonNet Device Manager.

The new SonNet network is now ready for commissioning.

Commissioning a SonNet Network

A SonNet network can be commissioned in 2 ways using the JACE driver;

1. An existing network, where the receiver already has child nodes joined to the receiver (for example, where the network has been commissioned using CMS or the receiver has been moved from one JACE to another)
2. A completely new network, where the receiver has no child nodes

Commissioning an Existing Network

To commission an existing network, where routers and sensor end devices (EDs) have already joined the receiver's network, requires very little management.

1. Right-click on the <SonNetNetwork> folder in the <Station\Config\Drivers> navigation tree, select <Actions> then <Set System Lock>
2. Using the drop-down list, select "False" and then click OK.

The existing network devices will appear in their respective folders. This may take several minutes to complete.

It is recommended that when all existing nodes have appeared in the driver, the System Lock property be set to True.

Commissioning a New Network

To commission a new network, where no routers and sensor end devices (EDs) are present on the receiver's network, or to add new devices to an existing network.

1.   Right-click on the <Receiver> folder in the <Station\Config\Drivers\SonNetNetwork> navigation tree, select <Actions> then <Enable Auto Commissioning Mode>

2.   Power up routers and EDs as required (see "Commissioning A SonNet System: Step-By-Step", pages 68 - 69)

3.   NB While the receiver is in auto commissioning mode it is important NOT to use other <Action> menu functions. Wait until all devices have joined the network.

4.   Right-click on the <Receiver> folder in the <Station\Config\Drivers\SonNetNetwork> navigation tree, select <Actions> then <Disable Auto Commissioning Mode>
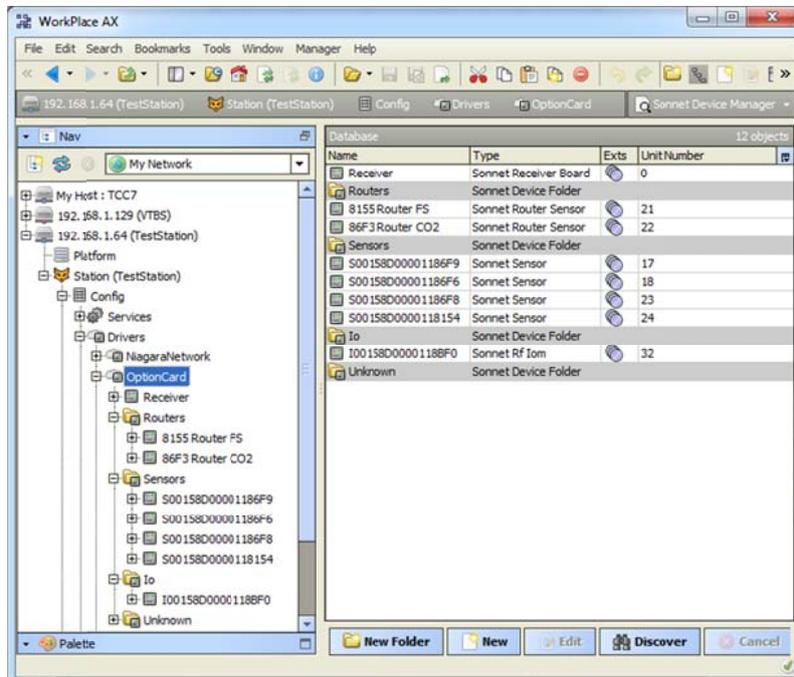
The new network devices will appear in their respective folders.

This may take several minutes to complete.

Configuring Network Devices

Device Prefixes**:**

When SonNet devices are first shown in the nav tree or the device's property page, they have default names which take the format of a <u>prefix</u> followed by the MAC address of the device.

Each prefix denotes a specific type of device:

- "U" denotes that the device is *unknown* (i.e. the receiver doesn't have full information yet for the device)
- "S" denotes that the device is a battery powered end device (ED)
- "IO" denotes that the device is an RF-IOM
- "R" denotes that the device is a router *without sensing capabilities*
- "X" denotes that the device is a router *with sensing capabilities*

There is no prefix for the receiver name.

NB It is strongly recommended that the device name is kept as the default name. A user friendly *display name* can be configured for each device. To set a display name, right-click on the device and select "Set Display Name" from the menu.

Receiver

1. Right-click on the <Receiver> folder in the <Station\Config\Drivers\SonNetNetwork> navigation tree, select <Views> then <Property Sheet>
2. Right-click on the <Receiver> folder in the <Station\Config\Drivers\SonNetNetwork> navigation tree, select <Actions> then <Get All Data>
3. Note that software version numbers, RF channel and receiver runtime are now all displayed.
4. **NB** After a period of time, the RF channel and receiver runtime values will be displayed as *stale*. This is normal, as these values are not updated unless requested.
5. Note the status, last fault cause and last update times.
6. Note the status of the auto commissioning feature.

The Receiver Property Page

Routers

1. Expand the <Routers> folder in the <Station\Config\Drivers\SonNetNetwork> navigation tree, select a router from the list, select <Views> then <Property Sheet>.
2. Ensure the receiver is **NOT** in auto commissioning mode.
3. Right-click on the router and select <Actions> then <Get All Data>

