SAMSUNG

Verizon 4G LTE Network Extender 2 User Guide 3.1

Network Systems

Samsung Electronics America

Document Version 1.1
October 2017

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Samsung Electronics America (SEA), Inc

Address:
85 Challenger Road
Ridgefield, New Jersey 07660

Phone: 1-800-SAMSUNG (726-7864)
Phone: 1-888-987-HELP (4357)

Internet Address:
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Preface

This user guide describes how to install the 4G LTE Network Extender 2 and provides cable connection specifications.

Relevance

This user guide applies to the following products/software

Model	Release
SLS-BU10B	3.1

Conventions in this Document

Samsung Networks product documentation uses the following conventions.

Symbols

Symbol	Description
	Indicates a task.
	Indicates a shortcut or an alternative method.
	Provides additional information.
	Provides information or instructions that you should follow to avoid service failure or damage to equipment.
	Provides information or instructions that you should follow to avoid personal injury or fatality.
	Provides antistatic precautions that you should observe.

Revision History

The following table lists all versions of this document.

Version	Date	Description
1.0	June 2017	First version - Updated Chapter 2 Network Extender Setup with additional LED information;
1.1	Oct. 2017	Second version -Updated all picture including Admin Website and Chapter 5 Troubleshooting

Organization of This Document

Section	Title	Description
Chapter 1	Getting Started	Provides an overview of the Network Extender.
Chapter 2	Device Setup	Describes the procedures needed to set up the Network Extender.
Chapter 3	The Network Extender Admin Website (Local)	Describes the Network Extender Admin Website (Local).
Chapter 4	Configuring Your Device	Provides detailed information regarding firewall settings.
Chapter 5	Troubleshooting	Provides information to troubleshoot STS LED statuses.
Appendix A	Acronyms	List of terms.

Related Documentation

- Verizon 4G LTE Network Extender 2 Quick Start Guide
- Verizon 4G LTE Network Extender 2 Product, Safety and Warranty

Personal and Product Safety

WARNING! This product contains chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

FCC Radiation Exposure Statement

To ensure the safety of users, the FCC has established criteria for the amount of radio frequency energy various products may produce depending on their intended usage. This product has been tested and found to comply with the FCC's exposure criteria.

Place your Network Extender at least 10 feet away from products that generate electromagnetic radiation (e.g., microwave oven).

The installation of the base unit should allow at least eight inches (20 centimeters) between the base and persons to be in compliance with FCC RF exposure guidelines.

Chapter 1 Getting Started

Introduction

Congratulations on the purchase of your Verizon Wireless 4G LTE Network Extender 2. The 4G LTE Network Extender 2 offers enhanced in-building 4G LTE wireless coverage of up to 7500 square feet circular coverage and capacity of up to 15 active users.

This user guide introduces you to Network Extender service and all the features of your new device.

Figure 1. Verizon Wireless 4G LTE Network Extender 2

Features

This Network Extender provides the following features:

- This Network Extender is a simple to install device that provides enhanced in-building wireless service without having to change your existing mobile phone.
- This Network Extender allows users to easily install and configure the system by connecting to an existing broadband network.
- This Network Extender supports an embedded web server, which allows you to customize your IP settings. For more information, see **Chapter 3The Network Extender Admin Website (**Local).

The Network Extender box contains:

- Network Extender
- Indoor GPS extension cable
- Ethernet cable
- Power adaptor
- Quick Start Guide
- Product Safety and Warranty Manual

Figure 2. Box Contents

The following optional wall and ceiling mount brackets are sold separately. Please contact your Verizon sales representative for details.

Figure 3. Optional Wall and Ceiling Mount Bracket (sold separately)

System Requirements

- This device only supports Verizon Wireless 4G LTE mobile handsets with Advanced Calling turned on, as shown in **Chapter 2 Device Setup, in the Making a Call on Your Network Extender** section.
- Internet Access: This Network Extender must be connected to an available LAN port on a router or modem with always-on Internet access with minimum download speed of 10 Mbps and an upload speed of 5 Mbps. Speeds of 20 Mbps download and 10 Mbps upload or higher are recommended.
- GPS signal: This Network Extender requires a continuous GPS signal from the provided GPS antenna. For initial GPS fix, four strong GPS satellite signals must be available. If necessary, please use the included 23’ GPS extension cable to position the GPS antenna as close to a window as possible.

