mPower™ Edge Intelligence

Conduit AEP Software Guide

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mPower Edge Intelligence Software Guide

Models: MTCDT, MTCDTIP, MTCAP

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Chapter 1 – Product Overview

About mPower Edge Intelligence

This guide reviews the mPower Edge Intelligence software for Conduit devices.

For hardware details, refer to the appropriate hardware guide. Use your device to provide secure data communication between many types of devices that use legacy and the latest communication technologies.

Some device models support (varies with model-refer to your specific hardware guide for details):

- Bluetooth communication to devices with this technology
- Wi-Fi communication to devices with this technology
- GPS capability
- Diversity

What's New

Manual version	Update description
5.3	Upgrades of Yocto, OpenSSL, and TLS (security improvements), Radio Firmware Upgrade (delta files), Device Firmware Upgrade (differential files), LoRaWAN (Basic Station, AS923 channel plan update), and Package Management
5.5	LoRaWAN changes: added LoRa Card Info and Default Device Profile to Key Management
6.0	Upgrade of Yocto, MQTT, IP Masquerading, 802.1X Authentication, RS-485 using MFSER card (Full & Half-duplex), Modbus update, Ping updates (adjust size), LoRaWAN (FUOTA max packet size)
6.3	Custom user roles, BACnet/Payload Management

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Chapter 2 – Using the Wizard to Configure Your Device

First-Time Setup

Setting Up Your Device using Setup Wizard (After Choosing Reset and Factory Default Settings)

Other than when you first power up the device, you must configure the device to factory default settings, reset it and then, access it through the default 192.168.2.1 IP address to see the first-time setup. To reset the device to factory default settings, go to **Administration > Save/Restore > Reset to Factory Default Configuration** and click the **Reset** button. This wizard helps you configure the main features of your device for initial setup.

Here are the steps for first-time setup:

1. Upon power up for the first time or after you set factory default settings, the device goes into commissioning mode. The system requires you to set up an admin user. Enter your desired username and click **OK**.
2. Enter a desired password for the admin user and click **OK**. This password must be of sufficient length and strength (with a mix of character classes such as letters, numbers, and symbols). Enter the password again to confirm. Click **OK**.
3. Log into your device using your new username and password.
4. On the first page, the system allows you set up the device as a **Network Router** device.
   a. The default mode establishes the device as a cellular **Network Router**.
   b. Click **Next**.

For Default Mode (set up as a Network Router):

1. Configure **Call Home**
   a. Check **Enabled.** (You must have an existing DeviceHQ™ account.)
   b. Click the **Call Home** button to activate Call Home (which enables the device to call home for configuration files, firmware updates, custom applications, and adds your DeviceHQ account key to the device). **NOTE:** Clicking the **Call Home** button, results in the device being reset to factory defaults.
   c. Click **Next.**
2. Set the date, time, and time zone.
   a. Enter the desired **Date**.
   b. Enter the desired **Time**.
   c. Select the **Time Zone** in which the device operates.
   d. Click **Next**.
3. Configure LAN network interfaces Eth0 and Br0. Enter the device address and network information for Network Router mode only. (**Note:** If you do not accept default settings, after applying changes to **Network Interface Configuration (br0** or **eth0)**, the device reboots.):

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a. In the **Network Interface Configuration – eth0** section, leave the **eth0** assigned to the bridge **br0**, or unassign **eth0** from bridge and enter network settings for the **eth0** interface - **IPv4 Address** and **Mask.**
b. In the **Network Interface Configuration – br0** section, enter network settings for the **br0** interface - **IPv4 Address** and **Mask**.

4. Configure your device's **Cellular** connection.
   a. To use Cellular, check **Enable**. When enabled, your device functions as a router.
   b. Check **Diversity** to enable the use of two cellular antennas for better performance. (For devices that use two antennas, Diversity is enabled by default. See *Installing the Router* in your User Guide for more details).
   c. To enable the dial-on-demand feature, check **Dial-on-Demand**. This indicates to the device to bring up the Cellular connection when there is outgoing IP traffic, and take down the Cellular connection after a given idle timeout. **Note:** This field is only available on specific models where the device defaults to Cellular instead of WWAN.
   d. Enter the **APN** (Access Point Name). The APN is assigned by your wireless service provider. (This field is not available on all models.)
   e. Click **Next**.
5. Set up **Cellular Authentication**:
   a. Select the authentication protocol **Type** used to negotiate with the remote peer: **PAP, CHAP, or PAP-CHAP**. The default value is **NONE**.
   b. Enter the **Username** with which the remote peer authenticates. Optional. Username is limited to 60 characters.
   c. Enter the **Password** with which the remote peer authenticates. Optional. Password is limited to 60 characters.
6. Set up **Remote Management:**
   a. Check **Enabled** to configure the device to check in at the next scheduled check-in time.
   b. Check **SSL Enabled** to activate SSL on the annex protocol.
   c. **Server Name** for DeviceHQ is provided.
   d. **Server Port** for DeviceHQ is provided.
   e. **App Store URL** for DeviceHQ is provided.
   f. Enter your **DeviceHQ Account Key**. (**NOTE:** You must already have a DeviceHQ account.)
   g. Click **Next.**
7. Configure **HTTP/HTTPS Access**.
   a. In the **HTTP Redirect to HTTPS** panel define how the device handles HTTP traffic. Check **Enabled** to enable HTTP and redirect to HTTPS.
   b. Configure HTTP **Port**. By default, 80.
   c. Check **Via LAN** (enabled by default) to allow traffic from local area network.
   d. Check **Via WAN** (disabled by default) to allow traffic from the wide area network.
   e. In the **HTTPS** panel, define how the device handles secure HTTP traffic.
   f. Check **Via WAN** to allow traffic from the wide area network. Note: HTTPS traffic via LAN is enabled by default and cannot be changed.

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g. Configure HTTPS **Port**. By default, 443.

8. Set up **Bootloader Protection** by setting a u-boot password.
   a. Enter a password and click **Enable**. The password will be set immediately.
   b. To change the password, enter a new password and click **Change Password**.
   c. To disable the password, click Disable.
9. Click **Finish**.
10. To save your changes, click **Save and Apply**.

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Chapter 3 – Home

Device Information

This page provides a high-level view of the device. It shows the configuration for one or more network interfaces including a cellular interface. Click **Home** to display the following information:

1. **Device**:
   - **Model Number**: The MultiConnect® Conduit model ID.
   - **Serial Number**: The MultiTech device ID.
   - **IMEI**: International Mobile Station Equipment Identity.
   - **Firmware**: mPower Edge Intelligence firmware version.
   - **Current Time**: Current date and time of the device. For information on setting the date and time, go to **Setup > Time Configuration**.
   - **Up Time**: Amount of time the device has been continuously operating.
   - **WAN Transport**: Current transport for IP traffic leaving the LAN. If two WAN interfaces are configured for use (Wi-Fi and cellular), the current WAN will be set based on the WAN configurations at ***Setup > WAN Configuration***.
   - **Current DNS**: the actual DNS IP addresses that are used by the current WAN.
   - **GeoPosition**: the GPS coordinates of the device (provided a GPS satellite fix is acquired).
2. **LAN (**LAN network interfaces, **br0, eth0, eth1, eth2,** and **wlan1**):
   - **Bridge** (**br0**)

     MAC Address: Media Access Control Address used to uniquely identify the devices LAN Ethernet interface.

     IPv4 Address: IP address of this device. To configure the IP address, go to **Setup > Network Interfaces Configuration**.

     Mask: Network mask of the bridge (**br0**). To configure the network mask, go to **Setup > Network Interfaces Configuration**.

     DHCP State: Current state of the DHCP server configured for the bridge (br0). To configure, go to **Setup > DHCP Configuration**.

     Interfaces: lists all the interfaces added to the bridge **(br0).**

   - **Ethernet (eth0, eth1, and eth2)**

     Bridge: specifies if the network interface is added into the bridge (**br0**).

     MAC Address: Media Access Control Address used to uniquely identify the devices LAN Ethernet interface.

     IPv4 Address: LAN IP address of the **Ethernet** interface. To configure the IP address, go **Setup > Network Interfaces Configuration**.

     Mask: Network mask of the **Ethernet** interface. To configure the network mask, go to **Setup > Network Interfaces Configuration.**

     DHCP State: Current state of the DHCP server configured for the bridge (**br0**). To configure, go to **Setup > DHCP Configuration**.

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Lease Range: Current DHCP lease range of the **Ethernet** interface. To configure, go to **Setup > DHCP Configuration**.

DHCP State: Current state of this device's DHCP server. To configure go to **Setup > DHCP Configuration**.

Lease Range: Current DHCP lease range of this device's DHCP server. To configure go to **Setup > DHCP Configuration**.

- **Wi-Fi Access Point (wlan1)**:

  State: Current state of the Access Point. To configure go to **Wireless > Wi-Fi Access Point**.

  Bridge: specifies if the network interface is added into the bridge (**br0**).

  MAC Address: Media Access Control Address used to uniquely identify the devices LAN Ethernet interface.

  IPv4 Address: LAN IP address of the wlan1 interface. To configure the IP address, go **Setup > Network Interfaces Configuration**.

  Mask: Network mask of the Access Point (wlan1). To configure the network mask, go to **Setup > Network Interfaces Configuration**.

  DHCP State: Current state of the DHCP server configured for the wlan1 network interface. To configure, go to **Setup > DHCP Configuration**.

  SSID: the Service Set Identifier (SSID) for this device's Wi-Fi Access Point. For configuration go to **Wireless > Wi-Fi Access Point**.

  Security: the current security protocol of this device's Wi-Fi Access Point. To configure go to **Wireless > Wi-Fi Access Point**.

3. **Bluetooth Classic**
   - **State**: Current state of the Bluetooth link. To configure go to **Wireless > Bluetooth-IP**.
   - **MAC Address**: Media Access Control Address used to uniquely identify the Bluetooth interface.
   - **Device Name**: Name of Bluetooth device configured to link to. For configuration go to **Wireless > Bluetooth-IP.**
   - **Device MAC**: Media Access Control Address of the Bluetooth device configured to link to. To configure go to **Wireless > Bluetooth-IP**.
4. **WAN** (WAN network interfaces, **ppp0**, **wlan0, eth0, eth1,** and **eth2**):
   - **Cellular (ppp0) :**

     State: Current state of the cellular link.

     Connection Mode: PPP or **WWAN** (only visible on LTE devices)

     Cellular Service: LTE, 3G, and **2G**.

     Cellular IP Mode: Auto or **Auto - Addresses Only**.

     Protocol Support: Choose from **IPv4** or **IPv6**. If you choose **IPv6**, also enter the **Connect Timeout**.

     Signal: Current signal strength of the cellular link. Mouse hover provides dBm value.

     Ec/Io: Signal to Noise Ratio (used to calculate RSSI in 3G devices).

     RSCP: Received Signal Code Power (used to calculate RSSI in 3G devices)

     RSRP: Reference Signal Received Power (used to calculate RSSI in LTE devices)

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RSRQ: Reference Signal Received Quality (used to calculate RSSI in LTE devices)

Connected: Total time connected for the current session.

IPv4 Address: Current cellular WAN IP address issued to this device by the cellular carrier.

DNS: DNS IP addresses retrieved from the cellular network or configured by user in the Setup > Network Interfaces Configuration.

Roaming: Indicates whether or not this device's cellular link is currently connected to its home network.

Phone number: Device's cellular phone number also known as Mobile Directory Number (MDN). This field is blank if the MDN is not stored in the SIM card.

Tower: Tower ID of the cellular tower currently providing cellular service to this device.

- **Ethernet (eth0, eth1, and eth2):**

  Mode: Static, DHCP Client or DHCP Client – Addresses Only

  MAC Address: Media Access Control Address used to uniquely identify the devices LAN Ethernet interface.

  IPv4 Address: IP address of the Ethernet interface. To configure the IP address, go to **Setup > Network Interfaces Configuration**.

  Mask: Network mask of the network to which the device is currently connected.

  Gateway: Gateway IP address of the network to which the device is currently connected.

  DNS: DNS IP addresses retrieved from the cellular network or configured by user in the Setup > Network Interfaces Configuration.

- **Wi-Fi (wlan0)**:

  State: Current state of the Wi-Fi

  Mode: DHCP Client or DHCP Client – Addresses Only

  MAC Address: Media Access Control Address used to uniquely identify the Wi-Fi interface.

  IPv4 Address: The IP address that is obtained from the Wi-Fi network to which the device is currently connected.

  Mask: Network mask of the Wi-Fi network to which the device is currently connected.

  Gateway: Gateway IP address that is retrieved from the Wi-Fi network to which the device is currently connected.

  DNS: DNS IP addresses retrieved from the cellular network or configured by user in the **Setup > Network Interfaces Configuration**.

  SSID: the Service Set Identifier (SSID) of the Wi-Fi Access Point to which the device is currently connected.

5. **Accessory Cards** (if installed)
   - **Card1 (AP1)**

     Model Number: Model number of accessory card 1.

     Serial Number: Serial number of accessory card 1.

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Hardware: Hardware version of accessory card 1.

- **Card2 (AP2)**

  Model Number: Model number of accessory card 2.

  Serial Number: Serial number of accessory card 2.

  Hardware: Hardware version of accessory card 2.

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Chapter 4 – LoRaWAN

LoRaWAN Network Settings

The LoRaWAN Network Settings screen contains settings for the LoRaWAN network server, Lens Server and LoRa packet forwarder. A grouping of a gateway (like your device) and end-devices (sensors) can be connected to create an application network. Through the cloud-based Lens interface, you can manage your LoRa application networks including gateway and end-devices. When the LoRa Network Server is enabled, the gateway device acts as a network server allowing end-points to join with the correct credentials on the correct frequency and sub-band. LoRa can be configured for the 915 frequency band (AS, AU, KR, IL, and US), the 868 frequency band (EU, IN, and RU), or the global 2400 frequency band (ISM). For the US, the 915 band allows 8 sub-bands. For the EU, the 868 band has three default channels and five configurable channels. For specific industrial, scientific, and medical applications globally, the ISM 2400 band has three default channels.

The TX (transmit power) setting is used to control the transmission power of the gateway. The Rx 1 DR Offset and RX 2 Datarate are sent with a join response to configure the data rates used for receive windows. The offset is applied to the downlink data rate for reception on the first window according to LoRa WAN standards.

If LoRa two cards are installed, the system displays information for both cards: FPGA Version and Frequency Band using (ap1) and (ap2) labels.

- The system chooses the card to activate based on the selected channel plan.
- This allows 868 and 915 cards to be installed. Only one card is be active at any time.
- Two v1.5 915 or 868 cards can be used as long as they are the same frequency band.

You may also click Manual Configuration to the far right of LoRa Packet Forwarder Configuration, to manually configure your Packet Forwarder. For a Dual Packet Forwarder, you can also configure both cards manually provided you have two LoRa cards installed. This allows different channel plans or network servers to be configured for each forwarder. See examples link near each Config Card.

After you change any of these settings, click **Submit**. Then, click **Save and Apply** to save your changes.

LoRa Mode

The LoRa Configuration pane contains the configuration values for the LoRa network server that acts as a gateway for the LoRa endpoint devices.

Item	Default Value	Description
Mode	Network Server	Choose from Network Server, LoRa Packet Forwarder, Basic Station, or Disabled.
Packet Forwarder	Depends on latest software version	Packet Forwarder software version
Packet Forwarder Status	If configured properly, RUNNING	Packet Forwarder status. Values include RUNNING, RESTARTED, or DISABLED.
Network Server	Depends on latest software version	Network Server software version
Network Server Status	If configured properly, RUNNING	Network Server status. Values include RUNNING, RESTARTED, or DISABLED.

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Lens Server	Depends on latest software version	Lens Server software version
Lens Server Status	If configured properly, RUNNING	Lens Server status. Values include RUNNING, RESTARTED, or DISABLED.
Basic Station	Depends on latest software version	Basic Station software version (For LoRa cards - 868 and 915 only)
Basic Station Status	If configured properly, RUNNING	Basic Station status. Values include RUNNING, RESTARTED, or DISABLED.
FPGA version	Depends on latest software version	Shows the FPGA firmware version for the installed LoRa cards.
Frequency Band (MHz)	N/A	Frequency band used which is determined by the type of LoRa card installed. Values are 868 or 915 MHz.

LoRa Card Information

Item	Default Value	Description
Gateway EUI	N/A	Gateway ID of Conduit, queried from the LoRa card (if present).
Frequency Band	Depends on LoRa card	Frequency band set based on the installed LoRa peripheral.
FPGA Version	Depends on LoRa card	FPGA firmware version of the installed LoRa card.
Upgrade FPGA	N/A	Click on link to upgrade FPGA firmware on the LoRa card, if a later version is available.
Current Version	Depends on LoRa Card	Current FPGA firmware version of the installed LoRa card.
Upgrade Version	Depends on LoRa Card	Upgrade version of FPGA firmware if available. If this field displays an upgrade version, click Start to upgrade the firmware. If this field displays No Options Available, then you already have the latest version and you can click Cancel.

LoRaWAN Network Server Configuration

The LoRaWAN Server Configuration pane contains the configuration values for the LoRa network server that acts as a gateway for the LoRa endpoint devices.

Item	Default Value	Description
Channel Plan		

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Channel Plan	US915: 915, AU915: 915, AS923-1: 915, AS923-2: 915, AS923-3: 915, AS923-4: 915, KR920: 915, EU868: 868, IN865: 868, RU864: 868, ISM2400: 2400	LoRaWAN channel plan used for the upstream and downlink frequencies and datarates. Values are US915, EU868, IN865, AU915, AS923-1, AS923-2, AS923-3, AS923-4, KR920, RU864, or ISM2400. Available channel plans depend on the type of LoRa card installed. For more details on each Channel Plan, refer to the RP2-1.0.3 LoRaWAN® Regional Parameters document on the LoRa Alliance website, https://lora-alliance.org/.
Additional Channels	Depends on channel plan selected	A set of channels are configured based on this setting (MHz). Frequencies supported depends on channel plan selected. v2.1 Geolocation GW - default channels must be included in the configured range. The RU864 plan uses the following channels when configured with the default settings of 0: Radio 0: 868.9 MHz, 869.1 MHz Radio 1: 864.1 MHz, 864.3 MHz, 864.5 MHz, 864.7 MHz, 864.9 MHz.
Additional Channels 2	Depends on channel plan selected	A set of channels are configured based on this setting (MHz). Frequencies supported depends on channel plan selected. v2.1 Geolocation GW - Configurable for the range within the entire band.The RU864 plan will use the following channels when configured with the default settings of 0: Radio 0: 868.9 MHz, 869.1 MHz Radio 1: 864.1 MHz, 864.3 MHz, 864.5 MHz, 864.7 MHz, 864.9 MHz.

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Channel Mask	N/A	Mask of available channels. Leave empty to enable only selected sub-band or set as desired. Click the Edit button to select your desired channel mask(s) by checking the box under the available list of channels. Override channel mask to include coverage provided by additional gateways. US/AU 64-channel: 00FFFFFFFFFFFFFFFFF and EU/AS/IN/KR: 00FF. Combine the following FSB masks to support more than 8 channels. Settings will be sent to end-devices on first downlink after OTA join:

		`FSB0:`
		`00FFFFFFFFFFFFFFFFFF`
		`FSB1:`
		`000100000000000000FF`
		`FSB2:`
		`0002000000000000FF00`
		`FSB3:`
		`00040000000000FF0000`
		`...`
		`FSB8:`
		`0080FF00000000000000`
		`FSB1 + FSB8:`
		`0081FF000000000000FF`

Frequency Sub-Band	1	For US and AU only, 8 sub-bands are available.
Frequency Sub-Band 2	1	For US and AU only, 8 sub-bands are available (for extra LoRa Card).
Enable Diversity	Unchecked	Enable use of two LoRa cards.
Enable LBT	Unchecked	Enable Listen Before Talk. Note: Requires FPGA v33 or v61.
Max EIRP	20	Maximum uplink transmit power of end-devices (in dBm)
Dwelltime Up	0 (no limit)	Maximum uplink dwell-time for region (ms). 0 : no limit and 1 : 400 ms (depends on region).
Dwelltime Down	0 (no limit)	Maximum downlink dwell-time for region (ms). 0 : no limit and 1 : 400 ms (depends on region).
Network		

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Network Mode	Public LoRaWAN	Set Network Mode: Private MTS (sync word: 0x12 and US/AU) Downlinks per FrequencySubBand) Public LoRaWAN (sync word: 0x34) Private LoRaWAN (sync word: 0x12)
Join Delay (Private mode)	1 (5 if user input value is outside of range.)	Number of seconds before receive windows are opened for join. Must match Dot settings. Range: 1-15
Join Delay (Public mode)	5 (Also if user input value is outside of range.)	Number of seconds before receive windows are opened for join. Must match Dot settings. Range: 1-15
Lease Time (dd-hh-mm)	00-00-00	Amount of time until a successful join expires.
Address Range Start	00:00:00:01	Start address to assign to OTA joining motes.
Rx1 Delay	1	Number of seconds before receive windows are opened. Must match Dot settings. Range: 1-15
NetID	000000	LoRaWAN NetID setting for assigning network address and beacons.
Queue Size	16	Number of downlink messages to hold per node.
Address Range End	FF:FF:FF:FE	End address to assign to OTA joining motes.
Duty Cycle Period	60	Number of minutes in sliding windows for duty cycle restrictions (for EU only)
Datarate (hidden by default, click Show to see settings)		
Rx 1 DR Offset	0	Offset applied to upstream data rate for downstream data rate on first receive window. US: 0-4, EU/RU: 0-5, AS/IN: 0-7, AU: 0-7, KR: 0-5.
Rx 2 Datarate	10 (For US/AU), 2 (For all others)	Datarate for second receive window. US: 8-13, EU/IN/AS: 0-7, AU: 8-13, KR: 0-5.
Max Datarate	0	Maximum datarate to use for ADR. US: 0-4, EU/AS/RU: 0-7, AU: 0-6, KR: 0-5, IN: 1-5,7.

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Min Datarate	0	Minimum datarate to use for ADR. US: 0-4, EU/AS/RU: 0-7, AU: 0-6, KR: 0-5, IN: 1-5,7.
ADR Step (cB)	30	Step between each datarate setting for ADR (minimum: 25).
Max FUOTA Packet Size	N/A	Maximum packet size used for FUOTA downloads.
Duty Cycle (hidden by default, click Show to see settings)		
Enable Duty-Cycle Limit	Disabled	Allows the gateway to configure and enforce duty-cycle window limits on transmissions.
Duty-Cycle Period	60	Number of minutes in sliding windows for duty cycle restrictions (for EU only).
Duty-Cycle Ratio	N/A	Amount of time on-air allowed per window.
Class B Settings (hidden by default, click Show to see settings)		
Enable Beaconing	Checked	Enable beacon broadcasting.
Beacon Frequency	0	Beacon frequency (MHz).
Beacon Power	27	Beacon power (dBm). Select from drop-down: 0, 3, 6, 10, 11, 12, 13, 14, 16, 20, 23, 24, 25, 26, or 27.
Disable Ping Slot Frequency Hopping	Unchecked	Disable frequency hopping on beacons (only available in regions that support frequency hopping).
Ping Slot Frequency	0: uses the Channel Plan default	Frequency to use on ping slots (MHz).
Ping Slot Datarate	DEFAULT	Datarate to use on ping slots. US: 8-13, EU/IN/AS: 0-7, AU: 8-13, KR: 0-5. When using DEFAULT, the datarate matches the Rx2 Datarate setting and the ranges match the Rx2 Datarate ranges.
Info Descriptor	0	Info Descriptor of beacon. Select from drop-down: 0, 1, or 2.
Beacon Latitude	0	GPS latitude of antenna specified by Info Descriptor (degrees).
Beacon Longitude	0	GPS longitude of antenna specified by Info Descriptor (degrees).
Database (hidden by default, click Show to see settings)		

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Database Path	var/config/lora/lora-network-server.db	Path to backup database in non-volatile memory
Reduce Uplink Writes	Disabled (unchecked)	Write uplink data to database every 100 packets or 5 minutes to increase uplink throughput
Backup Interval	3600	Interval in seconds to backup the database to flash
Skip Field Check	Disabled (unchecked)	Skip checking JSON fields of UDP packets from packet forwarder, may increase uplink throughput
Trim Interval	600	Interval in seconds to run the trim packet data tables command
Trim Size	100	Maximum size of packet tables to keep in database
Fine TimeStamp (hidden by default, click Show to see settings)		
AES Key	Unique to each gateway	The AES-128 key used to decrypt fine timestamps (string, hex).
FTS Version	1	The default version of the encrypted/main fine timestamp (for FPGA >= v59). Select from drop-down: 0 or 1.
DSPs	1	Number of DSPs (Digital Signal Process) on the board to be booted.
DSP Stat Interval	10	DSP's reporting interval (seconds).
FSK SYNC	N/A	An hexadecimal string, 2 to 16 digits long, setting the "sync word" for FSK transmissions in TX and RX (most significant bit first).
Room Temperature	22	Reference room temperature Tref used for calibration (°C)
AD9361 Code	77	Temperature code returned by AD9361 radio when room temperature is Tref [0..255]
Match CRC Error	Unchecked	Enable/disable fine timestamp matching for packets with CRC error.
GPS Receiver	Checked	Whether or not to use the GPS receiver in conjunction with the packet forwarder.

Network Server Logging (hidden by default, click Show to see settings)

The logging pane specifies what format, the location and what level of server logs to save for the LoRa Server Network.

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Item	Default Value	Description
Log Destination	Syslog	Select the type logging destination, either Syslog or File (use only for debug purposes to avoid filling up device RAM).
Path	blank	Specify the log file location.
Log Level	INFO	Select the log level of the messages to be logged. Choose from drop-down: Info, Error, Warning, Debug, Trace, and Maximum. Maximum will provide all messages.

Network Server Testing (hidden by default, click Show to see settings)

The testing pane provides testing and debugging functions for the LoRa server.

Item	Default Value	Description
Disable Join Rx1	Disabled	Disable sending join accept message in Rx1.
Disable Join Rx2	Disabled	Disable sending join accept message in Rx2.
Disable Rx1	Disabled	Disable sending downlink messages in Rx1.
Disable Rx2	Disabled	Disable sending downlink messages in Rx2.
Disable Duty Cycle	Disabled	Disable duty cycle restrictions (**this is for testing purposes only -** do not use for deployments).

Server Ports (hidden by default, click Show to see settings)

To configure the server ports, enter the following:

Item	Default Value	Description
Local Only	Enabled (checked)	Configure local ports only
Upstream Port	1780	Upstream port
Downstream Port	1782	Downstream port
App Port Up	1784	Application port up
App Port Down	1786	Application port down

Payload Broker

To configure the payload broker, enter the following:

Item	Default Value	Description

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Enabled	Enabled (checked)	Enable MQTT protocol
Hostname	127.0.0.1	Hostname of payload broker
Port	1883	Port used by MQTT
Username	N/A	Username
Password	N/A	Password

Default App (hidden by default, click Show to see settings)

A default application is provided to communicate LoRaWAN network messages to remote servers. HTTP and MQTT protocols are supported. For information about the defined API and an example service, see here: https://github.com/MultiTechSystems/lorawan-app-connect

To configure the default app, enter the following:

Item	Default Value	Description
Enabled	Disabled (Unchecked)	Enable/disable default application.
Check Hostname	Disabled (Unchecked)	Enable/disable hostname check of app.
Client ID	N/A	The server client ID for MQTT(s) or HTTP(s) services. If you leave it blank, the system generates one for you.
Server URL	N/A	Server URL for MQTT(s) and HTTP(s) services.
App EUI	N/A	EUI of the default application.
Server Cert	N/A	The certificate to authenticate the server.
Client Cert	N/A	The certificate used to authenticate the client.
Client Key	N/A	The key used to authenticate the client.
Username	N/A	Authentication username for MQTT.
Password	N/A	Authentication password for MQTT.

LoRa Packet Forwarder Configuration

The LoRaWAN Packet Forwarder pane contains the configuration values for the Packet Forwarder mode.