⊟ Points	Sonnet Point Device Ext	
⊞ Temp	24.7 °C {ok}	
⊞ Vfc_Activation_Count	0 {ok}	
⊞ Co2	2000 ppm {ok}	
⊞ Runtime	2007 hr {stale}	
⊞ Temp_Sig	false {ok}	
⊞ Vfc_State	false {ok}	
⊞ Co2_Sig	false {ok}	
⊞ Pir_State	false {ok}	
⊞ Parent_Lqi	0.0 {down,stale}	
⊞ Parent_Lqi_Quality	- {down,stale}	
⊞ Mac Address	Mac Address	
☐ Last Update	03-Mar-2014 07:59 PM GMT	
☐ Parent Device	Receiver {ok}	
⊟ Config	Sonnet Sensor Config	
☐ Has Temp	true {ok}	
☐ Has Rh	false {ok}	
☐ Has Setpoint	false {ok}	
☐ Has Switch	false {ok}	
☐ Meas Interval	900.00 {ok}	
☐ Sig Temp	0.50 {ok}	
☐ Sig Rh	0.00 {ok}	
☐ Sig Setpoint	0.00 {ok}	
☐ Has Co2	true {ok}	
☐ Has Pir	true {ok}	
☐ Has Vfc	true {ok}	
☐ Has Fan	false {ok}	
☐ Pir Off Delay	30.00 {ok}	
☐ Sig Co2	400.00 {ok}	
☐ Co2 Auto Cal	true {ok}	
☐ MajorSoftwareVersion	6 {ok}	
☐ MinorSoftwareVersion	5 {ok}	

A typical router's property page

1. Note that software version numbers and runtime are now all displayed.
2. **NB** After a period of time, all values apart from measured values (such as temperature) will be displayed as *stale*. This is normal, as only measured values are updated unless requested.
3. Note the status, last fault cause and last update times.
4. Note the parent of the router.
5. Note the parent LQI values

NB When a request for data is made to a router, the request should be processed quickly, as the routers are permanently "awake". However, the exact response period will depend on how many routers (if any) the request and reply have to pass through. Normally, the response is within 30 seconds maximum.

All the router's "points", such as "Temp" for the measured temperature value, have default names. It is strongly recommended that point names are kept as the default names. A user friendly *display name* can be configured for each point. To set a display name, right-click on the point in either the nav tree or the device's property sheet and select "Set Display Name" from the menu.

To make changes to the router's Config properties, refer to the Router Actions Menu on page 52.

RF-IOMs

1. Expand the <Io> folder in the <Station\Config\Drivers\SonNetNetwork> navigation tree, select an RF-IOM from the list, select <Views> then <Property Sheet>.
2. Ensure the receiver is **NOT** in auto commissioning mode.
3. Right-click on an RF-IOM and select <Actions> then <Get All Data>

A typical RF-IOM's property page, showing the points expanded.

1. Note that software version numbers and runtime are now all displayed.
2. **NB** After a period of time, all values apart from measured values (such as temperature) will be displayed as *stale*. This is normal, as only measured values are updated unless requested.
3. Note the status, last fault cause and last update times.
4. Note the parent of the RF-IOM.
5. Note the parent LQI values

A typical RF-IOM's property page, showing the input and output configuration parameters expanded.

1. Note the measurement interval. This pertains to input measurements only
2. The output configuration parameters are for the output fallback values. These are written to the output channels in the event that the RF-IOM goes offline.
3. Note the input channel Types – these reflect the input jumper settings. **NB** – it is important NOT to change the inout jumpers while the RF-IOM is powered.
4. Note the low and high alarm levels for each input channel.
5. To set a new measurement interval, enter the required level in the appropriate box.
6. To set high alarm, low alarm or COV values, enter the required level in the appropriate box.
7. Notes: The units for alarm levels and COV are dependent on the input type. For example, if an input is set to mA, then the units for COV and alarm levels are also in mA.

Writing Output RF-IOM Values

Values for the RF-IOM output channels are written, by default, every 5 minutes. However, like inputs, the outputs can have a significant change value (SCV) set. If the output value changes by more than the SCV, the change is sent immediately. Each output channel can be configured for a different SCV value, down to 10mV steps.

To set the SCV for an output, expand the output channel in the points list, then expand Proxy Extensions, finally expand Write Parameters. Enter the required SCV in the Sig Change Trigger box (highlighted above).

RF-IOM Fallback Values

Fallback values are default values which are written to the RF-IOM output channels in the event that the RF-IOM goes offline (but remains powered). This is a safety mechanism so that plant controlled by the RF-IOM outputs can be set to a "safe" value if the control strategy cannot be updated from the RF-IOM.

To set fallback values for each output, expand the Output Configuration Parameters and enter the required values for each output.

Important!!! After making changes to the fallback values, it is essential to write the new data to the device by right-clicking the RF-IOM and from the Action Menu selecting Set Output Configuration.

RF-IOM Input Configuration

The default measurement interval determines how often the RF-IOM sends it measured input values. The default is 900 seconds. Like EDs, if an input value exceeds a configurable significant change value (SCV), the measured input value will be sent immediately. Each input has its own SCV.

To access input configuration properties, expand the Input Configuration Params section.

High and low alarm levels can also be set for each input.

Note that the alarm levels are in the same units as the input type. So, for example, if Input 1 is set for 0-10Vdc the alarm levels are also in Vdc. Similarly, SCV values are in the same units as the input type.

If an input is set as a VFC type, the input value will be either 0 (OFF) or 1 (ON). Changes of input state for a VFC input are sent immediately.

Important!!! After making any changes to the input configuration, it is essential to write the new data to the device by right-clicking the RF-IOM and from the Action Menu selecting Set Input Configuration.

NB – It is strongly recommended that the default measurement interval be left at the default value of 900 seconds to prevent unnecessary radio traffic.