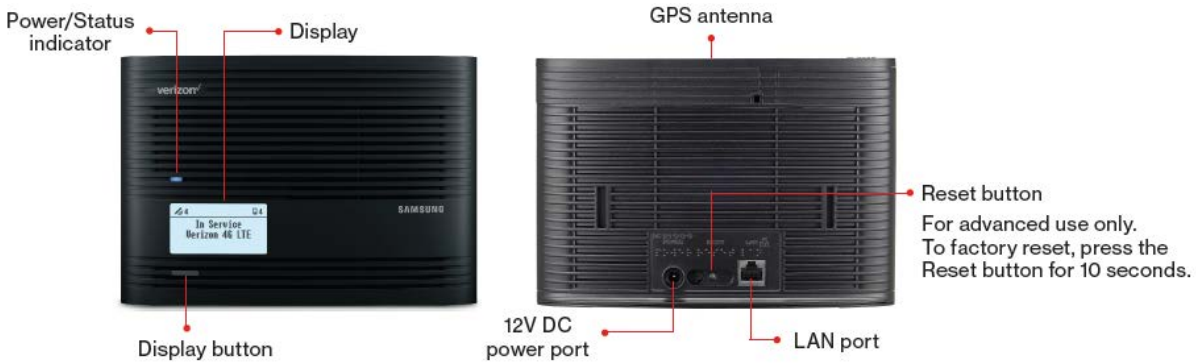
- Power: 120 VAC outlet
- Home satellite broadband access is not supported.

Network Extender Basics

This section will guide you through the basic features and functions of your Network Extender.

The included GPS antenna is required for the automated setup process and is necessary in the event the mobile phone is used to call for emergency services while in the coverage area of the Network Extender.

Figure 4. Components - Front and Rear View



The Network Extender includes the following key features and connections:

- **The Power/Status Indicator** shows the unit is on and in service.
- **The LCD Display** shows status messages and device icons indicating the number of LTE devices connected to the Network Extender and the number of GPS satellites tracked.
- **The Display Button** scrolls the LCD display to provide additional information about the device when in operation.
- **The GPS Antenna** is located under the GPS antenna cover on the top middle of the Network Extender. Slide the cover open to access to the GPS antenna to install the extension cable, if needed**.** See the **Configuring Your Device chapter.**
- **The LAN Port** allows you to connect an Ethernet cable to establish communication between the Network Extender and your broadband router. This connection port is then used to transmit voice and data through the Internet to the Verizon wireless network.

- **The Reset Button** allows you to reset the Network Extender to factory default settings. Use a pen to push and hold the Reset button for 10 seconds. The Power/Status Indicator will then become solid blue, indicating that the extender is resetting. Any manually configured parameters will require reconfiguration.
- **The 12V DC Power Port** is used to power the Network Extender when connected to the AC power adaptor. Use only the provided power adapter as using any other power source may damage the Network Extender.

Chapter 2 Network Extender Setup

Setup Procedure

This section outlines the procedures needed to set up the Network Extender.

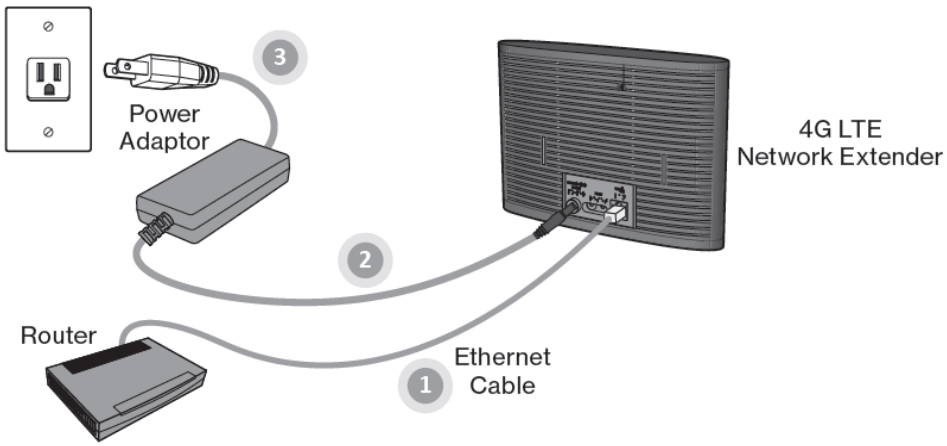
1. Confirm your package contains all components (see page 2, figure 2).
2. Review the Product Safety and Warranty document included in the package before installing the Network Extender.
3. For best results, place the Network Extender near a window, in an elevated location, such as the top of a bookshelf or cabinet.

