

Panduit SynapSense® 900 Gen1 Low Level DSLink Operations Guide

Release 1.0.0

3/27/2019

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1 INTRODUCTION

The Panduit SynapSense 900 (SS900) Gen 1 Low Level (LL) DsLink system consists of the following hardware and software components:

- 900 MHz radio gateway: IOT-9GWPOE
- 900 MHz radio sensors: IOT-9CT, IOT-9CTH, IOT-9CVM, IOT-9CHT
- The Panduit SynapSense900 Gen 1 Low Level DsLink

All these devices when configured and connected properly provide the SS900 DsLink System. This document describes the procedure of configuration and installation of all components.

2 HARDWARE SUPPORT

The 1.0.0 DsLink supports this hardware:

Product\Market	US	Europe	Japan	Asia
Ethernet gateway	IOT-9GWPOE	IOT-9GWPOE-8	IOT-9GWPOE-2	IOT-9GWPOE-4
High Temperature	IOT-9CHT	IOT-9CHT-8	IOT-9CHT-2	IOT-9CHT-4
Temperature	IOT-9CT	IOT-9CT-8	IOT-9CT-2	IOT-9CT-4
Tri-Axial Accelerometer	IOT-9CVM	IOT-9CVM-8	IOT-9CVM-2	IOT-9CVM-4
Temp Humidity 3' Lead	IOT-9CTHL03	IOT-9CTHL03-8	IOT-9CTHL03-2	IOT-9CTHL03-4
Temp Humidity	IOT-9CTH	IOT-9CTH-8	IOT-9CTH-2	IOT-9CTH-4

The minimum gateway firmwareVersion is “3.0.0.0”.

The ss900-dslink and GPT software shall only be used to communicate between Panduit-branded product and Cisco-branded product. This software shall not be used to allow any non-Panduit branded product to communicate with Cisco-branded product.

3 SYSTEM ARCHITECTURE

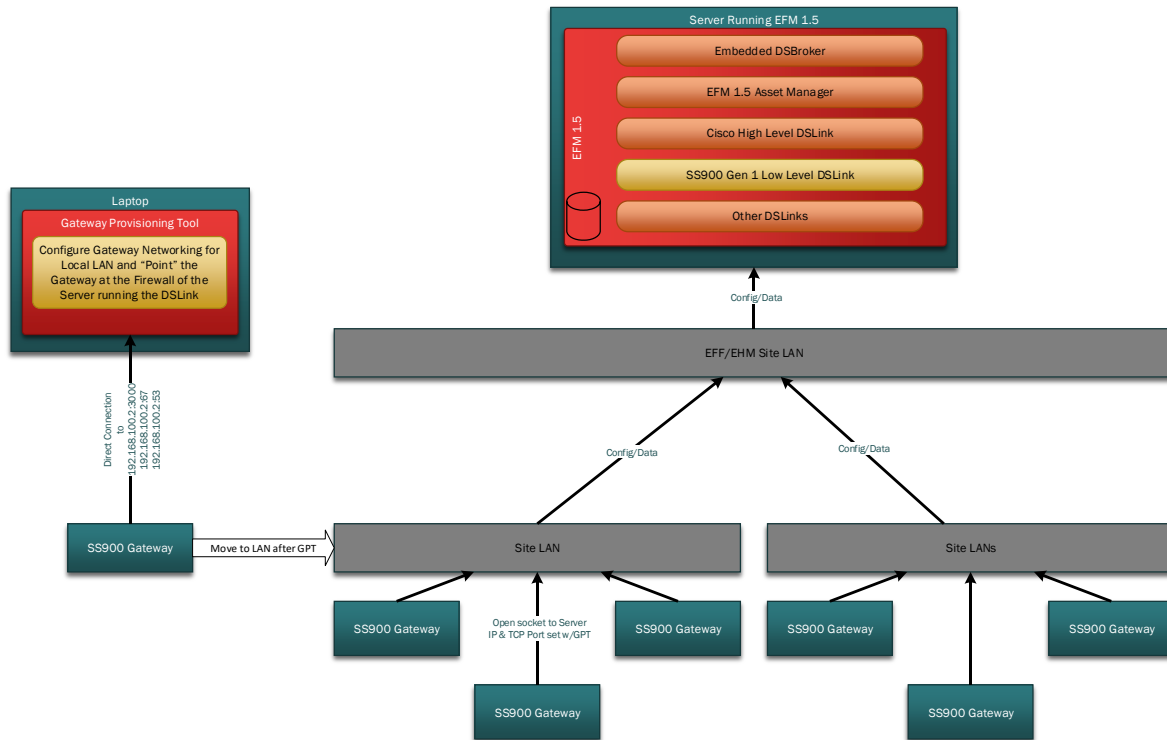


Figure 1 ss900 DsLink IoT System

The SS900 setup starts with setting up the following:

- Installing the DsLink in EFM 1.6
- Configuring the IOT-9GWPOE gateway
- Adding gateways using the Dataflow Editor¹
- Plugging in the gateways
- Verifying Communications from gateways to the DsLink server
- Powering up sensors
- Adding sensors using the Dataflow Editor (optional)
- Observe sensor auto-registration
- Observe sensor data

¹ It is critical to use the EFM Dataflow Editor when performing ACTIONS on the DsLink as it is the only client certified at this time. Other clients (i.e. EFM System Administrator) will allow entering strings in number fields. See "Issues with ACTION Forms in EFM System Administrator".

3.1 REQUIRED EQUIPMENT

To configure a Panduit IOT-9GWPOE 900 MHz Gateway device, either out of the box or re-used off a shelf, the following equipment is required:

- (1) Panduit IOT-9GWPOE SynapSense 900 MHz Power Over Ethernet Gateway.
- (1) Laptop/desktop containing
 - (1) wired Ethernet port for local configuration console provisioning
 - Java 8 JRE support (openjdk)
 - Bash shell support (Cygwin if using Windows)
 - unzip
- (1) Ethernet cable with RJ45 connections between the laptop and the gateway device.
- Cisco Kinetic Edge & Fog Processing Module (EFM) 1.6 must be pre-installed before proceeding with the following steps. EFM is not a part of the Panduit SS900 DSLINK package.

4 INSTALLING THE SS900 DSLINK

BY INSTALLING THE SOFTWARE YOU AGREE TO THE TERMS, CONDITIONS, AND LIMITATIONS SET FORTH IN THE EULA CONTAINED HEREIN. IF YOU DO NOT WISH TO ACCEPT THE TERMS, CONDITIONS, AND LIMITATIONS SET FORTH IN THE EULA, DO NOT INSTALL THE SOFTWARE.

The SS900 DSLink is part of the shipping package ss900-gen1-ll-dslink-1.0.0-release.zip file.

First, unzip the ss900-ll-dslink-1.0.0-release.zip file.

```
$ unzip -d ss900-gen1-ll-dslink-1.0.0-release ss900-gen1-ll-dslink-1.0.0-release.zip
$ cd ss900-gen1-ll-dslink-1.0.0-release
```

The release ZIP archive provides the End User License Agreement, Release Notes and the software ZIP archive. Next, unzip the ss900-ll-dslink-1.0.0.zip file.

```
$ unzip -d ss900-gen1-ll-dslink-1.0.0 ss900-gen1-ll-dslink-1.0.0.zip
$ cd ss900-gen1-ll-dslink-1.0.0
```

The software ZIP archive provides the Operations Guide, the Software License Agreements, the ss900-dslink.zip installable ZIP file, and onboarding files.

4.1 INSTALLING THE SS900-DSLINK.ZIP IN EFM 1.6

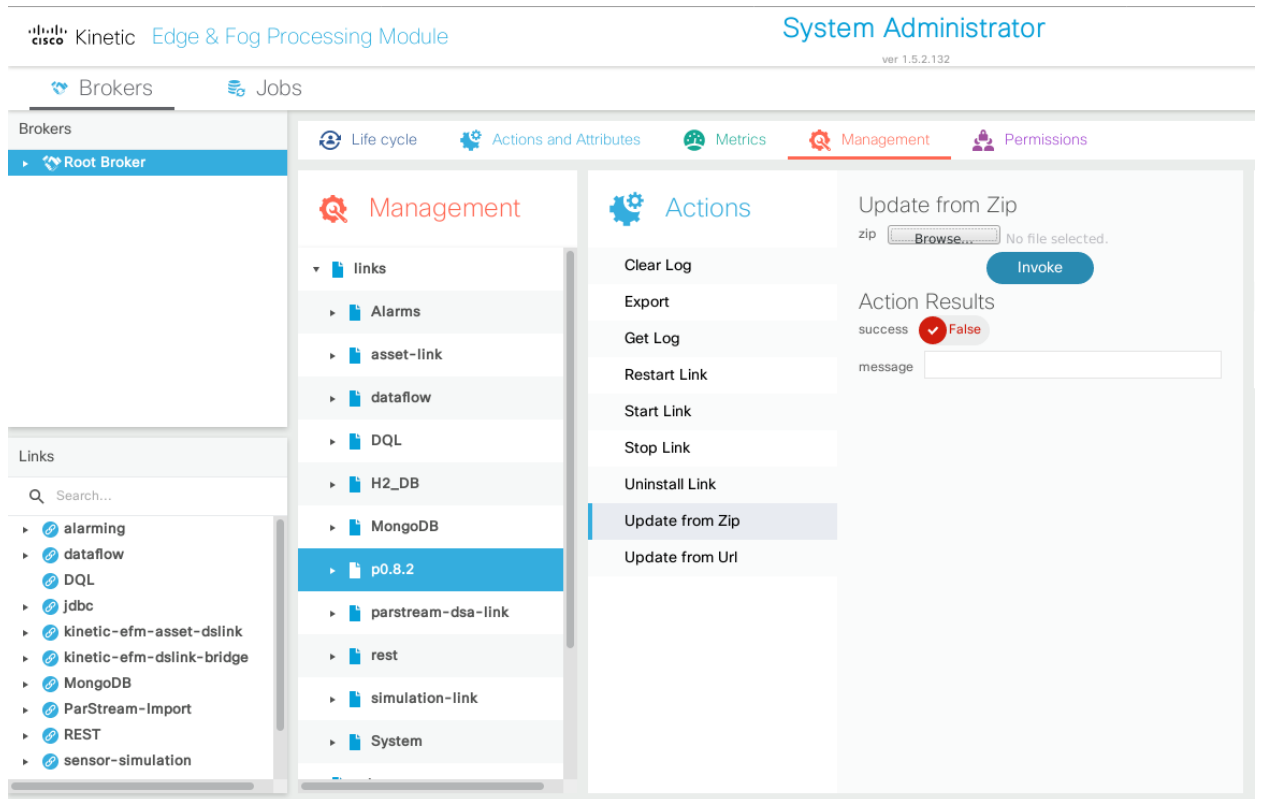
The procedure for installing the ss900-dslink.zip in EFM is based upon the version of the SS900 LL DSLink software currently installed.

If this is the first time the product is being installed, go to [Install the new ss900 DSLink](#).

If the previously installed DSLink is P0.8.x or newer, you may [Upgrade from Zip](#).

If the previously installed DsLink is P0.7.x or older, you must continue with [Uninstall previous version](#) before installing the new DsLink.

4.1.1 Upgrade from Zip



4.1.1.1 *Navigate to the EFM System Administrator page for the previously installed DsLink, similar to the one shown above.*

Click “Browse...”. Navigate to the ss900-dslink.zip file location and choose “Open”.

Next, click the Invoke button.

The DsLink will stop, update and then start again. All previously configured gateways and sensors are operational.

Next, following the instructions for updating the Asset Manager configuration files in [Installing the EFM 1.6 Asset Manager Discovery Files](#).

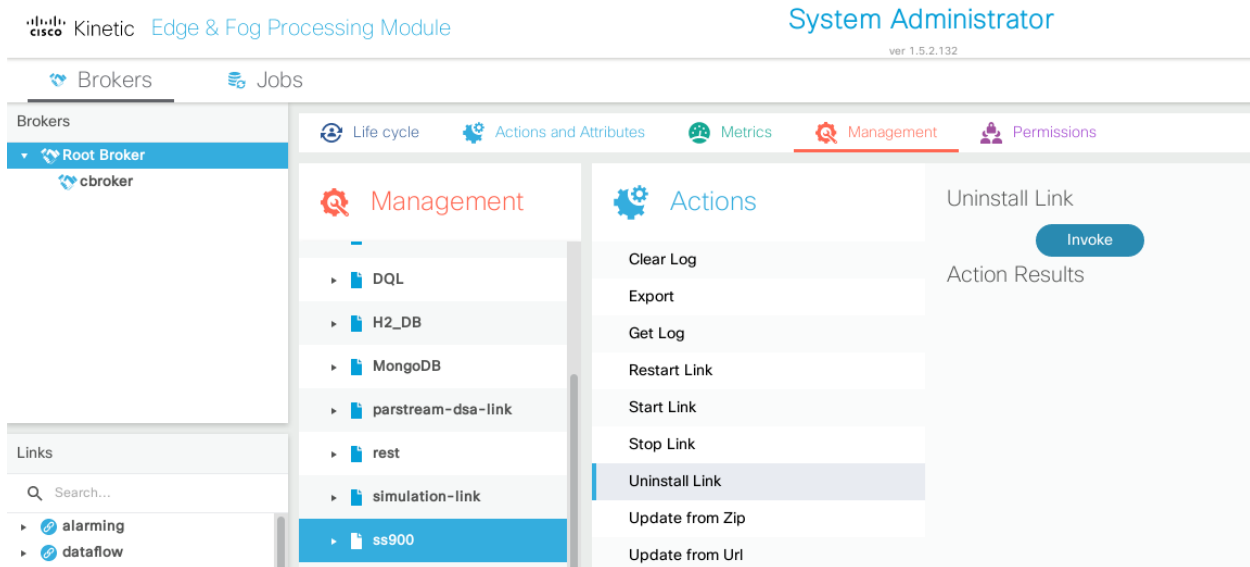
Please read the Release Notes and use the updated DsLink.