End Devices (EDs)

1. Expand the <Sensors> folder in the <Station\Config\Drivers\SonNetNetwork> navigation tree, select a sensor from the list, select <Views> then <Property Sheet>.
2. Ensure the receiver is **NOT** in auto commissioning mode.
3. Right-click on the sensor and select <Actions> then <Get All Data>A typical EDs property page

1. Note that software version numbers, battery level and runtime and device runtime are now all displayed.
2. **NB** After a period of time, all values apart from measured values (such as temperature) will be displayed as *stale*. This is normal, as only measured values are updated unless requested.
3. Note the status, last fault cause and last update times.
4. Note the parent of the sensor.
5. Note the parent LQI values

NB When a request for data is made to an ED, the request is buffered until the ED "wakes" to take and send its measurements. Because of this, it may take some minutes to retrieve the requested data. The exact period will depend on the measurement interval time (default 900 seconds), how many routers (if any) the request and reply have to pass through and when in that transmission cycle the request is made.

All the sensor's "points", such as "Temp" for the measured temperature value, have default names. It is strongly recommended that point names are kept as the default names. A user friendly *display name* can be configured for each point. To set a display name, right-click on the point in either the nav tree or the device's property sheet and select "Set Display Name" from the menu.

The VFC Activation Count Point

The VFC Activation Count Point can be used as a "backup" to count VFC input True state activations, in the event that the ED or router can carry on counting input pulse even if the ED or router goes offline. When the ED or router comes back online, the VFC counts totalled in strategy can be compared with the total held in the VFC Activation Count Point, to be sure no pulses have been missed while the ED or router has been offline.

The total held in the VFC Activation Count Point can be reset to 0 (see pages 53 and 55).

To make changes to the EDs Config properties, refer to the Sensor Actions Menu on page 54.

Commissioning Multiple Networks on the Same Site

It is quite a common requirement to need to commission several SonNet networks on the same site, for example one per floor in a multi-storey building. To avoid the possibility of SonNet wireless nodes intended for one network appearing on another, 2 commissioning methods are available.

Method 1: Pre-commission each network away from site.

This entails adding routers and EDs in the normal way to a receiver.

- If using an **RF-RXS**, this can be done with the receiver connected to the RS-232 port of a JACE.
- If using an **RF-RXS-N**, this can only be done with the receiver connected to a JACE option card slot.

1. Using Niagara AX or a web browser, set System Lock property to TRUE
2. Place the receiver into auto-commissioning mode and power up all routers and EDs required on the receiver's network to join.
3. When all devices have joined the network, take the receiver out of auto-commissioning mode.
4. Perform a "get all data" request on all devices
5. Power off all routers and EDs associated with the receiver
6. Power off the receiver
7. Repeat this process for each receiver/network
8. Take all SonNet devices to site and install
9. Power up each receiver in turn together with its associated routers and EDs, and using Niagara AX or a web browser set the System lock property for each network to FALSE
10. All pre-configured routers and EDs will join their respective receivers *without* the need to place any receiver into auto-commissioning mode on site.

Method 2: Commission each network individually on site.

This entails adding routers and EDs in the normal way to a receiver.

- If using an **RF-RXS**, this can be done with the receiver connected to the RS-232 port of a JACE.
- If using an **RF-RXS-N**, this can only be done with the receiver connected to a JACE option card slot.

1. Using Niagara AX or a web browser, set System Lock to property FALSE
2. Place only one receiver at a time into auto-commissioning mode and power up all routers and EDs required on the receiver's network to join.
3. When all devices have joined the network, take the receiver out of auto-commissioning mode.
4. Perform a "get all data" request on all devices

NB It is important to ensure all receivers NOT being commissioned have auto-commissioning disabled. Nodes which are already commissioned to an existing network must have reliable communications to that network to prevent them looking for other networks to join. Ensure all nodes on a commissioned network have a good link quality index (LQI) to their parents. In extreme cases, it may be prudent to temporarily power off "vulnerable" nodes while commissioning another network nearby.

Best Practise Points:

1. Always conduct a site survey, and ensure that if you plan to use an external extension aerial on the system receiver (for example, if the receiver is to be in a metal panel), you use the same external extension aerial on the SSK receiver for the survey. Document the survey thoroughly, and leave a copy on site.

2. When planning where routers and RF-IOMs are going to be needed, plan for "redundancy", i.e. what happens to all the EDs connected to a router if the router fails? Backup routers are worth considering. See pages 14 - 15.

3. Don't switch on EDs until they're ready to be commissioned. If they're powered on without a parent in range, they will eventually sleep to preserve battery life, only "waking" occasionally to scan for a parent. This may slow commissioning down. If an ED has been powered up for more than 20 minutes without a parent, power-cycle it. ***Pressing the reset button on an ED DOESN'T reset the ED, it only resets the battery hours run time***.

4. Generally speaking, wireless works best in a horizontal plane, so expect reduced signal strength if he receiver is on a different floor to the routers/RF-IOMs/EDs. A good rule of thumb is to have the receiver on the same floor as its children, though this isn't always the case.

5. 2.4GHz wireless signals don't go through metal! Plan to circumvent metal obstructions where possible.

6. If the installation environment is one where obstructions are likely to change regularly (in a warehouse, for example!), try to conduct the site survey under a "worst-case" scenario - i.e. assume that at some point, there's going to be an obstruction between the ED/router/RF-IOM and its parent at some time. Simulate it, if possible.

7. When commissioning the installed system, turn the receiver on first, then all the routers and RF-IOMs - starting with "layer" nearest the receiver and working outwards. It's worthwhile checking all the routers are OK in JACE driver **before** finally powering up the EDs.

8. When EDs first join a network, values such as hours run and battery hours run will not be displayed - the values are shown as question marks. This is normal, these values need to be requested from the device (right-click on device and select "Refresh Node Information").

9. Remember that when a receiver scans all 16 channels for the best one, the channel chosen is the best *where the receiver is*. On "long" networks with several "layers" of routers, the channel chosen by the receiver may not always be the quietest at the far end of the network. When the installed network is finally formed, press the receiver reset button and ensure the network reforms properly. This will ensure that, in the event that the receiver needs to change channels (for example), it will work seamlessly.