Item	Default Value	Description
Network Settings		

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Network	Manual	Select the network for Packet Forwarder mode including Manual (user determined), Radio Bridge Chirpstack, The Things Network, Senet, and Loriot. **Note:** For Manual configuration, if you don't add manual SR paths, the system automatically finds/specifies them for you.
Channel Plan	US915: 915AU915: 915, AS923-1: 915, AS923-2: 915, AS923-3: 915, AS923-4: 915, KR920: 915, EU868: 868, IN865: 868, RU864: 868, ISM2400: 2400	LoRaWAN channel plan used for the upstream and downlink frequencies and datarates. Values are US915, EU868, IN865, AU915, AS923-1, AS923-2, AS923-3, AS923-4, KR920, RU864, or ISM2400. Available channel plans depend on the type of LoRa card installed. For more details on each Channel Plan, refer the RP2-1.0.3 LoRaWAN® Regional Parameters document on the LoRa Alliance website, https://lora-alliance.org/.
Enable Diversity	Unchecked	Enable use of two LoRa cards.
Additional Channels	Depends on channel plan selected	A set of channels are configured based on this setting (MHz). Frequencies supported depends on channel plan selected. v2.1 Geolocation GW - default channels must be included in the configured range. The RU864 plan uses the following channels when configured with the default settings of 0: Radio 0: 868.9 MHz, 869.1 MHz Radio 1: 864.1 MHz, 864.3 MHz, 864.5 MHz, 864.7 MHz, 864.9 MHz

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Additional Channels 2	Depends on channel plan selected	A set of channels are configured based on this setting (MHz). Frequencies supported depends on channel plan selected. v2.1 Geolocation GW - Configurable for the range within the entire band.The RU864 plan will use the following channels when configured with the default settings of 0: Radio 0: 868.9 MHz, 869.1 MHz Radio 1: 864.1 MHz, 864.3 MHz, 864.5 MHz, 864.7 MHz, 864.9 MHz.
Server Settings		
Server address	N/A	Server IP address to forward received uplink packets and transmit received downlink packets. The system provides the default address for The Things Network (based on your channel plan) and Semtech Demo. Refer to the router addresses table of The Things Network for the list of specific addresses based on channel plan: https://www.thethingsnetwork.org/docs/gateways/packet-forwarder/semtech-udp.html If you choose The Things Network with the AS923 channel plan, there are four different addresses available. **NOTE:**No server addresses are available for The Things Network when using IN865 or RU864 channel plans.
Upstream Port	N/A	IP Port to send received uplinks to. The system provides default ports for The Things Network and Semtech Demo.
Downstream Port	N/A	IP Port to connect to network server for downlink packets. The system provides default ports for The Things Network and Semtech Demo.
Forward CRC		

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Forward CRC Disabled	Unchecked	Enable (check) to send packets received with CRC disabled to the network server.
Forward CRC Error	Checked	Enable (check) to send packets received with CRC errors to the network server.
Forward CRC Valid	Checked	Enable (check) to send packets received with CRC valid to the network server.
SX1301		
Antenna Gain	3	Gain of configured antenna (-128 to 128 dBi).
Max TX Power EIRP	N/A	Transmit power limit with antenna gain (dBm).
Frequency Sub-Band	1	Assign subset of 8 sub-bands from Channel Plan. Select from drop-down 1-8. (For US and AU only, 8 sub-bands are available.)
Duty Cycle		
Enable Duty-Cycle Limit	Disabled	Allows the gateway to configure and enforce duty-cycle window limits on transmissions.
Duty-Cycle Period	60	Number of minutes in sliding windows for duty cycle restrictions (for EU only).
Duty-Cycle Ratio	N/A	Amount of time on-air allowed per window.
Listen-Before-Talk (LBT) - Available for AS923 and KR920 only		
Enabled LBT	Unchecked (disabled)	Enable (check) LBT (Listen-Before-Talk) when supported by hardware. Note: Requires FPGA v33 or v61.
LBT RSSI Offset	-128 dB	Adjustment value for RSSI during LBT.
LBT RSSI Target	-65 dBm	Target RSSI level for LBT, if RSSI level is above the target, then transmit is not possible.
Scan Time	128 **µs**	Amount of clear time below threshold needed to allow transmission. Select from 128 or 5000 microseconds (**µs**).
Add LBT channels	Check	Set the LBT channels automatically.
Basics		

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Public	Unchecked (disabled)	Enable public mode: sync word 0×34, Disable for private mode: sync word 0×12.
Gateway ID Source	Manual	Either specified in configuration (Manual) or queried from device (Hardware).
Gateway ID	N/A	Installed LoRa card EUI (Extended Unique Identifier).
Gateway ID 2	N/A	Second Installed LoRa card EUI (Extended Unique Identifier).
Packet Forwarder Path	opt/lora/lora_pkt_fwd	Path to packet forwarder binary file to execute.
Intervals		
Keep Alive Interval	10 seconds	Interval to send a ping to the network server.
Stat Interval	20 seconds	Interval to update the network server with gateway statistics.
Push Timeout	100 ms	Timeout default.
Autoquit Threshold	60	Number of messages sent without acknowledgment from the network server
Beacon Configuration		
Enable Beaconing	Checked	Enable beacon broadcasting.
Disabled Beacon Frequency Hopping	Unchecked	Disable frequency hopping on beacons (only available in regions that support frequency hopping.
Beacon Frequency	0: uses the Channel Plan default	Beacon frequency (MHz).
Beacon Power	27	Beacon power (dBm). Select from drop-down: 0, 3, 6, 10, 11, 12, 13, 14, 16, 20, 23, 24, 25, 26, or 27.
Info Descriptor	0	Info Descriptor of beacon. Select from drop-down: 0, 1, or 2.
Beacon Latitude	0	GPS latitude of antenna specified by Info Descriptor (degrees).
Beacon Longitude	0	GPS longitude of antenna specified by Info Descriptor (degrees).

Basic Station Configuration

To configure Basic Station, use the following settings:

Item	Default Value	Description

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Station Card 1		
Credentials	LNS	Choose connection method to reach network server. Select from LNS or CUPS.
URI	N/A	URI to connect to CUPS or LNS server.
Station Configuration	Example	Station configuration for the gateway. See included example file.
Server Cert	N/A	Server certificate used to authenticate CUPS or LNS server.
Gateway Cert	N/A	Client certificate used by server to authenticate gateway.
Gateway Key	N/A	Client key used by server to authenticate gateway.

Key Management

For Local Network Settings, after you change these fields, click **Submit**. Then, click **Save and Apply** to save your changes.

Join Server

Choose the location of your join server.

Item	Default Value	Description
Location	Cloud Key Store	Choose Remote or local Join Server to handle OTA join requests. Select from drop-down either **Cloud Key Store** or **Local Keys**.

Add End Device Credentials

In order to use this section, you must choose **Local Keys** under **Join Server** and click on **Add New** to add new end-device credentials.

Item	Default Value	Description
Dev EUI	N/A	Enter Device EUI.
App EUI	N/A	Enter App EUI.
App Key	N/A	Enter App Key.
Class	A	Select Device Class from A, B, or C.
Device Profile	N/A	Select Device Profile from drop-down.

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Network Profile	N/A	Select Network Profile from drop-down.

Once you enter the above values, click **Finish**. Your saved end-device information displays under the **Local End-Device Credentials**. To delete all credentials, click **Delete All**. To add new credentials, click **Add New**. And to upload credentials, click **Upload**. After clicking **Upload**, browse and select the file to upload by clicking **Choose CSV or JSON file.** To append to the current credential list, check **Append to current list. Note:** This option fails with an error message, if the file to be uploaded contains a device that already exists.

Settings (for Cloud Key Store**)**

Item	Default Value	Description
Join Server URL	https://join.devicehq.com/api/m1/joinreq	Join Server address (You can verify the join server by clicking the Test button.)
Enable Lens API	Disabled (Unchecked)	Enable Lens API to use Lens portal to manage LoRaWAN network.
Lens API URL	https://lens.devicehq.com/api/	Lens API URL.
Check-In Interval	3600	Number of seconds between device check-in to Lens cloud.
Gateway EUI	N/A	Gateway EUI (Extended Unique Identifier)
UUID	N/A	Universally Unique Identifier (128-bit ID)
Serial Number	N/A	Device serial number

Messages (available using Cloud Key Store)

Item	Default Value	Description
Network Stats	Enabled	Send periodic network stats to Lens servers.
Packet Metadata	Enabled	Send metadata on uplink and downlink packets to Lens servers.
Packet data	Disabled	Send data from uplink and downlink packets to Lens servers.
Gateway Stats	Enabled	Send periodic gateway stats to Lens servers.
Local Join Metadata	Enabled	Send periodic gateway stats to Lens servers.
DeviceHQ	Enabled	Allows Lens to control DeviceHQ connectivity settings (optional).

Gateway Info (available using Cloud Key Store)

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Item	Default Value	Description
Gateway EUI	N/A	Gateway EUI (Extended Unique Identifier)
UUID	N/A	Universally Unique Identifier (128-bit ID)
Serial Number	N/A	Device serial number

Traffic Manager (available using Cloud Key Store)

Item	Default Value	Description
JoinEUI Filter	N/A	Applied to received Join Requests to limit the number of messages sent to Join Server from unwanted devices (Read-only display of logic downloaded from Lens settings).
DevEUI Filter	N/A	Applied to received Join Requests to limit the number of messages sent to the Join Server from unwanted devices (Read-only display of logic downloaded from Lens settings).

Local Network Settings

Item	Default Value	Description
Enabled	Checked (enabled)	Enable or disable Local Network Settings.
Default Device Profile	N/A	Default device profile to use for newly joined end-devices authenticated with the Local Network Settings, AppEUI and AppKey. Profile options are defined on the LoRaWAN > Profiles page.
Network ID (AppEUI)	Name	Specify Network ID format from local application network ID or App EUI. Select from drop-down: Name or EUI.
Name	Uses local device name.	Gateway device name.
Default Network Profile	DEFAULT-CLASS-A	Default network profile to use for newly joined end-devices authenticated with the Local Network Settings, AppEUI and AppKey. Profile options are defined on the LoRaWAN > Profilespage.
Network Key (AppKey)	Passphrase	Choose Network Key from Passphrase or Key.
Passphrase	N/A	Enter Passphrase if used.

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Key	N/A	Enter Key if used. (128-bit hexadecimal value)

Spectral Scan Configuration

Item	Default Value	Description
Enabled	Unchecked (disabled)	Enable or disable Spectral Scan.
Scan Settings		
Samples	10000	Total number of RSSI points.
Bandwidth	250	Channel bandwidth (in KHz).
Step	100000	Frequency step between start and stop (in Hz).
Offset	0	Offset to be applied to resultant data (in db).
Floor	-120	Threshold below which results are ignored (in db).
Scheduling		
Start	9:00	Start time for scans in UTC time (leave blank if you want current time).
Interval	1	Time period between run sets (minutes).
Stop	Never	Stop criteria for scans. Select from drop-down: Never, After Duration, and After Number of Scans
Duration	1	Time period to run continuous scans (in hours). Use 0 for once. (Shows up if you choose After Duration under Stop.)
Scan Sets to Run	0	Scan limit (Shows up if you choose After Number of Scans under Stop.)
Scan Sets - First set range is required and two default ranges are provided. Others are optional up to 5 max. Each range set is independent and flexible. Enter start and stop range and click Add to add that range as an additional set. Click Remove to delete one.		
Start 1	902100000	Start frequency 1 (in Hz) - Required.
Stop 1	903900000	Stop frequency 1 (in Hz) - Required.
Start 2	923000000	Start frequency 2 (in Hz) - Optional.
Stop 2	928000000	Stop frequency 2 (in Hz) - Optional.
Start 3	N/A	Start frequency 3 (in Hz) - Optional.

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Stop 3	N/A	Stop frequency 3 (in Hz) - Optional.
Start 4	N/A	Start frequency 4 (in Hz) - Optional.
Stop 4	N/A	Stop frequency 4 (in Hz) - Optional.
Start 5	N/A	Start frequency 5 (in Hz) - Optional.
Stop 5	N/A	Stop frequency 5 (in Hz) - Optional.

Gateways

This section displays all active and configured gateways. The following information displays:

Item	Description
Gateway EUI	Gateway EUI (Extended Unique Identifier)
IP address	Gateway IP address
IP Port	Port used for LoRaWAN Gateway
Version	Protocol version of Packet Forwarder
Last Seen	Time of last update, Minutes or hours ago
Options	Additional statistics and details for Gateway option in last five minutes. Click info icon for details.

Packets Received

Item	Description
Gateway EUI	Gateway EUI (Extended Unique Identifier)
Channels 1 -10	Number of packets received on this channel
CRC	Cyclic Redundancy Check failed
Adding Total	Count of packets on all channels including CRC errors

Network Statistics

Item	Description
Join Request Responses	Average Join Request Response in milliseconds: 90%, 70%, 30%
Join Packets	Number of Okay packets, Duplicates and MIC fails, Unknown, Late, Total
Transmitted Packets	Pkt (Packets) 1st Wnd (Window), Pkt 2nd Wnd, ACK Pkt, Total, Join 1st Wnd, Join 2nd Wnd, Join Dropped, Join Total
Received Packets	MIC Fails, Duplicates, CRC Errors, Total
Scheduled Packets	1st Wnd, 2nd Wnd, Dropped, Total

Duty Cycle Time-On-Air Available (seconds - only available for EU)

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Item	Description
Gateway EUI	Gateway EUI (Extended Unique Identifier)
Bands 0-3	Channel bands

Devices

This section allows users to add new end-devices. To add a new end-device:

1. Go to **LoRaWAN** > **Devices**.
2. Under **End Devices**, click **Add New**.
3. Enter the following fields:
   a. **Dev EUI** - the end-device EUI (Extended Unique Identifier)
   b. **Name** - the name of the end-device
   c. **Class** - LoRaWAN operating class of end-device. Is communicated to network server on Join. The end-device must be configured out-of-band for operating class. A, B, or C are currently supported. (A, B, or C).
   d. **Serial Number** - Serial number of end-device
   e. **Product ID** - Product ID for end-device
   f. **Hardware Version** - Hardware version for the end-device
   g. **Firmware Version** - Firmware version for the end-device
   h. **LoRaWAN Version** - Software version for LoRaWAN server
4. Click **Finish**.
5. The new end-device displays under the **End Devices** list including some device details and statistics.
6. To edit the device, click the pencil icon, or to delete it, click the x icon next to that device.
7. To delete all devices, click the **Delete All** button.

Device Sessions

The normal join process involving properly configured and registered gateways and end-devices creates sessions FOTA (Firmware Over-the-Air) automatically.

However, you can use the Device Sessions section, if you want to create a session manually, otherwise known as ABP (Activation by Personalization). The manual session includes only the gateway and end-devices. The server is not involved.

To add a new session manually:

1. Go to **LoRaWAN** > **Devices**.
2. Under **Sessions**, click **Add New**.
3. Enter the following fields:
   a. **Dev EUI** - End-device EUI (Extended Unique Identifier)
   b. **Dev Addr** - Network device address assigned to end-device
   c. **Class -** Device Class (B or C)
   d. **App EUI** - Application EUI
   e. **Join EUI** - Join Request EUI

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   f. **Net ID** - Network ID
   g. **App Session Key** - Pre-shared application session key
   h. **Net Session Key** - Derived network session key based on pre-shared application key
   i. **Multicast Session** - Select from the drop-down: No (not multicast session), Class B, or Class C

4. Click **Finish**.
5. The new session displays under the **Sessions** list including some device details and statistics.

   a. **Dev EUI** - End-device EUI (Extended Unique Identifier)
   b. **Dev Addr** - Network device address assigned to end-device
   c. **Up FCnt** - Packet counter of last received packet
   d. **Down FCnt** - Packet counter of last sent packet
   e. **Last Seen** - Time of last packet received
   f. **Joined** - What is the device joined to, Cloud or local version
   g. **Details** - Additional session information (click on info icon)
   h. **Multicast Session** - Select from the drop-down: No (not multicast session), Class B, or Class C

6. To edit the session, click the pencil icon, or to delete it, click the x icon next to that session.
7. To delete all sessions, click the **Delete All** button.

Device Groups

This page allows you to create **Device Groups** in order to perform mass firmware upgrade OTA and multicast messaging to all devices in that group.

The **Groups** table displays existing groups. Use the **View**, **Edit,** or **Remove** buttons to see, modify, or delete an existing group in the table.

To create a new device group:

1. Go to **LoRaWAN > Device Groups**.
2. Click the **Add New** button.
3. The Add Group dialog box appears. Enter your desired **Group Name**.
4. You can also enter an optional **Group EUI**. If you do not provide one, the system generates a Group EUI automatically.
5. Select the desired end device(s) to include in your group by clicking the box next to each **Device EUI**.
6. Click **Add**.

To import your device group:

1. Click **Import**.
2. Click **Choose File** and browse to select your desired file.
3. Click **Import**.

To export all your device groups, click **Export All**.

Groups table fields

Item	Description

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Name	Device Group Name (user-defined)
EUI	Optional Device Group EUI (the system generates one for you if undefined)
Size	Number of devices in the group
Options	Edit and Delete options

Profiles

When connected to the LoRaWAN server, the profiles can be downloaded from the cloud. There are two-kinds of profiles: End-Device and Network.

Make profile changes in the Lens cloud and the device updates during a periodic check-in or when end-device associated with the profile joins or rejoins the network.

See existing profiles under the End-Device Profiles and Network Profiles lists. Refer to tables for profile details. Click Refresh to update the list.

Settings provided in the device profile must reflect the default settings of the end-device when it is first joined to the network. The end-device should be in this default configuration. Any deviation between the device profile and the actual default end-device settings may result in lost downlinks to the end-device due to non-matching Rx window parameters.

To add a new device profile:

1. Go to **LoRaWAN > Profiles**.
2. Under **End-Devices Profiles**, click **Add New**.
3. Enter the fields or check the following boxes:
    a. Profile ID - Enter your desired profile name.
    b. Max EIRP
    c. Max Duty Cycle - Select from the drop-down including DEFAULT or a range of options from 100% to 0.003%.
    d. MAC Version.
    e. RF Region - Select from the drop-down including DEFAULT, US915, AU915, AS923, KR920, EU868, IN865, and RU864.
    f. Region Version.
    g. Supports Class C (Check box to enable. If this is enabled, then you may enter a value for the following field.)
        i. Timeout Class C
    h. Supports Class B (Check box to enable. If this is enabled, the following fields appear and you may enter values for them.)
        i. Ping Slot Period
        ii. Ping Slot Datarate
        iii. Ping Slot Frequency
    i. Supports Join (check box to enable)
    j. Support 32 Bit FCnt (check box to enable)

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End-Device Profiles (edit/add new)

Parameter	Description
Profile ID	name of profile
Max EIRP	maximum transmit power of the end-device
Max Duty Cycle	maximum duty-cycle of the end-device
MAC Version	LoRaWAN version supported by end-device, LW1_0 has different MAC commands, and network messages from LW1_1
RF Region	end-device region or channel plan
Region Version	revision of Regional Parameters specification
Supports C	true if end-device can use class C mode
Timeout C	time for the end-device to reply to a confirmed downlink before retransmission
Supports B	true if end-device can use class B mode
Timeout B	time for the end-device to reply to a confirmed downlink before retransmission
Ping Slot Period	how often the end-device opens class B windows – 1 (once per second) up to 128 (once per beacon period)
Ping Slot Datarate	datarate used for class B window
Ping Slot Frequency	frequency used for class B window
Supports Join	true if end-device supports OTA join
Rx1 Delay	default delay between end of Tx and beginning of the first Rx window, if not provided the LoRaWAN default for the selected channel plan will be used.
Rx1 DR Offset	default datarate offset of first Rx window, if not provided the LoRaWAN default for the selected channel plan will be used
Rx2 DR Index	default datarate of second Rx window, if not provided the LoRaWAN default for the selected channel plan will be used
Rx2 Frequency	default frequency of second Rx window, if not provided the LoRaWAN default for the selected channel plan will be used
Preset Frequencies	additional channels configured at the end-device
Supports 32 Bit FCnt	true if end-device supports 32 bit counters

Network Profiles

Settings provided in the network profile reflect the settings of the end-device to be received in MAC commands after it is first joined to the network. These are the desired settings for the end-device to operate with. Any

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deviation between the network profile and the default end-device settings are sent to the end-device in successive MAC commands until all settings have been relayed.

NOTE: Network profile settings will override device profile and network settings.

To add a new network profile:

1. Go to **LoRaWAN > Profiles**.
2. Under **Network Profiles**, click **Add New**.
3. Enter the fields or check the following boxes:
   a. Profile ID – Enter your desired profile name.
   b. Max Duty Cycle - Select from the drop-down including DEFAULT or a range of options from 100% to 0.003%
   c. Class- Select from the drop-down including A, B, or C.
   d. Timeout Class C
   e. Rx1 Delay
   f. Rx1 DR Offset - Select from drop-down which varies with your selected channel plan.
   g. Rx2 DR Index - Select from drop-down which varies with your selected channel plan.
   h. Rx2 Frequency
   i. Channel Mask
   j. Redundancy

Network Profiles (edit/add new)

Parameter	Description
Profile ID	name of profile
Max Duty Cycle	maximum duty-cycle of the end-device
Class	operating class for end-device: A, B or C
Timeout C	time for the end-device to reply to a confirmed downlink before retransmission
Rx1 Delay	default delay between end of Tx and beginning of the first Rx window, if not provided the LoRaWAN default for the selected channel plan will be used
Rx1 DR Offset	default datarate offset of first Rx window, if not provided the LoRaWAN default for the selected channel plan will be used
Rx2 DR Index	default datarate of second Rx window, if not provided the LoRaWAN default for the selected channel plan will be used
Rx2 Frequency	default frequency of second Rx window, if not provided the LoRaWAN default for the selected channel plan will be used
Channel Mask	bitmask of enabled channels, US/AU use a twenty character mask, other use a four character mask

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US	first 2 characters are not used, the next two control the 500 KHz channels: ▪ enable all channels – 00FFFFFFFFFFFFFFFF ▪ enable bottom half - 000F00000000FFFFFFFF
EU	enable all channels - FFFF
Redundancy	number of times an unconfirmed uplink should be repeated

Packets

This section shows three lists: transmitted, recent join requests, and recently received packets on the LoRa network. Each packet includes relevant packet details.

Packets (Transmitted)

Item	Description
Device EUI	End-device EUI (Extended Unique Identifier) transmitting the uplink packet or destination of the downlink packet
Freq	Frequency used to transmit packet
Datarate	Datarate used to transmit packet
SNR	Signal to noise ratio of received packet
CRC	Cyclic redundancy check failed
RSSI	Received signal strength
Size	Size in bytes of packet
FCnt	MAC packet counter
Type	Type of packet includes these possible values: ▪ **JnAcc** - Join Accept Packet ▪ **JnReq** - Join Request Packet ▪ **UpUnc** - Uplink Unconfirmed Packet ▪ **UpCnf** - Uplink Confirmed Packet - ACK response from network requested ▪ **DnUnc** - Downlink Unconfirmed Packet ▪ **DnCnf** - Downlink Confirmed Packet- ACK response from end-device requested
Tx/Rx Time	Time packet was sent or received
Details	Additional packet details (click on info icon to view popoup)

Recent Join Requests

Item	Description

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Join EUI	8-byte EUI (Extended Unique Identifier) found in the join request
Nonce	Join nonce provided by end-device in the Join Request
Elapsed	Round trip time in milliseconds for the Join Server to service the join request
Result	If the result of the request is valid, it displays: **Success**. If the result is an error, one of the following displays: ▪ **MICFailed** - AppKey setting did not match the end-device record in Join Server ▪ **Dropped** - Downlink packet could not be scheduled for transmit on any available gateways ▪ **Duplicate Dev Nonce** - Nonce in join request has already been used ▪ **JoinReq Failed** - Other server error ▪ **UnknownDevEUI** - Device record was not found at Join Server ▪ **Gateway Mismatch** - Join Server configuration does not allow this device to join through this gateway ▪ **Server Error** - Join Server is not reachable possibly due to Internet connection settings or DNS resolution

Recent Rx Packets

Item	**Description**
Time	Time packet was received
Freq	Frequency used to transmit packet
Datarate	Datarate used to transmit packet
CRC	Cyclic redundancy check failed
SNR	Signal to noise ratio of received packet
RSSI	Received signal strength
Size	Size in bytes of packet

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Type	Type of packet includes these possible values: ▪ **JnAcc** - Join Accept Packet ▪ **JnReq** - Join Request Packet ▪ **UpUnc** - Uplink Unconfirmed Packet ▪ **UpCnf** - Uplink Confirmed Packet - ACK response from network requested ▪ **DnUnc** - Downlink Unconfirmed Packet ▪ **DnCnf** - Downlink Confirmed Packet- ACK response from end-device requested
Data	Actual data in packet (payload)
Details	Additional packet details (click on info icon to view popup)

Downlink Queue

You can manually send a downlink packet to an end-device.

The packet remains in the queue until sent. Once it has been transmitted/received, the packet displays under **Packets**.

To manually send a downlink packet:

1. Go to **LoRaWAN > Downlink Queue**. Click on **Add New**.
2. Enter the following fields for the new Queue Item:
   a. **Dev EUI** - receiving end-device EUI (Extended Unique Identifier)
   b. **App Port** - port field set in the downlink packet
   c. **Data Format** - encoding scheme for the packet (select either Hex or Base64).
   d. **Data** - the payload (data being transmitted)
   e. **Ack Attempts** - number of allowed downlink request ack retries
   f. **RxWindow** - specify the Rx Window to use for downlink (0 - no priority, 1- first Rx Window, 2- second Rx Window)
3. Click **Finish**.
4. The new **Queue Item** displays under the **Downlink Queue** list including some device details and statistics.
   a. **Dev EUI** - receiving end-device EUI (Extended Unique Identifier)
   b. **App Port** - port field set in the downlink packet
   c. **Size** - total packet minus header
   d. **Ack** - number of retries to receive ACK from end-device
   e. **RxWnd** - the Rx Window to use for downlink (0 - no priority, 1- first Rx Window, 2- second Rx Window)
   f. **Queued** - Time packet has been added to the queue
   g. **Details** - additional statistics displayed related to the packet
5. To edit the item, click the pencil icon, or to delete it, click the x icon next to that item.
6. To delete all items, click the **Delete All** button.

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Operations

The LoRaWAN **Operations** page offers two different features on one page: **FOTA** or **Multicast Messaging**.

The device offers the option of FOTA using your LoRaWAN network. To use this feature, you must properly configure your LoRa network and end-devices (must be joined to the network). You may set a countdown for an immediate update or schedule the upgrade for a specific time. You can also update multiple devices on your LoRa network.

The device also offers the option of Multicast Messaging over the LoRaWAN network.

To perform **FOTA**:

1. Go to **LoRaWAN > Operations**.
2. Under **Operations Settings**, select **FOTA** in the **Operation Type** drop-down.
3. Click **Browse** and select your **Firmware Upgrade File** (.bin).
4. Under the **Fragment Description** field, enter the fragment description for the FOTA session in HEX format.
5. You have the option to specify a **Setup Time In by clicking Change**. Setup time specifies how long from the time scheduled before the Multicast Setup Process begins. Under **Setup Time Input** from the drop-down, select either:
   a. **Countdown to Setup from Now:** Enter **Number of Days** plus hours, minutes and seconds in **HH:MM:SS** (default: 30 seconds) **OR**
   b. **Specify Future Date and Time:** Select your desired **Date** and **Time**.
6. Otherwise, click **Hide** to hide **Setup Time Input** details. Click **Change** to show and modify.
7. You have the option to specify a **Launch Time In**. Launch time specifies how long the Multicast Process runs before starting firmware transmission. Under **Launch Time Input** from drop-down, select either:
   a. **Countdown to Launch from Setup:** Enter **Number of Days** plus hours, minutes and seconds in **HH:MM:SS** (default: 90 seconds) **OR**
   b. **Specify Future Date and Time:** Select your desired **Date** and **Time**.
8. Choose the desired **Target End-Devices** to receive the upgrade. Select either a previously-saved **End-Device Group** or **Individual Devices** from the drop-down on the right. Check the box near your desired device or group to designate it for upgrade. You can also check **Select/Deselect All box** to select or deselect all groups in the list.
9. Click the **Settings** tab, if you wish to change the defaults for the following FOTA parameters
   a. **Delete Successful Logs** (default: checked)
   b. **Multicast Group ID**
   c. **Number of Parity Fragments per Session** (default: 100)
   d. **Sleep Delay between Setup Messages** (default: 1000 microseconds)
   e. **Sleep Delay between Data Fragments** (default: 1500 microseconds)
   f. **Sleep Delay between Parity Fragments** (default: 3000 microseconds)
   g. **Maximum Packet Size**
10. After configuring FOTA, click **Schedule** to finalize your FOTA update.
11. Once the scheduled upgrade is submitted, you can track its progress through the **Progress** tab. A progress bar appears at the top of the page. The progress bar shows the transfer of the file from the PC to the

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device. Once completed, the page switches to the Progress tab. The job displays in either **Scheduled, Active**, or **Completed Jobs** lists depending on the job phase and timing.

To perform the Multicast **Messaging**:

1. Go to **LoRaWAN > Operations**.
2. Under **Operations Settings**, select **Message** in the **Operation Type** drop-down.
3. Select from either **Textbox** or **File** under **Payload Source**.
4. Select from either **Hexadecimal** or **Base64** under **Payload Format**.
5. Enter the message contents under **Payload**.
6. Enter the **Port** from a range of **1-220** (default: 1).
7. Under **Transmission Setup**, you have the option to specify a **Setup Time In by clicking Change**. Setup time specifies how long from the time scheduled before the Multicast Setup Process begins. Under **Setup Time Input** from the drop-down, select either:
   a. **Countdown to Setup from Now:** Enter **Number of Days** plus hours, minutes and seconds in **HH:MM:SS** (default: 30 seconds) **OR**
   b. **Specify Future Date and Time:** Select your desired **Date** and **Time**.
8. Otherwise, click **Hide** to hide **Setup Time Input** details. Click **Change** to show and modify.
9. You have the option to specify a **Launch Time In**. Launch time specifies how long the Multicast Process runs before starting message transmission. Under **Launch Time Input** from drop-down, select either:
   a. **Countdown to Launch from Setup:** Enter **Number of Days** plus hours, minutes and seconds in **HH:MM:SS** (default: 90 seconds) **OR**
   b. **Specify Future Date and Time:** Select your desired **Date** and **Time**.
10. Choose the desired **Target End-Devices** to receive the message. Select either a previously-saved **End-Device Group** or **Individual Devices** from the drop-down on the right. Check the box near your desired device or group to designate it to receive the message. You can also check **Select/Deselect All box** to select or deselect all groups in the list.
11. Click the **Settings** tab, if you wish to change the defaults for the following message parameters
    a. **Delete Successful Logs** (default: checked)
    b. **Multicast Group ID**
    c. **Sleep Delay between Setup Messages** (default: 1000 microseconds)
    d. **Sleep Delay between Data Fragments** (default: 1500 microseconds)
    e. **Maximum Packet Size**

    These parameters are constants for multicast messaging and cannot be modified:

    a. **Number of Parity Fragments per Session** (value: 100)
    b. **Sleep Delay between Parity Fragments** (value: 3000 microseconds)
12. After configuring Mulitcast **Messaging**, click **Schedule to schedule your message**.
13. Once the message is submitted, you can track its progress through the **Progress** tab. A progress bar appears at the top of the page. The progress bar shows the transfer of the message from the PC to the device. Once completed, the page switches to the Progress tab. The job displays in either **Scheduled, Active**, or **Completed Jobs** lists depending on the job phase and timing.

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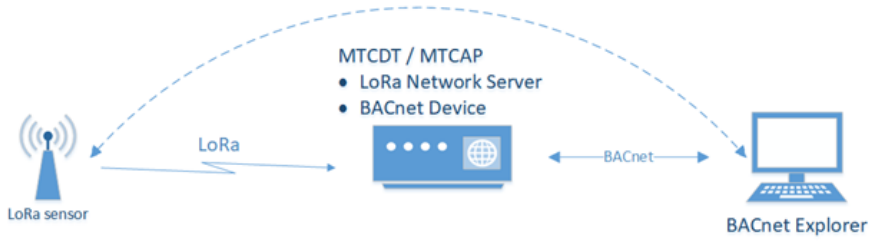
Chapter 5 – Payload Management

BACnet Overview

This topic provides an overview of SCADA-BACnet and LoRa Sensor support in mPower. BACnet is a communication protocol used to integrate and manage sensors and other building automation products payloads.