4.1.1.2 Uninstall previous version

Before installing Release 1.0.0, you must do this in sequence:

- If the version currently installed is P0.8.0 or older, record the existing configuration of gateways and sensors.
- “Stop Link” the currently installed ss900-dslink using EFM System Administrator.

- If the DsLink is still visible in the device tree, use the “quit” ACTION on the running DsLink.
- Use “Uninstall Link” on the currently installed ss900-dslink in EFM System Administrator.



Skipping “STOP” may cause the previously installed ss900-dslink to continue running, creating a conflict with the 1.0.0 ss900-dslink. It may be necessary to use the “kill” command in Linux (“taskkill” on Windows) to stop the DsLink. After stopping the DsLink, check using ps on a Linux EFM server:

```
# ps ax | grep java | grep ss900 | grep -v grep
```

If you see:

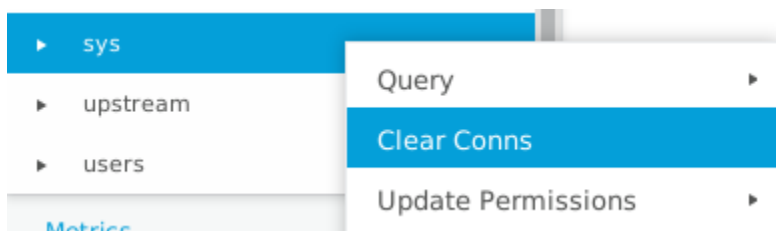
```
386 ?          Sl      0:30 java -jar ss900-dslink.jar --name ss900 --nodes nodes.json --
key .key --log info --broker http://127.0.0.1:48400/conn --token
sXR8rQ1zAv1lvADP6PTJCDFLYFXtv9z3nXphqICmulpkqCNJ
```

Then you must “kill 386”.

4.1.1.3 Use “Clear Conns” after Uninstall

When a DsLink is uninstalled and reinstalled as the same name, the name given in the tree may have a “-” character followed by other characters appended to it. For example: if your DsLink name was “ss900”, when you “Start Link”, the actual name in the Links tree may become “ss900-M” or “ss900-p”.

To avoid this problem, right click on the “/sys/” node and choose “Clear Conns” after uninstalling the DsLink.



If you have Dataflows that use absolute paths to attributes, please convert them to use Asset Manager based paths instead.

4.1.2 Install the new ss900 DSLink

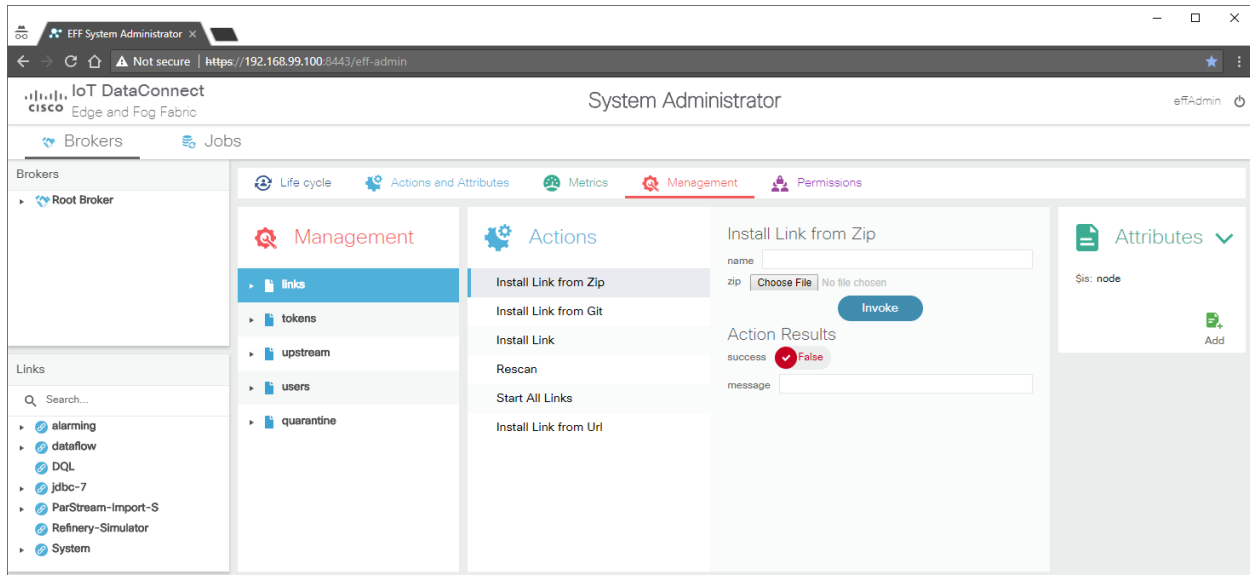


Figure 2 EFM DSLink installation

Navigate to the EFM System Administrator page shown above and point to the ss900-dslink.zip file location in the above page and hit the invoke button.

- Install the ss900-dslink.zip using EFM.
- Rescan to pick it up in list of available DSLinks
- Start the ss900 DSLink
- Configure the gateways and sensors.

When the ss900 DSLink finishes initialization, it appears on the list of DSLinks as shown below.

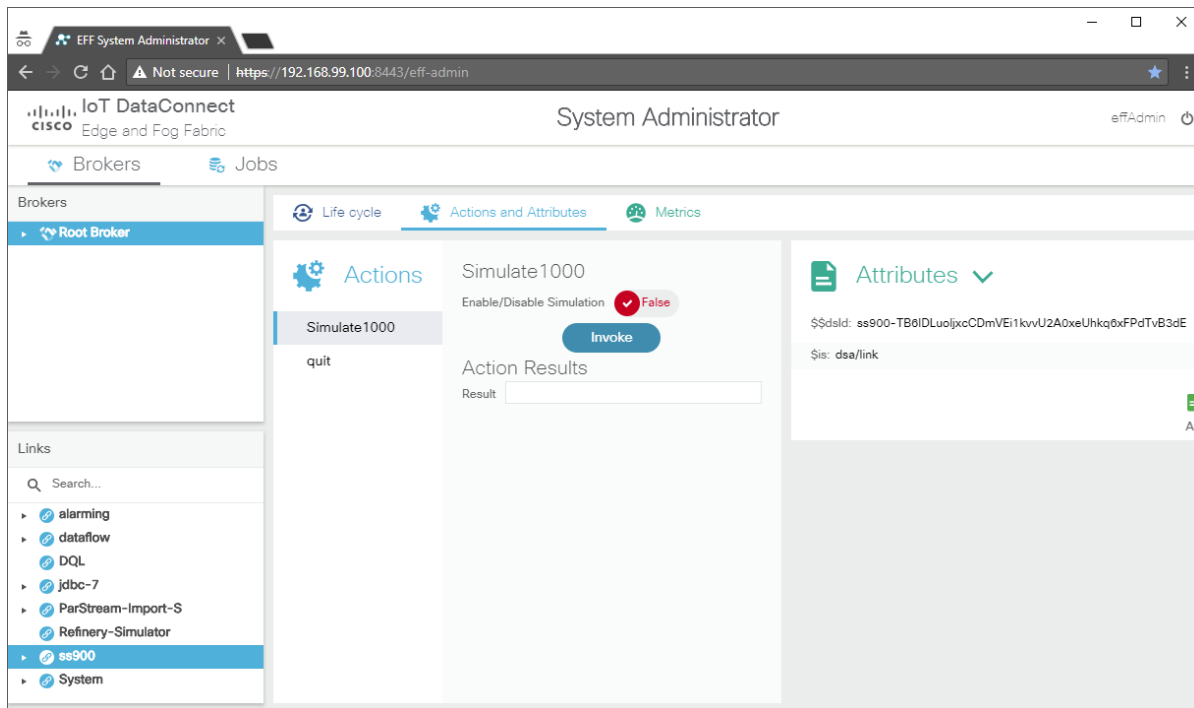


Figure 3 After DSLink (ss900) installed

The DSLink is now ready to add the 9GW gateways and sensors.

To use a 9GW gateway, the 9GW **must** be provisioned.

5 FACTORY RESET THE GATEWAY DEVICE

It is necessary to begin the process of using the DSLink by Start by resetting the gateway 9GW to factory default settings. This will put the gateway into a known state that simplifies the provisioning process. To factory reset the device, depress and hold the Action button on the gateway device for at least 10 seconds. All LEDs will turn a solid red color then, flash orange. The gateway will attempt to obtain a DHCP address at this point.

6 PROVISIONING OPTIONS

There are three ways to provision (configure) a gateway.

- [Using the Internet Cloud Pointing feature of SynapSense900.com](#)
 - Requires a web browser with Internet access and a LAN with DHCP server that provides Internet access.
- [Local Configuration Mode](#)
 - Requires a web browser and direct connection to the gateway.

- Gateway Provisioning Tool CLI (via Panduit tech support only)
 - Requires a direct connection to the gateway and the ability to open firewall ports on the local PC.
 - Only used when Internet access is not available and the local configuration mode does not show a “Primary Server [URL/IP]” field.

7 PROVISIONING THE GATEWAY USING THE INTERNET (SYNAPSENSE900.COM)

Prerequisites:

- Web browser with Internet access.
- A LAN with DHCP server that provides Internet access to the gateway.

Connect the gateway to a network that supplies a DHCP server that provides Internet access to the gateway. The DHCP server must provide leases that use publicly accessible Internet DNS servers.

Reset the gateway configuration: Power up the gateway. Wait for the gateway to start up. This takes about 20 seconds. Press and hold the “Action” button on the back until all three lights are solid red for 10 seconds. Release the Action button to reset the device to defaults. It will restart again after a few seconds.

Go to <https://www.synapsense900.com/point>

Enter the “ID” and “GS” as the picture shows:


infrastructure for a connected world


PANDUIT

[\[Login \]](#)

Enter Gateway Information

Please enter your Gateway ID and Gateway Serial.

Gateway ID 

Gateway Serial 



Gateway Back Label

[Gateway Server Settings](#)
[Cancel](#)

www.panduit.com/synapsense synapsense900support@panduit.com

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[Privacy Policy](#)

Click “Gateway Server Settings”.

A new page appears:

infrastructure for a connected world

PANDUIT

[\[Login \]](#)

Edit Gateway Server Settings

[Reset Defaults](#)

Last Check-in Date 2/26/2018 11:00 PM

Enterprise/Express Host Address

Enterprise/Express Port Number

DHCP

DYNAMIC

[Submit](#)
[Go Back](#)

www.panduit.com/synapsense synapsense900support@panduit.com

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Change the “Enterprise/Express Host Address” to be the “serverIP” of the SS900 DSLink server. The value that you would use for the “serverIP” is described under “[Firewall Considerations](#).”

If this gateway is being re-used, after adding the gateway to the DSLink configuration, use the [Gateway Reform feature](#) before configuring wireless sensors.

8 PROVISIONING THE GATEWAY USING THE LOCAL CONFIGURATION CONSOLE

The gateway can be configured using a local web browser.

Using an Ethernet cable, connect the laptop Ethernet port directly to the Ethernet port of the gateway device. If the 9GW uses POE, it will be necessary to use a power adapter temporarily. If it is necessary to use a POE switch for power, the DHCP server on the switch **MUST** be disabled.

Reset the gateway configuration: Power up the gateway. Wait for the gateway to start up. This takes about 20 seconds. Press and hold the “Action” button on the back until all three lights are solid red for 10 seconds. Release the Action button to reset the device to defaults. It will restart again after a few seconds.

While the gateway is starting up, press and hold the “Action” button on the back. When all three lights flash red, quickly release the button. The device will enter local configuration console mode.

If the network adapter IP configuration was not set to DHCP, it must be set to DHCP. When the gateway is reset to defaults and forced into local configuration mode, the gateway provides a DHCP server for a 192.168.100.1/24 network, effectively automatically configuring the PC’s network settings.

Open a web browser and go to <http://192.168.100.1/>. This will present the gateway local configuration console web user interface.