10. As each network is commissioned, save the layout - even if there isn't a background graphic loaded. This is a good aid to quickly viewing network topology.

Trouble-Shooter's Guide

System ED		
Symptom	**Cause**	**Actions**
No connectivity to receiver	ED has not been authorized to the receiver	Manually authorize ED to receiver or use auto-commissioning
	No radio connection	Check aerial on receiver
	Receiver not switched on	Switch receiver on
	ED not switched on	Switch ED on
	Incorrect battery polarity	Check battery polarity
	Flat ED battery	Change ED battery
	After switching on, if an ED cannot join a network after about 20 minutes, it will go into "sleep" mode to preserve battery life, only waking occasionally	Power-cycle the ED (switch it OFF and back ON) after ensuring all routers and the receiver are powered, and the routers have successfully joined the network
ED appears in "Unknown" category when commissioning	ED has joined network but has yet to pass configuration data to the receiver	None - normal operation
ED stays in "Unknown" category when commissioning for more than 30 minutes	ED hardware error	Check ED options fitted (SP pot, thermistor, RH&T element)
ED doesn't show hours run, firmware version, battery hours run or last update time	Normal. To help preserve battery life, an ED doesn't send this information unless it is requested	Request information using the "Get all data" method
ED connects directly to the receiver, even though there's a router between them	Normal. An ED will *ALWAYS* join a network using the least number of "hops" to the receiver.	None - normal operation. The ED will re-join the network *via* the router if it loses its direct path to the receiver
Only 12 EDs connect directly to my receiver	Normal. The maximum number of directly connected EDs a receiver will allow is 12	If there are more than 12 EDs, at least one router must be used
Only 8 EDs connect directly to my router	Normal. The maximum number of directly connected EDs a router will allow is 8	If there are more than 8 EDs, at least one additional router must be added
I replaced the battery in my ED, but the battery hours run doesn't show as having been reset	Normal. Updated ED information hasn't been requested	Request information using the "Refresh Node Information" method
	The battery hours run reset procedure wasn't carried out when the battery was replaced	Power OFF the ED, press and hold the PCB button near the battery WHILE powering the ED ON
My ED was switched on in error before the receiver and routers, but hasn't joined the network	After switching on, if an ED cannot join a network after about 20 minutes, it will go into "sleep" mode to preserve battery life, only waking occasionally	Power-cycle the ED (switch it OFF and back ON) after ensuring all routers and the receiver are powered, and the routers have successfully joined the network

System Router		
Symptom	**Cause**	**Actions**
No connectivity to receiver	Router has not been authorized to the receiver	Manually authorize router to receiver or use auto-commissioning
	No radio connection	Check aerial on receiver
		Check aerial on router
	Receiver not switched on	Switch receiver on
	Router not switched on	Switch router on
	Incorrect supply polarity	Check supply polarity
	Router fuse	Check router fuse is OK, replace if necessary
Router appears in "Unknown" category when commissioning	Router has joined network but has yet to pass configuration data to the receiver	None - normal operation
Router stays in "Unknown" category when commissioning for more than 3 minutes	Router hardware error	Check router options fitted (thermistor, RH&T element)
Router connects directly to the receiver, even though there's a router between them	Normal. An router will ALWAYS join a network using the least number of "hops" to the receiver.	None - normal operation. The router will re-join the network via the other router if it loses its direct path to the receiver
Only 4 routers connect directly to my receiver	Normal. The maximum number of directly connected routers a receiver will allow is 4, **if there are 12 directly connected EDs**	None - normal operation
Only 8 routers connect directly to my router	Normal. The maximum number of directly connected routers a router will allow is 8 **if there are 8 directly connected EDs**	None - normal operation

RF-IOM		
Symptom	**Cause**	**Actions**
No connectivity to receiver	RF-IOM has not been authorized to the receiver	Manually authorize RF-IOM to receiver or use auto-commissioning
	No radio connection	Check aerial on receiver
		Check aerial on RF-IOM
	Receiver not switched on	Switch receiver on
	RF-IOM not switched on	Switch RF-IOM on
	Incorrect supply polarity	Check supply polarity
	RF-IOM fuse	Check RF-IOM fuse is OK, replace if necessary
RF-IOM appears in "Unknown" category when commissioning	RF-IOM has joined network but has yet to pass configuration data to the receiver	None - normal operation
RF-IOM stays in "Unknown" category when commissioning for more than 3 minutes	RF-IOM hardware error	Check RF-IOM
RF-IOM connects directly to the receiver, even though there's a RF-IOM between them	Normal. An RF-IOM will ALWAYS join a network using the least number of "hops" to the receiver.	None - normal operation. The RF-IOM will re-join the network via the other RF-IOM or router if it loses its direct path to the receiver
Only 4 RF-IOMs connect directly to my receiver	Normal. The maximum number of directly connected RF-IOMs a receiver will allow is 4, if there are 12 directly connected EDs	At least one more RF-IOM or router must be added
Only 8 RF-IOMs connect directly to my router	Normal. The maximum number of directly connected RF-IOMs a RF-IOM or router will allow is 8 if there are 8 directly connected EDs	At least one more RF-IOM or router must be added
Input LED flashing	Normal. This denotes that the input has been set up and a VFC digital input, but is in the OFF state.	None - normal operation
Input LED ON	Normal. This denotes that the input has been set up and a VFC digital input, but is in the ON state.	None - normal operation
Input type changed but the change is not shown	RF-IOM not reset after change has been made.	Press the reset button on the RF-IOM