To get data from the LoRa sensor through mPower:

1. Verify the device has the BACnet license. BACnet payload management requires a license which is installed on your mPower device when it ships from the factory. If the Payload Management pages are not available, contact your account manager for a license. To add a license, refer to Licensing .
2. Verify **LoRaWAN Network Settings**.
   a. Go to **Network Settings > Network Server**.
      i. Set **LoRa Mode** to **Network Server.**
      ii. Set the Channel Plan for your region.
      iii. Make sure the **Packer Forwarder** and the **Network Server** are running.
   b. Go to Key Management.
      i. Set the **Join Server** to **Local Join Server**.
      ii. Configure **Local Network Setting**.
      iii. Configure **Local Network Setting.**
   c. Set up and connect your sensor. These steps depend on the sensor brand and are outside the scope of this document.
   d. Observe the **LoRaWAN > Packets** page. If the LoRaWAN network and sensor are configured properly, a Join Request from the sensor appears in the Recent Join Requests pane with the Success result. You will see Packets sent by the sensor in the Packets pane.
   e. Click **Refresh** to update the data on the page.
   f. Go to the **LoRaWAN > Devices** page. A new entry with the sensor Device EUI has been added to the End Devices and Sessions panes.
   g. Configure **BACnet.** For details, refer BACnet Configuration.
   h. Add sensors through Managed Sensors page.
   i. Create BACnet Objects.
   j. Setup a BACnet Explorer to get sensor data via BACnet. These steps depend on which BACnet Explorer you select and are outside the scope of this document.

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Configuring BACnet

To configure the system as a BACnet device:

1. Go to **Payload Management > BACnet Configuration.**
2. Check **Enabled** to enable the **BACnet Device**.
3. Enter a **Port** value between 1 to 65535. Required.
4. Enter a **Device Object Identifier** value between 1 to 4194302. Required.
5. Enter a **Device Object Name** of up to 64 characters. Required.
6. Enter a **Device Description** of up to 64 charact6ers. Optional.
7. Enter **APDU Timeout** value between 1-65 seconds. Default is 3. Required.
8. Enter number of **APDU Retries.** Range is 1-255. Default is 3. Required.
9. Click **Submit** and then click **Save and Apply.**

BACnet Objects

BACnet Objects define the data transferred from the sensor to the BACnet explorer.

mPower supports the following BACnet object types:

- Analog input
- Binary input
- Positive integer value
- Integer value
- Character string value

Add BACnet objects either through the Web UI or by importing a BACnet Objects map from a field.

Note: Once a BACnet object has been added to mPower, the Source, Device EUI, Property, and Type values cannot be modified.

Adding a New BACnet Object through the Web Management Interface

Before adding a BACnet Object, you must add one ore more sensors through the Managed Sensors page.

To add a new BACnet Object:

1. Go to **Payload Management > BACnet Objects**.
2. Click the **Add Object** tab.
3. Select a **Device EUI** from the drop-down list.
4. Select a **Property** from the drop-down list. Required. The Property lists contains properties that correspond to the sensor definition of the selected Device EUI.
5. Select a **Type** from the drop-down list. Required. Type is based on the selected Property.
6. Enter an **Identifier** between 0-4194302. Required. Identifier provides a unique value in mPower for BACnet objects of the same type.
7. Enter a **Name** up to 32 characters. Required.
8. Enter a **Description** up to 32 characters. Optional.
9. Click **Submit** to add a new object and go to the BACnet Objects page. Click **Submit** and **Add New Object** to continue adding BACnet Objects for the selected DeviceEUI.

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Note: If an object of the same type and identifier exists or if a required fields is empty, mPower returns an error message detailing the error.

Importing BACnet Objects

mPower allows you to add BACnet objects by importing a valid JSON file.

Note: Imported BACnet Objects overwrites the existing BACnet Object list.

To import a BACnet Objects list:

1. Go to **Payload Management > BACnet Objects**.
2. Click the **Folder** icon under **Choose File** and browse to select the file you want to use.
3. Click **Import.**
4. Click **Save and Apply.**

Managed Sensors

Adding Managed Sensors

To add managed sensors through the web interface:

1. Go to **Payload Management > Managed Sensors**.
2. Click **Add Sensor** in the upper right corner.
3. Enter the **Device EUI** in the format XX-XX-XX-XX-XX-XX-XX-XX.
4. Select the sensor **Manufacturer** from the drop-down list.
5. Select the sensor type from the **Type** drop-down list. These options depend on the Manufacturer selected in the previous step.
6. Click Finish to add the sensor.

Importing Managed Sensor Information

To import a list of LoRa sensors, sensor information must be in a JSON file in the following format:

```
[

    {
        "id" : "XX-XX-XX-XX-XX-XX-XX-XX",
        "sensor" : "manufacturer/sensor_model",
        "src" : "lora"
    }

]
```

Where ID is the sensor Device EUI, sensor includes the manufacturer's name and sensor model type by a slash. The only src is lora, which must be all lowercase.

```
[

    {
        "id" : "98-34-e5-05-00-00-0e-da",
        "sensor" : "radiobridge/RBS301-WAT",
        "src" : "lora"
```


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```
        }
]
```

To import the sensor file:

1. Go to **Payload Management > Managed Sensors**.
2. Click the **Folder** icon under **Choose File** and browse to select the file you want to use.
3. Click **Import.**
4. Click **Save and Apply**.

Viewing Sensor Details

To view sensor details:

1. Go to **Payload Management > Managed Sensors**.
2. Click the **View Details** (eye) icon for the sensor..

mPower opens a Sensor Details window showing DeviceEUI, source, manufacturer/sensor type and any BACnet Objects for that sensor. The window includes a link for adding new BACnet objects. For more information, refer to BACnet Objects.

Deleting a Sensor

To delete a sensor:

1. Go to **Payload Management > Managed Sensors**.
2. Click the **Remove** (trashcan) icon for the sensor.
3. Confirm the deletion.

Deleting All

To delete all the sensors:

1. Go to **Payload Management > Managed Sensors**.
2. Click **Delete All**.
3. Confirm the deletion.

Downloading the Managed Sensor List

To download a JSON file with sensor details:

1. Go to **Payload Management > Managed Sensors**.
2. Click the Download.

Sensor Definitions

Sensor definitions are a sensor definition JSON file and a corresponding sensor decoder file.

By default mPower includes pre-defined sensor definitions for MultiTech's Radio Bridge, Adeunis, and Elsys sensors. These appear on the Sensor Definitions tab and Default tab. The Sensor Definitions tab also lists any custom sensor definitions that have been imported into mPower. For just a list of custom definitions, go to the Custom tab.

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Viewing Sensor Definition Details

To view sensor details:

1. Go to **Payload Management > Sensor Definitions.**
2. Click the **View Details** (eye) icon for the sensor definition.

mPower opens a Sensor Details window showing the properties, type, an units for that sensor definition.

Filtering and Sorting the Sensor Definition Lists

To filter the Sensor Definition list:

- Enter filter term in the Filter By field.

To sort the Sensor Definition list:

- Click on a column heading.

Importing Custom Sensor Definitions

When importing customer sensor definitions, you must upload both a sensor definition JSON file describing the sensor data structure and a corresponding sensor decoder that declares the decode Uplink function.

The sensor definition file for importing definitions must be JSON format that has three sections: description (optional), properties (required), and decoder (required).

Example Sensor Definition JSON File Structure

```
{

    "description" : "Optional description goes here",

    "properties" : {

         "DeviceID"              : {"type" :"string", "size" : 16},
         "DeviceStatus"          : {"type" : "uint8"},
         "BatteryVoltage"        : {"type" : "uint16", "units" : "amp"},
         "CounterA"              : {"type" : "uint16"},
         "CounterB"              : {"type" : "uint16"},
         "SensorStatus"          : {"type" : "uint8"},
         "TotalCounterA"         : {"type" : "uint16"},
         "TotalCounterB"         : {"type" : "uint16"},
         "PayloadCounter"        : {"type" : "uint8"}
    },

    "decoder": "SampleDecoder.js"

  }
```

Sensor Decoder

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The Sensor decoder file is a snippet of JavaScript code that defines the “decodeUplink” function. The JavaScript decodeUplink() function is called when a data uplink message is received from a sensor. This function decodes the binary payload received from the sensor to a human-readable JSON object that gets sent upstream to the BACnet Server.

Note: Only use primitive classes in your decoder as the interpreter cannot handle derived types.

For a Sample Decoder refer to: Decoder Sample.

To import custom sensor files:

1. Go to **Payload Management > Sensor Definitions** and click on the **Import** tab.
2. Enter the sensor **Manufacturer** name up to 15 characters. Must start with a letter and may only contain alphanumeric characters, hyphens, and underscores. It is case sensitive. Required.
3. If uploading a variation of an existing sensor type, check **Allow Overwrite** so mPower uses the new definition for that sensor type.
4. Enter a part number or model version for the sensor up to 32 characters. Must start with a letter and may only contain alphanumeric characters, hyphens, and underscores. It is case sensitive. Required.
5. Click the **Folder** icon under **Sensor Definition** and browse to select the file you want to use.
6. Click the **Folder** icon under **Sensor Decoder** and browse to select the file you want to use. Note that mPower does not validate the decoder file.
7. Click **Import.**
8. Click **Save and Apply**.

Deleting a Custom Sensor Definition

Default sensor definitions cannot be deleted. To delete a custom sensor definition:

1. Go to **Payload Management > Sensor Definitions.** To narrow the list to just custom definitions, click the **Custom** tab.
2. Find the sensor definition you want to delete. Click the **Remove** (trashcan) icon for that sensor definition.
3. Confirm the deletion.

Deleting All Custom Sensor Definitions

Default sensor definitions cannot be deleted. To delete all custom sensor definitions:

1. Go to **Payload Management > Sensor Definitions.** To narrow the list to just custom definitions, click the **Custom** tab.
2. Click **Delete All**.
3. Confirm the deletion.

Decoder Sample

This is a sample of a Sensor Definition Decoder file for reference.

SampleDecoder.js file content:

```
//////////////////////////////////////////////////////////////////////////////////////
/////
```


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```
//                          Prototypes
////////////////////////////////////////////////////////////////////////////
/////
Uint8Array.prototype.readUInt16BE = function (offset) {
    var dataView = new DataView(this.buffer);
    return dataView.getUint16(offset);
};
Uint8Array.prototype.readInt16BE = function (offset) {
    var dataView = new DataView(this.buffer);
    return dataView.getInt16(offset);
};
Uint8Array.prototype.readUInt8 = function (offset) {
    var dataView = new DataView(this.buffer);
    return dataView.getUint8(offset);
};
Uint8Array.prototype.readUInt32BE = function (offset) {
    var dataView = new DataView(this.buffer);
    return dataView.getUint32(offset);
};


////////////////////////////////////////////////////////////////////////////
/////
//                          Helper functions
////////////////////////////////////////////////////////////////////////////
/////
function bcd(dec) {
return ((dec / 10) << 4) + (dec % 10);
}

function unbcd(bcd) {
return ((bcd >> 4) * 10) + bcd % 16;
}

function toHEXString(payload, index, length){
    var HEXString = '';
    for(var i = 0; i < length; i++){
        if(payload[index + i] < 16){
            HEXString = HEXString + '0';
        }
        HEXString = HEXString + payload[index + i].toString(16);
    }
    return HEXString;
}

function readInt16BE(payload, index){
    var int16 = (payload[index] << 8) + payload[++index];
    if(int16 & 0x8000){
        int16 = - (0x10000 - int16);
    }
```


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```
    return int16;
}

function readUInt16BE(payload, index){
    return (payload[index] << 8) + payload[++index];
}

function readInt8(payload, index){
    var int8 = payload[index];
    if(int8 & 0x80){
        int8 = - (0x100 - int8);
    }
    return int8;
}

////////////////////////////////////////////////////////////////////////////////
/////////////////
// decodeUplink: Take received byte array and add custom
// code to define specific byte paramaeters
//
//   Input:
//    port = manufacturer specific, use if specified, else ignore
//    byteArray = sesnor data post base64 decode, byte array of payload values
//
//
//     Sensor payload as HEX: 02060004A30B00EDB9EF00010100000000000040004B0
//
//     Incoming payload (byteArray):
//             [
02,06,00,04,A3,0B,00,ED,B9,EF,00,01,01,00,00,00,00,00,00,04,00,04,B0 ]
//
//     { received_at: '2022-09-08T14:40:31.418Z',
//       payload_type: 2,
//       payload_variant: 6,
//       device_id: '0004a30b00edb9ef',
//       device_status: 0,
//       battery_voltage: 2.57,
//       counter_a: 0,
//       counter_b: 0,
//       sensor_status: 0,
//       total_counter_a: 4,
//       total_counter_b: 4,
//       payload_counter: 176 }
//
//   WARNING:  PLEASE ONLY USE PRIMITIVE CLASSES!!!! Dervived classes NOT
supported
//
//    function DecoderTest() {
//      var bytes = new Uint8Array([0x02, 0x06, 0x00, 0x04, 0xA3, 0x0B, 0x00,
0xed, 0xb9,
```


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```
//              0xef, 0x00, 0x01, 0x00, 0x00, 0x00, 0x00, 0x00, 0x04, 0x00,
0x04, 0xb0]);
//      return decodeUplink(1, bytes);
//  }
//
////////////////////////////////////////////////////////////////////////////
/////////////////
function decodeUplink(port, byteArray) {
    var d = {};
    var payload = byteArray;

    d.payloadType = payload[0];
    d.payloadVariant = payload[1];
    d['DeviceID'] = toHEXString(payload, 2, 8)

    switch(d.payloadVariant){
        case 0x06:
            d['DeviceStatus'] = payload[payload.length - 13];
            d['BatteryVoltage'] = readUInt16BE(payload, payload.length -
 12) / 100;
            d['CounterA'] = readUInt16BE(payload, payload.length - 10);
            d['CounterB'] = readUInt16BE(payload, payload.length - 8);
            d['SensorStatus'] = payload[payload.length - 6];
            d['TotalCounterA'] = readUInt16BE(payload, payload.length - 5);
            d['TotalCounterB'] = readUInt16BE(payload, payload.length - 3);
            d['Payloadcounter'] = payload[payload.length - 1];
            break;
        case 0x07:
            d['SensorStatus'] = payload[payload.length - 5];
            d['TotalCounterA'] = readUInt16BE(payload, payload.length - 4);
            d['TotalCounterB'] = readUInt16BE(payload, payload.length - 2);
            break;
        case 0x08:
            d['DeviceStatus'] = payload[payload.length - 4];
            d['BatteryVoltage'] = readUInt16BE(payload, payload.length -
 3) / 100;
            d['SensorStatus'] = payload[payload.length - 1];
            break;
    }

    // return the decoded payload as an object or return an empty object
    return d;

}

// Uncomment below to test

//    function DecoderTest() {
//      var bytes = new Uint8Array([0x02, 0x06, 0x00, 0x04, 0xA3, 0x0B, 0x00,
0xed, 0xb9,
```


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```
//              0xef, 0x00, 0x01, 0x00, 0x00, 0x00, 0x00, 0x00, 0x04, 0x00,
0x04, 0xb0]);
//      return decodeUplink(1, bytes);
//  }