Figure 5. Network Extender Placement

4 Plug one end of the provided Ethernet cable into an available LAN port on your router and the other end into the LAN port on your Network Extender (1).

5 Plug the power supply connector into the DC 12V power port located at the rear of the Network Extender (2). Insert one end of the power cord into the power supply and then plug the other end into an available outlet (3).

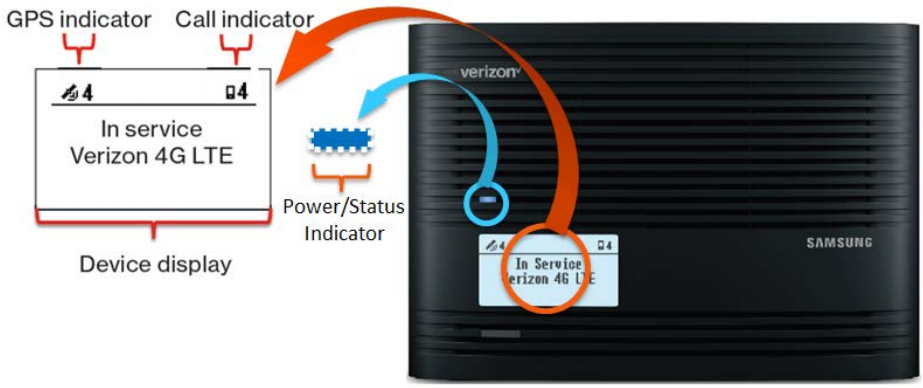
Figure 6. Connect the Ethernet Cable and Power



A GPS signal is required for proper operation and E911 service. If a GPS signal is not acquired after 30 to 60 minutes, please see **Chapter 4 Configuring Your Device**.

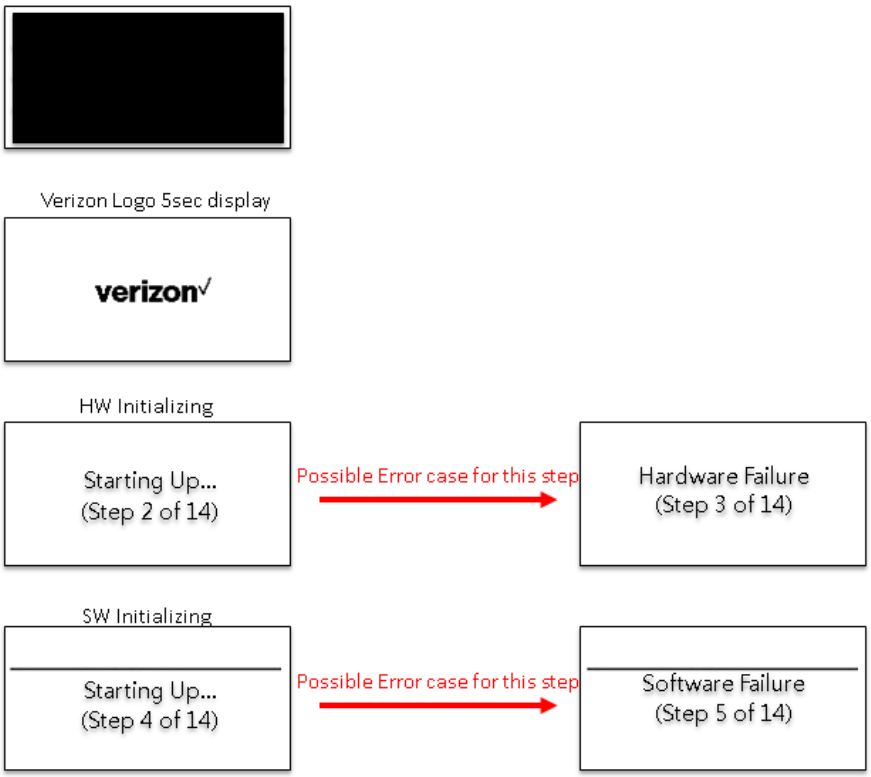
To see the status of the GPS acquisition, use the Admin website (Local) as shown in **Chapter 3 The Network Extender Admin Website (**Local).