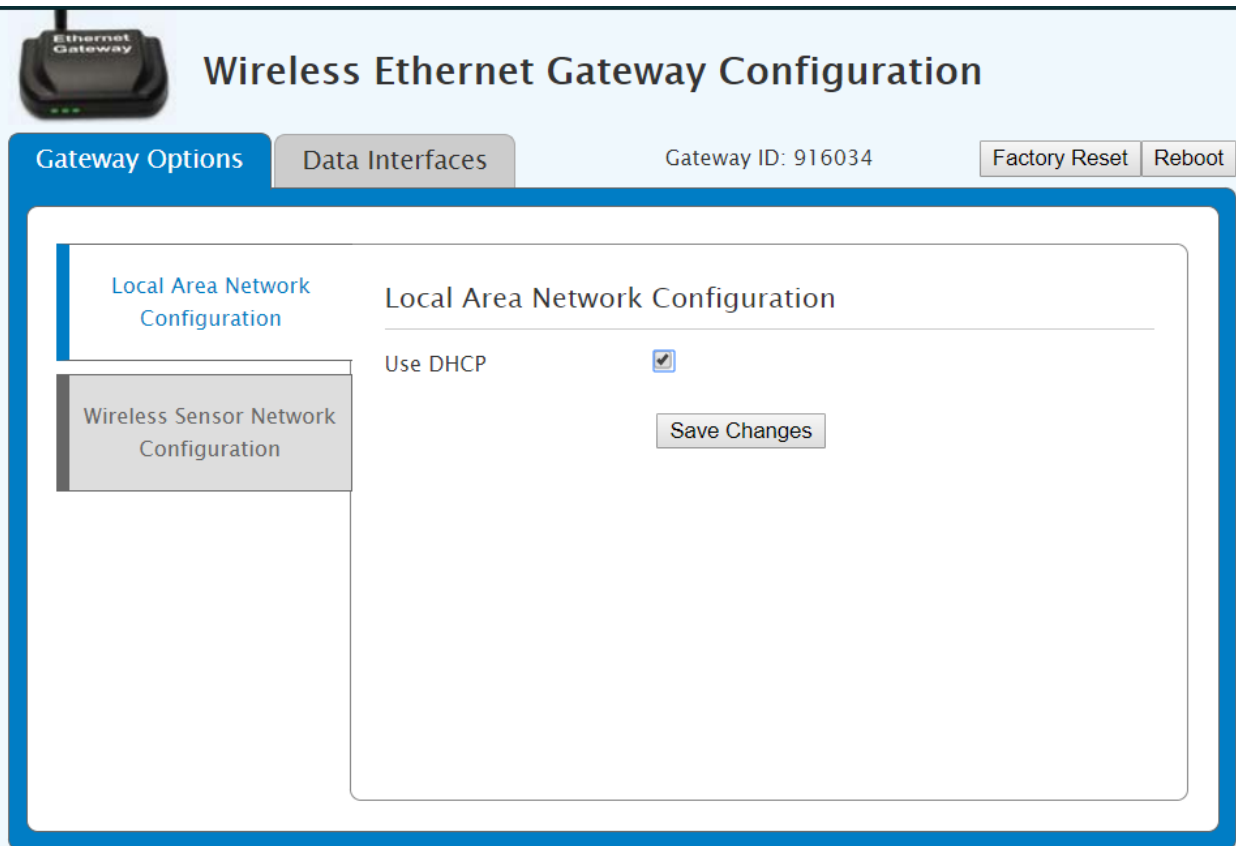



Figure 4 Local Config Console - LAN Configuration - DHCP

On the “Local Area Network Configuration” page, enter the network configuration for this gateway. Then click “Save Changes.”

To configure a static IP address, uncheck “Use DHCP” and fill in appropriate network configuration data.



Wireless Ethernet Gateway Configuration

Gateway Options
Data Interfaces
Gateway ID: 916034
Factory Reset
Reboot

Local Area Network Configuration
Wireless Sensor Network Configuration

Local Area Network Configuration

Use DHCP
☐

IP Address

Network Mask

Default Gateway

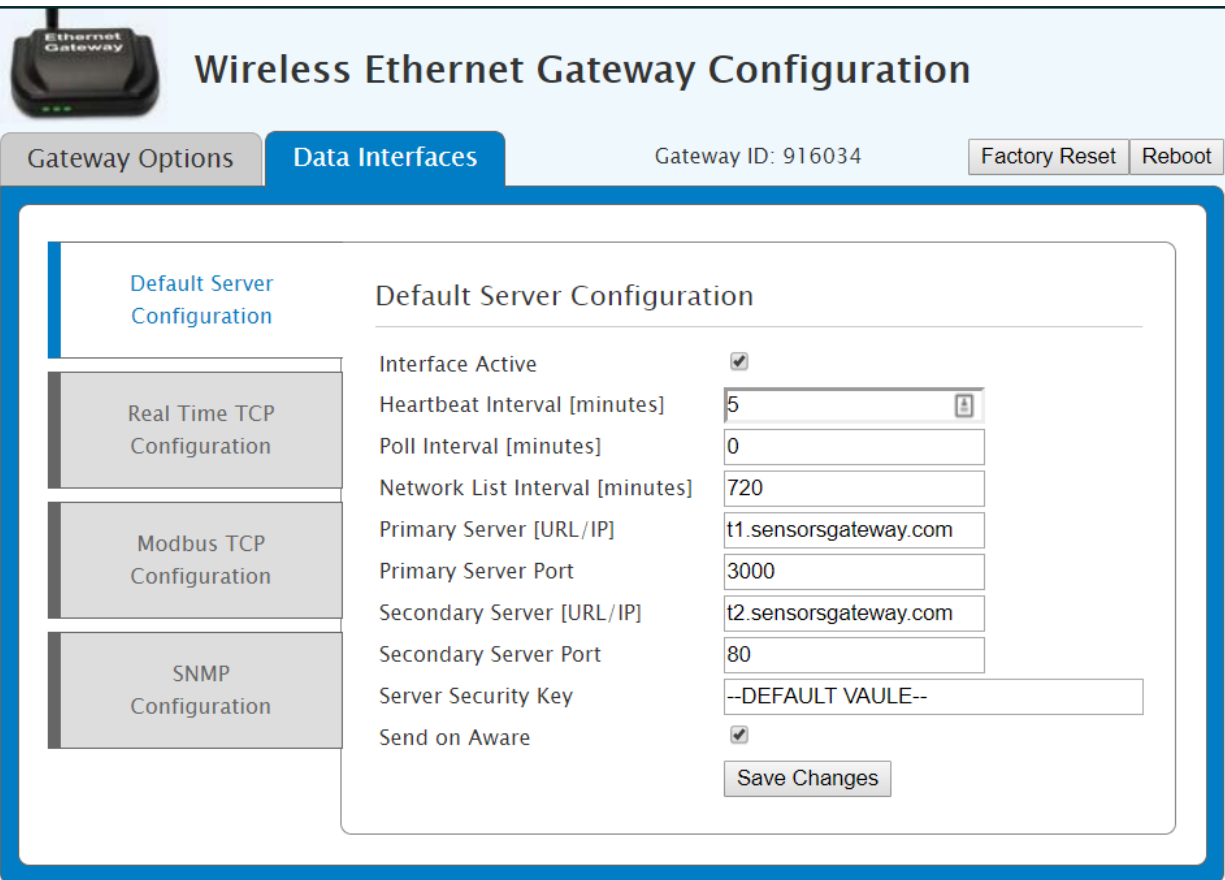
Primary DNS

Secondary DNS

Save Changes
Success

Figure 5 Local Config Console - LAN Configuration - Static IP

Click on the "Data Interfaces" tab. You should see the following screen:



Wireless Ethernet Gateway Configuration

Gateway Options | **Data Interfaces** | Gateway ID: 916034 | Factory Reset | Reboot

Default Server Configuration

Real Time TCP Configuration

Modbus TCP Configuration

SNMP Configuration

Default Server Configuration

Interface Active ☒

Heartbeat Interval [minutes]

Poll Interval [minutes]

Network List Interval [minutes]

Primary Server [URL/IP]

Primary Server Port

Secondary Server [URL/IP]

Secondary Server Port

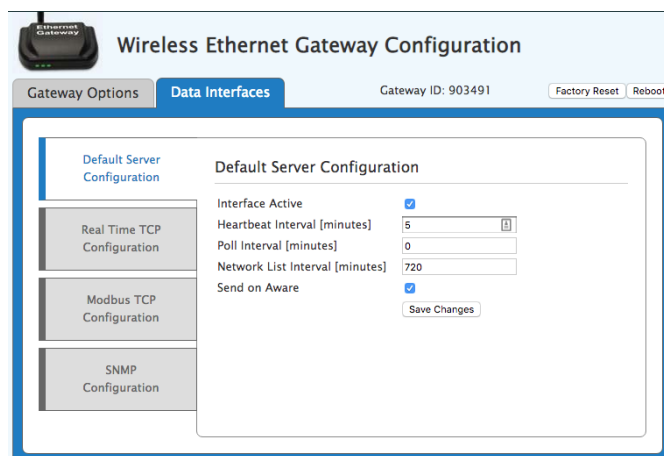
Server Security Key

Send on Aware ☒

Save Changes

Figure 6 Local Config Console - Default Server Configuration - Defaults

Note: In some exceptional cases (such as after a firmware update), you may find the screen is missing the Primary Server and Secondary Server settings:



Wireless Ethernet Gateway Configuration

Gateway Options | **Data Interfaces** | Gateway ID: 903491 | Factory Reset | Reboot

Default Server Configuration

Real Time TCP Configuration

Modbus TCP Configuration

SNMP Configuration

Default Server Configuration

Interface Active ☒

Heartbeat Interval [minutes]

Poll Interval [minutes]

Network List Interval [minutes]

Send on Aware ☒

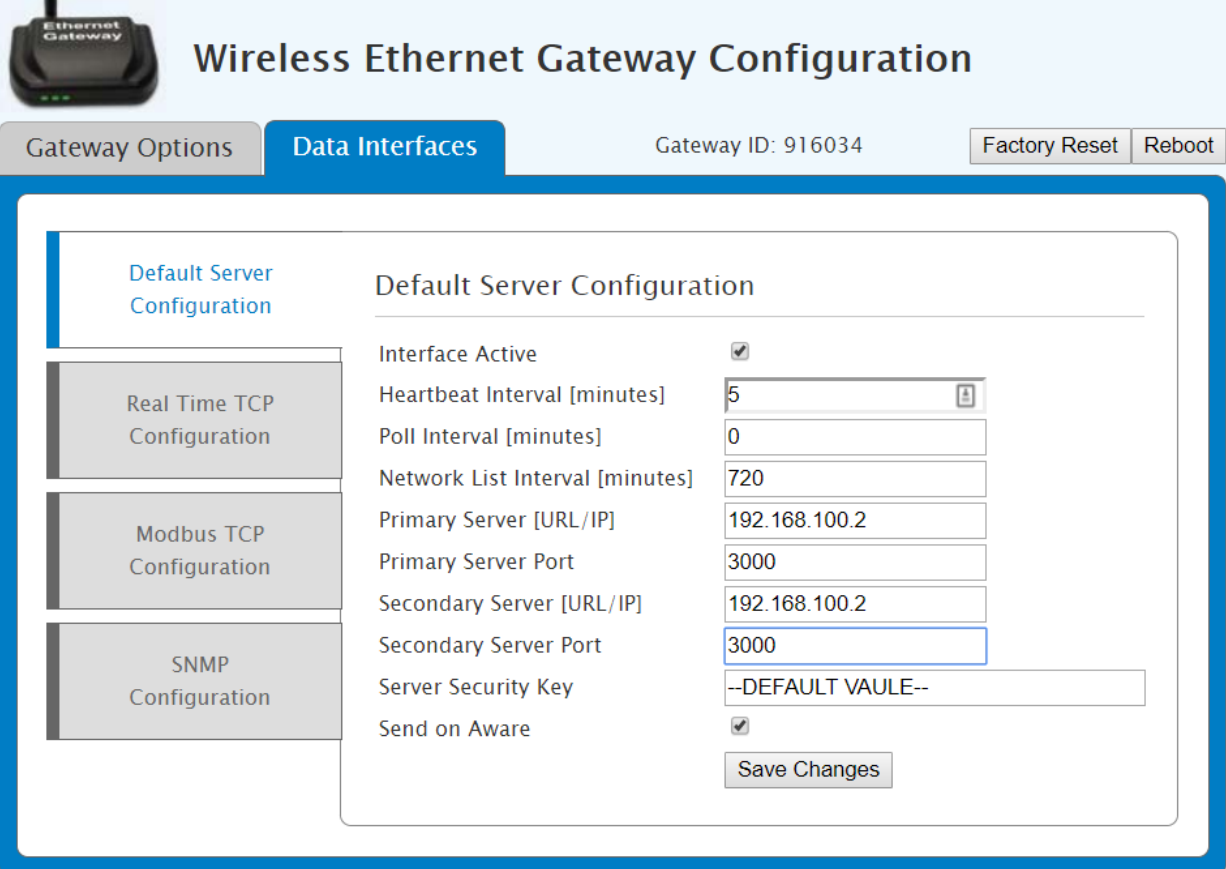
Save Changes

Figure 7 Local Config Mode - Default Server Config - No Server URL/IPs

When this occurs, please use [SynapSense900.com Cloud Pointing](https://SynapSense900.com). If you do not have Internet access, please contact Panduit Technical Support, which may require the Gateway Provisioning Tool software to configure the gateway.

Enter the IP address of the DSLink server “serverIP” into the primary and secondary server [URL/IP] boxes.

Enter the DSLink “serverPort” (the default is 3000) as the “Primary Server Port” and “Secondary Server Port”, then click "Save Changes".



The screenshot shows the 'Wireless Ethernet Gateway Configuration' interface. At the top, there's a 'Gateway Options' tab and a 'Data Interfaces' tab. The 'Gateway ID' is 916034. There are 'Factory Reset' and 'Reboot' buttons. The main configuration area is titled 'Default Server Configuration'. On the left, there are three sub-tabs: 'Default Server Configuration' (selected), 'Real Time TCP Configuration', and 'Modbus TCP Configuration'. The 'Default Server Configuration' sub-tab shows the following settings:


Configuration Item	Value
Interface Active	<input checked="" type="checkbox"/>
Heartbeat Interval [minutes]	5
Poll Interval [minutes]	0
Network List Interval [minutes]	720
Primary Server [URL/IP]	192.168.100.2
Primary Server Port	3000
Secondary Server [URL/IP]	192.168.100.2
Secondary Server Port	3000
Server Security Key	--DEFAULT VAULE--
Send on Aware	<input checked="" type="checkbox"/>

At the bottom of the configuration area is a 'Save Changes' button.

Figure 8 Local Config Console - Default Server Configuration - example

Click on the “Gateway Options” tab.

Click on the “Wireless network Configuration” tab. You may need to scroll to the bottom of the page.