//  print( DecoderTest() );
```


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Chapter 6 – Setup

Global DNS

The **Global DNS** Configuration page allows the user to set user-defined DNS servers. User-defined DNS servers in this page are always used to resolve hostnames regardless of what the WAN settings are and what WAN interface is being used. If the **Global DNS** primary and secondary servers are not configured here, the DNS servers used default to the servers configured for the current WAN.

Here are the key configuration scenarios for both **Global DNS** and forwarding server and their results (the device refers to a MultiTech device):

- If you do not configure **Global DNS** and enable forwarding, the device acts as a proxy server for any devices on the LAN network(s). In this mode, the device uses WAN DNS settings. Client settings: On the client, you must configure the device as the default gateway and DNS server. The easiest way to accomplish this is by using the DHCP server on the device.
- If you configure **Global DNS** and enable forwarding, DNS requests are forwarded to servers configured in the **Global DNS** settings. The device still acts as a proxy. Client settings: Clients must be configured the same as in the previous case above.
- If you configure **Global DNS** and disable forwarding, the default gateway and DHCP server on clients should point to the device and the DNS servers on the client must use the same DNS as the **Global DNS** settings. Client settings: The client device uses the device as default gateway and the DHCP server, but must have DNS servers configured to what options you plan to use.
- If neither item is configured/enabled, make sure to configure your device properly to forward DNS.

To configure **Global DNS**:

1. Click **Setup > Global DNS.**
2. Under **Global DNS Configuration**, leave **Enable Forwarding Server** unchecked. (If you check this, the forwarding server is active and global DNS is not configured).
3. To set global DNS servers, enter IP addresses for the both **Primary** and **Secondary Servers**. (These servers override any DNS servers specified elsewhere in the UI. If none are entered, the system defaults to servers configured for the current WAN.)

Hostname Configuration

Hostname allows the user to change the hostname of the device to distinguish the device from other devices on the network.

To modify the default hostname:

1. Under **Hostname Configuration**, enter the **Hostname** for your device.
2. Click **Save and Apply** to save your changes **OR** click **Reset to Default** to return to default settings.

WAN Setup

Configuring WAN Failover Priority

Failover mode regulates which WAN is used for the Internet connection and switches the WAN if a connectivity failure is detected.

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Failover mode enables the WAN with the highest priority as displayed on the **WAN Configuration** page. If the WAN with priority 1 is disabled or a connection failure is detected, the WAN with priority 2 is automatically selected for establishing connection to the Internet.

Ethernet (eth0) is priority 1 by default.

If Ethernet is used as WAN, the DHCP server must be disabled.

1. Click **Setup > WAN Configuration**.
2. Under **Options**, click the up and down arrows to change the priority of the appropriate WAN.
3. Click **Save and Apply** to save the change.

For field descriptions see Failover Configuration Fields

For information on editing WAN Failover see Editing Failover Configuration

Editing Failover Configuration

The device can use the active or passive mode to monitor the Internet availability in WAN. The default condition is active mode.

Active mode can be type ICMP (ping) or TCP. ICMP periodically pings the designated host at the specified interval. TCP tries to make a connection to the designated host at the interval specified.

For both ICMP and TCP, if a response is not received, the device switches to the WAN with lower priority. The device continues to ping the designated host at the interval specified for WAN with the higher priority and switches back when the ping is successful. When passive mode is enabled, the device switches the WANs when the network interface is down. The currently active WAN is displayed on the home page under the label WAN Transport.

To edit failover configuration:

1. Click **Setup > WAN Configuration**.
2. Under the **Options** column at the right, click the pencil icon (edit) for the selected WAN. The **Failover Configuration** page is displayed.
3. Make the desired changes. Refer to Failover Configuration Fields for details.
4. Click **Finish**.
5. If you are finished making changes, click **Save and Apply**.

Failover Configuration Fields

Field	Description
Monitoring Mode	Use the drop-down list to select the mode to connect to the host: PASSIVE or ACTIVE.
Interval	Enter the number of seconds between each check. Default is 60 seconds.
Host Name	Enter the host name or IP address to use for the check. Default is www.google.com.
Mode Type	Use the drop-down list to select the mode type: ICMP or TCP. Default is ICMP. (Active Monitoring Mode)
TCP Port	Enter the TCP Port number to connect to the host. (Mode TCP)

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Field	Description
ICMP Port	Enter the number of ICMP pings to be sent to the specified host. Default is 10. (Mode ICMP)

Configuring IP Address for LAN

Your device manages traffic for your local area network (LAN). To change the IP address and DNS configuration:

1. Go to **Setup** > **Network Interfaces** > **br0** and click the **pencil icon** to edit.
2. To configure the address LAN information:

   In the **IP Address** field, type the device's IP address. The default is 192.168.2.1.

   In the **Mask** field, type the mask for the network. The default is 255.255.255.0.
3. To resolve domain names, configure domain name server information (DNS), go to **Setup > Global DNS** and refer to the Global DNS section (WAN DNS) for options and instructions on how to properly configure this feature.
4. Click **Submit**.
5. To save your changes, click **Save and Apply**.

Configuring Dynamic Domain Naming System (DDNS)

This feature allows your router to use a DDNS service to associate a hosted server's domain name with a dynamically changing internet address. To configure your router to use DDNS:

1. From **Setup**, select **DDNS Configuration**.
2. In the **Configuration** group, check **Enabled**.
3. In the **Service** drop-down list, select a DDNS service. To define a service that isn't listed choose **Custom**.
   a. For custom DDNS service, in the **Service** field, type the DDNS server's URL.
   b. For custom DDNS service, in the **Port** field, type the DDNS server's port.
4. In the **Domain** field, type the registered Domain name.
5. In the **Update Interval** field, type the days that can pass with no IP Address change. At the end of this interval, the existing IP Address is updated on the server so that the address does not expire. The range of the interval you can enter is between 1 and 99 days. The default is 28 days.
6. Check **Use Check IP**, if you want to query the server to determine the IP address before the DDNS update. The IP address is still assigned by the wireless provider and the DDNS is updated based on the address returned by Check IP Server. If disabled, the DDNS update uses the IP address from the Cellular link. The default is **Use Check IP**.
7. In the **Check IP Server** field, type the name to which the IP Address change is registered. Example: checkip.dyndns.org
8. In the **Check IP Port** field, type the port number of the Check IP Server. The default is 80.
9. Click **Submit**.
10. To save your changes, click **Save and Restart**.

Entering authentication information

Your DDNS server requires you to identify yourself before you can make changes.

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1. In the **Username** field, type the name that can access the DDNS Server. The default is NULL. You receive your name when you register with the DDNS service.
2. In the **Password** field, type the password that can access the DDNS Server. The default is NULL. You receive your password when you register with the DDNS service.
3. Click **Submit**. If you are finished making changes click **Save and Apply**.

Forcing a DDNS server update

To update the DDNS server with your IP address, click **Update**.

Configuring Dynamic Host Configuration Protocol (DHCP) Server

To view, add, or edit DHCP servers, see the **IPv4 DHCP Servers** (IPv4 support) or **DHCPv6 and Router Advertisement** (for IPv6 support) list under **Setup > DHCP Configuration.**

You can configure multiple DHCP servers. Only one DHCP server can be created per LAN network interface. You can configure your device to function as a DHCP server that supplies network configuration information, such as IP address, subnet mask, and broadcast address, to devices on the network.

By default, the DHCP server is configured and enabled for Bridge (**br0**) network interface. If a LAN network interface is NOT under the bridge, DHCP server can be configured and enabled for it..

DHCP Server is disabled automatically if you modify the network interface under **Setup > Network Interface** including:

- changes to the interface subnet
- adding network interface under the bridge
- changing the interface from LAN to WAN (Ethernet interface only)
- removing all LANs from under the bridge (DHCP for **br0** will be disabled in this case)

DHCP Server cannot be enabled if the network interface is under the bridge, or is not enabled or configured properly (for example, when **eth0** is configured as WAN, or Wi-Fi Access Point is disabled).

To edit the configuration of an existing IPv4 DHCP server or add a new one:

1. Go to **Setup > DHCP Configuration**. See the **IPv4 DHCP Servers** list.
2. To edit a **DHCP Server**, click the pencil icon (edit) for the selected interface, **OR** to add a **DHCP Server**, click the **Add IPv4 DHCP Server** button.
3. The **DHCP Configuration** fields appear. To use the **DHCP** feature, check **Enabled**.
4. In the **Interface** field, select the network interface. Note: The Interface field is read-only when you edit DHCP Server.
5. The **Subnet** field displays the subnet address.
6. The **Mask** field displays the network's subnet mask.
7. In the **Gateway** field, type the gateway address.
8. In the **Domain** field, type your network domain, if any.
9. In the **Lease Time** field, enter the DHCP lease time. Lease time is set in days, hours, and minutes (dd-hh-mm). A Lease Time of 00-00-00 is an infinite lease time.
10. In the **Lease Range Start** field and in the **Lease Range End** field, type the range of IP addresses to be assigned by DHCP.
11. Click **Submit**. If you are finished making changes, click **Save and Apply**.

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To edit the configuration of an existing DHCPv6 and Router Advertisement server or add a new one:

1. Go to **Setup > DHCP Configuration**. See the **DHCPv6 and Router Advertisement** list.
2. To edit a **DHCP Server**, click the pencil icon (edit) for the selected interface, **OR** to add a **DHCP Server**, click the **Add DHCPv6/RA** button.
3. The **DHCP Configuration** fields appear. To use the **DHCP** feature, check **Enabled**.
4. In the **Interface** field, select the network interface from the drop-down including **eth0** and **wlan1**. **Note:** Interface field is read-only when you edit DHCP Server.
5. In the **Router Advertisement Mode,** select from the drop-down the DHCP IPv6 mode including **SLAAC** or **Stateless DHCP**.
6. In the **Lease Time** field, type the DHCP lease time. Lease time is set in days, hours, and minutes (dd-hh-mm). A Lease Time of 00-00-00 is an infinite lease time.
7. Click **Submit**. If you are finished making changes, click **Save and Apply**.

To add fixed addresses for the DCHP server, see **Assigning Fixed Addresses**.

Assigning Fixed Addresses

To add fixed addresses for the DCHP server make the changes under the **Fixed Addresses** section on the **DCHP Configuration** page:

1. In the **MAC Address** field, type the MAC address to which the specified IP address binds.
2. In the **IP Address** field, type the fixed IP address to be assigned.
3. Click **Add**.
4. To save your changes, click **Save and Apply**.

Configuring LLDP

Overview

Link Layer Discovery Protocol (LLDP) is a simple link layer protocol that allows an end device to announce itself to a neighboring switch or router.

It reports itself with a few basic characteristics, so it is easy to determine the exact location of the device. Thus, the benefits are that (switch) outlets can be quickly checked for proper connectivity, which greatly enhances and simplifies deployment and management for users.

The LLDP feature allows the network manager to see on the connected switch which device is connected to which port on the switch, how much power is being requested, what the IP address is, etc. Using this information, they can determine where the Conduit is located and, if necessary, remotely disconnect power to the Conduit in case of a PoE device.

Configuring LLDP

To configure and enable LLDP:

1. Go to **Setup > LLDP Configuration.**
2. Check **Enabled.**
3. Enter a **System Name** and **System Description** of up to 250 characters. Description is optional.
4. Enter a **TX Interval** between 5-32768 seconds. Default is 30.
5. Enter a **TX Hold** value between 2-10. Default is 4.

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6. Click **Submit.**
7. To save your changes, click **Save and Apply**.

Note:

- **TX Interval**, transmit interval, defines the interval between LLDP messages in seconds.
- **TX Hold**, transmit hold multiplier, helps define the total time used determine the LLDP message Time-to-Live (TTL). TTL is the interval in seconds for which the LLDP message remains valid and is stored in neighboring devices that discover the mPower device.
- **Example:** If TX interval is 30 seconds and the TX hold is 4. The LLDP message advertised TTL is 120 seconds.

Configuring SNMP

The device offers Simple Network Management Protocol (SNMP) which is used for collecting information from network devices on an IP network.

You also have the option to configure SNMP traps which are alerts sent from SNMP-enabled devices to an SNMP agent or manager typically providing device status or condition information.

You can also access the **MIB** file which is a management information base. This file is a formal description of a set of network objects managed using the Simple Network Management Protocol (SNMP). The format of the **MIB** is defined as part of the SNMP. (All other **MIBs** are extensions of this basic management information base.)

Click **Download MIB**, to download the MIB file.

To configure SNMP:

1. Go to **Setup > SNMP Configuration**.
2. Under **SNMP Server Configuration**, check **Enabled** to activate the SNMP server. Click **Submit**.
3. If needed, click **Add** under **Allowed IP Addresses** for **SNMP v1/v2c**.
4. Click **Add Server Configuration**.
   a. Make sure that **Enabled** is checked.
   b. Under **Version**, select from the drop-down either **SNMP v1/v2c** or **SNMP v3**.
   c. For **SNMP v1** and **SNMP v2c**:
      i. Enter the **Configuration Name** for your SNMP configuration.
      ii. Enter **Community String** which is a read-only string used to authenticate incoming SNMP requests.
   d. For **SNMP v3**:
      i. Enter the **Authentication Protocol** from the drop-down, including **NONE, MD5**, or **SHA1**.
      ii. Enter the **Security Name** which is a username used to authenticate incoming SNMP v3 requests. If you selected **MD5** or **SHA1** for Authentication Protocol:
         - Enter the **Authentication Password**, which is a password used to authenticate incoming SNMPv3 requests.
         - Confirm the password.
      iii. Enter the **Encryption Protocol** for SNMPv3 messages from the drop-down, including **NONE, DES** or **AES-128**. If you selected **DES or AES-128** for **Encryption Protocol**:

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- Enter the **Encryption Password**.
- Confirm the password.

e. Click **Submit**.

5. The **SNMP Configuration** list displays your recently added SNMP Server Configuration. To edit the configuration, click the pencil icon under **Options**.
6. To delete an existing configuration, click the trash can icon under **Options**.
7. To save your changes, click **Save and Apply**. Or continue to **SNMP Trap Destinations** and **Add Trap Destinations**.

To configure SNMP Traps:

1. Go to **Setup > SNMP Configuration > SNMP Trap Configuration**, check **Enabled** to enable sending SNMP traps on the device..
2. The engine ID displays to the right of **Enabled**. Modify the engine ID or use the default value.
3. Click **Submit.**
4. Click **Add Trap Destination**.

   a. Make sure that **Enabled** box is checked.
   b. Enter the **Destination Name.**
   c. Select from the drop-down the **Version** of SNMP (**SNMP v1/v2c** or **SNMP v3**).
   d. For **SNMP v1** or **SNMP v2c**

      i. Enter the **Destination IP Address**.
      ii. Enter the **Community String**.

   e. For **SNMPv3**:

      i. Enter the **Destination IP Address**.
      ii. Enter **Security Name**.
      iii. Enter the **Authentication Protocol** from the drop-down, including **NONE, MD5,** or **SHA1**. If you selected **MD5** or **SHA1** for **Authentication Protocol**:

         i. Enter the **Authentication Password**, which is a password used to authenticate incoming SNMPv3 requests.
         ii. Confirm the password.

      iii. Enter the **Encryption Protocol** for SNMPv3 messages from the drop-down, including **NONE, DES**, or **AES-128**. If you selected **DES** or **AES-128** for Encryption Protocol:

         i. Enter the **Encryption Password**.
         ii. Confirm the password.

   f. Click **Submit**.

5. The **SNMP Trap Destination** list displays your recently added SNMP Trap Destination. To edit the destination, click the pencil icon under **Options**.
6. To delete an existing destination, click the **trash can** icon under **Options**.
7. To save your changes, click **Save and Apply**.

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To download the MIB file:

1. Click **Download MIB** in the far right corner of the device display.
2. Download/save the file from your browser.

Configuring the Global Positioning System (GPS)

This GPS information applies only to the device models that support GPS.

Some devices have a built-in GPS receiver. If your device has a GPS receiver, the device can forward NMEA (National Marine Electronics Association) sentences from the GPS receiver to another device connected to the device. You can also send the GPS data over the network to a remote computer.

The key areas of GPS configuration include: **Server Configuration**, **Client Configuration** and **NMEA Configuration** along with **Current Position** information.

Notes:

- All enabled sentences are forwarded periodically using the interval specified in the **NMEA Configuration** section. Before forwarding, the device adds an ID prefix and ID to each enabled NMEA sentence. If set, the NMEA sentences available are those provided by the built-in receiver which are: GPGGA, GPGSA, GPGSV, GPGLL, GPRMC, GPVTG.
- You can simultaneously enable the TCP Server, and TCP/UDP client.

GPS Server Configuration

To setup the GPS Server Configuration:

1. Go to **Setup > GPS Configuration > Server Configuration**.
2. To enable server configuration, check **TCP Server**.
3. In the **Port** field, type the port number on which the TCP server is listening for connections. The default is **5445**. You can use up to five digits. Each digit itself must be between **0** and **9**. Numbers above **65,535** are illegal as the port identification fields are 16 bits long in the TCP header.
4. Enter **Password** and confirm **Password**.
5. Click **Submit**.
6. To save your changes, click **Save and Apply**.

Local Configuration

Dumping NMEA Sentence Information

Note: This feature requires installation and configuration of mCard Accessory Card (such as an MTAC-MFSER) into your device first.

To use the serial port to dump NMEA sentence information, you must first disable the serial port client/server.

1. Go to **Setup > Serial IP Configuration > Serial Port Settings** and set the mode to **Enabled**.
2. Go to **GPS Configuration > Local Configuration**, check **Serial Port Dump**.
3. **Submit**.
4. To save your changes, click **Save and Apply**.

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Sending GPS information to a remote server

The **Client Configuration** allows the device to connect to a remote server using the IP and port information for uploading GPS data.

1. To allow the device to connect, go to **Setup > GPS Configuration > Client Configuration**.
2. Check **TCP/UDP Client**.
3. From the **Protocol** drop-down list, select the protocol of the client (**TCP or UDP**).
4. In the **Remote Host** field, type the IP address of the remote host.
5. In the **Port**, field type the port number of the remote host.
6. If your remote host requests a password, type that password in the **Password** field. The password is sent to the server in response.
7. Click **Submit**.
8. To save your changes, click **Save and Apply**.

Configuring NMEA Sentences

To configure the time interval, additional prefix or ID information, and which NMEA sentences that can be sent:

1. Go to **Setup > GPS Configuration > NMEA Configuration**.
2. In the **Interval** field, type the amount of time, in seconds, that passes before the NMEA information is sent. The default is **10** seconds. The range is **1** to **255** seconds.
3. You can further identify the device, also called a remote asset, that is collecting and sending the GPS information. To do so:

   Add ID: The ID is an unique remote asset identification string. The ID string can be any length up to 20 characters. The *&* and *$* are invalid characters. The ID must follow the standard NMEA sentence structure.

   To add more information to the beginning of the ID, in the **Add ID Prefix** field, type the information.
4. Select which **NMEA Sentence** types you want to send. Select any combination of these options: **GGA, GSA, GSV, GLL, RMC,** and **VTG**.
5. Click **Submit**.
6. To save changes, click **Save and Apply.**

SMTP Settings

The following table lists the configuration fields in the SMTP window.

Field	Description
SMTP Configuration	
Enabled	Click to use the SMTP feature.
Server	Enter the SMTP server address.
Port	Enter the port number that the SMTP server uses.
Email	Enter the sender email address. This address will be added as the sender email address to the sent emails.
Username	Enter the name that can access the SMTP server.
Password	Enter the password that can access the SMTP server.

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Field	Description
Mail Log Settings	
Entries to Keep	Enter the desired number of mail log entries that are to be stored in the device. The range of values is **10** to **1000**. If you click **Submit**, this setting is not applied to the emails that are in progress or deferred. Note that logs are not saved on the device. Also, logs do not persist through power cycles.
Send a Test Email	
Address	To make sure that the SMTP is configured properly, enter a destination email address, then click **Send Test Email**.

Configuring the Serial Port in Serial IP Mode

This feature requires installation and configuration of mCard Accessory Card (such as an MTAC-MFSER) into your device first. To configure the serial terminal connected to the RS-232 connector on your accessory card:

1. Go to **Setup > Serial-IP Configuration >Serial Port Configuration**.
2. Under **General Configuration**, select the **Mode** from the drop-down including **Disabled** (default), **Serial IP**, or **Modbus RTU/TCP Gateway.*** **Disabled** means that **Serial-IP** and **Modbus Gateway** are both disabled. However, you can configure the serial port which can be used by other features like GPS. **NOTE:** If you want to use **Modbus Gateway,** you may have the TCP connection encrypted with TLS. Make sure to check **Protocol** under **IP Pipe** and select **SSL/TLS**.
3. If **Serial-IP** is enabled in **Mode** under **General Configuration**, then under **IP Pipe:**
   a. Select from the Mode drop-down including **SERVER** or **CLIENT**.
   b. Select from the **Protocol** drop-down including **UDP, TCP, or SSL/TLS**.
   c. Enter **Server IP Address**.
   d. Enter **Server Port**.
   e. Enter **Secondary Server IP Address** (optional).
   f. Enter **Secondary Server Port** (optional).
4. If **Modbus RTU/TCP Gateway** is enabled in **Mode** under **General Configuration,** then under **Protocol**, select the **Standard** from the drop-down including **RS-232**, **RS-485 HALF-DUPLEX**, and **RS-485 FULL DUPLEX**. If you select either RS-485 option:
   a. Make sure you have the proper cable for half or full duplex, otherwise it will not work properly.
   b. If the device is the first or last in the chain, click the checkbox to enable **RS-485 Termination.**
5. From the **Baud Rate** drop-down list, select the baud-rate at which the serial terminal communicates. The default is **115200**.
6. From the **Flow Control** drop-down list, select the flow control for the serial port. The options are **NONE** or **RTS-CTS**. The default is **NONE**.
7. From the **Parity** drop-down list, select the parity for the serial port. The options are **NONE, EVEN,** or **ODD**. The default is **NONE**.
8. From the **Data Bits** drop-down list, select the data bits for the serial port. Data bit options are **7** or **8**. The default is **8**.

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9. From the **Stop Bits** drop-down list, select the stop bits for the serial port. The options are **1** or **2**. The default is 1.
10. Click **Submit**.
11. To save your changes, click **Save and Apply**.

***Note on Modbus RTU/TCP Gateway:** This feature was developed for a specific application/use case where a Modbus RTU slave is connected to the Serial Port and a remote Modbus TCP Master. The Modbus Gateway application works as a translator between Modbus RTU (slave) and Modbus-TCP (master) devices.Without Modbus Gateway enabled, the Serial-IP feature simply passes raw data between the serial DB9 interface and the socket representing the TCP connection in the system to a configured remote device. When the Modbus Gateway is enabled, its application runs in the system. The application works as a translator converting between the Modbus-TCP and Modbus RTU protocols. The Modbus Gateway passes data between an RTU connected to the serial port and a Modbus TCP remote client/server. The Modbus Gateway and the Serial-IP features cannot work simultaneously.

Configuring Device to Act as Client for Serial IP

You can set up the device to act as a client.

The TCP, UDP, SSL/TLS client feature enables the device to act as a proxy TCP, UDP, or SSL/TLS client to the serial terminal connected to the RS-232 port on the device. This helps the serial terminal access any TCP, UDP, or SSL/TLS server on the LAN/WAN allowing two-way traffic between the serial device and the remote server.

To use this function, make sure you set a valid **Mode** under **Serial-IP Configuration** (i.e. **Mode** is not **Disabled**). To configure the IP Pipe in TCP, UDP, SSL/TLS server mode:

1. Go to **Setup > Serial-IP Configuration > Serial Port Settings > IP Pipe** group.
2. From the **Mode** drop-down list, select **CLIENT**.
3. From the **Protocol** drop-down list, select the desired protocol: **TCP**, **UDP**, or **SSL/TLS**.
4. In the **Server IP Address** field, enter the address of the far-end TCP, UDP, or SSL/TLS server.
5. In the **Server Port** field, enter the port value used by the far-end TCP, UDP, or SSL/TLS server.
6. If the primary server is unavailable, in the **Secondary IP Address** field, enter the address of the alternate TCP, UDP, or SSL/TLS server.
7. If the primary server is unavailable, in the **Secondary Port** field, enter port number value of the alternate TCP, UDP, or SSL/TLS server.
8. From the **Connection Activation** drop-down list, select a connection method. Options are:

   ALWAYS-ON.

   DTR-ASSERT. When the DTR signal is asserted, the connection is established.

   CR. Three carriage returns must be received before the TCP, UDP, or SSL/TLS connection is established to the remote server.

   ON-DEMAND. Set the connection as available on-demand.
9. From the **Connection Termination** drop-down list, select a disconnect method for the IP pipe. Options are:

   ALWAYS-ON.

   TIMEOUT. The IP pipe connection disconnects if the configured timer expires with no data sent or received. In the **Timeout** field, enter the desired number of seconds for this timeout. The valid timeout range is from **0 to 900 seconds**. Timeout of zero seconds disables the timeout and it is equivalent to **ALWAYS-ON**.

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SEQUENCE. A sequence of received characters disconnects the IP pipe.

DTR-TOGGLE. When the DTR control signal is toggled, the IP pipe disconnects.

10. In the **Buffer Timeout** field, enter the timeout after which data is sent to the network if the buffer is not full (in milliseconds).
11. In the **Buffer Size** field, enter the size of the buffer for reading data from the serial port and sending to the network (in bytes). Data is sent when the buffer is full.
12. Click **Submit**.
13. To save your changes, click **Save and Apply**.

To configure security settings:

1. Make sure you select **SSL/TLS** under **Protocol**.
2. Under **Security Settings**, click the **Show** to the right.
3. Select any TLS version. Check **TLSv1.3, TLSv1.2** and/or **TLSv1.1 (deprecated)**. Default: **TLSv1.3** and **TLSv1.2** are enabled.
4. Check any preferred Cipher Suite from the following list: **TLS_AES_256_GCM_SHA384, TLS_CHACHA20_POLY1305_SHA256, TLS_AES_128_GCM_SHA256, ECDHE-RSA-AES256-GCM-SHA384, ECDHE-RSA-AES128-GCM-SHA256,TLS_AES_128_GCM_SHA256,** and also including the following deprecated ciphers: **ECDHE-RSA-AES256-GCM-SHA384, ECDHE-RSA-AES256-SHA, DHE-RSA-AES256-GCM-SHA384, AES256-SHA, ECDHE-RSA-AES128-GCM-SHA256, ECDHE-RSA-AES128-SHA, DHE-RSA-AES128-GCM-SHA256, DHE-RSA-AES128-SHA,** and/or **AES128-SHA.** Default: **All.** (You can also set the priority order of the ciphers).
5. Click **Submit**.
6. To save your settings, click **Save and Apply**.

Configuring Device to Act as Server for Serial IP

You can set up the device to act as a server.

The TCP, UDP, SSL/TLS server feature enables a TCP, UDP, SSL/TLS client on the Ethernet network to connect to the remote serial terminal that is connected to the RS-232 port on the device. The device acts as a TCP, UDP, SSL/TLS server which allows two-way traffic between the TCP, UDP, SSL/TLS client and the remote terminal on the serial port.

To use this function, make sure you set a valid **Mode** under **Serial-IP Configuration** (i.e. **Mode** is not **Disabled**). To configure the IP Pipe in TCP, UDP, SSL/TLS server mode:

1. Go to **Setup > Serial-IP Configuration > Serial Port Settings > IP Pipe** group.
2. In the **Mode** drop-down list, select **SERVER**.
3. From the **Protocol** drop-down list, select the desired protocol: **TCP**, **UDP**, or **SSL/TLS**.
4. In the **Buffer Timeout** field, enter the timeout after which data is sent to the network if the buffer is not full (in milliseconds).
5. In the **Server Port** field, type the desired port value in the range **1** to **65535**.
6. In the **Buffer Size** field, enter the size of the buffer for reading data from the serial port and sending to the network (in bytes). Data is sent when the buffer is full.
7. From the **Connection Termination** drop-down list, select a disconnect method for the IP pipe. Options are:

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ALWAYS-ON.

TIMEOUT. The IP pipe connection disconnects if the configured timer expires with no data sent or received. In the **Timeout** field, enter the desired number of seconds for this timeout. The valid timeout range is from **0 to 900 seconds**. Timeout of zero seconds disables the timeout and it is equivalent to ALWAYS-ON.

SEQUENCE. A sequence of received characters disconnects the IP pipe.

DTR-TOGGLE. When the DTR control signal is toggled, the IP pipe disconnects.

8. Click **Submit**.
9. To save your changes, click **Save and Apply**.

To configure security settings:

1. Make sure you select **SSL/TLS** under **Protocol**.
2. Under **Security Settings**, click the **Show** to the right.
3. Select any **TLS version**. Check **TLSv1.3, TLSv1.2** and/or **TLSv1.1 (deprecated)**. Default: **TLSv1.3** and **TLSv1.2** are enabled.
4. Check any **Cipher Suite** from the following list: **TLS_AES_256_GCM_SHA384, TLS_CHACHA20_POLY1305_SHA256, TLS_AES_128_GCM_SHA256, ECDHE-RSA-AES256-GCM-SHA384, ECDHE-RSA-AES128-GCM-SHA256,TLS_AES_128_GCM_SHA256**, and also including the following deprecated ciphers: **ECDHE-RSA-AES256-GCM-SHA384, ECDHE-RSA-AES256-SHA, DHE-RSA-AES256-GCM-SHA384, AES256-SHA, ECDHE-RSA-AES128-GCM-SHA256, ECDHE-RSA-AES128-SHA, DHE-RSA-AES128-GCM-SHA256, DHE-RSA-AES128-SHA**, and/or **AES128-SHA**. Default: **All.**
5. Click **Submit**.
6. To save your settings, click **Save and Apply**.

Time Configuration

You can configure how your device manages the setting of time on its domain of systems. As a default, the date and time corresponds to the operating system regional settings. But you can change this configuration. Set the date and time manually or configure the device to get this information from an SNTP server or from the cellular network.

Setting the Date and Time

To set the device's date and time:

1. From **Setup**, select **Time Configuration**.
2. In the **Date** field, select today's date from the pop-up calendar that opens.
3. In the **Time** field, type the time (24-hour).
4. From the **Time Zone** drop-down list, select your time zone. The default selection is UTC (Universal Coordinated Time, Universal Time).

   Note: To learn more about time zones, visit the following website : http://www.https://greenwichmeantime.com/time-zone/

5. Click **Submit**. Your updated time settings display under **Current**.
6. To save your changes, click **Save and Apply**.

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Configuring SNTP Client to Update Date and Time

To configure the server from which the SNTP date and time information is taken, and how often:

1. To enable SNTP to update the date and time, check **Enabled**.
2. In the **Polling Time** field, type the time that passes (in minutes), after which the SNTP client requests the server to update the time. Default is 120 minutes.
3. In the **Server** field, type the SNTP server name or IP address that is contacted to update the time.
4. In the **Backup Server 1 - 4** fields, you may enter the SNTP server name or IP address of up to four backup SNTP servers. These fields are optional.
5. Click **Submit**.
6. To save your changes, click **Save and Apply**.

Cellular Time

This feature allows you to configure the device to update the date and time from the cellular network and specify how often to do so.

To use cellular network to update the date and time:

.

1. For Cellular Time, select **Enabled**.
2. In the **Polling Time** field, type the time that passes, after which the device requests to update the time from the cellular network. The range is 5-1440 minutes. Default is 120 minutes. You must enter time in minutes.
3. Click **Submit.**
4. To save your changes, click **Save and Apply.**

Note: For L4G1 devices on the Verizon network, Quectel radio firmware version EG25GGBR07A08M2G_01.002.01.002 reports the year incorrectly. Updating Quectel radio firmware to version EG25GGBR07A08M2G_30.004.30.004 corrects the issue. An incorrect device date invalidates CA and Server certificates and causes connection issues. Verify the date is correct before leaving this feature enabled.

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Chapter 7 – Wireless

Wi-Fi Access Point

If you ordered a device with Wi-Fi capability, it can be configured as a wireless access point (AP). This allows Wi-Fi enabled devices to connect to your device using Wi-Fi. The Wi-Fi access point can have up to 5 clients at a time. To set up your device as an access point:

Note: mPower does not support concurrent wireless mode, if Wi-Fi as WAN, Bluetooth IP, or Bluetooth Low Energy is enabled, you can't enable Wi-Fi Access Point.

1. Go to **Wireless > Wi-Fi Access Point**.
2. To enable Wi-Fi Access Point mode, select **Enabled**.
3. To set the SSID (service set identifier) for the access point supported by your device, in the **SSID** field, type the name. The Wi-Fi devices look for this ID in order to join the wireless network. All wireless devices on a WLAN must use the same SSID in order to communicate with the access point.
4. To specify the data rates supported, in the **Network Mode** drop-down list, select the desired option. Possible values are B/G/N-Mixed, B/G-Mixed, B-Only, and N-Only.
5. From the **Channel** drop-down list, select the channel on which the device operates. Channels 1-11 are available.
6. In the **Beacon Interval** field, enter the period of time, in milliseconds, when the access point sends a beacon packet. Beacons help synchronize a wireless network. For most applications, the default value of 100 provides good performance.
7. In the **DTIM Interval** field, enter how often a beacon frame includes a Delivery Traffic Indication Message, and this number is included in each beacon frame. It is generated within the periodic beacon at a frequency specified by the DTIM Interval. A delivery traffic indication message is a kind of traffic indication message (TIM) which informs the clients about the presence of buffered multicast/broadcast data on the access point. The default value of 1 provides good performance for most applications. You might want to increase this value when using battery powered Wi-Fi devices, which can sleep (at reduced power consumption) during the longer DTIM interval period. You must balance the power savings from increasing the DTIM interval against possible reduced communication throughput.