6 When the Network Extender is plugged in, the Power/Status LED indicator will blink blue.

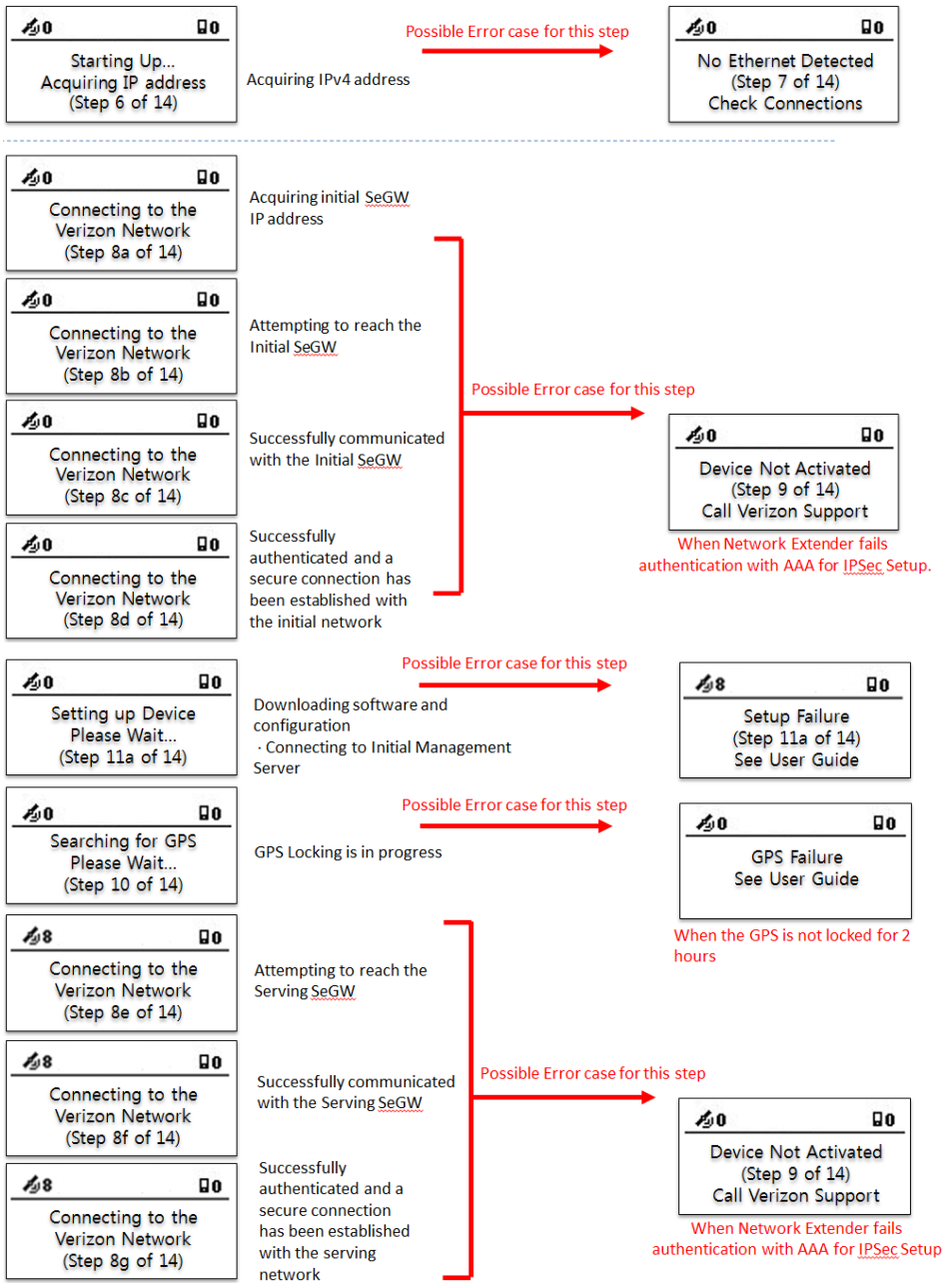


7 The initial startup of the Network Extender will take 30-60 minutes. During this process, the LED will blink.

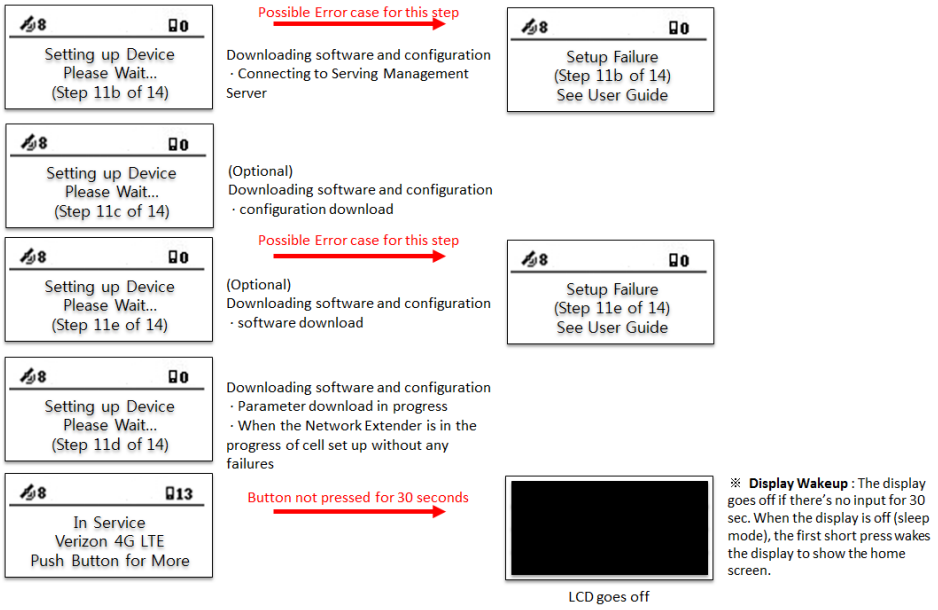
8 The Startup process will begin when the extender turns on.



9 The Network Extender will first attempt to acquire a local IP address. Next, it will connect to the Verizon network and then search for GPS.



10 The last step in the startup process is for the Network Extender to download the latest software (if necessary) and the configuration data. Finally, when the Network Extender successfully completes the startup process, the LED will return to solid blue and the display will show “In Service.”



Making a Call

Once the Network Extender is in service, your phone must be within 50 feet of the Network Extender to connect to the Network Extender and make calls.

To verify your Verizon phones are connected to the Network Extender:

1. Make sure your Verizon Wireless 4G LTE mobile phone has the Advanced Calling feature turned on.
2. Dial #48 from your mobile phone and listen for the following confirmation: "You are under 4G LTE Network Extender coverage …"
3. Some phones may show a home icon  when connected to the Network Extender.

The Network Extender's coverage depends on environmental factors, such as physical structures and the strength of external cell towers.