System Receiver		
Symptom	**Cause**	**Actions**
LED D603 flashing once per second	The receiver has found no children on the network	Check aerial and extension co-ax (if fitted)
		If commissioning a network, ensure the receiver is in auto-commissioning mode, or manually authorize new devices
		Ensure network devices are switched on and in range
LED D603 on receiver not lit at all	No power to receiver	Check power to receiver
	Receiver not switched on	Switch on receiver
	Receiver fuse	Check power supply polarity if using a DC supply
		Check receiver fuse is OK, replace if necessary
LED D604 flashing occasionally	Reception of network data	None - normal operation

System Receiver RF-RXS-N		
Symptom	**Cause**	**Actions**
Network LED flashing once per second	The receiver has found no children on the network	Check aerial and extension co-ax (if fitted)
		If commissioning a network, ensure the receiver is in auto-commissioning mode, or manually authorize new devices
		Ensure network devices are switched on and in range
LEDs on receiver not lit at all	No power to receiver	Check power to JACE
No communications	SonNet driver configured for wrong JACE slot	Configure SonNet driver for correct slot (see page 51)
Data LED flashing occasionally	Reception of network data	None - normal operation

System Receiver RF-RXS		
Symptom	**Cause**	**Actions**
Network LED flashing once per second	The receiver has found no children on the network	Check aerial and extension co-ax (if fitted)
		If commissioning a network, ensure the receiver is in auto-commissioning mode, or manually authorize new devices
		Ensure network devices are switched on and in range
LEDs on receiver not lit at all	No power to receiver	Check power to receiver
	Receiver not switched on	Switch on receiver
	Receiver fuse	Check power supply polarity if using a DC supply
		Check receiver fuse is OK, replace if necessary
No communications via RS-232 port	USB port connected to PC	Disconnect USB
Data LED flashing occasionally	Reception of network data	None - normal operation

Estimating Network Coverage in the Absence of a Site Survey

The theoretical transmission distance that can be achieved between two wireless devices can be calculated from a few "key" parameters;

- *Transmission power of device*. This is the wireless device's transmission power and is typically measured in dBm. With greater transmission power, greater distances can be achieved.

- *Receiver sensitivity of device*. This is the wireless device's receiver sensitivity and is typically measured in dBm. With greater receiver sensitivity, the device is able to receive weaker signals, which means greater distances can be supported

- *Antenna gain*. The gain for an antenna is typically measured in dBi and basically indicates how much the signal is boosted by the antenna.

- *Frequency*. The frequency is typically measured in MHz or GHz and indicates which electromagnetic band is used for wireless communication.

The formula for calculating the theoretical transmission distance is based on the Friis Transmission Equation for _**free space loss**_. The Friis Transmission Equation can be modified to give range, as follows:

$$r = \frac{10^{(Pt + Gt + Gr - Pr)/20}}{41.88 * f}$$

where:

r = range in km
Pt = Transmit power (dBm)
Pr = receiver gain (dBm)
Gt = transmitter aerial gain (dBi)
Gr = receiver aerial gain (dBi)
f = frequency (MHz)

SonNet Routers, RF-IOMs and Receivers	
Frequency	2400 MHz
Tx power	10 dBm
Tx antenna gain	3 dBi
Rx antenna gain	3 dBi
Rx sensitivity	-102 dBm
Theoretical Range (km)	7.9km

SonNet End Devices	
Frequency	2400 MHz
Tx power	0 dBm
Tx antenna gain	1.2 dBi
Rx antenna gain	1.2 dBi
Rx sensitivity	-96 dBm
Theoretical Range (km)	0.8km

Note that this gives the _**theoretical transmission distance that can be achieved**_. Certainly, there are likely to be significant differences between the theoretical transmission distance and the actual results in the field, as these calculations are based on an unobstructed line-of-sight signal with no electronic interference.

However, the real world presents many variables that result in less "ideal" wireless performance, such as building obstructions and reflected signals.

Therefore, it is always preferable to conduct a thorough site survey in order to determine what is actually happening to the wireless signals in the field. Before conducting a site survey, however, it may be helpful to evaluate the different options available for the wireless hardware. The formula provides a straightforward way to perform this evaluation and whether the desired transmission distance it can be achieved and so make an informed decision when selecting SonNet devices for different wireless applications.

Attenuation Properties of Common Building Materials

Building Material	2.4 GHz Attenuation
Solid Wood Door 4.5cm	6 dB
Hollow Wood Door 4.5cm	4 dB
Interior Office Door w/Window 4.5cm /1.3cm	4 dB
Steel Fire/Exit Door 4.5cm	13 dB
Steel Fire/Exit Door 6.4cm	19 dB
Steel Rollup Door 3.8cm	11 dB
Brick 8.9cm	6 dB
Concrete Wall 45.7cm	18 dB
Cubical Wall (Fabric) 5.7m	18 dB
Exterior Concrete Wall 6.4cm	53 dB
Glass Divider 1.3cm	12 dB
Interior Hollow Wall 10.2cm	5 dB
Interior Hollow Wall 15.2cm	9 dB
Interior Solid Wall 12.7cm	14 dB
Marble 5.1cm	6 dB
Bullet-Proof Glass 2.5cm	10 dB
Exterior Double Pane Coated Glass 2.5cm	13 dB
Exterior Single Pane Window 1.3cm	7 dB
Interior Office Window 2.5cm	3 dB
Safety Glass-Wire 0.6cm	3 dB
Safety Glass-Wire 2.5cm	13 dB

Strategy Tips

1. When using wireless devices to control critical plant, it is always advisable to add strategy safeguards that can take protective action in the event a wireless device loses communications with its parent receiver.

An example of this is where an RF-IOM analogue output is used to switch on an electric heater battery. One of the key interlocking safety features would be to ensure that the supply fan is running before allowing the heater to be powered on.

In this example, the fan status (taken from, for example, a Sontay PA-930 air DP switch or PM-CSX current switch) is connected to a VFC input on RF-IOM1 and the output from RF-IOM2 is used to driver the heater battery.