Wireless Ethernet Gateway Configuration

Gateway Options

Data Interfaces

Gateway ID: 916034

Factory Reset

Reboot

Local Area Network Configuration

Wireless Network Configuration

Current Wireless Network Settings

Active Channel 0

Total Network Devices 45

Gateway Device List

Total Devices in List 45

Slot	Device ID
1	333333
2	222222
3	444444
4	316479
5	140980
6	325554
7	325959
8	194071
9	322222

Add Device to Gateway

Slot Index [1-512]

Device ID

Security Code

Add Sensor

Erase Device List

Reform Wireless Network

Figure 9 Local Config Console - Wireless Network Config - shows a previously configured wireless network

Click on “Reform Wireless Network”. Wait for the operation to complete.



Wireless network reset in process...Please wait.

The gateway will complete the requested operation and return to previous page.

Figure 10 Local Config Console - Wireless Network Reset In Process

When complete, the page will reload. The device is ready to be deployed.



Wireless Ethernet Gateway Configuration

Gateway Options

Data Interfaces

Gateway ID: 916034

Factory Reset

Reboot

Local Area Network Configuration

Wireless Network Configuration

Current Wireless Network Settings

Active Channel4

Total Network Devices0

Gateway Device List

Total Devices in List0

Add Device to Gateway

Slot Index [1-512]

Device ID

Security Code

Add Sensor

Erase Device List

Reform Wireless Network

Figure 11 Local Config Console - Wireless Network Configuration - defaults

9 CONFIGURING THE HARDWARE IN THE DSLINK

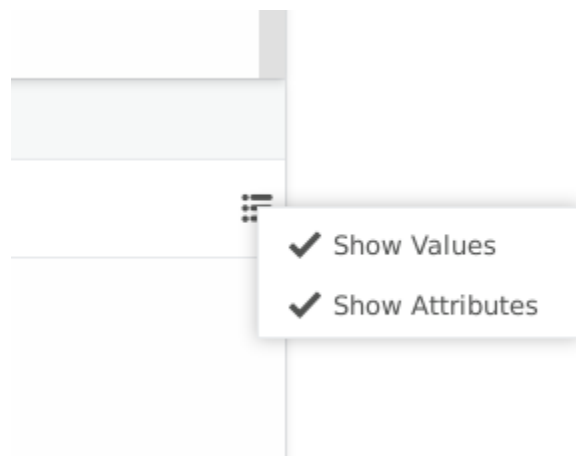
The following sections provide a prescriptive procedure for adding gateways and sensors manually. Sensors are discovered and registered automatically (by default) so there is little need to add a sensor manually. One reason to add a sensor manually is to set sensor parameters to something other than default before the sensor is discovered. Another is that you may turn off automatic registration (`ss900/wsn_server/$autoRegister`) in a production environment so it only communicates with registered sensors.

In all cases, you must add a gateway before a sensor can be added or discovered. Any automatically registered sensor that is registered with the first gateway the sensor discovered. When the number of sensors on a gateway exceeds 100, the sensors must be manually distributed to specific gateways using the `registeredNodes` attribute of the gateway configuration. A single gateway can support 100 sensors.

All configuration is performed using the Dataflow Editor in EFM. This is important because this UI has support for tooltips and pre-populating ACTION dialogs. The following sequence of screen shots shows how to interact with gateways and sensors.

9.1 TURN ON ATTRIBUTES USING THE HAMBURGER IN THE DATAFLOW EDITOR

The attributes on nodes will not appear in the Dataflow Editor by default. You should turn them on:



10 INSTALL GATEWAY DEVICE INTO IOT NETWORK

Now that you have some sense of an operational system, it is critically important to install the hardware properly. Please follow these instructions carefully. Starting with one of the gateway provisioning methods above is required. If you get into trouble, repeat the gateway provision process.

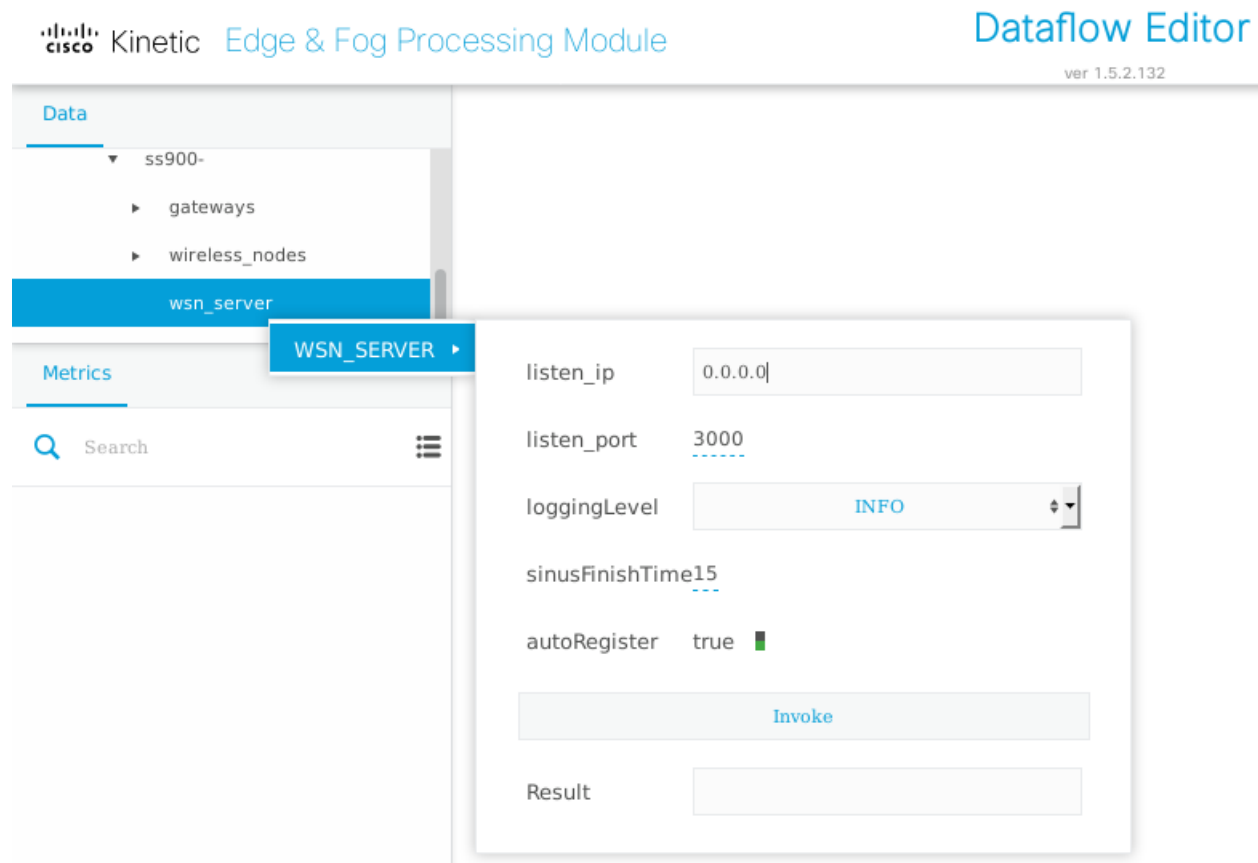
The Panduit IOT-9GWPOE 900 MHz Gateway device is now ready to be installed into the targeted IoT network. The gateway will attempt to communicate to the ss900 DSLink continually.

10.1 FIREWALL CONSIDERATIONS

The DSLink may be installed on a server behind a firewall. The firewall must be configured to port forward to the server running the DSLink. By default, the DSLink will be listening on:

ss900/wsn_server/listen_ip (IPv4 Address): 0.0.0.0

ss900/wsn_server/listen_port (TCP Port): 3000



This means it will accept connections on ANY Ethernet interface on the server. The port forwarding rules must forward from the firewall (i.e. default router) to a SPECIFIC Ethernet interface on the server. For instance:

	External (Public) Interface	Server Internal Interface	DSLink
IP Address	192.168.0.115	10.0.2.15	0.0.0.0
TCP Port	33000	3000	3000

To improve security of a deployment, the DSLink may be configured to listen on a specific interface. However, if the IP address (interface) is not available when the DSLink starts, the DSLink will not function properly. This may be resolved by stopping and restarting the DSLink when the interface is available. Or

may be resolved by choosing the IP address of a server internal interface that is always available at the time when the DSLink starts. An alternative is to use firewall rules to only permit traffic to the DSLink TCP Port from certain interfaces/networks.

Each gateway is configured with a serverIP and serverPort that refer to the IP Address and TCP Port that are accessible from the perspective of the gateway, as it connects to the server running the DSLink. In the example above, a gateway connecting from the External Interface would use the External (Public) Interface settings for the serverIP and serverPort. Further, a gateway on the LAN of the Server Internal Interface would use those as the serverIP and serverPort.

10.2 MANUAL OR AUTOMATIC SENSOR REGISTRATION

The DSLink, by default, starts with autoRegister set to true. When a sensor is discovered by a gateway, it must be registered for the sensor to communicate through that gateway. Automatic Registration simplifies provisioning by automatically adding sensors as they are discovered.

For very large and more predictable deployment of sensors, autoRegister may be set to false. When autoRegister is false, you must manually manage each gateway's registeredNodes list. If a sensor is added or removed from registeredNodes, the gateway will automatically start a Reform Action. Please wait until GatewayID/health/\$reform_in_progress becomes false before powering on that sensor to avoid having the sensor enter Link Mode.

10.3 CONNECTING THE GATEWAY TO THE NETWORK

Move the Ethernet cable to a port on the LAN which has access to the server where the DSLink resides. It is recommended that you "ping" the server from your PC on the same network beforehand.

10.4 ADD A GATEWAY DIALOG

To add a gateway in the new installed DSLink (ss900) open the **Dataflow Editor** and select the ss900 and click on the gateway and 9GW, as shown in Figure 12 Adding Gateway in ss900 DSLink.

Enter the numbers after the "ID:" from the bottom of the gateway, fill in all required fields then press the Invoke button.



Other parameters that were supplied during gateway provisioning must be supplied again in the DSLink..

If all information is correct, the 9GW will be added to the network within 2 minutes. The Dataflow Editor tool provides default values pre-populated in the device fields, please use defaults.

Open the triangles and right click on the 9GW node. This node has the ACTION menu for the IOT-9GWPOE gateway. Be sure to enter the same network IP address used during gateway provisioning, otherwise the gateway may not connect to the DSLink. Notice the tooltip.

To get the gateway to communicate through the firewall, configure the gateway to open a socket on the Public IP using GPT AND configure the same on the 9GW node:

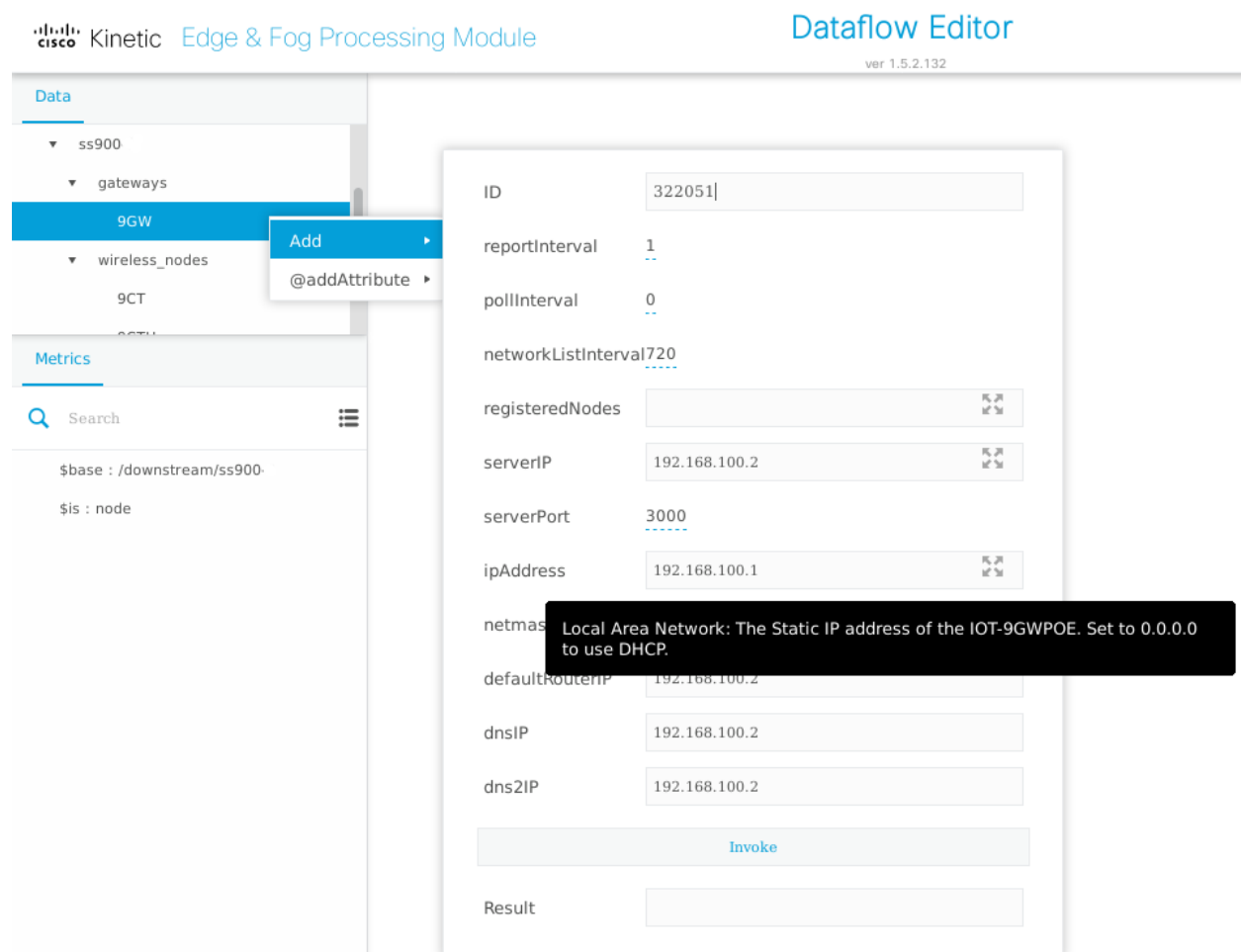


Figure 12 Adding Gateway in ss900 DSLink

- To use DHCP, enter 0.0.0.0 as the ipAddress of the gateway.
- The reportInterval is how often the gateway will pass data to the server collecting sensor data. In minutes.
- The pollInterval is how often the gateway will check for data to be sent down to the sensors. If the pollInterval is zero, the reportInterval shall be used.