To turn on Advanced Calling on your 4GLTE Verizon Wireless phone, follow the steps below for your device's operating system:

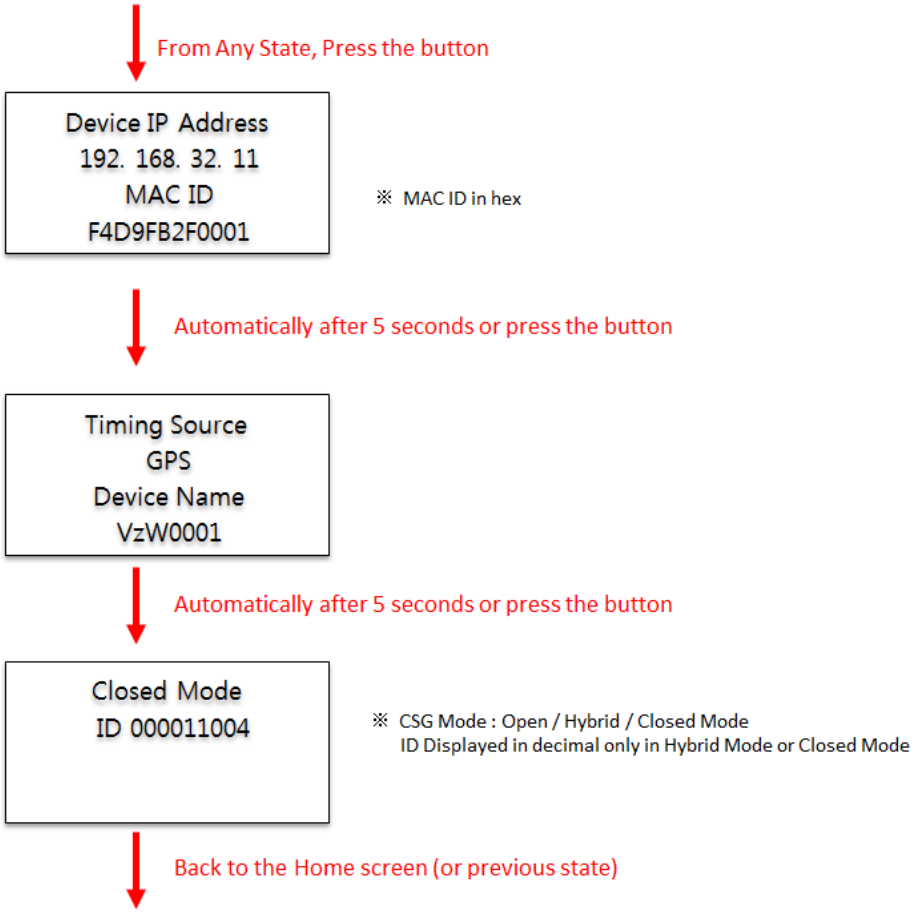
- Android™: Go to Settings > Advanced Calling and turn ON service.

On some devices, it may be found in Wireless Calling, HD Voice or VoLTE call.

- Apple® iOS: Go to Settings > Cellular > Cellular Data Options > Enable LTE > Voice & Data. Additionally, on the "My Verizon" Mobile App, enable Advance Calling feature for your phones.
- Windows®: Go to Settings > Cellular+SIM > SIM settings and turn ON Advanced Calling.

Additional LCD Display Information

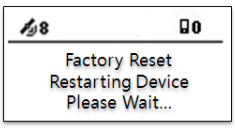
To see additional information such as the Network Extender IP address, Timing Source and CSG mode, press the button.



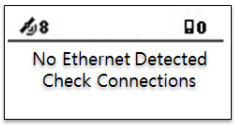
During the startup process, these are the possible error messages that may come up. If this occurs, the error message will be blinking. For more information on what to do if you see one of these messages, please refer to **Chapter 5 Troubleshooting**.

When the extender is rebooting by FeMS

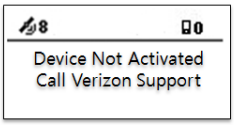
When the user pushes the factory reset button



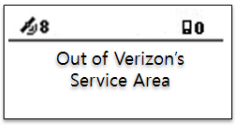
When BH port is disconnected



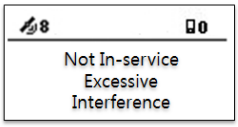
When authentication fails to initial & Serving network



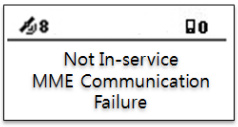
Failure to come into service due to unlicensed area



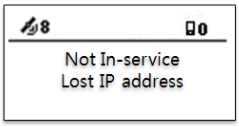
When signal of neighboring cell detected by OTAR is too strong



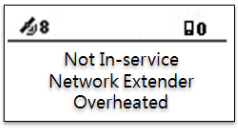
When the extender is unable to communicate with MME



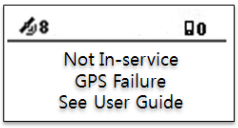
When local IP address acquisition failed.