8. In the **RTS Threshold** field, type the frame size at which the AP transmissions must use the RTS/CTS protocol. This is often used to solve hidden node problems. Using a small value causes RTS packets to be sent more often, consuming more of the available bandwidth. However, the more RTS packets that are sent, the quicker the system can recover from interference or collisions.

For related information, see Setting Security Options and Viewing Information About Wi-Fi Clients Using Your Wireless Network.

Setting Security Options

Specify the security protocol that your device uses to secure the communications from it to the connected devices under **Security Options**.

1. From the **Mode** drop-down list, select the security protocol you want to use. Options include:

   None

   WEP: Use Wired Equivalent Privacy protocol to allow a group of devices on the network to exchange coded messages.

   WPA-PSK: Use Wi-Fi protected access to secure data exchanged on your network.

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WPA2-PSK: Use Wi-Fi protected access version 2 to secure data exchanged on your network.

WPA/WPA2-PSK: Use Wi-Fi protected access version 1 and 2 to secure data exchanged on your network.

2. To select **WEP** mode:
   a. From the **Encryption** drop-down list, select the encryption to be used. Choose from **64 bit 10 hex digits** or **128 bit 26 hex digits**.
   b. To generate a key from a phrase, in the **Passphrase** field, type a phrase. Click **Generate**.
   c. To manually enter keys, type the keys in the Key 1, Key 2, Key 3 or Key 4 fields.
3. To select **WPA-PSK, WPA2-PSK** or **WPA-PSK/WPA2-PSK** modes:
   a. Select the WPA Algorithm from the drop-down list. Choose from **TKIP, AES** or **TKIP+AES**.
   b. In the **Shared Key** field, type the key that is used for encrypting and decrypting the data.
   c. To remove the mask characters, thereby making the Shared Key visible, check **Unmask**.
4. When done, click **Submit**.
5. To save your changes, click **Save and Apply**.

Viewing Information About Wi-Fi Clients Using Your Wireless Network

To view information about clients (such as computers, tablets, and smart phones) that are connected to your device's Wi-Fi access point:

1. The Clients group displays a list of clients using your device's Wi-Fi.
2. To update the list, click **Refresh**.

Wi-Fi as WAN

To setup the device's Wi-Fi as WAN (aka Wi-Fi Station):

Note: mPower does not support concurrent wireless mode, if Wi-Fi Access Point, Bluetooth IP, or Bluetooth Low Energy is enabled, you can't enable Wi-Fi as WAN.

1. Go to **Wireless > Wi-Fi as WAN.**
2. To enable Wi-Fi as WAN mode, check **Enabled**. (**Note:** After you enable or disable **Wi-Fi as WAN** and apply that change, the device reboots.)
3. Click **Save and Apply**. **Note**: **Save and Apply** the device to get a list of available Wi-Fi Networks.
4. Go to **Wireless > Wi-Fi as WAN**.
5. Searching for available Wi-Fi networks starts automatically. After 30 to 60 seconds, a list of detected Wi-Fi Access Points appears in the **Available Networks** group.
6. In the **Available Wi-Fi Networks** group, click the SSID for the Wi-Fi access point you want to use. The **Add Saved Network** window opens. Here are the available fields to enter information:

   Network Name

   Hidden Network(only check if your target network is currently hidden)

   SSID

   BSSID: Service Set Identifier for wireless LAN (unique identifier for BSS)

   Security Mode: None, WEP, WPA, WPA-PSK, WPA-2, or **WPA-2-PSK**

   Username

   Password

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Unmask (Check, Uncheck)

WPA Algorithm: TKIP, +AES, TKIP, or **AES**

Shared Key

Key Index: 0 - 3

Network Key

IEEE 802.1x

7. Review the information, enter any required security info, then click **Finish**. The Wi-Fi access point you just added appears in the **Saved Wi-Fi Networks** group.
8. If desired, add additional access points to the list of Saved Networks. The device tries to connect to **Saved Wi-Fi Networks** in the order they are listed. You can change the order by clicking the up or down arrows shown under **Options**.
9. When finished, click **Save and Apply**. The Status field displays "Connected" if you have successfully connected to the Wi-Fi access point.

Note 1: You cannot edit the network name and you cannot delete a network if it is used in another configuration.

Note 2: MTCDT3AC supports Concurrent WiFi Mode (i.e. Concurrent Wi-Fi Access Point and Wi-Fi as WAN at 5G).

Setting up Bluetooth

The Bluetooth-IP feature allows a data connection between a remote TCP/UDP client or server and a local Bluetooth device. To set up the Bluetooth connection:

Note: mPower does not support concurrent wireless mode, if Wi-Fi Access Point, Wi-Fi as WAN, or Bluetooth Low Energy is enabled, you can't enable Bluetooth-IP.

1. Go to **Wireless > Bluetooth-IP**
2. To enable the feature, check **Enabled**. Click **Submit**.
3. Confirm that the far-end Bluetooth device is powered on and waiting for a connection.
4. In the **Available Devices** group, click **Refresh**. A list of detected Bluetooth devices appears.
5. Click the name of the Bluetooth device that you want to use. The name and MAC address appear under the **Selected Device**.
6. To add a device, click **Add Device** and enter the device name and the **MAC address**.
7. Click **Finish**.
8. To save your changes, click **Save and Apply**.

Note: You cannot edit the network name and you cannot delete a network if it is used in another configuration.

IP Pipe in TCP/UDP Server mode

1. In the **IP Pipe** group, from the **Mode** drop-down list, select **SERVER**.
2. From the **Protocol** drop-down list, select the desired protocol, either **TCP** or **UDP**.
3. In the **Server Port** field, type the desired port value in the range **1** to **65535**.
4. From the **Connection Termination** drop-down list, select a disconnect method for the IP pipe. Options are:
   - **ALWAYS-ON**
   - **SEQUENCE:** A sequence of characters received from the Bluetooth side used to disconnect the IP pipe.

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- **TIMEOUT:** The IP pipe connection disconnects if the configured timer expires with no data sent or received. A timeout of zero seconds disables the timeout, it is equivalent to **ALWAYS-ON**.

To configure the IP Pipe in TCP/UDP Client mode

1. In the **IP Pipe** group, from the **Mode** drop down list, select **CLIENT**.
2. From the **Protocol** drop-down list, select the desired protocol, either **TCP** or **UDP**.
3. In the **Server IP Address** field, type the address of the far-end TCP-UDP server.
4. In the **Server Port** field, type the port value used by the far-end TCP/UDP Server.
5. In case the primary server is unavailable, in the **Secondary IP Address** field and in the **Secondary Port** field, type the IP address and port number, respectively, of the alternate TCP/UDP server.
6. From the **Connection Activation** drop-down list, select a connection method. Options are:
   - **ALWAYS-ON**
   - **ON-DEMAND**
   - **CR:** Three carriage returns must be received from the Bluetooth side before TCP/UDP connection is established to the remote server.
7. From the **Connection Termination** drop-down list select a disconnect method for the IP pipe. Options are:
   - **ALWAYS-ON:**
   - **TIMEOUT:** The IP pipe connection disconnects if the configured timer expires with no data sent or received. A timeout of zero seconds disables the timeout, it is equivalent to **ALWAYS-ON**.
   - **SEQUENCE:** A sequence of characters received from the Bluetooth side used to disconnect the IP pipe.
8. Click **Submit**.
9. To save your changes, click **Save and Apply**.
   - The device immediately connects to the local Bluetooth device. If successful the **Status** field displays **Connected**. If **IP Pipe** is configured for **SERVER**, the IP connection is initiated by the far-end TCP/UDP client.
   - If **Mode** is set to **CLIENT**, the device initiates connections for the far-end TCP/UDP server based on the configured **Connection Activation** conditions are met.

To configure security settings:

1. Make sure you select **SSL/TLS** under **Protocol**.
2. Under **Security Settings**, click the **Show** to the right.
3. Select any TLS version. Check **TLSv1.3, TLSv1.2** and/or **TLSv1.1 (deprecated)**. Default: **TLSv1.3** and **TLSv1.2** are enabled.
4. Check any preferred Cipher Suite from the following list: **TLS_AES_256_GCM_SHA384, TLS_CHACHA20_POLY1305_SHA256**, **TLS_AES_128_GCM_SHA256, ECDHE-RSA-AES256-GCM-SHA384, ECDHE-RSA-AES128-GCM-SHA256,TLS_AES_128_GCM_SHA256,** and also including the following deprecated ciphers: **ECDHE-RSA-AES256-GCM-SHA384, ECDHE-RSA-AES256-SHA, DHE-RSA-AES256-GCM-SHA384, AES256-SHA, ECDHE-RSA-AES128-GCM-SHA256, ECDHE-RSA-AES128-SHA, DHE-RSA-AES128-GCM-SHA256, DHE-RSA-AES128-SHA,** and/or **AES128-SHA.** Default: **All**.
5. Click **Submit**.
6. To save your settings, click **Save and Apply**.

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Bluetooth Low Energy (BLE)

Bluetooth Low Energy allows you to search and/or scan for BLE devices. You can connect with selected BLE device to obtain the list of UUIDs for services and characteristics that are supported on the device.

> **Note:** mPower does not support concurrent wireless mode, if Wi-Fi Access Point, Wi-Fi as WAN, or Bluetooth Low Energy is enabled, you can't enable Bluetooth-IP.

A python library called gattlib is integrated into the device and can be used for scans, reads, writes, and handling notifications.

You must develop a custom application to read and accept the data from a BLE device. Please refer to the example on the BLE for mLinux page as well as the Creating a Custom Application page.

1. Go to **Wireless > Bluetooth Low Energy > Settings**, check the **Enabled** box.
2. Under **Power Mode**, select from the drop-down including **Custom, High, Medium** or **Low**.
3. Click **Submit.**
4. Under the **Available Device Servers**, the detected BLE devices appear.
5. To choose a device from the **Available Device Servers**, click on the name of your desired device.
6. If you do not see your desired device, click **Add Device.** Enter the **Name** and **MAC Address** of your BLE device.
7. Click **OK**. Your device appears under **Saved Devices**.
8. Click **Save and Restart** to save your changes.

You may also restart BLE by clicking **Reset Bluetooth** above **Saved Devices** section.

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Chapter 8 – Firewall

Normal Firewall Settings

The device's firewall enforces a set of rules that determine how incoming and outgoing packets are handled. By default, all outbound traffic originating from the LAN is allowed to pass through the firewall, and all inbound traffic originating from external networks is dropped. This effectively creates a protective barrier between the LAN and all other networks.

Go to **Firewall > Settings** to see the current firewall configuration. The firewall's **Normal Settings** mode (default) lets you manipulate and add **DNAT, SNAT,** and **Filter** rules directly. **DNAT** rules can manipulate the destination address and port of a packet; similarly **SNAT** rules can manipulate the source address and port of a packet. We recommend using these normal settings. Filter rules apply an **ACCEPT, REJECT, DROP**, or **LOG** action to a packet. **DNAT, SNAT,** and **Filter** rules can be associated if they are named the same.

The firewall is built on top of iptables. The different rule groups correspond to their respective chains in iptables.

Note: As a best security practice, the device employs minimum firewall rules by default. This means by default the device allows all outbound traffic from it in the **Output Filter Rules**. (Traffic through the device is handled by the **Port Forwarding Rules**.) But all traffic to the device via WAN interfaces is blocked by default in the Input Filter Rules. Users may create their own specific and targeted input filter rules to allow certain traffic to the device based on their specific needs.

- Adding Prerouting Rules
- Input Filter Rules
- Forward Filter Rules
- Output Filter Rules
- Adding Postrouting Rules
- Legacy Settings

Prerouting Rule

Add a DNAT rule

To add prerouting or DNAT rule to your firewall:

1. Go to **Firewall > Settings** to display the **Firewall** window.
2. In the **Prerouting Rules** group, click **Add DNAT Rule**.
3. In the **Filter Rule** section, enter a name for the rule and optionally, a description.
4. In the **Destination IP** field, enter the destination IP address that applies to this rule.
5. In the **Destination Port** field, enter the destination port that applies to this rule. If there is a range of ports, the ending port is automatically set.
6. In the **Destination Mask** field, enter the subnet mask of the destination that applies to this rule.
7. In the **Destination Interface** field, select the interface used by the destination that applies to this rule from the drop-down menu. Select from **ANY, LAN, WAN, ETHERNET, CELLULAR, WI-FI WAN, WI-FI AP,** or **OPENVPN**.
8. In the **Source IP** field, enter the source IP address that applies to this rule.
9. In the **Source Port** field, enter the source port that applies to this rule.
10. In the **SourceMask** field, enter source subnet mask that applies to this rule.

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11. In the **SourceMAC** field, enter the source MAC address for the device that applies to this rule.
12. In the **SourceInterface** field, select the source interface that applies to this rule from the drop-down menu. Select from **ANY, LAN, WAN, ETHERNET, CELLULAR, WI-FI WAN, WI-FI AP,** or **OPENVPN**.
13. In the **Protocol** drop-down list, select the protocol of the messages that apply to this rule. Select from **TCP/UDP**, **TCP**, **UDP**, or **ANY**.
14. In the **NAT IP** field, enter the local IP address for the Network Address Translation.
15. In the **NAT Port** field, enter the port used for the Network Address Translation.
16. **Check Enable NAT Loopback if you want to redirect LAN packets destined for the WAN's public IP address.**
17. Click **Submit**.
18. To save your changes, click **Save and Apply**.

Input Filter Rules

To add an input filter rule to your firewall:

1. Go to **Firewall > Settings** to display the **Firewall** window.
2. In the **Input Filter Rules** group, click **Add Rule**.
3. In the **Filter Rule** section, enter a name for the rule and optionally, a description.
4. In the **Destination IP** field, enter the destination IP address that applies to this rule.
5. In the **Destination Port** field, enter the destination port that applies to this rule. If there is a range of ports, the ending port is automatically set.
6. In the **Destination Mask** field, enter the subnet mask of the destination that applies to this rule.
7. In the **Destination Interface** field, select the interface used by the destination that applies to this rule from the drop-down menu. Select from **ANY, LAN, WAN, ETHERNET, CELLULAR, WI-FI WAN, WI-FI AP,** or **OPENVPN**.
8. In the **Source IP** field, enter the source IP address that applies to this rule.
9. In the **Source Ports** field, enter the source port range that applies to this rule.
10. In the **Source Mask** field, enter source subnet mask that applies to this rule.
11. In the **Source MAC** field, enter the source MAC address for the device that applies to this rule.
12. In the **Source Interface** field, select the source interface that applies to this rule from the drop-down menu. Select from **ANY, LAN, WAN, ETHERNET, CELLULAR, WI-FI WAN, WI-FI AP,** or **OPENVPN**.
13. In the **Protocol** drop-down list, select the protocol of the messages that apply to this rule. Select from **TCP/UDP**, **TCP**, **UDP**, or **ANY**.
14. In the **Chain** field, select the grouping based on the type of traffic affected by the rule from the drop-down menu. Select from **INPUT, FORWARD,** or **OUTPUT**.
15. In the **Target** field, select the desired action of the firewall based on this rule from the drop-down menu. Choose from **ACCEPT, REJECT, DROP,** or **LOG**.
16. Click **Submit**.
17. To save your changes, click **Save and Apply**.

Forward Filter Rules

This page defines rules for forward filtering of connections and data.

1. Go to **Firewall > Settings** to display the **Firewall** window.
2. Click **Add Rule** in the **Forward Filter Rules** section.

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3. Enter a name for the rule and optionally, a description.
4. In the **Destination IP** field, type the IP address of the device or network that packets are to be sent to. Type **ANY** if the destination address does not matter.
5. In the **Destination Port** field, type the port packets are destined for. Common destination ports are listed in the Destination Port field's attached drop-down list. Type **ANY** if the destination port does not matter.
6. In the **Destination Mask** field, type the network mask of the destination network.
7. In the **Destination Interface** field, select the interface used by the destination that applies to this rule from the drop-down menu. Select from **ANY, LAN, WAN, ETHERNET, CELLULAR, WI-FI WAN, WI-FI AP,** or **OPENVPN.**
8. In the **Source IP** field, type the IP address of the device or network that the traffic originates from. Type **ANY** if the source address does not matter.
9. In the **Source Port** field, type the port that is the origin of the traffic. Type **ANY** if the source port does not matter.
10. In the **Source Mask** field, type a network mask for the origin of the traffic.
11. In the **Source MAC** field, enter the source MAC address for the device that applies to this rule.
12. In the **Source Interface** field, select the source interface that applies to this rule from the drop-down menu. Select from **ANY, LAN, WAN, ETHERNET, CELLULAR, WI-FI WAN, WI-FI AP,** or **OPENVPN**.
13. In the **Protocol** drop-down list, select the protocol of the messages that apply to this rule. Select from **TCP/UDP**, **TCP**, **UDP**, or **ANY**.
14. In the **Chain** field, this parameter is the grouping based on the type of traffic affected by the rule from the drop-down menu. Keep this field as **FORWARD**.
15. In the **Target** field, select the desired action of the firewall based on this rule from the drop-down menu. Choose from **ACCEPT, REJECT, DROP,** or **LOG**.
16. Click **Submit**.
17. To save your changes, click **Save and Apply**.

Output Filter Rules

To prevent a device within the LAN from communicating with a device in an external network, you must establish a firewall rule to drop packets destined to the external device.

1. Go to **Firewall > Settings** to display the **Firewall** window.
2. Click **Add Rule** in the **Output Filter Rules** section.
3. Enter a **Name** for the rule and optionally, a **Description**.
4. In the **Destination IP** field, type the IP address of the device or network that packets are to be sent to. Type **ANY** if the destination address does not matter.
5. In the **Destination Port** field, type the port for which that the packets are destined. Common destination ports are listed in the Destination Port field's attached drop-down. Type **ANY** if the destination port does not matter.
6. In the **Destination Mask** field, type the network mask of the destination network.
7. In the **Destination Interface** field, select the interface used by the destination that applies to this rule from the drop-down. Select from **ANY, LAN, WAN, ETHERNET, CELLULAR, WI-FI WAN, WI-FI AP,** or **OPENVPN**.
8. In the **Source IP** field, type the IP address of the device or network that the traffic originates from. Type **ANY** if the source address does not matter.

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9. In the **Source Port** field, type the port that is the origin of the traffic. Type **ANY** if the source port does not matter.
10. In the **Source Mask** field, type a network mask for the origin of the traffic.
11. In the **SourceMAC** field, enter the source MAC address for the device that applies to this rule.
12. In the **Source Interface** field, select the source interface that applies to this rule from the drop-down. Select from **ANY, LAN, WAN, ETHERNET, CELLULAR, WI-FI WAN, WI-FI AP,** or **OPENVPN**.
13. From the **Protocol** drop-down, select the protocol of the messages that apply to this rule. Choose from **TCP/UDP**, **TCP**, **UDP**, or **ANY**.
14. In the **Chain** field, select the grouping based on the type of traffic affected by the rule from the drop-down. Select from **INPUT, FORWARD,** or **OUTPUT**.
15. In the **Target** field, select the desired action of the firewall based on this rule from the drop-down. Choose from **ACCEPT, REJECT, DROP,** or **LOG**.
16. Click **Submit**.
17. To save your changes, click **Save and Apply**.

Postrouting Rule

Add a SNAT rule

To add postrouting or SNAT rule to your firewall:

1. Go to **Firewall > Settings** to display the **Firewall** window.
2. In the **Postrouting Rules** group, click **Add SNAT Rule**.
3. In the **Postrouting Rule** section, enter a name for the rule and optionally, a description.
4. In the **Destination IP** field, enter the destination IP address that applies to this rule.
5. In the **Destination Port** field, enter the destination port that applies to this rule. If there is a range of ports, the ending port is automatically set.
6. In the **Destination Mask** field, enter the subnet mask of the destination that applies to this rule.
7. In the **Destination Interface** field, select the interface used by the destination that applies to this rule from the drop-down menu. Select from **ANY, LAN, WAN, ETHERNET, CELLULAR, WI-FI WAN, WI-FI AP,** or **OPENVPN**.
8. In the **Source IP** field, enter the source IP address that applies to this rule.
9. In the **Source Port** field, enter the source port that applies to this rule.
10. In the **SourceMask** field, enter source subnet mask that applies to this rule.
11. In the **SourceInterface** field, select the source interface that applies to this rule from the drop-down menu. Select from **ANY, LAN, WAN, ETHERNET, CELLULAR, WI-FI WAN, WI-FI AP,** or **OPENVPN**.
12. In the **Protocol** drop-down list, select the protocol of the messages that apply to this rule. Select from **TCP/UDP**, **TCP**, **UDP**, or **ANY**.
13. In the **NAT IP** field, enter the public IP address for the Network Address Translation.
14. In the **Target** field, select the desired action of the firewall based on this rule from the drop-down menu. Choose from **SNAT** or **MASQUERADE**.
15. In the **NAT Port** field, enter the port used publicly for the Network Address Translation.
16. Click **Submit**.
17. To save your changes, click **Save and Apply**.

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Adding Port Forwarding Rules

For a device within the LAN to be visible from the internet or from an outside network, create a forwarding rule to allow incoming packets to reach the device.

1. Go to **Firewall > Settings** to display the **Firewall** window.
2. In the **Port Forwarding** group, click **Add Rule**.
3. In the **Filter Rule section**, enter a name for the rule and optionally, a description.
4. In the **Destination IP** field, enter the destination IP address that applies to this rule.
5. In the **Destination Port** field, enter the destination port that applies to this rule. If there is a range of ports, the ending port is automatically set.
6. In the **Destination Mask** field, enter the subnet mask of the destination that applies to this rule.
7. In the **Destination Interface** field, select the interface used by the destination that applies to this rule from the drop-down menu. Select from **ANY, LAN, WAN, ETHERNET, CELLULAR, WI-FI WAN, WI-FI AP,** or **OPENVPN.**
8. In the **Source IP** field, enter the source IP address that applies to this rule.
9. In the **Source Ports** field, enter the source port range that applies to this rule.
10. In the **Source Mask** field, enter source subnet mask that applies to this rule.
11. In the **Source MAC** field, enter the source MAC address for the device that applies to this rule.
12. In the **Source Interface** field, select the source interface that applies to this rule from the drop-down menu. Select from **ANY, LAN, WAN, ETHERNET, CELLULAR, WI-FI WAN, WI-FI AP,** or **OPENVPN**.
13. In the **Protocol** drop-down list, select the protocol of the messages that apply to this rule. Select from **TCP/UDP**, **TCP**, **UDP**, or **ANY**.
14. In the **Chain** field, select the grouping based on the type of traffic affected by the rule from the drop-down menu. Select from **INPUT, FORWARD,** or **OUTPUT**.
15. In the **Target** field, select the desired action of the firewall based on this rule from the drop-down menu. Choose from **ACCEPT, REJECT, DROP,** or **LOG**.
16. Click **Submit**.
17. To save your changes, click **Save and Apply**.

A default filter allowing forwarded packets through the firewall is automatically created. If desired, you can use the **Advanced Settings** mode of the Port Forwarding configuration to further restrict packets based on source address and source ports using the **Inbound Filter Rule**. In most cases, this is not necessary.

Trusted IP

Trusted IP is a simplified interface to create iptables rules to allow or block specific IPs, IP ranges, or subnets. This feature allows users to create whitelists (which are allowed or trusted IPs) or black lists (which are blocked or unwanted IPs). You can add, edit, and delete IP addresses as needed.

If you select **White List** as **Trusted IP Mode** and you do not set any IP range, no traffic will be allowed. If you select **Black List** as **Trusted IP Mode** and you do not set any IP range, all traffic will be allowed.

To set up a Trusted IP range:

1. Go to **Firewall > Trusted IP**.
2. Check the **Enabled** box to turn on Trusted IP.
3. Select the **Trusted IP Mode** from the drop-down, either **White List** or **Black List**. (**NOTE**: Be aware of the behavior of each list and its consequences based on your specific configuration. For example, if you select

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White List as **Trusted IP Mode**, you should include the device **IP Address Range** or **IP Address** and **Subnet Mask** to maintain your local device LAN access.)

4. To add IP addresses, click **Add IP Range** in the upper right corner.
5. Under the **Add IP Range**, enter or select the following parameters:
   a. **Name**
   b. Mode from drop-down, either **Subnet** or **IP Range**.
   c. For **Subnet**:
      i. **IP Address**
      ii. **Subnet Mask**
   d. For **IP Range**:
      i. **IP Address Start**
      ii. **IP Address End**
   e. **Destination Port** (default: **ANY**)
   f. **Protocol** from drop-down including **ANY, TCP/UDP, TCP**, or **UDP**
   g. Click **Finish**.
6. The system displays your recently added and existing IP ranges in a list. The list includes the relevant details. You may edit any IP ranges by clicking on the pencil icon under **Options**.
7. You may delete any IP ranges by clicking on the trash can icon under **Options**.
8. If you want to revert back to default settings (where **Trusted IP** is disabled and all IP ranges are removed), click the **Reset to Default** button in the lower right corner
9. Click **Submit**.
10. To save your changes, click **Save and Apply**.

Firewall Status

The firewall status page allows you to view the current state of the Filter Rules, NAT tables, and iptables-save command output. You may also download an archive that contains log files showing the same output from each view.

To view the status for each firewall section as currently configured in the UI:

1. Go to **Firewall > Status** and view the **Firewall Status** page. You may change the display by clicking **Show** or **Hide** for each section.
2. The system displays the output view for each section including: **Filter Rules, NAT Rules,** and **IP Tables Dump**.
3. Click **Refresh** to update the views.
4. To download the archive file containing the same output shown in all three views, click **Download**. You can save or open the file from your browser. This archive contains three log files: iptables-filter.log, iptables-nat.log, and iptables-save.log.

Setting up Static Routes

To set up a manually configured mapping of an IP address to a next-hop destination for data packets:

1. Go to **Firewall > Static Routes**.

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2. In the **Static Routes** window, click **Add Route**.
3. In the **Name** field of the **Add Route** dialog box, type the name of the route.
4. In the **IP Address** field, type the remote network IP address of the remote location.
5. In the **IP Mask** field, type the network mask that is assigned on the remote location.
6. In the **Gateway** field, type the IP address of the routing device that supports the remote IP Network.
7. Click **Finish**.
8. To save your changes, click **Save and Apply**.

Legacy Firewall Settings

The device's firewall enforces a set of rules that determine how incoming and outgoing packets are handled. By default, all outbound traffic originating from the LAN is allowed to pass through the firewall, and all inbound traffic originating from external networks is dropped. This effectively creates a protective barrier between the LAN and all other networks.

The firewall is built on top of iptables. The different rule groups correspond to their respective chains in iptables.

The Legacy Firewall Settings provide the older version of the firewall software interface. These settings include Port Fowarding, Input Filter Rules, and Output Filter Rules. We recommend using the Normal Settings by clicking on the Normal button. For additional information, see:

- Adding Port Forwarding Rules
- Adding Input Filter Rules
- Adding Output Filter Rules
- Normal Settings

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Chapter 9 – Cellular

Configuring Cellular

To configure how cellular is used on your device:

1. Go to **Cellular > Cellular Configuration** to display the **Cellular Configuration** window.
2. Check **Enabled**.
3. Check and change the Cellular Configuration fields as desired. For field descriptions, see Cellular Configuration Fields.
4. Click **Submit**.
5. To save your changes, click **Save and Apply**.

Configuring Wake Up On Call

This feature allows the device to wake up and initiate a cellular connection when there is an incoming call, SMS, or LAN activity.

The Wake Up on Call function is not available for the LVW2 or Cat M1 devices (even though you can access those settings in the device software.)

1. Go to **Cellular > Wake Up On Call** to display the configurations.
2. Check the **Wake Up On Call** box.
3. Select a Wake Up setting. For wakeup methods, see Wake Up On Call Method Settings.
4. Click **Submit**.
5. To save your changes, click **Save and Apply**.

Note: This feature only defines when the device brings up its cellular link, not when the device takes it down. See the **Dial on Demand** option on the **Cellular Configuration** page at **Cellular > Cellular Configuration** to configure the criteria for bringing the cellular link down.

Wake Up On Call Method Settings

The triggers that wake up the device to re-establish the cellular link are:

- On Ring:*

  Any incoming call will bring up the cellular link.

  Enabled: Check to allow any incoming call to wake up the device.

  Message: The expected response from the integrated cellular modem to an incoming call.
- On Caller ID:*

  Only incoming calls in the caller ID list will bring up the cellular link.

  Enabled: Check to allow a specific caller to wake up the device.

  Caller ID: Field to specify a caller ID. Enter the ID then click **Add** to add the caller to the approved caller ID trigger list.
- On SMS (not available if you enabled SMS through **SMS > General Configuration**):

  Only specific SMS messages will bring up the cellular link.

  Enabled: Check to allow specific SMS messages to wake up the device.

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Message: Field to specify the SMS message contents. Click **Add** to add the SMS message to the approved SMS trigger list.

***Note:** For AT&T users, these triggers are not available as voice support is disabled.

For Wake-Up-On-Call field descriptions, see Wake Up On Call General Configurations.

Wake Up On Call General Configurations

Field	Description
Wake Up on Call check box	Enables the Wake Up On Call feature.
Dial On Demand LAN	When checked, the device allows network activity on the LAN that needs WAN access to trigger the Wake Up and establish the cellular link. If this configuration is not checked, the device will only establish a cellular connection when the selected Wake Up method is triggered via incoming call, caller ID, and/or short message service (SMS).
Time Delay	Time that passes between a receiving call and initiating the Wake Up On Call connection.
Acknowledgment String to Caller	String used to acknowledge to the delivering SMSC (short message service center) the receipt of an SMS.
Init String Number	Device initialization strings specific to the integrated cellular modem required for the Wake Up On Call feature.

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Radio Status

Field	Description
Module Information	
IMEI	International Mobile Station Equipment Identifier
IMSI	International Mobile Subscriber Identifier.
Manufacturer	Company that developed the cellular module.
Model	Cellular module model number.
Hardware Revision	Module's hardware revision.
MDN (Phone Number)	Mobile Directory Number. In some SIM/carriers, the value may not be present and therefore not displayed.
MSID	Mobile Station ID. Some SIM/carriers do not contain this value and therefore the value is not displayed.
Firmware Version	Module's firmware version.
Service Information	
Home Network	Cellular service provider associated with the module's data account.
Current Network	Current cellular service operator (Not available for C2 or EV3 models).
RSSI	Received Signal Strength Indication (RSSI is pure wide band power including intracell power, interference, and noise): RSSI [dBm] = RSCP[dBm] - Ec/Io[dB].
Service	Cellular service connection type.
Roaming	Indicates whether or not the current service is provided by the Home Network carrier.
Tower	Tower ID of the cellular tower currently providing cellular service to this device.
Engineering Details	
Tx Pwr	Transmit Power.
PCS	3G Service.
Ec/Io	Signal to Noise Ratio (used to calculate RSSI in 3G devices).
RSCP	Received Signal Code Power (used to calculate RSSI in 3G devices).
RSRP	Reference Signal Received Power (used to calculate RSSI in LTE devices).
RSRQ	Reference Signal Received Quality (used to calculate RSSI in LTE devices): RSRQ = (N * RSRP) / RSSI where N is the number of Physical Resource Blocks (BRBs) over which RSSI is measured, typically equal to system bandwidth.
DRX	Discontinuous Reception.
Mobility Management State	State of cellular radio.
Radio Service State	On/off status of cellular radio.
Network Operator Mode	Cellular provider's Network Operation Mode.

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Field	Description
Block Error Rate	Number of erroneous blocks / total number of received blocks.
Service Domain	Network Domain/Service Area.
Update Options	
MDN (Phone Number)	Update the cellular module's phone number. This number is updated only on the device. The MDN that the carrier has associated with this device does not change.

Configuring SMS

This function is not available if you enable SMS through **Cellular > Wake Up On Call**. To enable short message service (SMS) via the Web Management interface or API:

1. From the Web Management interface, go to **Cellular > SMS Configuration > SMS Settings**.
2. Check **Enabled**.
3. In the **Sent SMS to Keep** field, enter the total number of sent SMS messages to keep in the device's history.
4. In the **Received SMS to Keep** field, enter the total number of received SMS messages to keep in the device's history.
5. In the **Resend Failed SMS** field, enter the total number of resend attempts for SMS messages that failed to send.
6. Click **Submit.**
7. To save your changes, click **Save and Apply**.

SMS Field Descriptions

Field	Description
Enabled	Enables the SMS utilities required to send SMS via API and the Web Management interface.
Sent SMS to Keep	The total number of sent SMS messages to keep in the device's history.
Received SMS to Keep	The total number of received SMS messages to keep in the device's history.
Resend Failed SMS	The total number of resend attempts for SMS messages that failed to send.

SMS Commands

SMS commands are disabled by default.

First, make sure to enable SMS under **Cellular > SMS Configuration > SMS Settings**.

To enable these available commands (for status and debugging purposes) and set security filters:

1. Go to **Cellular > SMS Configuration > SMS Commands**, check the SMS commands you wish to enable. Refer to the table of **SMS Command Descriptions** for details on available commands.
2. Check the security filters, you wish to use (can be one or both):
    - **Password:** If enabled, SMS commands will require **p password** in the syntax. For example: **p 123456 #serial** where 123456 is your password.

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Use the **default password** (last six digits of the radio's IMEI or last six digits of the MEID).

Or click on **Use custom password** and enter your own password.

You can also toggle the eye icon to make the password visible or hidden.

- **Whitelist**: If enabled, SMS commands can only be received from a number in the whitelist (you must enter a phone number).

  Enter the phone number and click **Add Number**.

  Note: Due to differences between service providers, for every US number you add to the **Whitelist**, create two separate entries: 1) one using the **phone number** and 2) the other using **1 + phone number**. Tip: Since the number format varies with provider, you can send your device an SMS message from the number in question and see what format is used.

3. Refer to the **Required SMS Command Format** field to see the format based on your chosen settings.
4. Click **Submit**.
5. To save your changes, click **Save and Apply**.

Here is an example SMS Command (#serial – Server mode):

Serial-IP Port Status:

Mode: **Server**