- registeredNodes is a formatted string of comma separated records. Each record is a sensor ID, followed by a colon, followed by the sensor model type: "sensorID:sensorType". In general, the sensor list must be in the following format:
sensor1ID:sensor1Type,sensor2ID:sensor2Type,...,sensorNID:sensorNType. For example, a 9CT temperature sensor with ID 919191 and a 9CVM vibration meter sensor with ID 232323 would be specified as "919191:9CT,232323:9CVM".
- The serverIP and serverPort are discussed in 10.1 Firewall Considerations.

10.5 GATEWAY COMMUNICATION WHEN THE DSLINK HOST IS REBOOTED

When the EFM server is rebooted (the DSLink is restarted), the gateway will continue to connect to the serverIPs at the smaller of each gateway's configured reportInterval and pollInterval. If there is no data to report, the pollInterval is the longest time it will take for the gateway to connect to the serverIPs.

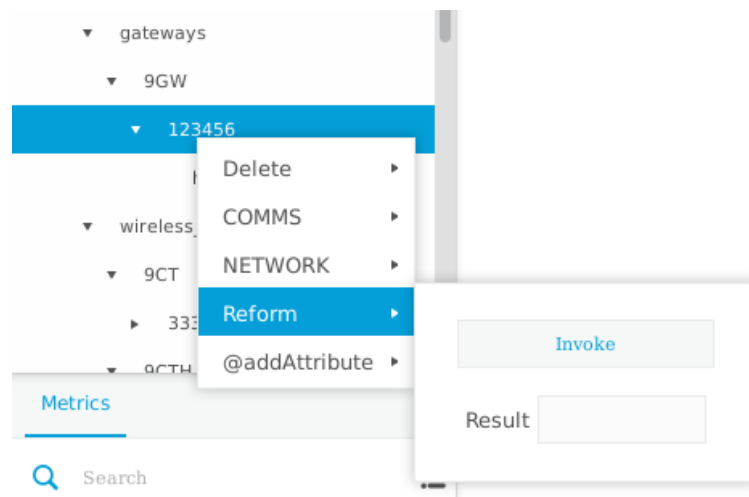
10.6 GATEWAY REFORM

The gateway stores a list of registeredNodes which are allowed to communicate through the gateway. Sensors cannot be removed from this list. To clear the registeredNodes list, the gateway must be Reformed.

A gateway reform will occur any time the gateway node's registeredNodes attribute is written. This includes when the gateway is GPT'd and when the gateway is added or COMMS/registeredNodes is changed. The DSLink will not automatically reform the gateway under any other circumstances.

If the gateway reports to the DSLink that too many sensors are registered, the DSLink will indicate via the root node status that the gateway should be manually reformed with the message: "GatewayID:%d has %d sensors registered. This is greater than the maximum of %d sensors. Please use the Reform Action on GatewayID:%d".

The manual Reform action is available as a sub-menu of the gateway instance.



After executing the Reform Action, please wait until the GatewayID/health/\$reform_in_progress is set to false before making any software or hardware configuration changes. Changes to avoid while \$reform_in_progress is true includes: powering on new or configured sensors, reconfiguring that gateway, or configuring any wireless nodes in the registeredNodes list for that gateway.

10.7 CHECKING HEALTH OF THE GATEWAY

The gateway must be able to connect to the DSLink and the DSLink must send configuration data to the gateway. Since the DSLink can only communicate with the gateway after the gateway opens communications to the DSLink, the initial configuration “sync” may be delayed up to 5 minutes. To check if the gateway is fully connected inspect the “HEALTH” channel.

The health node on each gateway will indicate when the gateway has contacted the DSLink. This occurs when all health attributes become “true”:

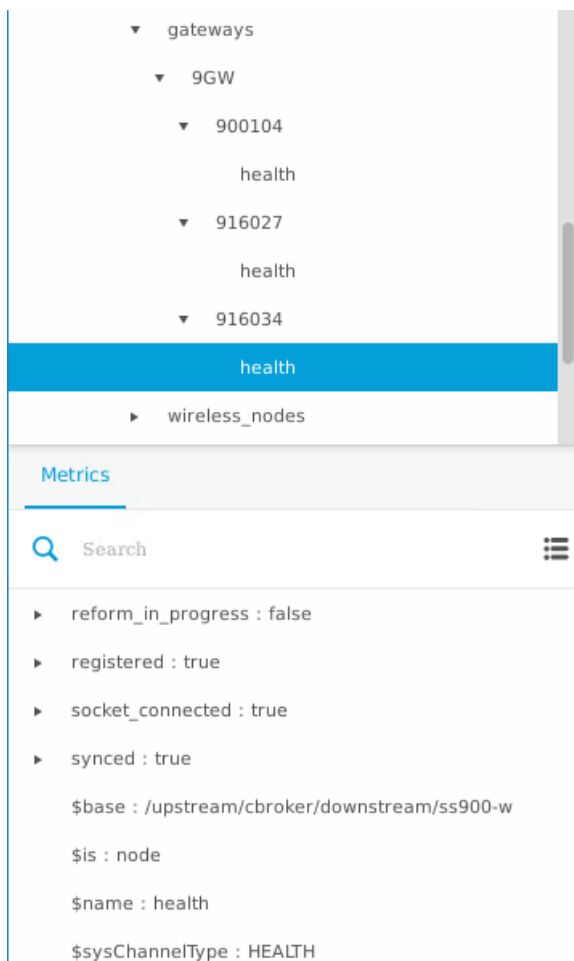


Figure 13 Checking Gateway/DSLink Health

11 ADDING/DISCOVERING SENSORS

With the steps in the “Install Gateway Device into IoT Network” section completed, the system is now ready to add sensors.

11.1 POWER OFF SENSORS

Sensors² which have been powered up for more than 10 minutes will be in power save mode. It is CRITICAL that the sensors be unpowered before adding them. Batteries must be removed for AT LEAST 60 seconds for the internal capacitors to discharge. Please be patient³.

11.2 DETECTING DISCOVERED SENSORS

When a sensor has been automatically discovered, the device will appear under the wireless_nodes node of the appropriate type:

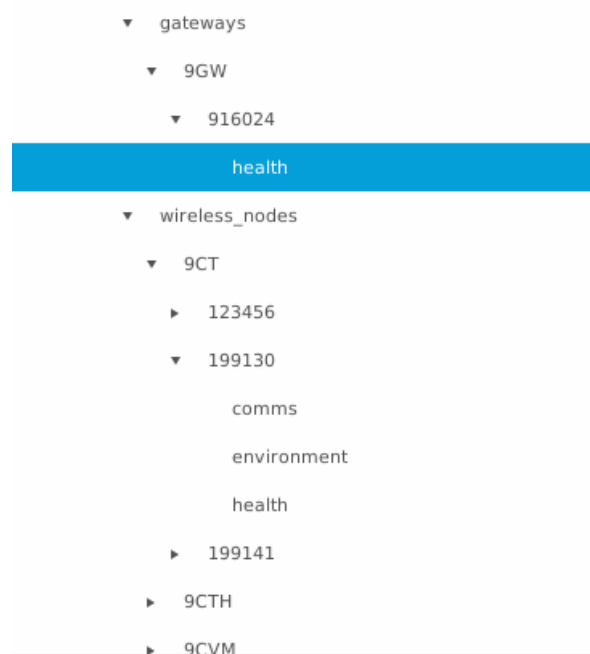


Figure 14 Detecting Discovered Sensors

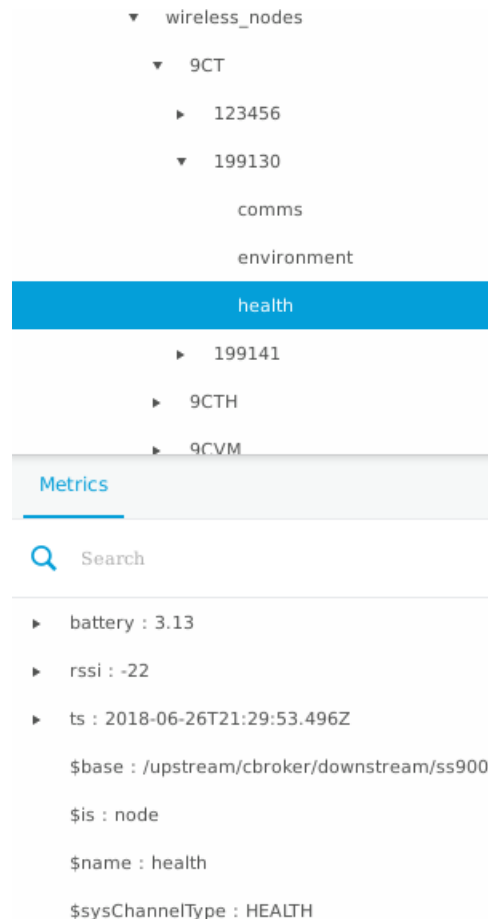
² The DsLink supports the sensors listed under [Hardware Support](#).

³ The sensor has no indication it is asleep, therefore waiting a full 60 seconds is a mere inconvenience compared to waiting 2-4 hours for a sensor to join the network.

When `ss900/wsn_server/autoRegister` is true, discovered sensors are automatically added to the DSLink and registered on the first configured gateway that discovered the sensor.

11.3 SENSOR HEALTH

The sensors may/may not be in contact with the gateway. A sensor added manually will take time to join the network. When the sensor is connected and configured by the gateway it will display good health numbers:



11.4 ADD SENSORS USING THE EFM DATAFLOW EDITOR (OPTIONAL)

Select the `ss900` link and then select the `wireless nodes` tab and select the sensor type to be installed. The above figure shows the temperature sensor installation (9CT). Enter all the relevant information and press the Invoke button.

Adding a sensor as the wrong sensor type can result in sensor malfunction. Workaround: As an example, do not attempt to add a 9CT product as a 9CVM device type. If this situation occurs, Delete the device and re-add it as the correct type. The device may recover functionality after several minutes. In some

cases, the sensor may also need to be power cycled: remove the batteries for 60 seconds, then replace the batteries.

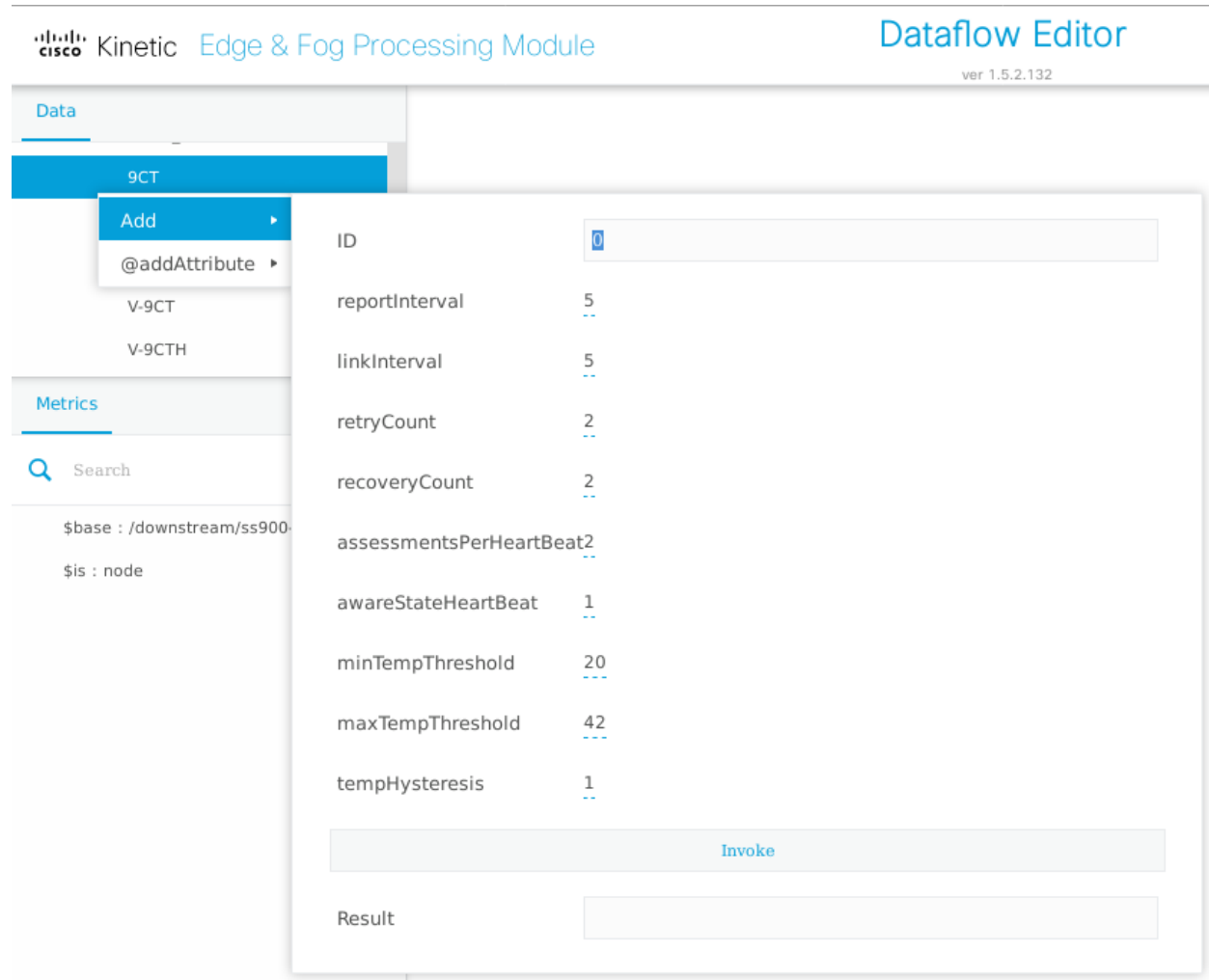


Figure 15 Adding Sensors in DSLink

11.5 SENSOR COMMUNICATION PARAMETERS

Sensors will report their measurements every reportInterval.