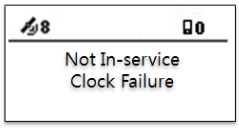
When the extender temperature is too high



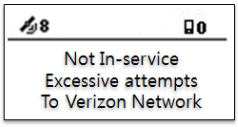
When GPS gets out of lock



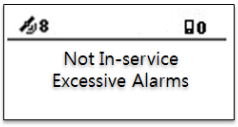
When the clock signal is abnormal



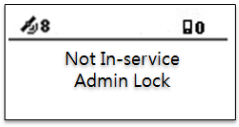
Auto Lock
· Excessive Warm Starts (IPsec tunnel establishment) attempts to reach the Initial Network or the Serving network
· Excessive Cold Start (BOOT/BOOTSTAP events) attempts to reach the Initial Network or the Serving network



Auto Lock
· Excessive Alarms



Admin lock



Chapter 3 The Network Extender Admin Website (Local)

This section contains detailed information regarding the Network Extender Admin Website (Local) where you can see the device status and make changes to settings.

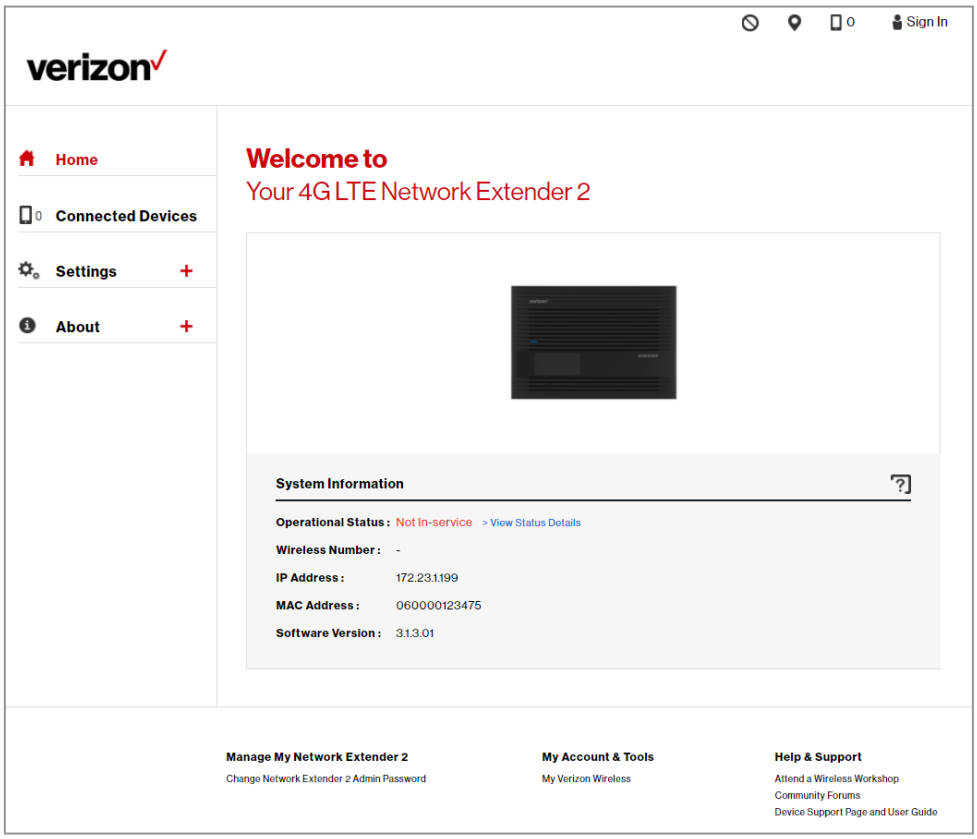
To access settings and manage the Network Extender, sign in to the web interface by following these steps:

1. Use a computer connected to the same network as the Network Extender.
2. Press the button below the display on the extender to see your Network Extender's IP address.
3. Open a browser and enter the IP address of the Network Extender into the address bar: http://<ip address of network extender>

The extender's IP address (once acquired) can also be found on the display by pressing the display button.