If RF-IOM1 goes offline, the control strategy and RF-IOM2 no longer knows if the fan is running, so it is potentially unsafe to switch the heater battery on.

The simple Niagara Workbench strategy below monitors the status of RF-IOM1, and if it goes into a "Down" state (i.e. it goes offline), it will cause the BooleanSelect to output the value held in the BooleanWritable module (FALSE in this case), rather than the normal control status derives from strategy.
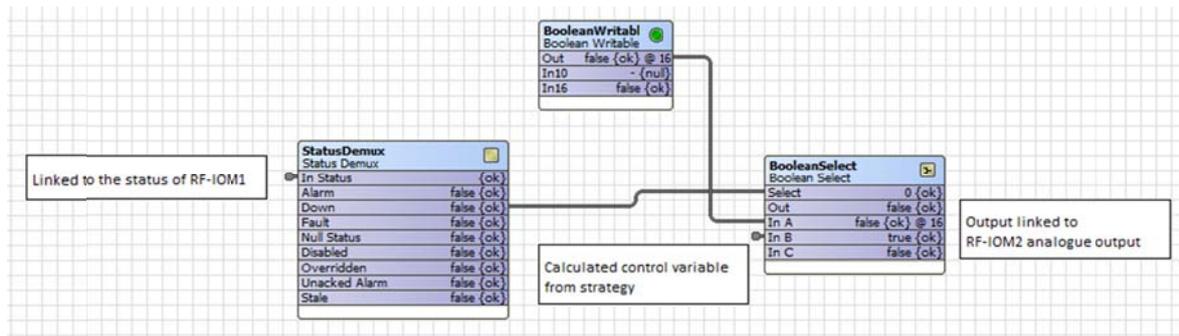
Note that in the event that RF-IOM2 goes offline, the output controlling the heater can be configured to go a 0V using the appropriate fall-back value setting.

This ensures that the heater battery will be switched off if either of the RF-IOMs goes offline.

2. It should be remembered that only measured values from an ED, router or RF-IOM are normally sent, whether by transmission time or significant change of value.

Therefore, other parameters, such as battery runtime, parent LQI and device runtime, are NOT sent unless requested. As simple strategy to request this information on a timed interval basis can be achieved.

Add a "Daily Trigger" to the wiresheet, and set its parameters to a time of day (probably at night, when there's least activity).

Right-click on the trigger, select <Link Mark> from the menu, and then right-click on the SonNet device to be updated and select <Link from "trigger name">.
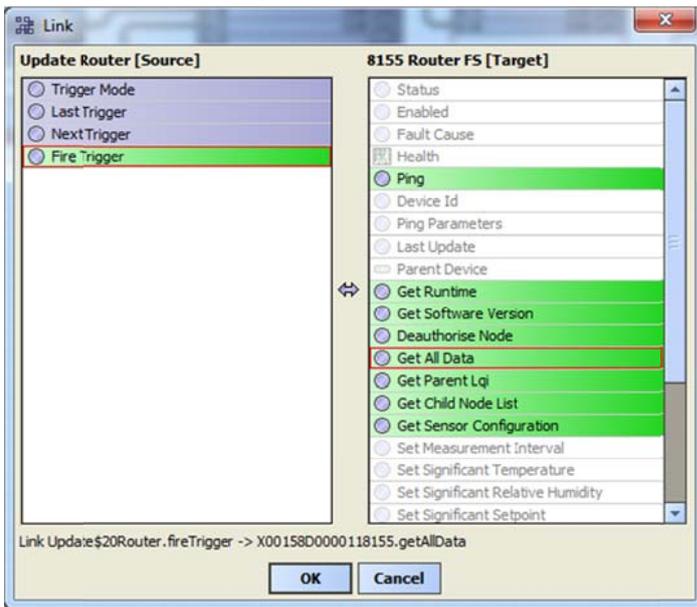
Select <Fire Trigger> on the trigger side and "Get All Data" on the SonNet device side. Other options are to select <Get Runtime> or <Get Parent Lqi>, if these are specifically what is required to be updated. Click the <OK> button.

Specific updates are preferable to <Get All Data>, as less network traffic is generated and consumes less battery power in EDs.

Now, when the trigger module fires, it will cause a "Get All Data" command to be sent to the SonNet device.

NB If several SonNet devices are to be updated this way, it is strongly recommended that the update times are staggered by at least 15 minutes, to avoid heavy network traffic.

3. Strategy can be used to on a wiresheet to show the status of a SonNet device.

Add a StatusDemux module to the wiresheet, with a Boolean Writable. Link the <Down> slot to an input of the Boolean Writable.
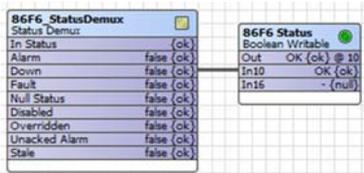
Right-click on a SonNet device, select <Link Mark> from the menu.
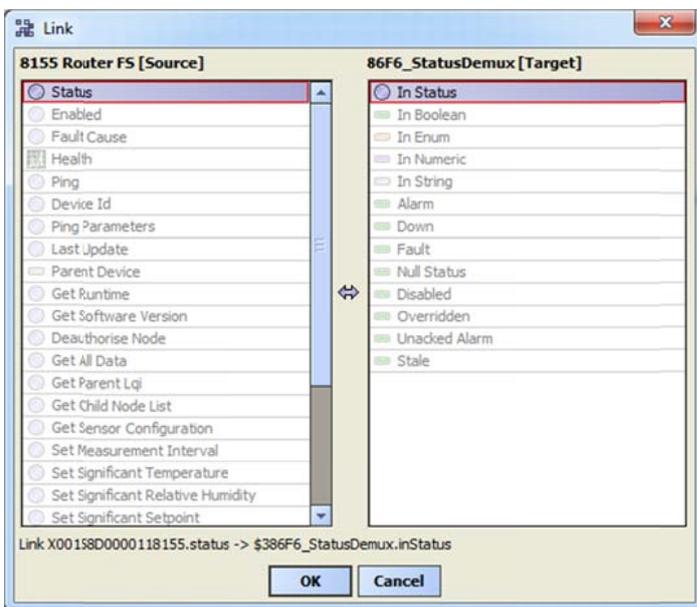
Right-click on the StatusDemux module and select <Link from "device name"> and select <Status> on the device side and "In Status" on the StatusDemux module side. Click the <OK> button.