If the sensor supports an “aware state”, they will report at the awareStateHeartBeat.

Because the wireless sensor network is designed to tolerate outages, there are several configuration communication parameters that may be customized. The most important one is linkInterval. To fully understand linkInterval you have to understand Link Mode, and Link Mode is a mode a sensor enters when the Sensor can no longer communicate with its Gateway.

The following three parameters play a role in how Link Mode works.

- linkInterval Interval in minutes sensor scans for gateway in link mode. (Default: 120)
- retryCount Number of attempts to send a message to a gateway. (Default: 2)
- recoveryCount Number of failed sequences before sensor enters link mode. (Default: 2)

linkInterval

The interval, in minutes, at which the sensor attempts to link/re-link with the gateway. Link intervals greater than 1 hour will be rounded to the nearest hour.

Accepted values between 1 and 720 (1 minute to 12 hours).

recoveryCount

The number of messages the sensor sends without acknowledgment from gateway before entering link mode.

Accepted values are between 0 and 10.

0 means unlimited (power cycling sensor will be required if gateway changes channel).

retryCount

The number of times the sensor attempts to send/resend a single message to gateway.

Accepted values are between 0 and 10.


For example, consider the following settings: linkInterval = 60, recoveryCount = 5, retryCount = 4.

When the sensor is transmitting its data messages, and it realizes that the Gateway failed to receive its latest message, the Sensor will try retryCount amount of times to send the failed message again. After failing retryCount amount of times, it tallies +1 to its internal recoveryCount and continues on its regular reportInterval/awareState check-ins.

After its internal recoveryCount reaches the value of recoveryCount parameter, the sensor will then enter link mode. Once in link mode it then tries to find a new gateway. It will send 3 gateway acknowledgement messages after 1 minute of being in link mode. If all 3 fail, it will then wait 5 minutes to send 3 acknowledgements again. Fail again? Then 10 minutes, then 30 and 60 minutes. If it fails to find a gateway after the 60 minute attempt, it will then go off of the linkInterval and find a gateway on the linkInterval.

11.6 OBTAINING DATA FROM SENSORS

The DSLink exposes “observable” data on nodes using “channels”. The observable nodes are specific to the type of sensor. For instance, a temperature sensor has an “environment” node:


Kinetic
Edge & Fog Processing Module

Data

▼ 9CT

▼ 194071

comms

environment


health


▶ 199130

▶ 199141

▶ 308969

Metrics





▼ temperature : 21.4

\$base : /upstream/cbroker/downstream/ss900

\$is : node

\$type : number

\$sysUnitName : degree Celsius

\$sysValidUntilDuration : 660000

\$base : /upstream/cbroker/downstream/ss900

\$is : node

\$name : environment

\$sysChannelType : ENVIRONMENTAL

Data can be hierarchical, let's look at a vibration sensor:

▼ 9CVM

▼ 325662

comms

health

▼ vibration

x_axis

y_axis

z_axis

V-9CT

Metrics

Q Search

► duty_cycle : 0

\$base : /upstream/cbroker/downstream/ss900

\$is : node

\$name : vibration

\$sysChannelType : VIBRATION

In this figure the axis-independent metric is “duty_cycle”, it is therefore on the vibration node itself.

The vibration sensor can sense frequency and speed on the x, y, z axes. In this case the sensor has never reported. This looks bad... let’s check its health:

▼ 9CVM

▼ 325662

comms

health

▼ vibration

x_axis

y_axis

z_axis

V-9CT

Metrics

Q Search

▶ battery :
▶ rssi :
▶ ts :

\$base : /upstream/cbroker/downstream/ss900

\$is : node

\$name : health

\$sysChannelType : HEALTH

The “battery” “rssi” and “ts” have no values, which indicate the sensor is offline. In this case, it most likely never joined the network. This happens if the sensor is sitting around for more than 10 minutes when first powered up. So, it is important to make sure the gateway is up and running and configured by the DLink before powering up sensors. Not to worry, remove the battery (a screwdriver is required to open the sensor) and wait at least a FULL 60 seconds, then replace it.

When a sensor joins the gateway, it will get configured. However, it’s possible that the gateway will wait a few minutes before sending a status message to the DLink. When it does join it will display good health and valid (possibly 0) values:

▼ 9CVM

▼ 325662

comms

health

▼ vibration

x_axis

y_axis

z_axis

V-9CT

Metrics

Q Search

▶ battery : 2.92

▶ rssi : -35

▶ ts : 2018-06-26T22:09:20.720Z

\$base : /upstream/cbroker/downstream/ss900

\$is : node

\$name : health

\$sysChannelType : HEALTH

▼ 9CVM

▼ 325662

comms

health

▼ vibration

x_axis

y_axis

z_axis

V-9CT

Metrics

Q Search

▶ frequency : 0

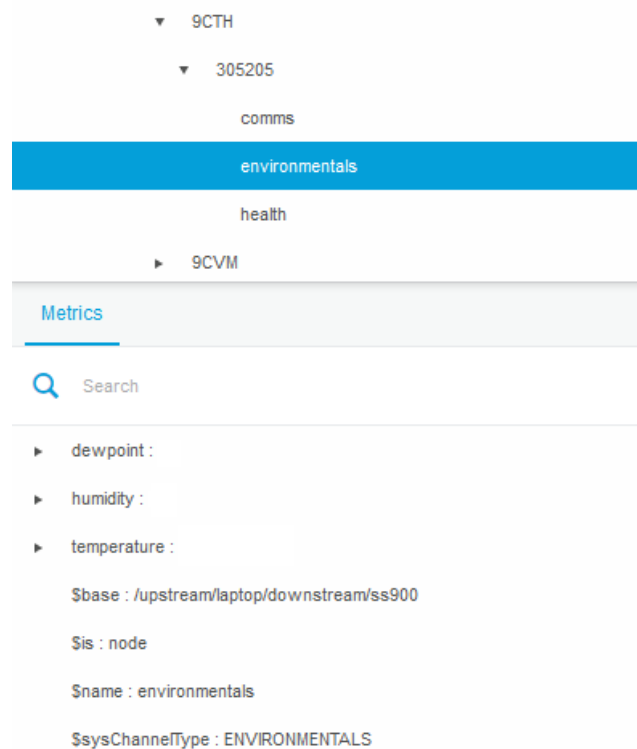
▶ speed : 0

\$base : /upstream/cbroker/downstream/ss900

\$is : node

\$sysChannelType : VIBRATION_ON_AXIS

12 SENSORS NOT REPORTING DATA



When a sensor measurement (observable), such as environmentals/temperature, is not present, this indicates the sensor has not reported data or the data has expired according to the `sysValidUntilDuration`. If the sensor previously reported any data, the `health/$ts` will be set to the time of the last phenomena.

Note that the sensor “comms” group provides a “status” field. The “status” field is “Up” when a sensor is functioning properly. Or “CommsLost” when the sensor misses an expected reporting interval. Or “Down” when the sensor has not checked in within the `sysValidUntilDuration` (in milliseconds) since the last measurement was reported, or if the sensor has not checked in since the DSLink was started.

13 DELETING A GATEWAY

To delete a gateway, click on the ss900 in the Dataflow editor and select the gateway to be deleted and shown in the figure below. Click on the Actions and Attributes tab and hit delete and then hit invoke.

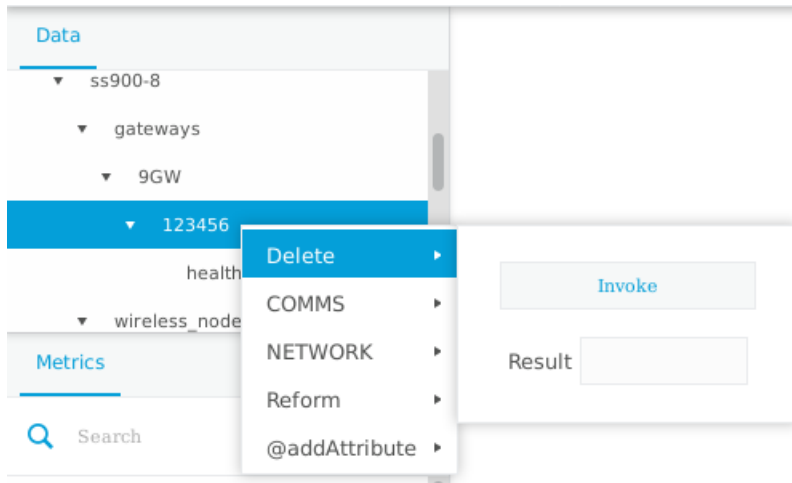


Figure 16 : Deleting a gateway.

Warning: After deleting a gateway, the gateway may require a power cycle and may require re-provisioning using GPT.

13.1 REPLACING A GATEWAY

The process for replacing a gateway with a new one is:

- Open the gateway instance's COMMS Action form.
- Select the contents of the registeredNodes list and Copy it to the clipboard. Record this value in a text file.
- Record all of the other COMMS and NETWORK Action form settings.
- Click on the instance and view the Metric. Record the \$server_ip and \$server_port attributes.
- Delete the gateway from the DSLink.
- Use GPT to provision the new gateway.
- Add the new gateway to the DSLink using all of the recorded values above.
- Go into the field and remove the old gateway.
- Install the new gateway.
- Depending on the failure mode of the old gateway, expect that the sensors may take up to 4 hours to find the new gateway.
- Note that the old gateway must be re-provisioned using GPT before any further use.

14 DELETING A SENSOR

To delete a sensor from the system, select the appropriate sensor from the sensor type tab and right click on the sensor. A sub-menu shows up select delete and hit invoke. This deletes the sensor as shown in the figure below.

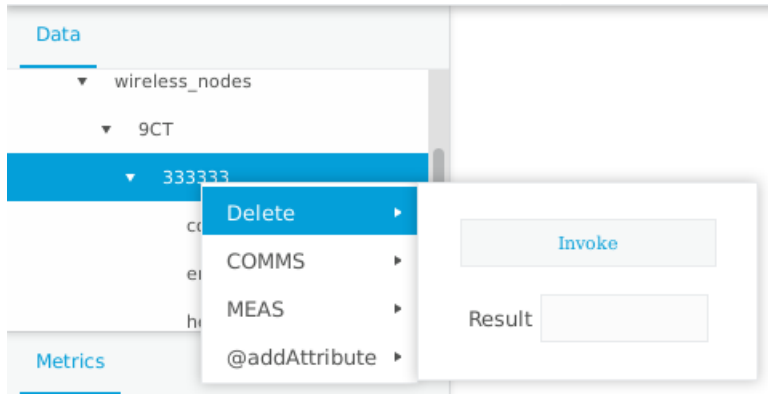


Figure 17 Deleting a sensor

15 DISCOVERY IN THE EFM 1.6 ASSET MANAGER

15.1 INSTALLING THE EFM 1.6 ASSET MANAGER DISCOVERY FILES

It is necessary to install the discovery files for the Panduit DSLink into the EFM Asset Manager, so it can discover sensors as assets.

The discovery files are provided in the DSLink distribution (not the DSLink itself). The files are in the “onboarding” directory.

To install these files, execute the script “onboarding/ss900-dslink-install-am-1.6.sh” on the EFM server. To summarize, the script automates this procedure:

- a) Install the panduit-link-efm16 files in the Asset Manager Discovery folder
- b) Install the images in the web server products folder

15.2 ASSET MANAGER: DISCOVERY

When discovery has been configured properly and the DSLink shows sensors operating properly you will see them discovered in the Asset Manager:

Asset Manager

Discovery

📶 Total Devices 5

📶 Discovered Devices 5

All Fields ▾

Panduit SynapSense® IOT-9CHT Onboarding



Class Panduit SynapSense® High Temperat...

Path /downstream/ss900/wireless_nodes/...