Protocol: SSL/TLS

Port: 3000

TX Bytes: 1234567

RX Bytes: 123456789

DCD Status: ON

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The response message to all SMS commands includes a time stamp. The time stamp format is **YYYY-MM-DD HH:MM**.

The system adds the time stamp to the existing commands at the end of the SMS message. In case the message exceeds the 160 character limit, the device information and the occurred event are not truncated. Only the time stamp is lost.

SMS Command Descriptions

The following table describes available SMS Commands under **Cellular > SMS Configuration** > **SMS Commands**. All SMS Commands are disabled by default. Check to enable.

SMS Command	Description
#reboot	reboot the device
#checkin	check in to DeviceHQ

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SMS Command	Description
#rm <enable|disable> <AccountKey>	enable or disable remote management using DeviceHQ (You must specify AccountKey when enabling Remote Management if not previously configured.)
#setcellular <enable|disable> [<APN>]	enable or disable Cellular and allows setting of the APN
#ping [<interface>] [<count>] <address>	ping IP address <count> times (range: 1-20, default = 4) through <interface> (choose from cellular, wifi, and ethernet or if not specified, the default gateway interface is used)
#apn	get APN string
#cellular	get cellular connection status
#radio	get radio status
#ethernet	get Ethernet interface configuration
#wan	get actual WAN transport and WAN priority configuration
#serial	get serial details: Mode (Server or Client), RX bytes, TX bytes, DCD Status, Protocol, Port (Server mode only), Server IP Address (Client mode only), and Server Port (Client Mode only)
#wifi	get Wi-Fi details: Date and time in format YYYY-MM-DD HH:MM, mode (WAN or Access Point), MAC address, status (for WAN mode only), SSID, Security settings (for Access Point only, None, WEP, WPA, WPA2-PSK, and WPA/WPA2-PSK)
#geoposition	get GPS coordinates, latitude and longitude (only available on devices with a GPS module acquiring sufficient GPS signal)
#wanips	retrieve IPv4 and IPv6 addresses that are currently assigned to existing WAN network interfaces
#lnsrestart	Upon reception, the device restarts the LoRa network server

Note: Arguments in square brackets [ ] are optional. Those in angle brackets < > are values.

Send SMS

To send an SMS message from the device:

1. Go to **Cellular > Send and Received SMS** to display the **Send SMS** section.
2. In the **Recipient** field, enter a phone number and click **Add**. You can add up to 100 phone numbers. Enter multiple recipient phone numbers in the same field separated by commas.
3. In the **Message** field, enter a text message up to 160 characters long.
4. Click **Send**. The system displays a confirmation indicating whether the message has been successfully sent or not.

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Viewing Sent SMS Messages

To view sent SMS messages from the device:

1. Go to **Cellular > Send and Received SMS** to display the **Sent SMS** section. The messages are sorted by date with the most recent messages on top. The table shows up to 30 characters for each message.
2. To view a full message, click the **eye** icon to the right of the message entry.
3. To delete a sent SMS message, click the **trash can** icon to the right of the message entry. A dialog box asks you to confirm that you want to delete the SMS message. Click **OK**.
4. To delete all the sent SMS messages, click **Delete All**. A dialog box asks you to confirm that you want to delete all the SMS messages. Click **OK**.
5. To configure, the receive list to automatically update, check the **Auto Refresh** box in the upper right corner.

Viewing Received SMS Messages

To view received SMS messages from the device:

1. Go to **Cellular >Send and Received SMS** to display the **Received SMS** section. The messages are sorted by date with the most recent messages on top. The table shows up to 30 characters for each message.
2. To view the full message, click the **eye** icon to the right of the message entry.
3. To delete an SMS message, click the **trash can** icon under **Options** to the right of the message. A dialog box asks you to confirm that you want to delete the SMS message. Click **OK**.
4. To delete all the received SMS messages, click **Delete All**. A dialog box asks you to confirm that you want to delete all SMS messages. Click **OK**.
5. To configure, the receive list to automatically update, check the **Auto Refresh** box in the upper right corner.

Cellular Radio Firmware Upgrade

Applies to specific models only

Cellular radio firmware upgrades are available for some specific Telit and Quectel cellular radios. Refer below for details on specific models.

There are two types of radio firmware upgrades:

1. **Full Firmware Image Upgrade:** When applied, the full firmware update replaces the current firmware image with the new image of the new version.
2. **Differential Firmware Upgrade:** When applied, the current firmware image is updated with the differences between it and the new version, and effectively becomes the new version of firmware.

You can distinguish between upgrade types by looking for the term **FULL** or **DELTA** in the radio firmware upgrade filename.

Those models that support both full firmware and delta upgrades include: **L4N1, L4E1,** and **L4G1**.

Those models that support only full firmware upgrades include: **LAT3, LDC3,** and **LSB3**.

Refer to your product model number on the product label usually found on the bottom or back of your device or also at the top of the page of the device UI.

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Note: If you have LoRa capability, you must have it disabled to perform the radio firmware upgrade.

There are two methods for updating the cellular radio firmware offered: 1) Upgrading using DeviceHQ® and 2) Upgrading using the device UI only.

Upgrading Cellular Radio Firmware Using DeviceHQ (Remote Management)

DeviceHQ can manage the Ceulluar Radio Firmware upgrade to your device when annex client checks in. **NOTE:** You must first enable and properly configure Remote Management in the device UI (refer to **Managing Your Device Remotely**).

1. Open **DeviceHQ**.
2. Select **Device > Your Device Name > Schedule > Upgrade Radio Firmware**.
3. **DeviceHQ** provides a list of eligible Telit and Quectel module firmware that a particular device can queue for download and install. Select the appropriate firmware.
4. The device checks in, downloads the firmware, automatically verifies the MD5 sum of the firmware to check the integrity of the upgrade file, and applies it to the modem module.
   Note: Allow at least 10 minutes after the device has downloaded the firmware file before taking any action. The system should reboot on its own after a successful download. Otherwise, after 10 minutes, you may reboot the device manually.
5. Once you have refreshed or the device checks in again, verify that the cellular radio firmware has been updated in DeviceHQ.

In the device UI, you can also check that the cellular radio firmware has been updated. Refer to the **Current Radio Firmware** on the **Radio Firmware Upgrade** page (see step 1 of Upgrading Cellular Firmware Using UI only) or also see the firmware version on the **Radio Status** page under **Cellular**.

Upgrading Cellular Firmware using UI only

You can also use the device UI to upgrade your cellular radio firmware. You must first obtain the appropriate binary upgrade file for the cellular radio in your device.

NOTE: If you use the firmware upgrade via Cellular using the UI and you get a timeout failure, first try to boost the signal strength and attempt it again. Otherwise, update via an Ethernet connection or use **DeviceHQ**.

1. Open the **Cellular Radio FW Upgrade** page under **Cellular**.
2. Enter the MD5 Check Sum or hash under **File MD5**.
3. Place the downloaded binary or differential file on your local computer. Browse for the file and select it.
4. Click **Start Upgrade**. The system should reboot automatically after a successful download. Otherwise, after ten minutes, you may reboot the device manually.
5. Check that the cellular radio firmware has been updated. Refer to the **Current Radio Firmware** on the **Cellular Radio Firmware Upgrade** page (see step 1 of Upgrading Cellular Firmware Using UI only) or also see the firmware version on the **Radio Status** page under **Cellular**.

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Chapter 10 – Tunnels

Setting Up GRE Tunnels

Tunneling allows the use of a public network to convey data on behalf of two remote private networks. It is also a way to transform data frames to allow them to pass networks with incompatible address spaces or even incompatible protocols. Generic Routing Encapsulation (GRE) is a tunneling mechanism that uses IP as the transport protocol and can be used for carrying many different passenger protocols.

The tunnels behave as virtual point-to-point links that have two endpoints identified by the tunnel source and tunnel destination addresses at each endpoint. Configuring a GRE tunnel involves creating a tunnel interface, which is a logical interface, then configuring the tunnel endpoints for the tunnel interface. To set up GRE tunnels:

1. Go to **Tunnels > GRE Tunnels > GRE Tunnels Configuration**.
2. Click **Add Tunnel**.
3. In the **Tunnel Name** field, enter a name for the new tunnel.
4. (Optional) In the **Description** field, you can enter a description that helps you further identify the tunnel.
5. In the **GRE Tunnel Settings** section:
   a. In the **Remote WAN IP** field, type the IP address of the gateway to which you want to connect.
   b. Click **Add** in the **Remote Network Routes** table.
   c. In the **Remote Network Route** field, type the IP address of the network that is routed through the tunnel.
   d. In the **Remote Network Mask** field, type the mask of the network.
   e. Click **Add**. The defined **Remote Network Route** is added and appears in the **Network Routes** list.
6. In the **Interface IP Address**, specify the IP address of the virtual GRE network interface. It should be equal to the IP address of the LAN interface that is used for establishing the Tunnel connection.
7. In the **Interface Network Mask**, specify the network mask of the virtual GRE network interface.
8. (Optional) In the **Checking period (minutes)** specify the interval to resolve the Remote WAN hostname by DynDNS. Recommended for hostnames that have dynamic IP addresses.
9. Click **Submit**.
10. The defined GRE tunnel configuration is added and appears in the **GRE Tunnels list**.
11. To update an existing tunnel, click the pencil icon under **Options** to the right of the desired tunnel in the displayed list.
12. Under **Edit Tunnel**, make your desired changes. This includes the option to enable or disable the tunnel by checking or unchecking **Enabled**.
13. Click **Submit**.
14. To save your changes, click **Save and Apply**.

IPsec Tunnels

Configuring Network-to-Network Virtual Private Networks (VPNs)

The device supports site-to-site VPNs via IPsec tunnels for secure network-to-network communication. Both tunnel endpoints should have static public IP addresses and must be able to agree on the encryption and authentication methods to use. Setting up an IPsec tunnel is a two-stage negotiation process. The first stage negotiates how the key exchange is protected. The second stage negotiates how the data passing through the tunnel is protected. For

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endpoints that do not have public static IP addresses, additional options may help such as **NAT Traversal** and **Aggressive Mode**.

By default, based on the encryption method chosen, the device negotiates ISAKMP hash and group policies from a default set of secure algorithms with no known vulnerabilities. This allows flexibility in establishing connections with remote endpoints. There is an **ADVANCED** mode that provides a way to specify a strict set of algorithms to use per phase, limiting the remote endpoint's negotiation options.

The default Encryption Method is: **AES-128**.

The default set of DH Group Algorithms is: **DH2(1024-bit), DH5(1536-bit), DH14(2048-bit), DH15(3072-bit), DH16(4096-bit), DH17(6144-bit), DH18(8192-bit), DH22(1024-bit), DH23(2048-bit)**, and **DH24(2048-bit)**.

You have the option to add multiple local and remote networks. These additional subnets can provide more complexity, flexibility, efficiency, and redundancy to your VPN. Using multiple networks allows different endpoints in different LAN subnets to securely communicate through the same tunnel. Users don't have to configure an additional tunnel for those subnets saving time and effort.

To set up a Network-to-Network VPN tunnel on your device:

1. From the Web Management interface, go to **Tunnels > IPsec Tunnels**.
2. Click **Add Tunnel** in upper right.
3. Enter a **Name** for the tunnel and an optional **Description**.
4. In the **Remote WAN IP** field, enter the external IP address of the remote endpoint.
5. Choose **Tunnel Type** from the drop-down. Values are **IKE** and **IKEv2**.
6. If you wish to allow all traffic through the tunnel, click on the checkbox for **Allow All Traffic**. This feature is disabled by default. In this case, you need to add explicit rules manually to allow traffic. This scenario is the best security practice.
7. Click **Add** under **Local Networks** to add a local network of the device that is used to establish the tunnel connection (leftsubnet). You can enter multiple networks
   a. Enter the **IP Address** and **Mask** under **Add Local Network**.
   b. Click **OK**. The network displays in the network list.
8. Click **Add** under **Remote Networks** to add a local network of the remote device at the other end of the tunnel connection (rightsubnet). You can enter multiple networks.
   a. Enter the **IP Address** and **Mask** under **Add Remote Network**.
   b. Click **OK**. The network displays in the network list.
9. The public IP address and LAN of this device do not need to be configured because they are already known by this device.
10. Select the **Authentication Method** from the drop-down either **Pre-Shared Key or RSA Signatures**. Authentication is performed using secret pre-shared keys and hashing algorithms (like SHA1 MD5) or RSA signatures.
11. If you select **Pre-Shared Key**, then enter the **Secret**. This key needs to be the same on both endpoints.
12. If you select **RSA Signatures**, enter the following (in .pem format):
    a. **CA Certificate**
    b. **Local RSA Certificate**
    c. **Local RSA Private Key**

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13. Select the **Encryption Method** from the drop-down including **AES-128, AES-192, AES-256** or **ADVANCED**. The encryption method needs to be the same on both endpoints. IKE encryption algorithm is used for the connection (**phase 1 -** ISAKMP SA). Based off of **Phase 1**, a secure set of defaults are used for phase 2, unless the **Advanced** option is used, in which case, you must specify all components of both **phases 1** and **2** including **Encryption, Authentication**, and **Key Group**. When you choose **Advanced** Encryption Method, you select the following (see **IPsec Fields** for field values) :
    a. **Phase 1 Encryption**
    b. **Phase 1 Authentication**
    c. **Phase 1 Key Group**
    d. **Phase 2 Encryption**
    e. **Phase 2 Authentication**
    f. **Phase 2 Key Group**

NOTE: For mPower 5.3 and above, deprecated encryption and hash algorithms are not available for creating new tunnels. But old tunnels that were created in 5.2 or lower will retain the deprecated settings unless changed. Those deprecated settings include: **3DES, ANY, MD5**, and **SHA-1**.

14. If the remote endpoint is set up with unique IDs, check the **Enable UID** box, and enter the **Local** and **Remote IDs**.
15. Click **Show** for **IPSec Tunnel: Advanced** features that limit the remote endpoint's negotiation options.
16. In the **IKE Lifetime** field, enter the duration in which ISAKMP SA lasts (in hours).
17. In the **Max Retries** field, enter the number of retries for the IPSec Tunnel. Enter zero for unlimited retries.
18. In the **Key Life** field, duration in which the IPSec SA lasts (in hours).
19. In the **Checking Period** field, enter the timeout interval (in minutes).
20. Check **Compression** to enable IPComp (compression algorithm).
21. Check **Aggressive Mode** to enable exchange identification in plain text (unencrypted for faster negotiation). NOTE: This mode is less secure and prone to dictionary and brute force attacks.
22. The defined IPsec tunnel configuration is added and appears in the **IPSec Tunnel** list.
23. To update an existing tunnel, click the pencil icon under **Options** to the right of the desired tunnel in the displayed list.
24. Under **Edit Tunnel**, make your desired changes. This includes the option to enable or disable the tunnel by checking or unchecking **Enabled**.
25. Click **Submit**.
26. To save your changes, click **Save and Apply**.

For field descriptions, see IPsec Tunnel Configuration Field Descriptions.

IPsec Tunnel Configuration Field Descriptions

Field	Description
IPSec Tunnel	
Name	Name used to identify the IPsec tunnel in configurations and logs.
Description	Optional text to describe the IPsec tunnel. This description shows up in the UI while hovering over the summary of an IPsec tunnel.
IPSec Remote Tunnel Endpoint	

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TUNNELS

Field	Description
Remote WAN IP	External IP address of the remote tunnel endpoint. The remote device is typically a router.
Remote Network Route	This field is used in conjunction with the **Remote Network Mask** field and describes the remote endpoint's subnet. This is used to identify packets that are routed over the tunnel to the remote network.
Remote Network Mask	This field is used in conjunction with the **Remote Network Route** field, to describe the remote endpoint's subnet. It identifies packets that are routed over the tunnel to the remote network.
Tunnel Type	Internet Key Exchange (IKE) for host-to-host, host-to-subnet, or subnet-to-subnet tunnels. Choose from **IKE** or **IKEv2**.
IPsec Tunnel: IKE	
Authentication Method	Choose between **Pre-Shared Key** or **RSA Signatures**. Authentication is performed using secret pre-shared keys and hashing algorithms (like SHA1 MD5) or RSA signatures (you provide the **CA Certificate, Local RSA Certificate**, and **Local RSA Private Key** in .pem format). If you check **Enable UID**, then **Local ID** and **Remote ID** become available as options.
Pre-Shared Key	Authentication is performed using a secret pre-shared key and hashing algorithms on both sides.
Secret	Secret key that is known by both endpoints.
Encryption Method	IKE encryption algorithm used for the connection (phase 1 - ISAKMP SA). Based off of phase 1, a secure set of defaults are used for phase 2, unless the **Advanced** option is used, in which case, all components of both phases 1 and 2 are specified by the user.
RSA Signatures	Authentication is performed using digital RSA signatures.
CA Certificate	Certificate Authority certificate used to verify the remote endpoint's certificate.
Local RSA Certificate	Certificate the local endpoint uses during **Phase 1 Authentication**.
Local RSA Private Key	The private key that the local endpoint uses during Phase 1 Authentication.
Encryption Method*	Choose an Encryption Method from the following list: **AES-128, AES-192, AES-256**, or **ADVANCED.** IKE encryption algorithm is used for the connection (phase 1 - ISAKMP SA). Based off of phase 1, a secure set of defaults are used for phase 2, unless the **Advanced** option is used, in which case, all components of both phases 1 and 2 are specified by the user.
Phase 1 Encryption*	If **Advanced** is selected for **Encryption Method**, select **Phase 1 Encryption** from the drop-down: **AES-128, AES-192, AES-256**, or **ANY AES**.

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Field	Description
Phase 1 Authentication*	If **Advanced** is selected for **Encryption Method**, select **Phase 1 Authentication** from the drop-down: **SHA-2, SHA2-256, SHA2-384, SHA2-512,** or **ANY.** .
Phase 1 Key Group*	If **Advanced** is selected for **Encryption Method**, select the **Phase 1 Key Group** from the drop-down: **DH2 (1024-bit), DH5 (1536-bit), D14 (2048-bit), DH15 (3072-bit), DH16 (4096-bit), DH17 (6144-bit), DH18 (8192-bit), DH22 (1024-bit), DH23 (2048-bit), DH24 (2048-bit),** and **ANY**.
Phase 2 Encryption*	If **Advanced** is selected for **Encryption Method**, select **Phase 2 Encryption** from the drop-drown: **AES-128, AES-192, AES-256, ANY AES,** or **ANY**.
Phase 2 Authentication*	If **Advanced** is selected for **Encryption Method**, select **Phase 2 Authentication** from the drop-drown: **SHA-2, SHA2-256, SHA2-384, SHA2-512,** or **ANY**.
Phase 2 Key Group*	If **Advanced** is selected for **Encryption Method**, select the **Phase 2 Key Group** from the drop-down: **DH2 (1024-bit), DH5 (1536-bit), D14 (2048-bit), DH15 (3072-bit), DH16 (4096-bit), DH17 (6144-bit), DH18 (8192-bit), DH22 (1024-bit), DH23 (2048-bit), DH24 (2048-bit),** and **ANY**.
Enable UID	Unique Identifier String to enable the **Local ID** and **Remote ID** fields.
Local ID	String Identifier for the local security gateway (optional)
Remote ID	String Identifier for the remote security gateway (optional)
IPSec Tunnel: Advanced	
IKE Lifetime	Duration for which the ISAKMP SA exists from successful negotiation to expiration.
Key Life	Duration for which the IPsec SA exists from successful negotiation to expiration.
Max Retries	Number of retry attempts for establishing the IPsec tunnel. Enter zero for unlimited retries.
Checking Period	Timeout interval in minutes. If Remote WAN IP address is a hostname that can be resolved by DynDNS, the hostname will be resolved at the set interval. Recommended for dynamic IP addresses.
Compression	Enable IPComp. This protocol increases the overall communication performance by compressing the datagrams. Compression requires greater CPU processing.

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Field	Description
Aggressive Mode	Whether to allow a less secure mode that exchanges identification in plain text. This may be used for establishing tunnels where one or more endpoints have a dynamic public IP address. Although this mode is faster to negotiate phase 1, the authentication hash is transmitted unencrypted. You can capture the hash and start a dictionary or use brute force attacks to recover the PSK.

***NOTE**: For mPower 5.3 and above, deprecated encryption and hash algorithms are not available for creating new tunnels. But old tunnels that were created in 5.2 or lower will retain the deprecated settings unless changed. Those deprecated settings include: **3DES, ANY, MD5,** and **SHA-1**.

OpenVPN Tunnels

OpenVPN is an open-source software application that implements virtual private network (VPN) techniques for creating secure point-to-point or site-to-site connections in routed or bridged configurations and remote access facilities. You can use and setup OpenVPN tunnels with this device.

To use OpenVPN, you must first install an OpenVPN application along with an easy-rsa tool and configure OpenVPN on your computer. Then you must also generate the certificates for the OpenVPN server and client before configuring the device.

To configure OpenVPN client and server on this device the following files are required:

- **CA PEM file or CA certificate (.crt)**
- **Diffie Hellman PEM file (.pem)**
- **Server Certificate to be used by the device endpoint (.crt)**
- **Server/Client Key to be used by the device endpoint (.key)**

Note 1: When you configure OpenVPN server and client make sure both sides use the same settings, and certificates.

Note 2: For mPower 5.3 and above, some encryption and hash configurations are deprecated and not available for creating new tunnels. But old tunnels that were created in 5.2 or lower will retain the deprecated settings unless changed. Deprecated settings for hash algorithms include: **MD4, MD5, RSA-MD4, RSA-MD5, and SHA-1. D**eprecated settings for encryptions ciphers include: **BF-CBC, CAST5-CBC, DES-CBC, DES-EDE-CBC, DES-EDE3-CBC, DESX-CBC, IDEA-CBC, RC2-40-CBC, RC2-64-CBC,** and **RC2-CBC**. Deprecated setting for Minimum TLS version is **1.1.**

Note 3: Some encryption and hash configurations are too weak and NOT supported at all in mPower 5.3 or higher. These settings do not function when performing an upgrade to mPower 5.3. The system provides a warning message during upgrade and replaces them with **Default**. The following TLS cipher suites are not supported: **TLS-DHE-RSA-WITH-CAMELLIA-256-CBC-SHA** and **TLS-DHE-RSA-WITH-CAMELLIA-128-CBC-SHA.** Also, the following hash algorithms are not supported: **DSA, DSA-SHA, DSA-SHA1, DSA-SHA1-old, ECDSA-with-SHA1, RSA-SHA, RSA-SHA1-2,** and **SHA**.

Existing OpenVPN tunnels are displayed in the OpenVPN tunnel list under **OpenVPN Configuration**. To update an existing tunnel:

1. Click the pencil icon under **Options** to the right of the desired tunnel in the displayed list.
2. Under **Edit Tunnel**, make your desired changes. This includes the option to enable or disable the tunnel by checking or unchecking **Enabled**.

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3. Click **Submit**.
4. To save your changes, click **Save and Apply**.

Configuration 1: OpenVPN Tunnel with TLS Authorization Mode (Device only)

This first configuration establishes the OpenVPN Tunnel connection from a device client to a device server using TLS as Authorization Mode. This involves adding and configuring both OpenVPN Server and Client sides within the device UI.

To add an **OpenVPN Server using TLS**:

1. Go to **Tunnels > OpenVPN Tunnels > OpenVPN Tunnel Configuration**.
2. Click **Add Tunnel**.
3. Enter the **Name**.
4. Select the **Type** as **SERVER** from the drop-down.
5. You can also enter an optional **Description**.
6. Under OpenVPN Tunnel Configuration, enter the following fields (using **TLS** as **Authorization Mode**):
   a. **Interface Type** as **TUN** from the drop-down.
   b. **Authorization Mode** as **TLS** from the drop-down.
   c. **Protocol** as **UDP**.
   d. **VPN Subnet**.
   e. **Port** number.
   f. **VPN Netmask**.
   g. **LZO Compression** as **ADAPTIVE** from the drop-down.
   h. **Hash Algorithm** as **DEFAULT**.
   i. **NCP (Negotiable Crypto Parameters)** as **DEFAULT**.
   j. **Min. TLS Version** as **1.2**.
   k. **TLS Cipher Suite** as **DEFAULT**.
   l. Enter the contents of the following files generated from the easy-rsa tool. You can copy and paste this content from the certificate files after opening from a text editor like Notepad. (all required):
      i. **CA PEM (.crt)**
      ii. **Diffie Hellman PEM (.pem)**
      iii. **Server Certificate PEM (.crt)**
      iv. **Server Key PEM (.key)**

      Note: Use the same **CA PEM** certificate and parameters as the server for the OpenVPN clients .
7. **Remote Network Routes** create a route from the server network to the client network. This allows the server to get access to the client's network. In the **OpenVPN Tunnel Network Routes**, click **Add**:
   a. Enter the **Remote Network Route** (should be the client subnet). For example, if the client IP address is 192.168.3.1, enter 192.168.3.0.
   b. Enter the **Remote Network Mask** (usually 255.255.255.0).
   c. You may enter **Gateway** (optional).
   d. Click **Add**.

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8. The system displays your recently-added **Push Route** with the client subnet (remote network route + mask).
9. **Push Routes** create a route from client's network to the server's network. This allows clients to get access to the server's network. Under **Push Routes**:
   a. Click **Client To Client** box if you want this optional feature (this establishes a connection between multiple clients that are connected to the server).
   b. In the **Push Network Route**, click **Add**.
   c. In the dialog box, enter the **Remote Network Route** (same address as the server subnet above).
   d. Enter the **Remote Network Mask** (same as above).
   e. You may enter **Gateway** (optional).
   f. Click **Add**.
   Note: If you use **Static Key Authorization Mode**, the **Push Routes** do not work.
10. The system displays your recently-added **Push Route** with the client subnet (remote network route + mask).
11. Click **Preview** to view the tunnel configuration.
12. Click **Submit**.
13. Click **Save and Apply** to save your changes

To add an **OpenVPN Client using TLS**:

1. Go to **Tunnels > OpenVPN Tunnels > OpenVPN Tunnel Configuration**.
2. Click **Add Tunnel**.
3. Enter the **Name** of the tunnel.
4. Select the **Type** as **CLIENT** from the drop-down.
5. You can also enter an optional **Description**.
6. Under OpenVPN Tunnel Configuration, enter the following fields (using **TLS** as **Authorization Mode**):
   a. **Interface Type** as **TUN** from the drop-down.
   b. **Authorization Mode** as **TLS** from the drop-down.
   c. **Protocol** as **UDP**.
   d. **Remote Host** (server public IP address).
   e. **Remote Port** number.
   f. **LZO Compression** as **ADAPTIVE** from the drop-down.
   g. **Hash Algorithm** as **DEFAULT**.
   h. **NCP (Negotiable Crypto Parameters)** as **DEFAULT.**
   i. **Min. TLS Version** as **1.2.**
   j. **TLS Cipher Suite** as **DEFAULT**.
   k. Enter the contents of the following files generated from the easy-rsa tool. You can copy and paste this content from the certificate files after opening from a text editor like Notepad. (all required):
      i. **CA PEM (.crt)**
      ii. **Client Certificate PEM (.crt)**
      iii. **Client Key PEM (.key)**

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7. If you use **TLS** as **Authorization Mode**, you do not need configure or add **Remote Network Routes**. The server adds the routes if the server's **Push Routes** are already configured. If you use **Static Key** as **Authorization Mode**, you must add and configure **Remote Network Routes**.
8. Click **Preview** to view the tunnel configuration.
9. Click **Submit**.
10. Click **Save and Apply** to save your changes.

Now the device client can access the device server subnet. You can ping the IP address of the device server subnet from the client console to test this.

Note: The PC connected to the device does not have access to the device server subnet.

Configuration 2: OpenVPN Tunnel with TLS Authorization Mode (Device and Connected PC)

This second configuration provides access between a device server and its subnet and device client and its subnet. An additional configuration is needed on the device server side. This also allows your PC to connect with the device server and ultimately to the device client through that server.

1. Configure the device server as shown under how to add an **OpenVPN Server using TLS**.
2. Open device console, go to **/var/config/ovpnccd/openVPNServerName**. Create the folder if not present in the device.
3. Create a file that has the client certificate name with the following information:
   a. **iroute [Client_Subnet] [Mask]**
   b. **example** -- echo “iroute 192.168.3.0 255.255.255.0” > mtrClient1
4. For each client, you must create a separate file in the folder **/var/config/ovpnccd/yourserverName**.
   Note: Make the file name the same as the Common Name value used to create the certificate.
5. Configure device client as shown under how to add an **OpenVPN Client**.

Once properly configured, you should have a connection between the device server and device client and their subnets. Your PC can also connect with the device server and thus the device client through that server.

Configuration 3: OpenVPN Tunnel with Static Key Authorization Mode (device server and client)

This third configuration establishes the OpenVPN Tunnel connection from a device client to a device server using Static Key as Authorization Mode. This involves adding and configuring both OpenVPN Server and Client sides within the device UI.

When using Static Key, the OpenVPN tunnel is created between only two end-points, the client and server. You cannot connect more than one client to the server in this mode. Remote Network Route must be specified in both configurations, client and server, in order to establish the connection between subnets.

To add an **OpenVPN Server using Static Key**:

1. Go to **Tunnels > OpenVPN Tunnels > OpenVPN Tunnel Configuration**.
2. Click **Add Tunnel**.
3. Enter the **Name**.
4. Select the **Type** as **SERVER** from the drop-down.
5. You can also enter an optional **Description**.
6. Enter the following fields (using **STATIC KEY** as **Authorization Mode**):

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a. **Interface Type** as **TUN** from the drop-down.
b. **Authorization Mode** as **STATIC KEY** from the drop-down.
c. **Protocol** as **UDP**.
d. **Local Address** as **DEFAULT**.
e. **Port** number.
f. **Remote Address** as **DEFAULT**.
g. **LZO Compression** as **ADAPTIVE** from the drop-down.
h. **Hash Algorithm** as **DEFAULT**.
i. **NCP (Negotiable Crypto Parameters)** as **DEFAULT**.
j. Generate and enter the **Static Key PEM** (required). Both server and client must use the same static key. See example below:

-----BEGIN OpenVPN Static key V1-----
3f4c9113b2ec15a421cfe21a5af015bb967059021c1fd6f66ecfd00533d967237875215e20e80a2d59efd
79148d6acdea9358dcafe0efdbb54003ff376c71432dd9d16f55e7d8917a32bfe07d61591b7bbb43c7ba
d214482b8547ec9dca8910f514d9f4270ccaeff1a79852ae27c1c307c9dc3c836d1c380bece3c70fd2104
e1968ed29b6c3388719226f959f69f9be43688ed27bc3a4dbc83f640370524b47bb871816af79586d07
08781fad384480d0609b11c31d27baa6e902d29277a474e3e2785a8410d595c0f9c75312375b4bd098
76e1a47a598e114749a09c35f098e9123015c2795c702e4a346a8bccd00305c7cb30beef66ad33f43dac
c2e662128
-----END OpenVPN Static key V1-----

7. **Remote Network Routes** create a route from the server network to the client network. This allows the server to get access to the client's network. In the **OpenVPN Tunnel Network Routes**, click **Add**:

   a. Enter the **Remote Network Route** (should be the client subnet). For example, if the client IP address is 192.168.3.1, enter 192.168.3.0.
   b. Enter the **Remote Network Mask** (usually 255.255.255.0).
   c. Click **Add**.

8. The system displays your recently-added **Remote Network Route** with the client subnet (remote network route + mask).

   Note: **Push Routes are not required with Static Key as Authorization Mode.**
9. Click **Preview** to view the tunnel configuration.
10. Click **Submit**.
11. Click **Save and Apply** to save your changes.

To add an **OpenVPN Client using Static Key**:

1. Go to **Tunnels > OpenVPN Tunnels > OpenVPN Tunnel Configuration**.
2. Click **Add Tunnel**.
3. Enter the **Name**.
4. Select the **Type** as **CLIENT** from the drop-down.
5. You can also enter an optional **Description**.
6. Enter the following fields (using **STATIC KEY** as **Authorization Mode**):

   a. **Interface Type** as **TUN** from the drop-down.
   b. **Authorization Mode** as **STATIC KEY** from the drop-down.

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c. **Protocol** as **UDP**.
d. **Local Address** as **DEFAULT**.
e. **Remote Host**.
f. **Remote Address** as **DEFAULT**.
g. **Remote Port** number.
h. **LZO Compression** as **ADAPTIVE** from the drop-down.
i. Select the **NCP (Negotiable Crypto Parameters)** as **DEFAULT** from drop-down.
j. Select the **Hash Algorithm** as **DEFAULT** from drop-down.
k. **Min. TLS Version** as **1.2.**
l. **TLS Cipher Suite** as **DEFAULT**.
m. Enter the **Static Key PEM** (required). Both server and client must use the same static key. See example below:

   -----BEGIN OpenVPN Static key V1-----

   3f4c9113b2ec15a421cfe21a5af015bb967059021c1fd6f66ecfd00533d967237875215e20e80a2d59efd79148d6acdea9358dcafe0efdbb54003ff376c71432dd9d16f55e7d8917a32bfe07d61591b7bbb43c7bad214482b8547ec9dca8910f514d9f4270ccaeff1a79852ae27c1c307c9dc3c836d1c380bece3c70fd2104e1968ed29b6c3388719226f959f69f9be43688ed27bc3a4dbc83f640370524b47bb871816af79586d0708781fad384480d0609b11c31d27baa6e902d29277a474e3e2785a8410d595c0f9c75312375b4bd09876e1a47a598e114749a09c35f098e9123015c2795c702e4a346a8bccd00305c7cb30beef66ad33f43dacc2e662128

   -----END OpenVPN Static key V1-----.

7. **Remote Network Routes** create a route from the server network to the client network. This allows the server to get access to the client's network. In the **OpenVPN Tunnel Network Routes**, click **Add**:

   a. Enter the **Remote Network Route** (should be the client subnet). For example, if the client IP address is 192.168.3.1, enter 192.168.3.0.
   b. Enter the **Remote Network Mask** (usually 255.255.255.0).
   c. Click **Add**.

8. The system displays your recently-added **Remote Network Route** with the client subnet (remote network route + mask).

   Note: **Push Routes** are not required with **Static Key** as **Authorization Mode.**
9. Click **Preview** to view the tunnel configuration.
10. Click **Submit**.
11. Click **Save and Apply** to save your changes.

Configuration 4: OpenVPN Tunnel with Static Key Authorization Mode and TCP

This fourth configuration establishes the OpenVPN Tunnel connection from a device client to a device server using Static Key as Authorization Mode and TCP protocol (instead of UDP for the third configuration). This involves adding and configuring both OpenVPN Server and Client sides within the device UI.

To add an **OpenVPN Server using Static Key and TCP**:

1. Go to **Tunnels > OpenVPN Tunnels > OpenVPN Tunnel Configuration**.
2. Click **Add Tunnel**.
3. Enter the **Name**.

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4. Select the **Type** as **SERVER** from the drop-down.
5. You can also enter an optional **Description**.
6. Enter the following fields (using **STATIC KEY** as **Authorization Mode**):
   a. **Interface Type** as **TUN** from the drop-down.
   b. **Authorization Mode** as **STATIC KEY** from the drop-down.
   c. **Protocol** as **TCP**.
   d. **Local Address** as **DEFAULT**.
   e. **Remote Host**.
   f. **Remote Address** as **DEFAULT**.
   g. **Remote Port** number.
   h. **Hash Algorithm** as **RSA-SHA1**.
   i. **LZO Compression** as **ADAPTIVE** from the drop-down.