If required, the facets of the Boolean Writable can be changed to "OFFLINE" for a True status, and ONLINE for a False status.

A <BooleanChangeOfStateAlarmExt> can be added to the Boolean Writable for alarming purposes.

4. Scaling a 4-20mA RF-IOM Input

Two Numeric Writables are used to set the upper and lower ranges (for example, the upper could be 40°C and the lower 0°C, for a temperature sensor, or the upper could be 500Pa and the lower 0°C, for a pressure sensor). The example below uses an upper of 100 and a lower of 0, typical for an RH sensor.

The input value from the RF-IOM is linked to InA slot of the Subtract1 module, and the scaled output is available from the Out slot of the Scaled Current Value module.
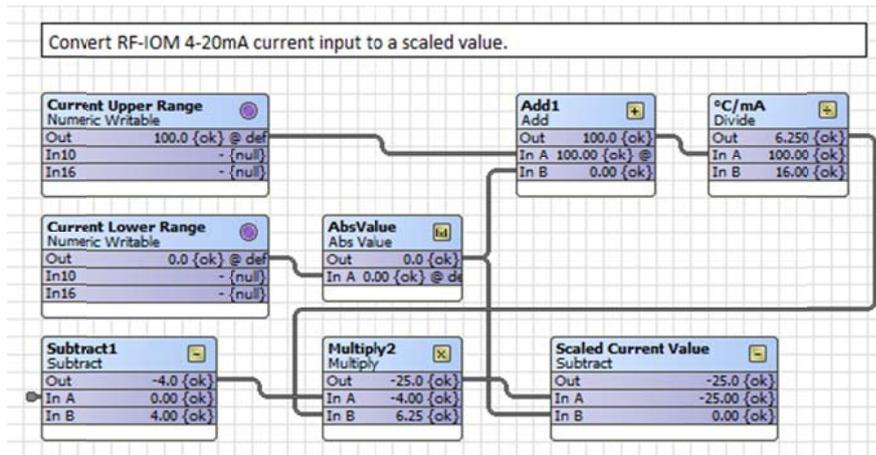
5. Scaling a voltage RF-IOM Input

Two Numeric Writables are used to set the upper and lower ranges (for example, the upper could be 40°C and the lower 0°C, for a temperature sensor, or the upper could be 500Pa and the lower 0°C, for a pressure sensor). The example below uses an upper of 100 and a lower of 0, typical for an RH sensor.

The input value from the RF-IOM is linked to InA slot of the Multiply3 module, and the scaled output is available from the Out slot of the Scaled Voltage Value module.
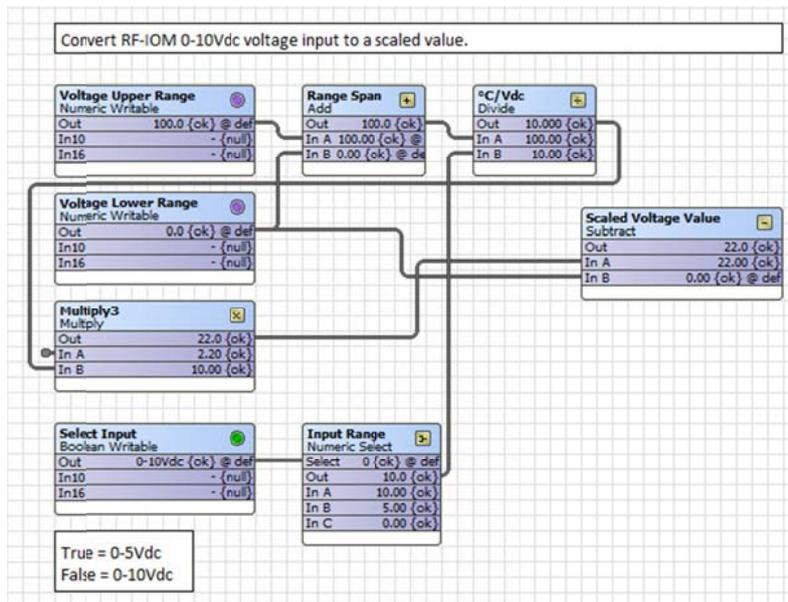
A Boolean Writable can be used to offer scaling for either 0-5Vdc or 0-10Vdc inputs.