Discove... 03/05/2019 08:44 am

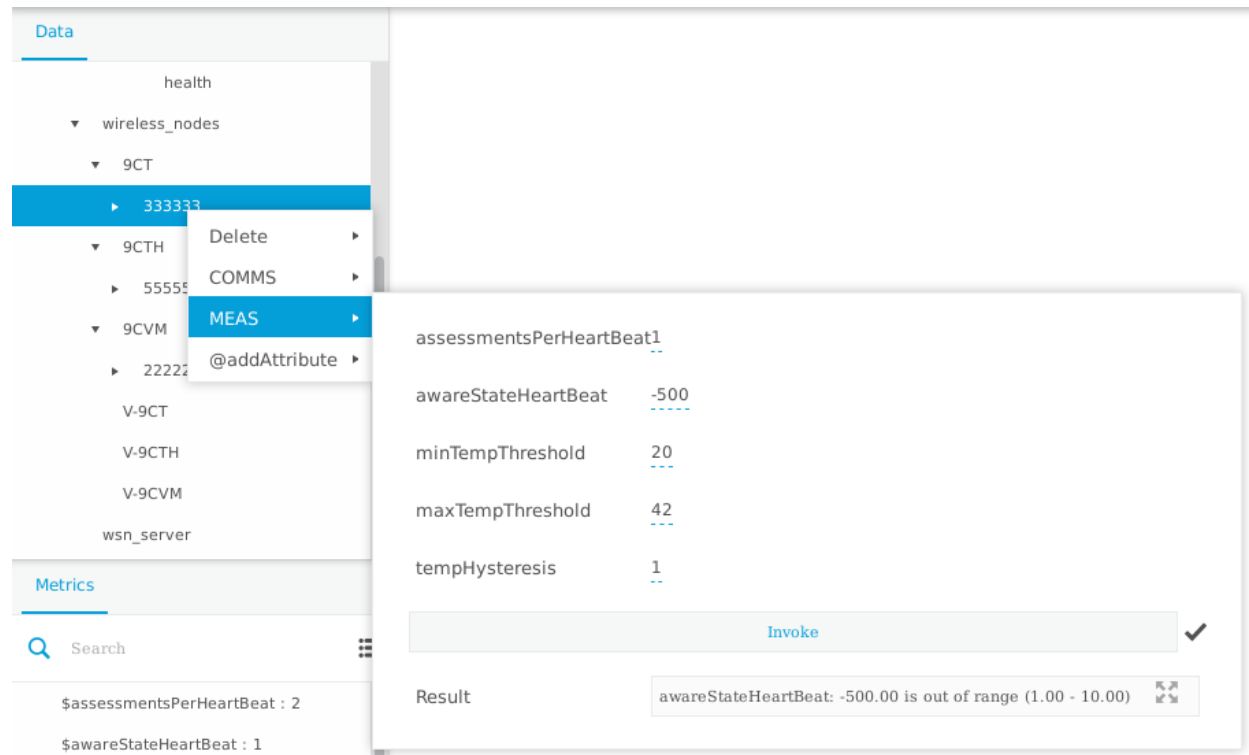
✓ Accept

⊘ Reject

Please refer to the Kinetic EFM 1.6 Asset Manager documentation for more information on using the Asset Manager.

16 DATA ENTRY VALIDATION

Every attempt was made to ensure only valid data can be entered. If invalid data is entered, an error will result, and the operation is terminated with no effect. For example:



16.1 VALID FIELD VALUES

There is no “secret decoder” ring for settings in 1.0.0. Given the large number of items which can be configured it is HIGHLY recommended to leave settings at their defaults. This will give best performance but may impact battery life.

16.2 TOOLTIPS

Every device configuration item has a tooltip (some may say “description available” however), for example:

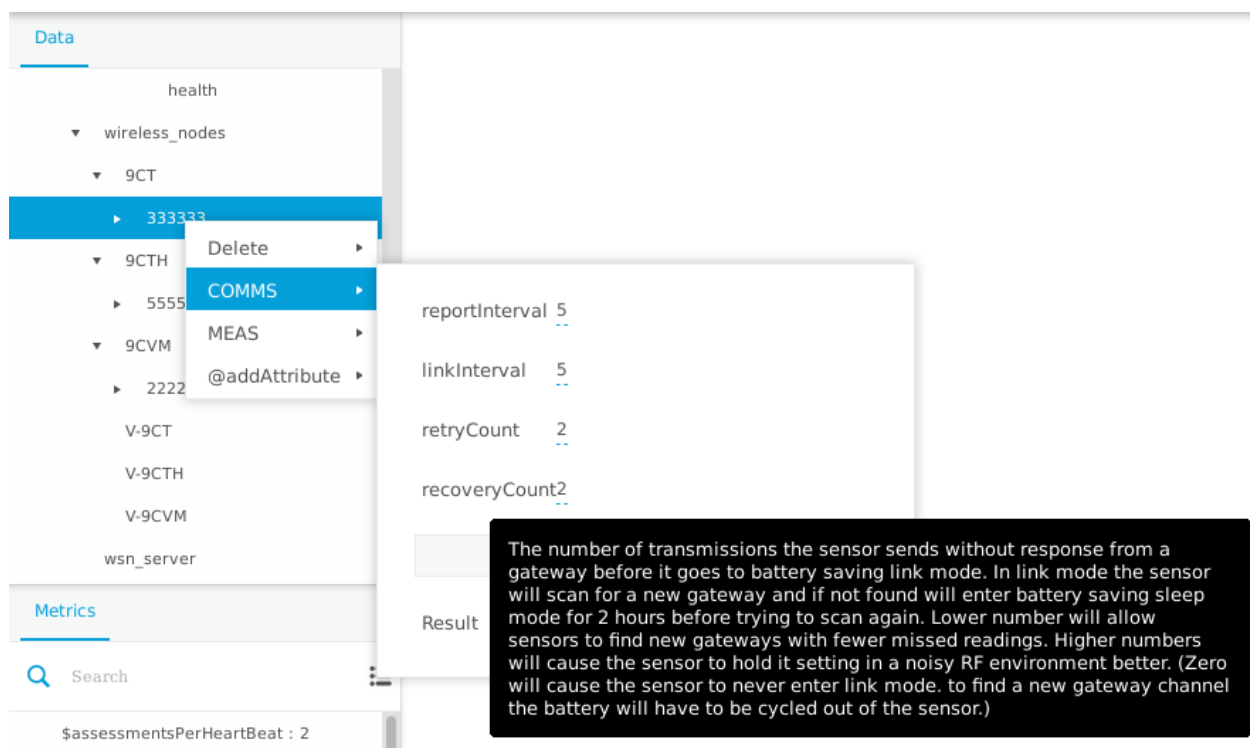


Figure 18 Tooltips

The field descriptions are quite technical. A guide for how to configure the system for complex behavior is not available with the Dslink itself at this time.

17 RECOVERY

17.1 DSLINK RESTARTS

The ss900 DsLink uses the “serialization” feature to store configuration in the “nodes.json” file. “Non-observable” data is restored on DsLink restarts. This file contains DsLink, gateway and sensor configuration.

17.2 “QUIT” ACTION

In the unlikely event the DsLink becomes unresponsive, it is possible to ask the DsLink to exit, allowing EFM to restart it. Note: early versions of EFM do not stop the “java” process when the DsLink is stopped, therefore the Quit ACTION can be used as a work around.

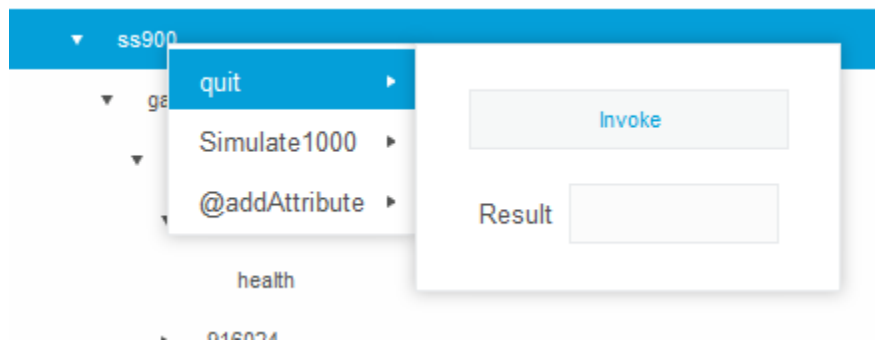


Figure 19 Quit / Simulate ACTIONS

18 TROUBLESHOOTING

18.1 CHANGES DID NOT TAKE EFFECT IMMEDIATELY

When changing gateway or sensor configuration, the new configuration will be applied at the next report interval. Please note that changed reporting intervals may take 1 or more report intervals to take effect after a sensor is power cycled or reconfigured.

18.2 DATAFLOW EDITOR ISSUES

The DsLink does attempt to populate the Change forms with last entered values. However, it is possible for the data in the form to be wrong. For instance,

- Change a parameter
- INVOKE
- re-open form – original values will be in the fields

As a work around, it is possible to see the values immediately change in the Metrics pane.

Another work around available is to select another tree node, re-select the ID of the node, right click to open the ACTION dialog to see the default value has been updated.

In the example below, linkInterval was set to 6, Invoke was clicked, Delete was highlighted, and then COMMS was highlighted, demonstrating that the form shows incorrect values, but Metrics is correct.

The screenshot displays the 'Dataflow Editor' interface for the 'Cisco Kinetic Edge & Fog Processing Module' (version 1.5.94). The interface is divided into three main sections: 'Data', 'Metrics', and 'Actions'.

- Data Section:** A tree view on the left shows a node '194071' expanded. A context menu is open over this node, with 'Delete' and 'COMMS' highlighted. The 'COMMS' menu item is further expanded, showing sub-items: 'Register', 'Unregister', 'MEAS', and '@addAttribute'.
- Form Section:** A central form displays configuration parameters for the selected node. The parameters and their values are:
 - reportInterval: (empty)
 - linkInterval: 5 (highlighted with a red arrow pointing left)
 - retryCount: 2
 - recoveryCount: 2
 - awareStateSampleRate1: (empty)
 Below the form is an 'Invoke' button and a 'Result' field.
- Metrics Section:** A list of metrics is shown on the bottom left. The metrics and their values are:
 - \$assessmentsPerHeartBeat: 2
 - \$autoRegister: true
 - \$awareStateHeartBeat: 1
 - \$awareStateSampleRate: 1
 - \$base: /upstream/cbroker/downstream/ss900-w
 - \$firmwareVersion: (empty)
 - \$is: node
 - \$linkInterval: 6 (highlighted with a red arrow pointing left)
 - \$maxTempThreshold: 42
 - \$minTempThreshold: 20
 - \$recoveryCount: 2

The red arrows highlight the discrepancy: the form shows 'linkInterval' as 5, while the metrics pane shows '\$linkInterval' as 6.

Figure 20: Dataflow editor issues

18.3 OBSERVING DSLINK ACTIVITY “UNDER THE HOOD”

18.3.1 Logs

It is possible to view the ss900 DSLink log file using “EFM System Administrator”.

18.3.2 \$status

The /ss900/\$status value is updated continuously as the DSLink processes events and data. This is a single line of status; however, it can be useful when trying to watch for gateways to connect, sensors being discovered or verifying data is being collected from the sensors. CISCO-193: due to an issue with EFM, the \$status value and other root (/ss900/) attributes are not visible in the EFM Dataflow Editor’s Metrics panel nor System Administrator’s Attributes viewer.

18.4 PORT/PROCESS CONFLICTS

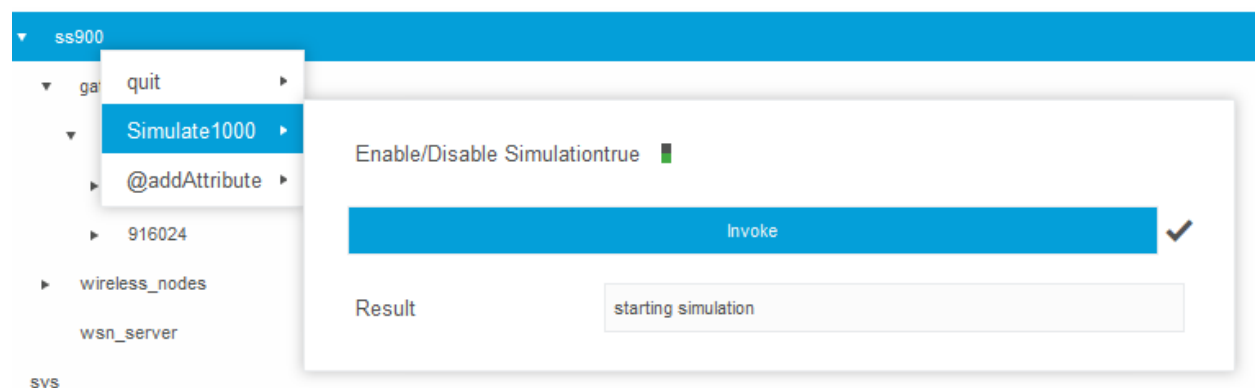
The DSLink has no way of protecting itself from other processes listening on its TCP port (i.e. port 3000). Even other errant ss900 DSLink “java” processes that may be running. In some cases when EFM may not kill the “java” process when the DSLink is stopped/uninstalled, it is possible a newly installed and started DSLink will not start properly because the old process is still running. Please “kill” the offending process. The same issue can occur if other DSLINKs or processes on the server are using TCP port 3000.

19 SIMULATION FEATURE

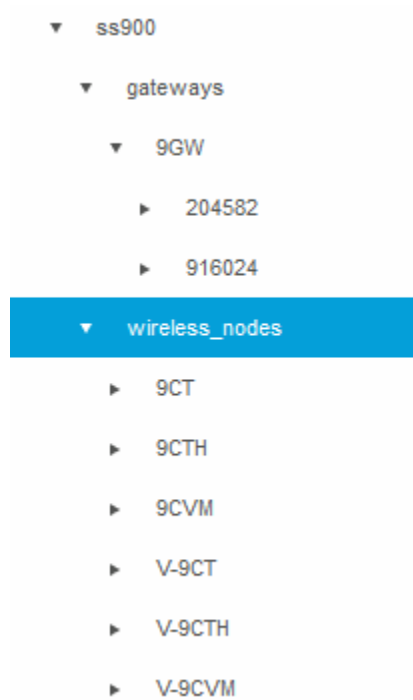
It is possible to simulate up to 1,000 wireless sensor nodes in 1.0.0. This is accomplished using the “Simulate1000” ACTION.