   j. **NCP (Negotiable Crypto Parameters)** as **CAMELLIA-256-CBC**.
   k. **Min. TLS Version** as **NONE.**
   l. **TLS Cipher Suite** as **DEFAULT**.
   m. Generate and enter the **Static Key PEM** (required). Both server and client must use the same static key. See example below:

      -----BEGIN OpenVPN Static key V1-----

      3f4c9113b2ec15a421cfe21a5af015bb967059021c1fd6f66ecfd00533d967237875215e20e80a2d59efd79148d6acdea9358dcafe0efdbb54003ff376c71432dd9d16f55e7d8917a32bfe07d61591b7bbb43c7bad214482b8547ec9dca8910f514d9f4270ccaeff1a79852ae27c1c307c9dc3c836d1c380bece3c70fd2104e1968ed29b6c3388719226f959f69f9be43688ed27bc3a4dbc83f640370524b47bb871816af79586d0708781fad384480d0609b11c31d27baa6e902d29277a474e3e2785a8410d595c0f9c75312375b4bd09876e1a47a598e114749a09c35f098e9123015c2795c702e4a346a8bccd00305c7cb30beef66ad33f43dacc2e662128

      -----END OpenVPN Static key V1-----
7. Click **Next**.
8. **Remote Network Routes** create a route from the server network to the client network. This allows the server to get access to the client's network. In the **OpenVPN Tunnel Network Routes**, click **Add**:
   a. Enter the **Remote Network Route** (should be the client subnet). For example, if the client IP address is 192.168.3.1, enter 192.168.3.0.
   b. Enter the **Remote Network Mask** (usually 255.255.255.0).
   c. Click **Add**.
9. The system displays your recently-added **Remote Network Route** with the client subnet (remote network route + mask).

   Note: **Push Routes are not required with Static Key as Authorization Mode.**
10. Click **Preview** to view the tunnel configuration.
11. Click **Submit**.
12. Click **Save and Apply** to save your changes.

To add an **OpenVPN Client using Static Key and TCP**:

1. Go to **Tunnels > OpenVPN Tunnels > OpenVPN Tunnel Configuration**.

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2. Click **Add Tunnel**.
3. Enter the **Name**.
4. Select the **Type** as **CLIENT** from the drop-down.
5. You can also enter an optional **Description**.
6. Enter the following fields (using **STATIC KEY** as **Authorization Mode**):
   a. **Interface Type** as **TUN** from the drop-down.
   b. **Authorization Mode** as **STATIC KEY** from the drop-down.
   c. **Protocol** as **TCP**.
   d. **Local Address** as **DEFAULT**.
   e. **Remote Host**.
   f. **Remote Address** as **DEFAULT**.
   g. **Remote Port** number.
   h. **Hash Algorithm** as **RSA-SHA1**.
   i. **LZO Compression** as **ADAPTIVE** from the drop-down.
   j. **NCP (Negotiable Crypto Parameters)** as **CAMELLIA-256-CBC**.
   k. **Min. TLS Version** as **NONE.**
   l. **TLS Cipher Suite** as **DEFAULT**.
   m. Generate and enter the **Static Key PEM** (required). Both server and client must use the same static key. See example below:

      -----BEGIN OpenVPN Static key V1-----

      3f4c9113b2ec15a421cfe21a5af015bb967059021c1fd6f66ecfd00533d967237875215e20e80a2d59efd79148d6acdea9358dcafe0efdbb54003ff376c71432dd9d16f55e7d8917a32bfe07d61591b7bbb43c7bad214482b8547ec9dca8910f514d9f4270ccaeff1a79852ae27c1c307c9dc3c836d1c380bece3c70fd2104e1968ed29b6c3388719226f959f69f9be43688ed27bc3a4dbc83f640370524b47bb871816af79586d0708781fad384480d0609b11c31d27baa6e902d29277a474e3e2785a8410d595c0f9c75312375b4bd09876e1a47a598e114749a09c35f098e9123015c2795c702e4a346a8bccd00305c7cb30beef66ad33f43daccc2e662128

      -----END OpenVPN Static key V1-----

7. Click **Next**.
8. **Remote Network Routes** create a route from the server network to the client network. This allows the server to get access to the client's network. In the **OpenVPN Tunnel Network Routes**, click **Add**:
   a. Enter the **Remote Network Route** (should be the client subnet). For example, if the client IP address is 192.168.3.1, enter 192.168.3.0.
   b. Enter the **Remote Network Mask** (usually 255.255.255.0).
   c. Click **Add**.
9. The system displays your recently-added **Remote Network Route** with the client subnet (remote network route + mask).

   Note: **Push Routes are not required with Static Key as Authorization Mode.**
10. Click **Preview** to view the tunnel configuration.
11. Click **Submit**.
12. Click **Save and Apply** to save your changes.

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Chapter 11 – Administration

User Accounts

Use this feature to add user accounts or change the password.

The system offers three roles or user types: administrator, engineer, and monitor. Administrators have full rights and permissions including change settings on the device. Engineers have read/write privileges and some access to controls on the device. Monitors have read-only access. Note: the system automatically checks for a strong password and tells you how to improve it.

Username requirements include:

- Must be unique.
- Is case-sensitive (for example, admin and ADMIN are treated as two different usernames).
- Acceptable characters: uppercase alphabetic, lowercase alphabetic, numeric, and non-alphanumeric (symbols like #).
- A hyphen (-) should not be used as the first character.

Password requirements include:

- User account is disabled if password is not set up.
- Must be at least eight characters in length.
- Contains three or more different types of characters such as: uppercase alphabetic, lowercase alphabetic, numeric, and non-alphanumeric (symbols like #).

Administrator details:

- Able to delete any local users. (Engineer and Monitor cannot delete any users.)
- Able to modify any other user details, except username.
- Can not modify another administrator user account if it is the only enabled local administrator user on the device.
- Able to modify own account details except Role, Username, and Enabled values.
- Able to disable and enable any local users except their own account. Also, not able to disable local user account if this is only local administrator.
- Able to change own password and other user passwords.

Engineer and Monitor details:

- Able to view and modify own user account details except Role, Username, and Enabled values.
- Access to only their own user account.
- Not able to delete users.
- Able to change own password.

To add new users:

1. Go to **Administration** > **User Accounts**.
2. Click **Add New User**.
3. Under **User Details**, enter the following fields:

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a. Username (required)
b. Role (required). Select the user role from the drop-down menu including **administrator**, **engineer**, **monitor** or a custom user role.
c. First Name
d. Last Name
e. Title
f. Division
g. Employee Identification

4. Under **Contact Information**, enter the following fields:

a. Email
b. Address
c. City
d. State
e. Country
f. Postal Code
g. Work Phone
h. Mobile Phone

5. Click **Submit**.
6. The **Change Password** page opens. Enter **New Password**. Click **Submit**.
7. The **Change Password** page opens. Enter **New Password**. Click **Submit**.

If the password is not set up for the new user, the user is disabled until the password is set.

Password Complexity

Password Complexity Rules allow an administrative user to choose rules and limitations on user passwords. You can determine various password parameters such as the minimum length of passwords, upper and lower case requirements, and characters not permitted.

Before choosing your options, you must first select between two different complexity modes: **Default** or **Credit**.

Default mode uses a minimum character length and may require a specific number of characters from each class. But requiring specific classes of characters actually makes brute force attacks easier because it reduces the search space.

For this reason, we recommend using **Credit** mode. This mode grants one credit per password character plus one extra credit for certain character classes up to their respective extra credit cap. You can still specify a minimum number of classes, but the strongest passwords come from their length.

In either mode, you should use longer passwords for increased security.

1. Go to **Administration > User Accounts**.
2. Click **Change Password Complexity Rules** button.
3. Under the **Change Password Complexity Rules** window, select from the drop-down between **Default** or **Credit** mode.
4. For **Default** mode**,** you may enter the following:

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a. **Minimum Password Length** (default = 8)
b. **Minimum Upper Case Characters** (default = 0)
c. **Minimum Lower Case Characters** (default = 0)
d. **Minimum Numeric Characters** (default = 0)
e. **Minimum Special Characters** (default = 0)
f. **Maximum Password Length** (default = 64)*
g. **Characters Not Permitted** (enter restricted characters in any order with no separators)

5. For **Credit** mode**,** you may enter the following:

a. **Minimum Password Credits** (default = 8)
b. **Minimum Character Classes** (default = 3)
c. **Upper Case Extra Credit Cap** (default = 0)
d. **Lower Case Extra Credit Cap** (default = 0)
e. **Numeral Extra Credit Cap** (default = 0)
f. **Special Extra Credit Cap** (default = 0)
g. **Maximum Password Length** in number of characters (default = 64)*
h. **Characters Not Permitted** (enter restricted characters in any order with no separators)

* **Note:** Entering a value of 0 indicates no maximum.

Custom User Roles Overview

By default, mPower has three user roles: Administrator, Engineer, and Monitor. mPower does not allow users to modify or delete these roles. Beginning with Release 6.3.0, mPower gives users the option to define custom user roles with a specific set of permissions per page or feature to better reflect the needs of their organization.

Once created, custom user roles appear in the Role drop-down list on the User Details page for new or existing users.

For each custom user role, you can define which features that role has read or write access to. The Visible toggle switch provides read access and visibility of the feature on the Web UI. The Write toggle switch provides write access.

When a feature is set to **Visible**, users assigned that role have read access to the feature via API and can view the feature on the Web UI. When Visible disabled, the feature is hidden to users assigned that role and they do not have read access to it via API.

The **Write** toggle switch gives users the ability to modify the feature (add, edit, or delete data). When Write is turned on, the user can modify the data via API and perform POST/PUT/DELETE requests. When it is disable, they cannot modify the data.

There are 4 options you can configure for each feature:

- **Full Access.** Write and Visible both enabled. The feature is visible on Web UI in the main menu, the user has full access to the functionality via Web UI and API.
- **Read-Only Access.** Visible enabled, Write disabled. The feature is visible on Web UI, and the system allows read data via API

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- **Full Restriction.** Write and Visible both disabled. The functionality is hidden on Web UI and is not available via API
- **Hidden page with WRITE access via API.** Write enable, Visible disabled. This hides the feature in the Web UI so the logged in user does not see it, but the system allows the user to perform POST/PUT/DELETE requests via API, and it can to modify data via API if needed. In some cases, the system applies this configuration to manage a dependency.

For example: You have two features, **Feature_A** and **Feature_B** that depend on each other in the API. You want to restrict access to Feature_B and hide it from users, but give a full access to Feature_A.

Because Feature_A depends on Feature_B, this configuration is not possible. When you enable Write for Feature_A, Write is automatically enabled for Feature_B as shown on the right.

Feature_B remains hidden to users, but this setting allows API changes in Feature_B that are required when the user works with Feature_A.

Creating New User Roles

To define a new user role and define permissions:

1. Go to **Administration > User Accounts**.
2. Click **Add Custom Role** at the top of the user page
3. Enter a **Name** and **Description** for the new role. Note that once the role has been created, you cannot edit the role name.
4. Under **Access Configuration**, enable read (visible) or write access for entire pages or individual features. When you enable access, it turns blue and the slider moves to the right. For more information on Visibility and Write access, refer to Custom User Roles Overview.
   - To enable or disable access for all the features on a page, click **Write** and/or **Visibility** for that page.
   - To enable or disable access for individual features, click show to open the section. Then enable or disable **Write** and/or **Visibility** access to that feature for this role.
   - For details on availability, limitations, and dependencies for each role, refer to the **User Roles Configuration Features** below.
5. When you have finished configuring role permissions, click **Submit.** The new role appears on the User Role drop-down list on the User Account page.

User Roles Configuration Features

Section	Page	Hardware Availability	Limitations and Dependencies
LoRaWAN	Network Settings	LoRa models only	None
LoRaWAN	Key Management	LoRa models only	None
LoRaWAN	Gateways	LoRa models only	None
LoRaWAN	Devices	LoRa models only	None

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Section	Page	Hardware Availability	Limitations and Dependencies
LoRaWAN	Device Groups	LoRa models only	None
LoRaWAN	Profiles	LoRa models only	None
LoRaWAN	Packets	LoRa models only	None
LoRaWAN	Downlink Queue	LoRa models only	None
LoRaWAN	Operations	LoRa models only	None
Payload Management	BACnet Configuration		rowspan="4" BACnet payload management options require a license. Refer to Licensing for information.
Payload Management	BACnet Objects		
Payload Management	Managed Sensors		
Payload Management	Sensor Definitions		
Setup	Network Interfaces		Dependency: When enabling write permission for Setup > Network Interface, the system also enables write permission for Administration > Access Configuration
Setup	WAN Configuration		None
Setup	Global DNS		None
Setup	DDNS Configuration		None
Setup	DHCP Configuration		None
Setup	LLDP Configuration		None
Setup	GPS Configuration	GPS models only	None
Setup	SMTP Configuration		None
Setup	Serial-IP Configuration	Serial port models only	Dependency: When enabling write permission for Serial-IP Configuration page, the system also enables write permission for GPS Configuration
Setup	SNMP Configuration		None
Setup	Time Configuration		None
Cellular	Cellular Configuration	Cellular models only	None

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Section	Page	Hardware Availability	Limitations and Dependencies
Cellular	Wake Up On Call	Cellular models only	Dependency: When enabling/disabling write permission for Wake UP On Call, the system also enables/disables write permission for SMS Configuration.
Cellular	Radio Status	Cellular models only	None
Cellular	SMS Configuration	Cellular models only	None
Cellular	Send and Received SMS	Cellular models only	None
Cellular	Cell Radio FW Upgrade	Cellular models only	None
Wireless	Wi-Fi Access Point	Wi-Fi models only	Dependencies: When enabling/disabling visible permission for Wi-Fi AP, it also enables/disables visible permission for Wi-Fi as WAN, and Statistics: Wi-Fi as WAN and Wi-Fi AP.
Wireless	WI-FI as WAN	Wi-Fi models only	Dependencies: When enabling/disabling visible permission for Wi-Fi as WAN, it also enables/disables visible permission for Wi-Fi AP, and Statistics: Wi-Fi as WAN and Wi-Fi AP. When enabling/disabling write permissions for Wi-Fi as WAN, the system also enables/disables write permissions for Wi-FI AP (Note: When enabling/disabling write for AP, the system does not change permissions for Wi-Fi as WAN)
Wireless	Bluetooth-IP	Wi-Fi models only	Dependency: When enabling/disabling WRITE permission for Bluetooth-IP, the system also enables WRITE permission for Serial-IP and GPS.
Wireless	Bluetooth Low Energy	Wi-Fi models only	None

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ADMINISTRATION

Section	Page	Hardware Availability	Limitations and Dependencies
Firewall	Settings		None
Firewall	Trusted IP		None
Firewall	Status		None
Firewall	Static Routes		None
Tunnels	GRE		None
Tunnels	IPSec		None
Tunnels	OpenVPN		None
Administration	Self-Diagnostics		None
Administration	Access Configuration		None
Administration	RADIUS Configuration		None
Administration	MQTT Broker		None
Administration	X.509 Certificate		None
Administration	X.509 CA Certificates		None
Administration	Remote Management		None
Administration	Notifications		None
Administration	Web UI Customization		Dependency: When enabling/disabling visible permission for Web UI Customization, the system also enables visible permission for the Support page.
Administration	Firmware Upgrade		None
Administration	Package Management		None
Administration	Save/Restore		None
Administration	Debug Options		None
Administration	Usage Policy		None
Administration	Licensing		None

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Section	Page	Hardware Availability	Limitations and Dependencies
Administration	Support		The write permission is ALWAYS ON and is disabled, not configurable. Dependency: When enabling/disabling visible permission for the Support feature, the system also enables visible permission for the Web UI Customization feature.
Status&Logs	Services		The write permission is disabled and NOT configurable.
Status&Logs	Mail Log		None
Status&Logs	Mail Queue		The write permission is disabled and NOT configurable.
Status&Logs	Notifications Sent		None
Statistics	System		The write permission is disabled and NOT configurable.
Statistics	Ethernet		None
Statistics	Wi-Fi as WAN	Wi-Fi models only	Dependency: Wi-Fi as WAN and Access Point write and visible permission depend on each other and are always in sync.
Statistics	Wi-Fi Access Point	Wi-Fi models only	Dependency: Wi-Fi as WAN and Access Point write and visible permission depend on each other and are always in sync.
Statistics	Cellular	Cellular models only	None
Statistics	Bluetooth	Wi-Fi models only	The write permission is disabled and NOT configurable.
Statistics	Serial	Serial port models only	The write permission is disabled and NOT configurable.
Statistics	GRE		The write permission is disabled and NOT configurable.

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Section	Page	Hardware Availability	Limitations and Dependencies
Statistics	IPSec		The write permission is disabled and NOT configurable.
Statistics	OpenVPN		The write permission is disabled and NOT configurable.
Statistics	MQTT		The write permission is disabled and NOT configurable.
Statistics	LoRa		None
Commands	Save Changes		The write permission can be enabled with visible permission disabled. However, if visible is enabled, write is enabled automatically.
Commands	Revert Changes		The write permission can be enabled with visible permission disabled. However, if visible is enabled, write is enabled automatically.
Commands	Restart Device		The write permission can be enabled with visible permission disabled. However, if visible is enabled, write is enabled automatically.
Commands	Restart LoRa Services		The write permission can be enabled with visible permission disabled. However, if visible is enabled, write is enabled automatically.
Apps	Applications		None

Editing User Roles

To edit permissions for a custom user role:

1. Go to **Administration > User Accounts.**
2. Click **Custom Roles** at the top of the page.
3. Click the **Edit** icon for the role you want to edit.
4. Make desired changes and click **Submit.** Note the Name cannot be changed.

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Deleting User Roles

To edit permissions for a custom user role:

1. Go to **Administration > User Accounts.**
2. Click **Custom Roles** at the top of the page.
3. Click the **Delete** icon for the role you want to delete.
4. Confirm the deletion.

Self-Diagnostics

The device offers self-diagnostics or periodic monitoring of certain issues such as memory errors or leaks, and security violations by applications. The following self-diagnostic features are available with this device (varies with model) :

- Security Violation
- Resource Overuse

This monitoring is intended detect corruption, or help prevent malicious activity. After an event is detected, the system disables the cellular radio module, sends an alarm or notification, logs the event, and sends a record of it via SMS, Email, or to the SNMP server. To receive notifications for specific diagnostic features, configure them under **Administration > Notifications**.

For the self-diagnostic features, go to **Administration > Self-Diagnostics** and refer to the following sections.

To turn on the **Resource Overuse** diagnostic that detects memory leaks or errors:

1. Check **Enabled** under **Resource Overuse**.
2. If you want the system to reboot the device after a **Resource Overuse** is detected, check **Reboot the device** under **Actions.**

To turn on the **Security Violation** diagnostic that detects security rule violations by applications:

1. Check **Enabled** under **Security Violation**.
2. If you want the system to disable WAN interfaces after a **Security Violation** is detected, check **Disable WAN Interfaces** under **Actions**.
3. If you want the system to disable user-defined firewall rules after a **Security Violation** is detected, check **Disable User-Defined Firewall Rules** under **Actions**.

After you completed your **Self-Diagnostic** configuration (selecting any or all of the above):

1. Click **Submit**.
2. To save changes, click **Save and Apply**.

If at any time you want to return the device to the default setting, click the **Reset to Default** button in the bottom right corner. (This disables or removes all enabled **Self-Diagnostic** features.)

RADIUS Configuration

The RADIUS protocol supports authentication, user session accounting, and authorization of users to the device. This authentication, accounting, and authorization is independent of the local users created on the device. The user can enable Authentication, Accounting, or both options.

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RADIUS user details:

- Access to device if role is one of those in the provided list (Administrator, Engineer, or Monitor).
- All RADIUS users do not have SSH access to the device.
- RADIUS creates a temporary session instead of a local account like local users.
- RADIUS uses shared key encryption.
- Local users shall take priority over RADIUS user (if a RADIUS user has the same username as a local user, the RADIUS user cannot log in even if the local user is disabled).
- RADIUS user with Administrator role can view and modify all local users (but cannot delete a local Administrator if it is the only local admin user on the device).
- RADIUS users with Engineer and Monitor role cannot view or modify user details. They do not have access to the **User Accounts** page.
- RADIUS users cannot change their own password in the Web UI.

To set up the RADIUS server configuration:

1. Go to **Administration** > **RADIUS Configuration**.
2. To enable authentication, check **Enable Authentication**.
3. To enable accounting, check **Enable Accounting**.
4. Enter the following fields for **RADIUS configuration**:
   a. Primary Server
   b. Authentication Port (for Primary Server)
   c. Accounting Port (for Primary Server)
   d. Secondary Server
   e. Authentication Port (for Secondary Server)
   f. Accounting Port (for Secondary Server)
5. Under **Options**, enter the following fields:
   a. **Shared Secret Key** value is used to: 1) encrypt packets between the RADIUS Server and device, 2) encrypt RADIUS attributes such as user password, and 3) verify that RADIUS messages have not been modified in transit. This value must be equal to the shared secret that is set up in RADIUS server. The Shared Secret Key can be up to 128 characters long. You can click the eye icon to hide the key.
   b. Authentication Protocol: select from drop-down list including **PAP**, **EAP-PEAPv0/MSCHAPv2**, or **EAP-TTLS/PAPv0**
   c. Timeout is the interval in seconds between tries to connect to RADIUS server in case of communication failure. Maximum is 10 seconds.
   d. Retries is the number of tries to connect to RADIUS server in case of communication failure.
6. Advanced Options are used when Authentication Protocol is EAP-PEAPv0/MSCHAPv2 or EAP-TTLS/PAPv0. If Protocol is PAP, these settings are ignored:
   a. Check **Use Anonymous ID** if you want to enable identity privacy. The device does not send its identity in plain text before the device has authenticated the RADIUS server.
   b. Anonymous ID is a name or value that the device will use in the identity response when “Use Anonymous ID” is enabled.

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c. Check **Check Server Certificate Hostname** to allow the server certificate CN (common name) to be validated by the device.

7. Click **Submit**.
8. To save your changes, click **Save and Apply**.

MQTT Broker Configuration

Use this page to configure the MQTT bridge to connect two MQTT brokers together including:

- configure server address for a remote MQTT broker
- specify MQTT Client ID
- add at least one topic
- configure authentication method

By default, the MQTT bridge is disabled.

To set up the MQTT broker:

1. Go to **Administration > MQTT Broker**.
2. Under **MQTT Bridge Configuration**, select **Enabled** to enable the MQTT broker to act as a bridge (disabled by default).
3. Enter the server address for the remote MQTT broker under **Primary Server** (required). If there is a backup server address, enter under **Secondary Server**.
4. Enter the primary port for the remote MQTT broker under **Primary Port** (required). If there is a secondary port, enter under **Secondary Port**.
5. Under Options, you can enter a unique identifier (name) that the broker uses to identify the client under **MQTT Client ID.**
6. Under Options, to allow SSL/TLS support during connection, select **Enable TLS**.
7. Once you select **Enable TLS**, a **TLS Version** drop-down appears. Select the minimum version of TLS to be used on the MQTT bridge including: **TLS 1.3, TLS 1.2 (default)**, or **TLS 1.1**.
8. Under Options, when SSL/TLS is enabled, click **Verify Hostname in the Server Certificate** if you want the bridge to verify that the hostname provided in the remote certificate matches the host/address being connected to (bridge_insecure option).
9. Continue with **Authentication** and/or **Advanced Options** if you wish to change those settings (see sections below).
10. Click **Submit**.
11. Click **Save and Apply** to save your changes.

To add a topic that the MQTT broker uses to filter messages for the connected client (you must add at least one topic for the broker to filter messages):

1. Under **Options**, click **Add Topic**.
2. Enter the following fields:

   a. Pattern - Define a topic pattern to be shared between the two brokers. Any topics matching the pattern are shared.

   b. Local Prefix - Local prefix is used to remap subtrees of topics. The topic entered in the topic field will be prepended with the local prefix before the subscriptions is done.

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c. Remote Prefix - Remote prefix is used to remap subtrees of topics. The topic entered in the topic field will be prepended with the remote prefix before the subscriptions is done.

d. QoS Level - Quality of Service level defines the publish/subscribe QoS level used for this topic. Select from the drop-down the following values: 0 (At Most Once), 1 (At Least Once), or 2 (Exactly once). Default - 0

e. Direction - The direction that the messages will be shared in; it is possible to import messages from a remote broker using in, export messages to a remote broker using out, or share messages in both directions.

3. Click **Finish**.

After adding the topic, the Web UI displays the new topic in the table view. The table shows the Full Local Topic, Full Remote Topic, QoS Level, Direction, and Options (edit or delete) for each topic**.**

Full Local Topic - the resulting topics that will be used on the local end of the bridge.

Full Remote Topic - the resulting topics that will be used on the remote end of the bridge.

To configure authentication:

1. Under **Authentication**, select the **Authentication Method** from the drop-down including:

- No Authentication – default value.
- User ID and Password - If you choose User ID and Password as the method, enter the **User ID** and/or **Password**.
- Pre-Shared Key (PSK) - If you choose Pre-Shared Key (PSK), enter the **Identity** and **Pre-Shared Key**.
- Device Certificate
- Imported Certificate - If you choose Imported Certificate, enter the **Local RSA Certificate (PEM)**and **Local RSA Private Key (PEM)**.

2. Click **Submit**.
3. Click **Save and Apply** to save your changes.

Advanced Options

The following **Advanced Options** are available for configuration:

.

Clean Session - When disabled (by default), all subscriptions on the remote broker are kept in case of the network connection dropping. If enabled, all subscriptions and messages on the remote broker will be cleaned up if the connection drops. Note: If disabled a large amount of retained messages could be sent each time the bridge reconnects.

If you are using bridges with clean session disabled, then you may get unexpected behavior from incoming topics if you change what topics you are subscribing to. This is because the remote broker keeps the subscription for the old topic. If you have this problem, connect your bridge with clean session enabled, then reconnect with clean session disabled as normal.

Notifications - When enabled (by default), the system publishes notification messages to the local and remote brokers giving information about the state of the bridge connection. Retained messages are published to the topic $SYS/broker/connection/<remote_clientid>/state unless otherwise set with notification_topics. If the message is 1 then the connection is active, or 0 if the connection failed.

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Try Private - When enabled (by default), the bridge attempts to indicate the remote broker that it is a bridge, not an ordinary client. If successful, this means that loop detection will be more effective and that retained messages will be propagated correctly. Not all brokers support this feature so it may be necessary to disable Try Private if your bridge does not connect properly.

Bridge Protocol Version - The version of the MQTT protocol to use with for this bridge. Can be one of the following: **mqttv31** or **mqttv311**. Default - **mqttv31**.

Click **Submit**, and then **Save and Apply** to save your changes.

MQTT Bridge Logs

The MQTT Broker Bridge logs are stored to the **/var/log/mosquitto.log.** The logs are also available on the **MQTT** tab on the **Status & Logs** page.

The log level in the **/var/log/mosquitto.log** depends on the Log Level configuration on the **Debug Options** page.

Generating a New Certificate

Because the device uses a self-signed website certificate, your browser shows a certificate error or warning. Ignore the warning and add an exception or add your device address to the trusted sites.

To generate a new certificate:

1. Go to **Administration > X.509 Certificate**. The **X.509 Certificate** window displays the details of the certificate that is currently used.
2. Click **Generate** to open the **Generate Certificate** window.
3. In the **Common Name** field, enter the name, hostname, or IP address, depending on what you use to connect to the device. The web browser uses this field to check for a valid certificate.
4. In the **Days** field, enter the amount of days before the certificate will expire.
5. In the **Country** field, enter the 2-letter code for the country name.
6. In the **State/Province** field, enter the state or province for which the certificate is valid.
7. In the **Locality/City** field, enter the locality or the city for which the certificate is valid.
8. In the **Organization** field, enter the organization name for which the certificate is valid.
9. In the **Email Address** field, enter the email address of the person responsible for the device. Typically this is the administrator. This field may be left blank.
10. Click **Generate**. Wait until the certificate is generated. You may have to reboot to complete the operation.
11. If you are finished making changes, click **Save and Apply**. The device reboots after applying those changes.

Importing a Certificate

To import a certificate (in **.pem** format):

1. Go to **Administration > X.509 Certificate**. The Certificate window displays the details of the certificate that is currently used.

   NOTE: A certificate with a key size greater than 2048 bits causes a delay accessing the Web UI after the device starts. A certificate with a key size less than 2048 bits is not recommended since it is less secure and may become breakable in the near future.
2. Click **Import** to open **Upload Certificate** window.

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3. Click **Browse** to select a valid certificate to be uploaded. Check that your certificate file format is **.pem**.
4. Click **Upload**. Wait until the file is uploaded.
5. To save your changes, click **Save and Apply**. The device reboots after applying those changes.

NOTE: Your certificate file must be in **.pem** format.

Uploading CA Certificate

This page allows a user to upload an X.509 CA (Certifying Authority) Certificate. This is also where you upload root CA certificates for the on-premises Device HQ server to the device.

To upload a CA certificate:

1. Go to **Administration > X.509 CA Certificates**.
2. Click **Choose File** and browse for your CA certificate file.
3. Click **Open**.
4. Once your file is selected, click **Import**.
5. Click **Save and Apply** to save your changes. The device reboots.
6. Your CA certificate file displays in the certificate list along with relevant details.
7. You may delete or remove a certificate by clicking the trash can icon to the right under **Options**.

Note: Both add and remove functions may take up to two minutes to update. Once updated, the changes are applied immediately. There is no need to restart the device after CA certificate is added or removed. For bi-directional certificate authentication or client authentication, go to **Device Administration > Access Configuration > HTTPS Security > Authentication** and check **Client Authentication.** See **HTTPS Security** on the**Access Configuration** page for more details**.**

Setting up the Remote Management

To modify DeviceHQ automatic update settings, go to options under **Auto-Update Settings** and refer to Managing Your Device Remotely.

1. Go to **Administration > Remote Management > Remote Server**. To allow the device to connect to the Remote Management Server, check **Enabled**.
2. If you want the device to use a secure connection, check **SSL Enabled**.
3. The **Server Name** field is pre-populated with the address of the Remote Management Server.
4. The **Server Port** field is pre-populated with the port the Remote Management Server listens on. You likely do not need to change this.
5. In the **Account Key** field, type the account key received from the Remote Management administrator. The device is not allowed to connect to the Remote Management Server without a valid account key.
6. For MTCAP only, in the **Device API Secret** field, enter the API Secret for the device from your Device HQ account to send backup battery data so that DeviceHQ can display it.
7. For MTCAP only, in the **Device API Authentication Token** field, enter the API Authentication Token for the device from your Device HQ account to send backup battery data so that DeviceHQ can display it.
8. Click **Submit**.
9. To save your changes, click **Save and Apply**.

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Managing Your Device Remotely

DeviceHQ® can monitor devices, reboot devices, and perform remote software and configuration updates.

NOTE: Reboot the device before performing any firmware updates.

To configure your device to use DeviceHQ:

1. Go to **Administration > Remote Management** and check **Enabled**.
2. Go to options under **DeviceHQ Check-In Settings**.
3. Enable the **Intervals** check box to check in to DeviceHQ periodically at the specified interval.**If you do not select **Intervals**, certain DeviceHQ features will NOT be available. See note at the end for this topic for details.*
   a. To define how often the device connects to DeviceHQ to check in and request any pending updates, set the **Check-In Interval** field to the desired number of minutes between 240-10080 (240 minutes to 1 week). **Note:**The minimum check-in interval is 4 hours. If you set a device's check-in interval to less than 4 hours, the change is ignored.
   b. To define how often the device connects to DeviceHQ to send GPS data, set the **GPS Data Interval** field to the desired number of minutes, between 240-10080 (240 minutes to 1 week). **Note:** Some MTR models do not have GPS. Then this field does not display.
4. Enable **Single Check-In** to configure your device to check-in to DeviceHQ at the specific date and time. If you enable **Single Check-In**, click the **Date** field to select the date from the calendar picker, and then enter the **Time** (HH:MM) for your device to check-in.
5. Enable **Repeatable** to check-in to DeviceHQ periodically at the specified time daily or at the specific days of the week.
   a. Select **Daily** from the **Repeat** drop-down to check in to DeviceHQ every day, and enter the **Time** (HH:MM) for your device to check-in.
   b. Select **Custom** from the **Repeat** drop-down, then specify the days of the week, and enter the **Time** (HH:MM) for your device to check-in.
6. Go to options under **Update Settings**
7. If **Sync with Dial-On-Demand** is checked and cellular dial-on-demand is enabled, the connection is not dialed solely for the purpose of connecting to DeviceHQ. The device will connect to DeviceHQ only when other traffic brings up the link.
8. Check **Allow Firmware Upgrade** if you want DeviceHQ to make automatic updates of your firmware.
9. Check **Allow Configuration Upgrade** if you want DeviceHQ to make automatic updates of your configuration software.
10. Check **Allow Radio Firmware Upgrade** if you want DeviceHQ to make automatic updates of your cellular radio firmware.