6. Scaling a Resistive RF-IOM Input for a 10K3A1 Thermistor

As a rule, for greatest accuracy, the precision of the module facets should be set to 12. The 3 coefficients, A, B and C are specific to a 10K3A1 thermistor, but others could be used, according to the Steinhart-Hart method. The final Subtract module can be omitted if °K is required, rather than °C.
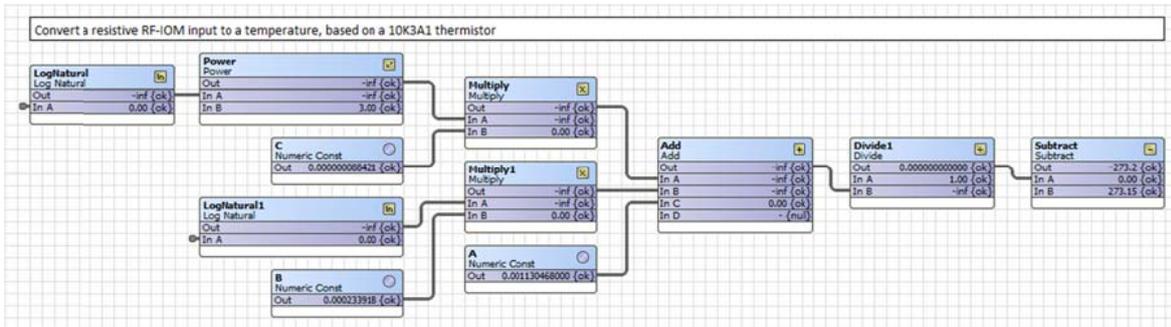
7. Stale Values

It will be noticed that some points shown in the receiver, router and ED property sheets are suffixed {stale}. This is because the driver looks for values to be updated with a configurable time. If any values aren't updated within this time they are marked as stale.

It is important to remember that, under normal conditions, *only measured values* are sent by devices (routers or EDs). Configuration parameters and other data are not sent *unless requested*, and will therefore eventually be marked as stale.

A devices *measured values* will be marked as stale if they are not updated within the response timeout period. Typically, an ED has its default transmission time set to 900 seconds, so if the response time is set to 1 minute (for example), the measured values will be marked as stale.

To ensure this doesn't happen, it is strongly recommended that the receiver response timeout is set accordingly;

- Right-click on the `<SonNetNetwork>` folder in the `<Station\Config\Drivers>` navigation tree, then select `<Views>` then `<Property Sheet>`
- Expand the `<Tuning Policies>` section, then expand the `<Default Policy>` section.
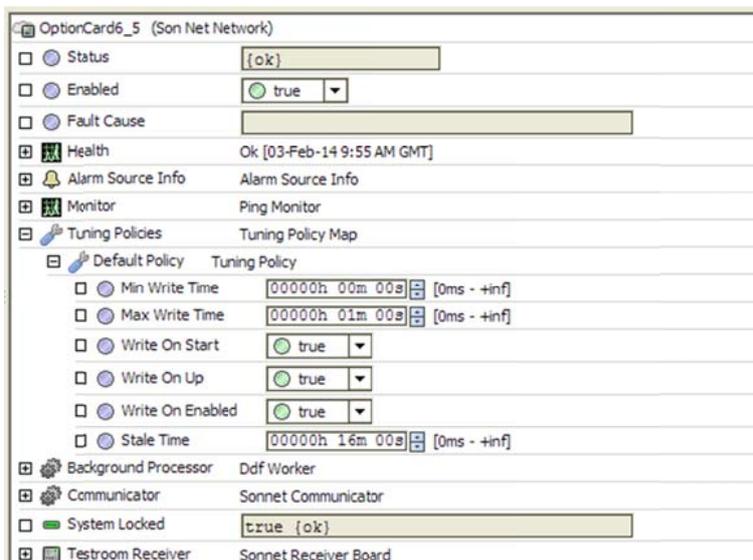
- Set the `<Stale Time>` to 16 minutes (or a value that reflects longest time a device may require to pass information to the driver, which may be affected not only by its default transmission time but by how many routers it may need to pass its measurement data through to get to the receiver.

Alarms

Alarms can be set up using the <Alarm> palette.

- Open the <Alarm> palette and drag a new <Alarm Class> onto the Alarm Service wiresheet. Call it "SonNet Alarms".
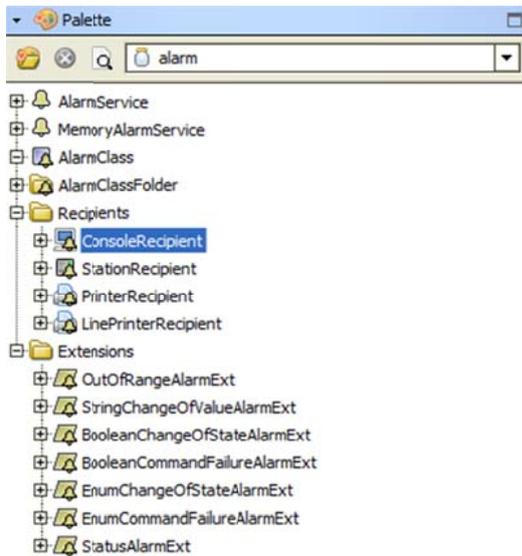
- Drag a new <ConsoleRecipient> onto the wiresheet and link it to the SonNet alarm class.
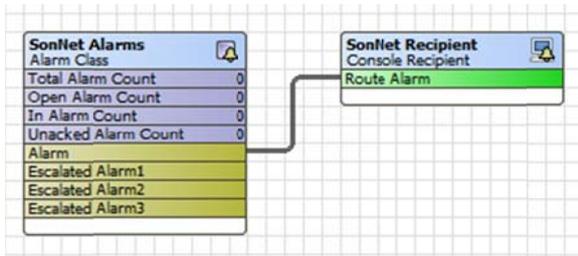
- Next, drag alarm extensions from the alarm palette onto points which require alarm monitoring. In the alarm extensions property sheet, set the alarm class to SonNet Alarms.

Alarms

Alarms can be set up using the `<Alarm>` palette.

- Open the `<Alarm>` palette and drag a new `<Alarm Class>` onto the Alarm Service wiresheet. Call it "SonNet Alarms".

- Drag a new `<ConsoleRecipient>` onto the wiresheet and link it to the SonNet alarm class.

- Next, drag alarm extensions from the alarm palette onto points which require alarm monitoring. In the alarm extensions property sheet, set the alarm class to SonNet Alarms.