19.1 STARTING SIMULATION

Flip the Enable/Disable Simulation button to “true”, then Invoke.



This will create 1,000 “virtual” wireless_nodes:



The simulation is spread across all virtual sensors in this manner:

(250) V-9CT
(250) V-9CTH
(500) V-9CVM

19.1.1 Behavior across DsLink restart

The DsLink normally restores all configuration on restart. However, simulated node configuration data is not saved. Use the simulate1000 ACTION to restore the nodes after restarting the DsLink.

19.1.2 Simulation Details

A sine wave is generated within the typical range for each sensor's measurement data.

The sine wave range (max/min) for each sensor observable (measurement) is:

- Temperature: max = 40, min = 20.
- Humidity: max = 95, min = 5.
- Dewpoint: max = 40, min = 20.
- Vibration Axes Frequency: min = 0.0, max = 10.0.
- Vibration Axes Speed: min = 0.0, max = 10.0.
- Vibration Duty Cycle: max = 95, min = 5.

19.1.2.1 Distribution

1,000 simulated wireless sensor nodes are created in the DSLink tree. Virtual devices do not have an associated gateway.

Each wireless sensor node requires a unique ID number. The following ID number algorithm is used:

Virtual Model	Low ID	High ID
V-9CT	800000	800249
V-9CTH	800250	800499
V-9CVM	800500	800999

These numbers were chosen because sensors seem to always have 6-digit ID numbers and sensors in the 800000 range have never been seen in practice.

19.1.2.2 Data Generation

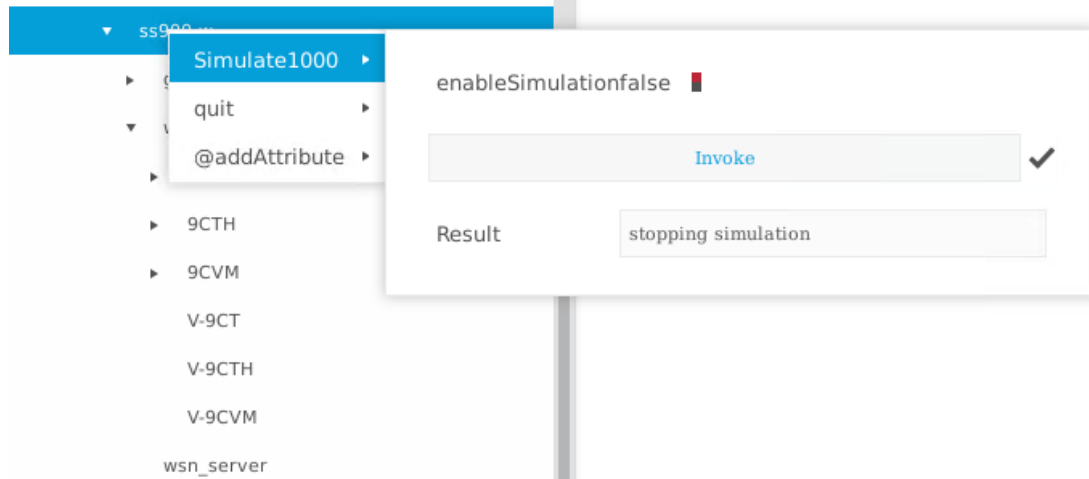
When Simulate1000 is enabled, a data generation function runs approximately once every 60 seconds to generate a new data point.

19.1.3 Standalone Data Generation

By default, sensor simulation generates sine wave data at a default period of 15 minutes for simulated sensors. The period of the sine wave may be changed by modifying the `ss900/wsn_server/$sinusFinishingTime`.

19.2 STOPPING SIMULATION

Flip the Enable/Disable Simulation button to “false”, then Invoke.



Notice, the triangles disappear from the virtual nodes. All virtual nodes are removed and data collection ceases.

20 SENSOR NETWORK MANAGEMENT

The DsLink supports up to 1000 sensors and 10 gateways.

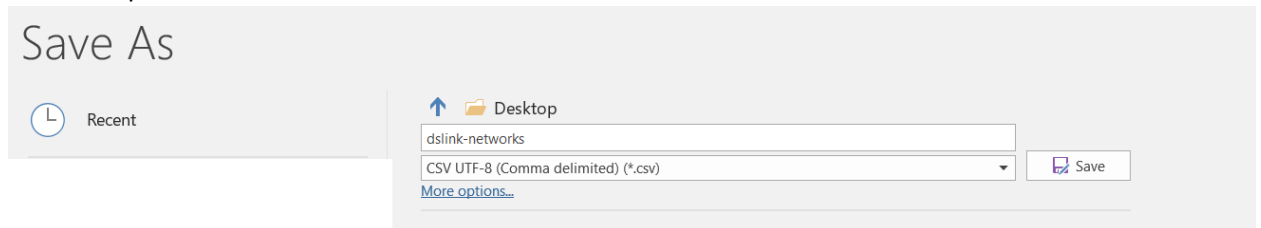
Bulk provisioning of sensors (using the default configuration values) can be performed by entering sensor ID's and their device type in the registeredNodes list of a gateway.

To manage the sensor network, you may use this recommended workflow:

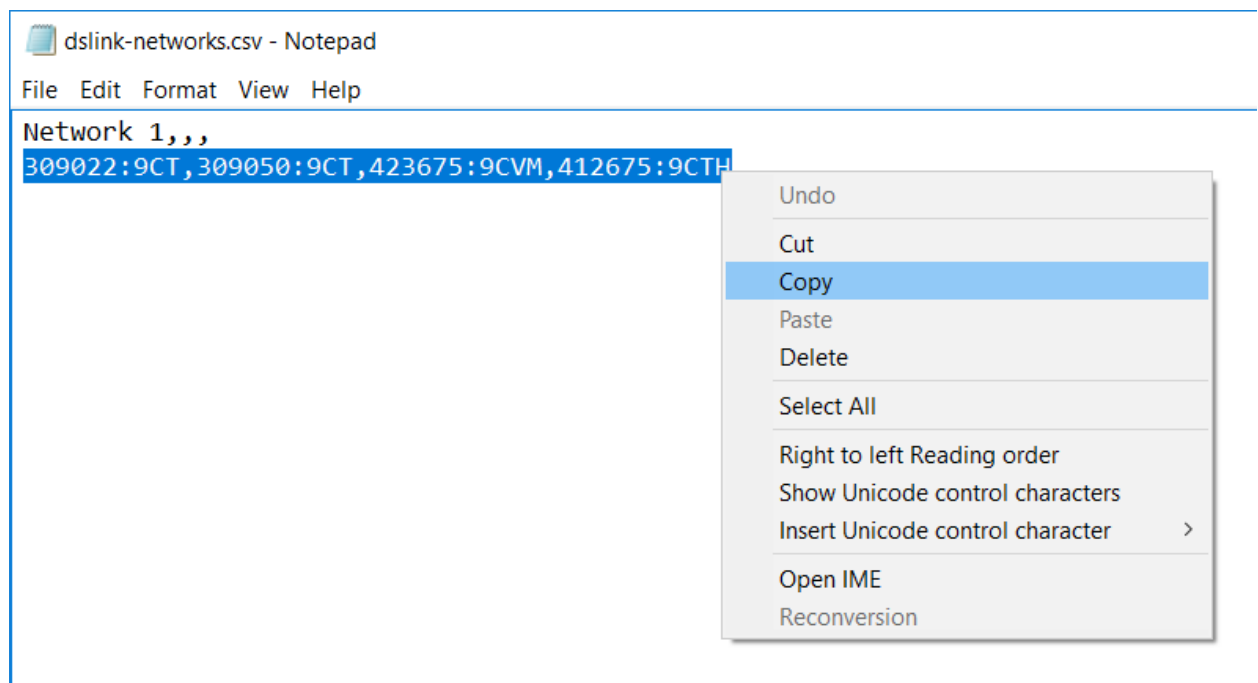
- Create an Excel spreadsheet.
- Each row represents a network.
- Add cells in the row for each sensor in the network (up to 100.)
- Cells are in the format SensorID:SensorType.
 - SensorID is an integer value printed on each sensor.
 - SensorType is portion of the model name that matches one of the nodes shown under the ss900/wireless_nodes/ tree, currently one of {9CT, 9CTH,9CVM} .

	A	B	C	D	E
1	Network 1				
2	309022:9CT	309050:9CT	423675:9CVM	412675:9CTH	
3					
4					
5					
6					
7					

- Repeat for up to 10 networks (rows) per DSLink instance.
- Save the spreadsheet as a CSV file.



- Open the CSV file in a text editor (notepad, etc.)
- Copy the comma separated list of sensors for the current network.



- Identify the gateway(s) the sensor network will be registered to.
- Open the EFM Dataflow.
- Right click on the 9GW and click Add.
- Paste the copied list of sensors into the registeredNodes box

ID	903491
reportInterval	1
pollInterval	0
networkListInterval	720
wirelessNodes	309022:9CT,309050:9CT,423675:9CVM,412675:9CTH
serverIP	192.168.100.2
serverPort	3000
ipAddress	192.168.100.1
netmask	255.255.255.0
defaultRouterIP	192.168.100.2
dnsIP	192.168.100.2
dns2IP	192.168.100.2
<input type="button" value="Invoke"/> ✓	
Result	OK

- Enter all remaining information into the Add dialog.
- Click “Invoke”.
- Sensors will automatically be added with default settings.
- If this is the first time the sensors are being deployed, to avoid a situation where the registeredNodes may enter Link Mode, the sensors must be powered off until this step of the process. Wait until GatewayID/health/\$reform_in_progress becomes false for each gateway before inserting the batteries into the sensors for that gateway. If sensors entered Link Mode, it may take several hours before the wireless node connects to a registered gateway.

21 FEATURE NOTES

Every effort has been made to ensure this product meets the specification set forth in the agreed upon Market Requirements Document for 1.0.0:

Panduit – Market Requirements Document (MRD)
SS900 Gen1 Low Level DSLink Feature List
V05-05-2018

This is a production release of the software that supports multiple gateways and wireless sensor nodes up to a limit of 10 radio gateways with 100 wireless sensor nodes per radio gateway for a total of 1,000 wireless sensor nodes.

Simulation of 1,000 wireless sensor nodes is also provided.

21.1 USAGE NOTES

Support for automatically adding a large numbers of sensors is accomplished by sensor auto registration when `ss900/wsn_server/autoRegister` is true (the default state). A gateway must be added before sensors can be auto registered. If a sensor is added before a gateway has been added the sensor and `ss900/wsn_server/autoRegister` is false, the sensor will need to be discovered or manually added to the gateway's COMMS/registeredNodes list.

It is not possible for the DSLink to discover and auto register gateways. To this end, the procedure to add a gateway using GPT and immediately add it to the DSLink must be followed.

21.2 LIMITATIONS

Not Possible to Ignore a Sensor

When `ss900/wsn_server/autoRegister` is true, deleting a sensor will result in the sensor being rediscovered the next time the sensor checks in or reports data. This cannot be disabled. It will be necessary to power off the sensor. Note that sensors must be “Discovered” in the Asset Manager for use with EFM enabled applications, so the sensor may be rejected by the enduser in the Asset Manager and thus ignored upstream. However, the DSLink tree will show the sensor regardless.

When `ss900/wsn_server/autoRegister` is false, deleting a sensor will result in the sensor being ignored. The sensor may still continue to attempt to report data through the gateway. The sensor must be power cycled to make it stop reporting through the gateway. To completely remove all traces of the sensor, the Reform operation on the gateway may be used to disassociate with the sensor.

Issues with ACTION Forms in EFM System Administrator

It is critical to use the EFM Dataflow Editor when performing ACTIONS on the DSLink as it is the only client certified at this time. Other clients (i.e. EFM System Administrator) will allow entering strings in number fields. There is no known solution for this. The DSLink does ATTEMPT to convert string on EVERY field to the correct data type.

EFM 1.6 Dataflow Editor is missing ACTION Forms

Occasionally, the Dataflow Editor may not show any Actions for any node.

Workaround: on the EFM server, execute “systemctl stop efm-server; systemctl start efm-server”.

Making multiple hardware state changes and/or software configuration changes too rapidly may not synchronize at the device properly

Changing sensor or gateway settings before the device applies the updates results in an interim config change taking effect, not the final config change.

Workaround: When all configuration changes have been completed, restart the DSLink. Wait for the gateways and sensors to check in. Wait at least two reportInterval/pollInterval time frames for the sensors and gateway to reconfigure to the latest settings. If any sensors have not checked in, they may need to be power cycled. Please avoid making configuration changes to each device more often than the two times the larger of reportInterval and pollInterval.

Unresponsive Gateway

It is possible the gateway will display an “amber” middle LED. This indicates the gateway has network connectivity but the DSLink is not responding. This can cause the gateway to get stuck for an indefinite period. This usually occurs because the socket between the gateway and the DSLink has not closed properly in the event the DSLink is restarted frequently. Restarting the DSLink is normally not necessary, so this is unusual. It may happen upon initial install however. If you can get into the EFM server (assuming a Linux host), you can verify the socket is in “TIME_WAIT” state using:

```
$ netstat -an | grep :3000
```

Power off the gateway, wait for the socket to closed (2 minutes), then power up the gateway. This should clear the condition.

21.3 RELEASE NOTES

A separate release notes document describes the release file, new features in this release, the changed content of this release, and known issues.