11. Click **Submit**.
12. Click **Save and Apply** to save your changes.

    ***NOTE**: If you do not select **Intervals**, certain DeviceHQ features will NOT be available including:
    - missed check-in alerts
    - device rebooted alerts
    - automatically scheduled device log uploads
    - home page notices for rebooted or missed check-in devices

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Notifications

The device can send alerts via email, SMS, and/or SNMP. To use these options, enable SMTP (see SMTP Settings for details), SMS (see Configuring SMS for details), and SNMP Traps (see Configuring SNMP for details).

A time stamp is added to the actual notifications. The format is **YYYY-MM-DD HH:MM**.

To setup notifications:

1. Go to **Administration > Notifications > Configuration**.
2. Under **Recipient Group**, click **Add Group** (you must add a group before you can edit/save your alert).
3. In the **Create Recipient Group** window, enter your **Group Name**.
4. Enter the person's **Name** and **Phone Number**. Click **Add Phone**.
5. Enter the person's **Name** and **Email**. Click **Add Email**.
6. Add name, phone number and email for each person in your group. When done, click **Submit**.
7. Click **Save and Apply** if you have no additional changes. Otherwise, skip to step 9.
8. See the list of available alerts:
    - **High Data Usage**
    - **Low Signal Strength**
    - **Device Reboots**
    - **Ethernet Interface Failure**
    - **Cellular Interface Failure**
    - **Ethernet Data Traffic**
    - **Cellular Data Traffic**
    - **WAN Interface Failover**
    - **Ping Failure**
    - **Security Violation**
    - **Resource Overuse**
    - **Wi-Fi Interface Failure***
    - **Wi-Fi Data Traffic***

    ***Only available on models with Wi-Fi capabilities
9. Click on the pencil icon under the **Edit** column for the alert you want to use and configure. The **Edit** dialog box appears for your chosen alert.

For **High Data Usage**:

1. Check **Enabled**.
2. Under **Data Plan Details**, select the **Plan Type** from the drop down menu which includes **Monthly** or **Custom Interval**.
3. If you choose **Custom Interval**, enter the **Interval** length in days.
4. Select the **Start Date** from the calendar picker.
5. Enter the **Limit** in **MB** for data usage.
6. In **Notify At**, enter the percentage of the limit that triggers notification to be sent.
7. Select alert recipients from **Recipient Group**.
8. Select how you want to send alerts by clicking **Email**, **SMS**, or **SNMP**.

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9. Click **OK**.
10. To save your changes, click **Save and Apply**.

For **Low Signal Strength**:

1. Check **Enabled**.
2. Enter the **Signal Threshold** in **dBm**.
3. Enter the **Duration** in seconds.
4. Under **Alerts**, select the recipients under **Recipient Group**.
5. In **Notify**, enter the frequency of notification (in hours). Default is **24**.
6. Select how you want to send alerts by clicking **Email**, **SMS**, or **SNMP**.
7. Click **OK**.
8. To save your changes, click **Save and Apply**.

For **Device Reboots**:

1. Check **Enabled**.
2. Under **Alerts**, select the recipients under **Recipient Group**.
3. In **Notify**, the field for frequency of notification is shown. The predefined value is **Always** and cannot be modified by the user.
4. Select how you want to send alerts by clicking **Email**, **SMS**, or **SNMP**.
5. Click **OK**.
6. To save your changes, click **Save and Apply**.

For **Ethernet Interface Failure**:

1. Check **Enabled**.
2. Enter the **Duration** in seconds.
3. Under **Notification Options**, select the recipients from the drop-down in **Recipient Group**.
4. In **Notify**, enter the frequency of notification (in hours). Default is **24**.
5. Select how you want to send alerts by clicking **Email**, **SMS** or **SNMP**.
6. Click **OK**.
7. To save your changes, click **Save and Apply**.

For **Cellular Interface Failure**:

1. Check **Enabled**.
2. Enter the **Duration** in seconds.
3. Under **Notification Options**, select the recipients from the drop-down in **Recipient Group**.
4. In **Notify**, enter the frequency of notification (in hours). Default is **24**.
5. Select how you want to send alerts by clicking **Email**, **SMS** or **SNMP**.
6. Click **OK**.
7. To save your changes, click **Save and Apply**.

For **Ethernet Data Traffic**:

1. Check **Enabled**.
2. Enter **Interval** in hours when alert is sent.

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3. Under **Notification Options**, select the recipients from the drop-down in **Recipient Group**.
4. In **Notify**, the constant value is **Always**.
5. Select how you want to send alerts by clicking **Email**, **SMS** or **both**.
6. Click **OK**.
7. To save your changes, click **Save and Apply**.

For **Cellular Data Traffic**:

1. Check **Enabled**.
2. Enter **Interval** in hours when alert is sent.
3. Under **Notification Options**, select the recipients from the drop-down in **Recipient Group**.
4. In **Notify**, the constant value is **Always**.
5. Select how you want to send alerts by clicking **Email**, **SMS** or **both**.
6. Click **OK**.
7. To save your changes, click **Save and Apply**.

For **WAN Interface Failover**:

1. Check **Enabled**.
2. Enter the **Timeout** in seconds.
3. Select what to **Notify On** from the drop-down.
4. Under **Notification Options**, select the recipients from the drop-down in **Recipient Group**.
5. In **Notify**, the constant value is **Always**.
6. Select how you want to send alerts by clicking **Email**, **SMS** or **SNMP**.
7. Click **OK**.
8. To save your changes, click **Save and Apply**.

For **Ping Failure**:

1. Check **Enabled**.
2. Under **Ping Details**, select the **Network Interface** from the drop-down.
3. Enter the **IP Address** or **URL** that you want to ping.
4. Enter the **Count**.
5. Enter the **Failure Threshold**.
6. Enter the **Ping Interval**.
7. Under **Notification Options**, select the recipients from the drop-down in **Recipient Group**.
8. In **Notify**, the constant value is **Always**.
9. Select how you want to send alerts by clicking **Email**, **SMS** or **SNMP**.
10. Click **OK**.
11. To save your changes, click **Save and Apply**.

For **Security Violation**:

1. Check **Enabled**.
2. Under **Notification Options**, select the recipients from the drop-down in **Recipient Group**.
3. In **Notify**, the constant value is **Always**.

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4. Select how you want to send alerts by clicking **Email, SMS** , or **SNMP.**
5. Click **OK.**

For **Resource Overuse**:

1. Check **Enabled**.
2. Under **Notification Options**, select the recipients from the drop-down in **Recipient Group**.
3. In **Notify**, the constant value is **Always**.
4. Select how you want to send alerts by clicking **Email, SMS** , or **SNMP.**
5. Click **OK.**

The following notifications are only available on models with Wi-Fi capabilities:

For **Wi-Fi Interface Failure**:

1. Check **Enabled**.
2. Enter the **Duration** in seconds.
3. Under **Notification Options**, select the recipients from the drop-down in **Recipient Group**.
4. In **Notify**, enter the frequency of notification (in hours). Default is **24**.
5. Select how you want to send alerts by clicking **Email**, **SMS** or **SNMP**.
6. Click **OK**.
7. To save your changes, click **Save and Apply**.

For **Wi-Fi Data Traffic**:

1. Check **Enabled**.
2. Enter **Interval** in hours when alert is sent.
3. Under **Notification Options**, select the recipients from the drop-down in **Recipient Group**.
4. In **Notify**, the constant value is **Always**.
5. Select how you want to send alerts by clicking **Email** or **SMS**.
6. Click **OK**.
7. To save your changes, click **Save and Apply**.

Customizing the User Interface

You can change how the user interface on your device appears. To change the interface:

1. From the Navigation pane, select **Administration > Web UI Customization**.
2. To define what information appears on the **Administration: Support** page, use the Support group. See Customizing Support Information.
3. To define other settings, use the **Device Settings** group. See Specifying Device Settings.

Customizing Support Information

To customize the interface displaying information that can be used to support users:

1. To enable display of the custom support information, go to **Administration > Web UI Customization > Support Information** and check **Show Custom Info**.
2. Type the desired information into the optional fields including:

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- **Company Name**
- **Country**
- **Fax**
- **Address 1**
- **Address 2**
- **City**
- **State/ Prv**
- **Zip Code**
- **City**

3. To add a phone number:
   a. Click **Add Phone**.
   b. A label can appear next to the phone number, for example **Fax** or **Phone** or **International**. In the **Label** field, enter text that describes the phone number.
   c. In the **Number** field, type the phone number.
4. To add a link to a website, click **Add Link**.
   a. To label the website, type label text in **Label** field.
   b. In the **URL** field, type the website's link.
   c. To add further descriptive text about the site, type the information in the **Text** field.
5. To add an image, click **Upload Image:**
   a. Click **Browse**, go to the location of the image, and select the image.
   b. Click **OK.**
6. To delete an existing image, click **Remove Image**.
7. Click **Submit**.
8. To save your changes, click **Save and Apply**.

Specifying Device Settings

To define other custom settings for devices:

1. Go to **Administration > Web UI Customization > Device Settings**.
2. Enter desired information in the optional fields including:
   - **Device Name**
   - **Custom ID**
   - **Button Color**
   - **Button Font Color**
   - **Highlight Color**
   - **Highlight Font Color**

Note: To define color fields, use **#rrggbb** format.

3. To add a favorite icon, also known as a shortcut icon or bookmark icon, in the **Custom Favicon** field, click **Browse** to find where the Favicon file resides, select the desired file, and click **Upload Icon**.

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4. To remove an existing favorite icon, click **Remove Icon**.
5. To add a custom logo, next to the **Custom Logo** field, click **Browse** to find where the logo file resides, select the desired file, and click **Upload Logo**.
6. To remove an existing logo, click **Remove Logo**.
7. Click **Submit**.
8. To save your changes, click **Save and Apply**.

Upgrading Firmware

Before upgrading: reboot the device.

Upgrade the device's firmware to the latest version. You can download firmware upgrades from the MultiTech website or update your firmware automatically through MultiTech's DeviceHQ™ system.

For added security, Signed Firmware Validation is automatically used once it's enabled after upgrading from version 5.1 and higher. This authentication method prevents attempts to load invalid or damaged firmware files in order to defeat possible tampering. The module does not load any firmware that MultiTech did not digitally sign.

First, check your firmware version. Refer to the top of your configuration software window. To upgrade the firmware on your device:

There are two types of device firmware upgrades based on the upgrade file:

1. **Full Firmware Image Upgrade**: When applied, the full firmware update replaces the current firmware image with the new image of the new version.
2. **Differential Firmware Upgrade:** When applied, the current firmware image is updated with the differences between it and the new version, and effectively becomes the new version of firmware. **NOTE**: This type is only available in mPower 5.3 or later.

   NOTE: When selecting the appropriate file, the differential upgrade files use diff in the filename. Full upgrade files do not contain diff in the filename.

To upgrade the firmware locally on your device:

1. Before you upgrade your firmware, save your present configuration as a backup. Otherwise, see DeviceHQ.
2. Go to the MultiTech website, locate the firmware upgrade file you want for your device, and download this file to a known location.
3. Select **Administration** > **Firmware Upgrade**. The Administration: Firmware Upgrade pane opens.
4. Click the **Choose Firmware Upgrade File** button:
   a. Click **Browse** to find where the firmware file resides that you want to apply.
   b. Select the file and click **Open**. The file name appears next to the **Choose Firmware Upgrade File** button. Make sure you select the correct BIN file; otherwise, your device can become inoperable.
5. Click **Start Upgrade**.
6. A message about time needed to upgrade appears. Click **OK**. A progress bar appears indicating the status of the upgrade. When upgrade is completed, your device reboots.
7. After the firmware upgrade is complete, verify your configuration to make sure it is what you expected.

Note:

- The new firmware is written into flash memory.

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- It may take up to 10 minutes to upgrade the firmware. Do not interfere with the devices's power or press the reset button during this time.
- The DeviceHQ is a cloud platform that provides the ability to remotely manage and upgrade devices. Please see the **Remote Management** section or visit www.devicehq.com for more information.

Package Management

The Package Management feature installs packages and displays already-installed packages for the user. The system allows you to install only packages signed by MultiTech. You also have the option to remove currently installed packages.

Package Management is only available to users with an Administrator role.

Note: If you reset the device to factory default settings or perform a device firmware upgrade (either full or differential), all installed packages are removed.

To install a new package:

1. Verify that the target package is signed by MultiTech.
2. Go to **Administration > Package Management**.
3. Click **Choose File** and browse to select your package file.
4. Click **Install**. The system provides the status of the installation.
5. After the system successfully installs your package, it displays the package details along with previously installed packages. The package details include: Package Name,Version, and Options (with a trash can icon for delete).

To remove an existing package:

1. Go to **Administration > Package Management**. See the **Installed Packages** list.
2. Click the **Trash Can** icon for the package entry you wish to remove.
3. The system displays a confirmation message asking if you want to uninstall the target package. If you want to proceed, click **OK**. If not, click **Cancel**.
4. If you proceed, the system provides the status of removal.
5. Once the system successfully uninstalls the package, verify its removal from the **Installed Packages** list.

Saving and Restoring Settings

Before using these settings and features, we recommend you clearly understand their behaviors and effects.

To restore previous configuration settings to your device, to restore settings to their factory or user-defined defaults, or to save the current configuration, see the following.

User-defined Default Settings

When you reset your device to user-defined default settings, the following actions occur:

- Your device restarts, then it restores custom apps if they are present in the configuration, and it reboots the system again
- All settings modified by the user (not saved in the user-defined default configuration) are removed/returned to user-defined default settings

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- Any non-Node-RED custom applications saved under this configuration are restored (custom applications are reinstalled)
- var/persistent is not erased
- Any Node-RED applications saved under this configuration are restored provided that Node-RED has not been removed from the device (including configurations uploaded to DeviceHQ)
- Installed packages are not included in user-defined default configurations but are not deleted (when you reset to user-defined default configuration, they are not restored this way)

Factory Default Settings

When you reset your device to factory default settings, the following actions occur:

- Your device restarts
- User-defined default configuration is deleted (if set)
- All settings modified by the user are removed/returned to factory default settings
- All custom applications are deleted
- All Node-RED applications are deleted
- All installed packages are deleted
- Customer images, favicons, and logos are deleted
- CA certificates are deleted and new certificates are generated
- Your web server's SSL certificate is deleted and a new certificate is generated
- SSH certificates are removed and new certificates are generated

Save and Restore Configuration

1. From the navigation bar, go to **Administration > Save/Restore > Save and Restore Configuration**.
2. To restore a configuration from a previously saved file:
   a. Next to the **Restore Configuration** field, click **Browse**.
   b. Navigate to the location where the configuration file is stored and select the desired file.
   c. Click **Restore**. The device reboots.
3. To save your current configuration to a file:
   a. Next to the **Save Configuration to File**, click **Save**.
   b. Navigate to the location where you wish to save the file and select location.

Factory Default

To reset the device's configuration to the factory default settings:

1. Click **Reset**.
2. A dialog box appears prompting you to confirm that you want to restore to factory default settings.
3. Click **OK**.

User-Defined Default

To restore the device to user-defined default settings, you must first set a current configuration as user-defined default.

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1. To set deployment-specific default settings as user-defined defaults, under **Set Current Configuration As User-Defined Default**:
   a. Click **Set**.
   b. A dialog box appears prompting you to confirm that you want to save the current configuration as user-defined settings.
   c. Click **OK**.
2. To restore the device's configuration to the user-defined configuration settings, go to **Reset to User-Defined Configuration** under **User-Defined Default**:
   a. Click **Restore**.
   b. A dialog box appears prompting you to confirm that you want to restore to a set of user-defined settings.
   c. Click **OK**. The device reboots.
3. To clear user-defined defaults, under **Clear User-Defined Defaults**:
   a. Click **Clear**.
   b. A dialog box appears asking you if you want to clear user-defined defaults.
   c. Click **OK**.

Reset Button Configuration

To enable reset to factory default settings:

1. Check **Enable Reset to Factory Default** under **Reset Button Configuration** (enabled by default).
2. Click **Submit**.
3. Then click **Save and Apply** to save your changes. No restart required.

   When you enable this option and press the reset button on the device for 5 seconds or more, the device will reset to factory default settings.

To enable reset to user-defined default settings:

1. Check **Enable Reset to User-Defined Default** under **Reset Button Configuration** (disabled by default).
2. Click **Submit**.
3. Then click **Save and Apply** to save your changes. No restart required.

   When you enable this option and press the reset button on the device 5 seconds or more, the device will reset to user-defined default settings.

To enable reset of **BOTH** factory default and user-defined default settings:

1. Check both options, **Enable Reset to Factory Default** and **Enable Reset to User-Defined Default** under **Reset Button Configuration**.
2. Click **Submit**.
3. Then click **Save and Apply** to save your changes. No restart required.

   To **Reset to User-Defined Configuration**:

   When you enable both options and press the reset button on the device for 5 seconds or more, the device will reset to user-defined default settings.

   To **Reset to Factory Default Configuration**:

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To override user-defined default configurations and restore the device to factory default settings, press and hold the reset button on the device for more than 30 seconds.

To disable **BOTH** factory default and user-defined default settings:

1. Uncheck both options, **Enable Reset to Factory Default** and **Enable Reset to User-Defined Default** under **Reset Button Configuration**.
2. Click **Submit.**
3. Then click **Save and Apply** to save your changes. No restart required.

   In this case, the reset button on the device only restarts the device and will not restore it to either factory default or user-defined default settings.

NOTE: Disabling factory default settings will mean there is no mechanism to restore the device to commissioning mode. Once the factory default has been disabled, do not lose track of your access credentials or access to the device will be lost.

Using the Debugging Options

The device has utilities to help troubleshoot and solve technical problems. You can set up your device:

- To automatically reboot itself at a particular time of day or use a particular offset in hours from boot.
- To record and report Syslog messages that can help you resolve potential issues with your device.

You can also communicate directly with the device's cellular radio. To do this:

1. From **Administration**, select **Debug Options**.
2. Click the down arrow to the far right of the Radio Terminal screen to view the terminal window.
3. Enter AT commands to the radio.

See other topics for additional Debug Options:

- Auto Reboot Timer (automatically reboot device)
- Call Home Remote Management
- Remote Syslog (configuring syslog)
- Ping and Reset Options
- Data Traffic Statistics

See also: Statistics Configuration Fields

Automatically rebooting the device

To choose a specific time to reboot daily, the amount of time that passes before the device automatically reboots itself, or to disable this function:

1. Go **Administration > Debug Options > Auto Reboot Timer**, select **DAILY, TIMER,** or **DISABLED** from the drop-down under **Auto Reboot**.
2. If you chose **DAILY**, enter the **Time** of day you want device to reboot (in HH:MM format).
3. If you chose **TIMER**, enter the Interval (in hours) for the amount of time that passes before the device automatically reboots itself.
4. If you do NOT want the device to automatically reboot, select **DISABLED** (default).

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Call Home Remote Management

You must have an existing **DeviceHQ™** account. This feature enables the device to call home for configuration files, firmware updates, custom applications, and adds your **DeviceHQ** account key to the device. To enable **Call Home Remote Management**:

1. From **Administration**, select **Debug Options**.
2. Enable **Call Home Remote Management.**
3. Click **Submit**.
4. To save your changes, click **Save and Apply**.

Configuring Remote Syslog

To enable and configure **Remote Syslog** to capture and send log data from your device, you can use a local syslog software or you can setup a log request in **DeviceHQ™**. In **DeviceHQ** under **Devices**, select your device. Then click on **Tasks** and select **Request Device Logs**. After the request has been completed, return to the device administration software.

Note: If you change **Debug Log Level**, it does not require reboot. However, you must reboot the system in order for the log level in **/var/log/api.log** to be changed.

1. To activate **Remote Syslog**, go to **Administration > Debug Options > Remote Syslog**, select**Enabled**. The **Hostname** is displayed to the right of **Enabled**. (**Hostname** can be modified in the **Hostname Configuration** pane under **Setup > Global DNS** page.)
2. To enable a remote server to receive and store the device's log data, under **Remote Syslog**, in the **IP Address** field, type the IP address of the desired server.
3. Select the **Protocol** used to communicate with the remote syslog server from the drop-down including **UDP, TCP,** or **SSL/TLS**.
4. If you select **SSL/TLS** for **Protocol,** then click **Show** to choose from the following **Security Settings**:
   a. Check to enable **TLS v1.3, TLS v1.2,** or **both**.
   b. Select from any or all of the available Cipher Suites based on the version(s) of TLS that you selected. For TLS v1.3: TLS_AES_256_GCM_SHA384, TLS_CHACHA20_POLY1305_SHA256, and TLS_AES_128_GCM_SHA384. For TLS v1.2: ECDHE-RSA-AES256-GCM-SHA384 and ECDHE-RSA-AES128-GCM-SHA256. You can also click **Select All**.
5. Enter the desired **Port** number that the remote syslog server uses.
6. To determine the amount of log information that is collected, under **Logging**, in the **Debug Log Level**, select the type of information from the values in the drop- down menu which includes: **Minimum, Error, Warning, Info, Debug,** and **Maximum**. The system will collect the type of information you specify. For example, **Maximum** will collect all the log data available while **Warning** will collect anything that is a warning or above that level.
7. To download syslog information directly from the device, click **Download**.
8. Click **Submit**.
9. To save your changes, click **Save and Apply**.

Data Traffic Statistics

The Data Traffic Statistics section is used to configure the statistics periodically depending on the configured timeout and data limit. By default, the Save Timeout is set to 300 seconds and the Data Limit is set to 5 MB. For the default scenario, the device saves the data if more than 5 minutes has elapsed, or if more than 5 MB has been

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sent or received from the last check. The device checks these conditions every minute, but the data is saved only if one of the conditions is met.

To configure **Data Traffic Statistics**:

1. Go to **Administration > Debug Options > Data Traffic Statistics**.
2. Enter the **Save Timeout** in seconds.
3. Enter the **Save Data Limit** in megabytes.
4. Click **Submit**.
5. To save your settings, click **Save and Apply**.

Statistics Configuration Fields

The device saves the statistics periodically depending on the configured timeout and data limit. By default, the Save Timeout is set to 300 seconds and the Data Limit is set to 5 MB. For the default scenario, the device saves the data if more than 5 minutes has elapsed, or if more than 5 MB has been sent or received from the last check. The device checks these conditions every minute, but the data is saved only if one of the conditions is met.

Field	Description
Save Timeout	The device saves the statistical data when the desired timeout period has elapsed. Default is 300 seconds (5 minutes).
Save Data Limit	The device saves the statistical data if the data limit is reached. Default is 5 MB.

Ping and Reset Options

Perform a Ping Test

Ping allows you to test the IP address or URL to ensure it is operational.

To perform a ping test:

1. Go to **Administration > Debug Options > Ping**.
2. Enter the **IP address or URL** of the site you wish to ping.
3. Enter the **Number of Requests** to set the number of ping requests.
4. To forbid fragmentation, check **Do Not Fragment**. Without fragmentation, the ping fails if the ping packet exceeds MTU size for the network path. By default, the option is disabled.
5. Under **Network Interface**, choose from the available drop-down menu options including: **ANY, BRIDGE, CELLULAR, WI-FI WAN, WI-FI AP, ETHERNET (ETH0),, ETHERNET (ETH1), and ETHERNET (ETH2)**. (Available interfaces vary with hardware model.) NOTE: When using Serial Modem Mode, only the following interfaces are available: **ANY, BRIDGE (BR0)** and **ETHERNET (ETH0)**.
6. Enter the **Packet Size** (in bytes). This specifies the number of data bytes to be sent. The default is 56, which translates into 84 bytes of data when combined with 8 bytes of ICMP header and 20 bytes of IP header. When specifying 0 bytes, the actual packet size is 28 bytes (ICMP header and IP header).
7. Click **Ping**.

Perform a Continuous Ping

To perform a continuous ping:

1. Enter the IP address or URL of the site you wish to continuous ping.

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2. Enter Packet Size (in bytes). This specifies the number of data bytes to be sent.
3. To forbid fragmentation, check **Do Not Fragment**. Without fragmentation, the ping fails if the ping packet exceeds MTU size for the network path. By default, the option is disabled.
4. Under **Network Interface**, choose from the available drop-down menu options including: **ANY, BRIDGE, CELLULAR, WI-FI WAN, WI-FI AP, ETHERNET (ETH0) , ETHERNET (ETH1), and ETHERNET (ETH2)**. (Available interfaces vary with hardware model.)
5. Click **Start Continuous Ping** to kick off the continuous ping. The system displays a message that ping is in progress.
6. The button changes to **Stop Continuous Ping**. Click the stop button to end the ping. Once done, the system displays the ping results.

Reset Options

For various reset options, go to **Administration > Debug Options > Reset Options:**

- To reset the modem, click **Reset Modem.**
- To reset Wi-Fi, click **Reset Wi-Fi**.
- If you use a Verizon SIM only, click **Reset Class 3 APN (Verizon)** to initiate the OMA DM procedure, retrieve APN settings from Verizon, and apply them automatically to your modem settings.
- To reset Bluetooth, click **Reset Bluetooth**

Usage Policy

The device shall provide a Usage Policy for the system. The default usage policy reads as follows:

This system is for the use of authorized users only. Individuals using this system without authority, or in excess of their authority, are subject to having all their activities on this system monitored and recorded by system personnel.

Anyone using this system expressly consents to such monitoring and is advised that if such monitoring reveals possible evidence of criminal activity, system personnel may provide the evidence of such monitoring to law enforcement officials.

This policy displays on the login page. You may modify or add language to the policy as needed.

To view or modify the **Usage Policy**:

1. Go to **Administration > Usage Policy**.
2. The default language appears. You may edit the language directly in the text box.
3. When completed, click **Submit**.
4. To save your changes, click **Save and Apply**.

If at any time you want to return the device to the default setting, click the **Reset to Default** button in the bottom right corner. (This reverts the **Usage Policy** back to the default language.)

Licensing

This page shows licenses on this device. Some licenses are factory installed. If you add a licensed feature after receiving the device and have a license file to add:

1. Go to **Administration > License.**

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2. Click **Add New** in the upper right corner.
3. Add the **License Key** and **Password**.
4. Click **OK.**

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Chapter 12 – Status & Logs

Viewing Device Statistics

The device collects sent/received traffic data for WAN, Cellular, and Ethernet networks. The daily statistical data is stored on the device for a 365-day period. All data that is older than 365 days is automatically deleted.

1. From **Status & Logs** on the left side of the Web Management interface, select **Statistics**.
2. The application categorizes statistics about your device. To see statistics that appear in a particular category, click the appropriate tab.

   System

   Ethernet

   Wi-Fi

   Access Point

   Cellular

   Serial

   Bluetooth

   GRE

   IPSec

   OpenVPN

   MQTT

   LoRa

Definitions

A data usage bar chart and a cumulative usage line chart are available for Ethernet, Wi-Fi, and Cellular. The Data Usage bar chart also shows statistics for data sent and data received. The following list includes some definitions to help you understand some of the data. Not all of the available statistics are listed here or shown in every tab.

- **Total**: Total number of sent/received bytes for a 365-day period.
- **Today**: Total number of sent/received bytes for today.
- **Sessions**: Bytes.
- **Packets**: Number of successfully transmitted (TX) and received (RX) packets.
- **Errors**: Number of errors that occurred. Possibly due to connection issues or network congestion.
- **Dropped**: Number of dropped packets. Possibly due to memory constraints.
- **Overruns**: Number of overruns that occurred. Possibly due to processing constraints.
- **Frame**: Number of invalid packets.
- **Carrier**: Number of signal modulation errors that occurred (possibly due to physical connection).
- **Collisions**: Number of packet collisions that occurred due to network congestion.
- **Queue Length**: Length of the transmit queue.
- **MTU** (Maximum Transmission Unit): the maximum size of packet content (Bluetooth only).
- **ACL** (Asynchronous Connection-Less): the typical protocol used for data packets (Bluetooth only).
- **SCO** (Synchronous Connection-Oriented): the typical protocol used for voice (Bluetooth only).
- **Events**: Number of events that occurred on a Bluetooth connection (Bluetooth only).

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- **Commands**: Number of commands given to devices on a Bluetooth connection (Bluetooth only).

Cumulative and Daily Usage

Click **Show Cumulative Usage** or **Show Daily Usage** to display the desired view. Default chart view is Daily Usage for 30-day period.

Timeframe of Chart

Change the time frame for the chart by clicking **Start Date** or **End Date** using calendar to set a different date.

Show Log

The associated run-time logs for this section.

LoRa Statistics

The **LoRa** statistics tab contains Received and Sent statistics for LoRa packets received and sent by the LoRa network server. These statistics can be cleared with the **Clear History** button. This tab also contains the list of nodes that have joined the network the device is supporting. There are statistics for each node and also status information in this table. This list can be refreshed by clicking on the **Refresh Node List** button.

Service Statistics

On the Web Management interface side menu, click **Status & Logs > Services** to display the **Service Statistics** window. This window shows the configuration (enabled or disabled) and the status of the following services:

- **DDNS**
- **SNTP**
- **TCP/ICMP Keep Alive**
- **Dial-on-Demand**
- **SMTP**
- **SMS**
- **Failover**
- **SNMP Server**
- **Security Violation**
- **Reverse SSH Tunnel**
- **MQTT Broker**
- **Remote Management**
- **LLDP**
- **Continuous Ping**

Mail Log

Mail Log shows the recent email delivery attempts and the mail log details. Mail log entries are sorted by date with the most recent on top. You can select the number of emails to display in the mail log. Possible values are **10, 25, 50**, or **100 emails**.

1. Go to **Status & Logs > Mail Log** to display the **Mail Log** window.
2. To see the delivery details, click the eye icon under **Options** for the desired email entry.

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3. To delete all mail log entries, click **Purge Log**.
   Note: Logs do not persist through power cycles.

Mail Queue

Mail Queue shows the emails that are waiting to be sent. The most recent email delivery attempts are on top. You can select the number of emails to display in the queue. Possible values are **10, 25, 50**, and **100 emails. Note:** Logs do not persist through power cycles.

1. Go to **Status & Logs > Mail Queue** to display the **Mail Queue** window.
2. To view the delivery details for an individual email, click the eye icon under **Options** for the desired email entry.

Notifications Sent

This page displays attempts to send Notifications via email, SMS, or SNMP.

The list includes the following details of each attempted notification: **Date, Message, Recipient Group**, and the status of the notification under each communication method including **Email, SMS**, and **SNMP**. A check indicates success via that method. An **X** means failure. No symbol or a blank space indicates that method was not attempted.

To view **Notifications Sent**:

1. Go to **Status & Logs > Notifications Sent**.
2. In the upper right corner, click **Refresh** to update the list.
3. To the right of **Refresh**, click **Delete All Notifications** if you want to remove all items in the list.

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Chapter 13 – Apps

Manage Apps

The **Manage Apps** screen under **Apps** provides information on installed custom applications including the status and version of all the installed applications.

NOTE: Support for Node-RED/Node.js on Multitech AT91SAM9G25-based products was discontinued within mPower 5.3.0. The option to use Node-RED as a custom application was available from mPower 5.3.3 to 5.3.8. On mPower 6.0 and higher, this option is no longer supported. For details on other methods to create custom applications, see Creating a Custom Application.

Custom Apps

Check **Enabled** to enable custom applications.

Uncheck **Backup On Install** if you do not want to backup the currently running application while installing a new version of the application. When checked, the backup is re-installed if the installation of a new version of the app fails.

The **Custom Apps** section contains the list of custom applications currently installed on the device. Each listing contains the information for a particular application including the **name, version, status, and info** of the application. The status value can be **Started, Running, Stopped, Failed, Install Failed,** and **Start Failed**.

Refer to Creating a Custom Application on the MultiTech Developer Resources website for complete instructions on developing, installing, and deploying custom applications.

To install a new Custom app, click **Add Custom App**:

1. In the **App ID** field, enter Application ID.
2. In the **App Name** field, enter Application Name.
3. Click **Browse**, go to the location of the custom app, and select the file.
4. To install the app, click **Install Custom App**.

After any changes to this section, click **Save and Apply** to apply those changes.

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