Admin Website Overview

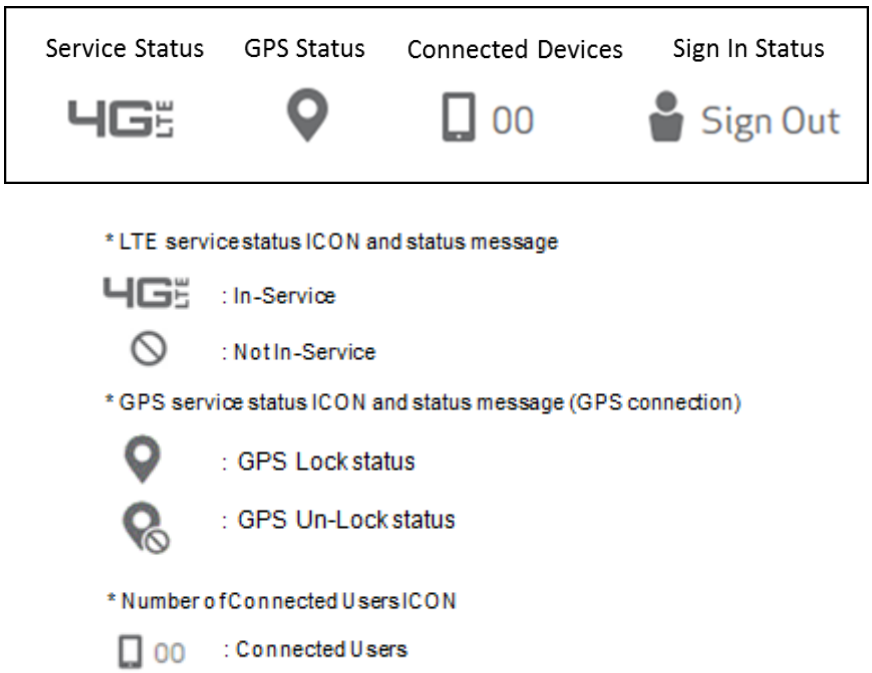
The Admin Website gives you detailed information on your Network Extender's status. You can also use the website to change the extender's settings.

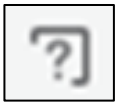


The Welcome page shows basic device information such as the Network Extender's MAC address, GPS fix location, device name and IP address.

The quick reference icons on the upper right of the Welcome page indicate device operation, GPS acquisition, number of devices connected, and sign in status.

Figure 7. Quick Reference Icons





Click this icon to see Help topics related to the page you're viewing.

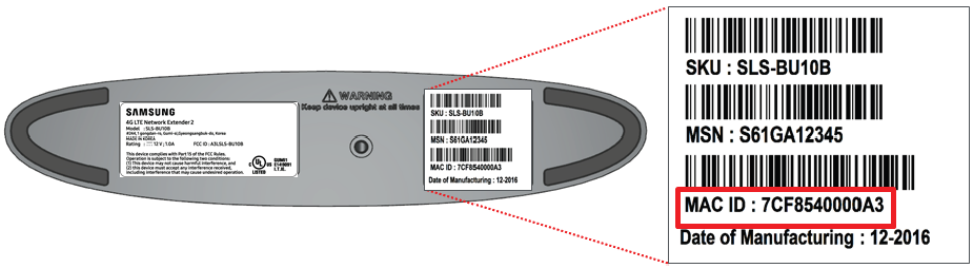
Table 1. Admin Website Initial Access Window

Items	Descriptions
Operational Status	Current operational state of the Network Extender.
Wireless Number	This is the wireless telephone number associated with this Network Extender's account. Please reference this wireless number when calling Verizon Wireless for support with this Network Extender.
IP Address	The Internet Protocol (IP) address assigned to the Network Extender.
MAC Address	The MAC address associated with the device which can also be found on a sticker attached to the Network Extender.
Software Version	Software version of the software installed on the Network Extender.

Sign In

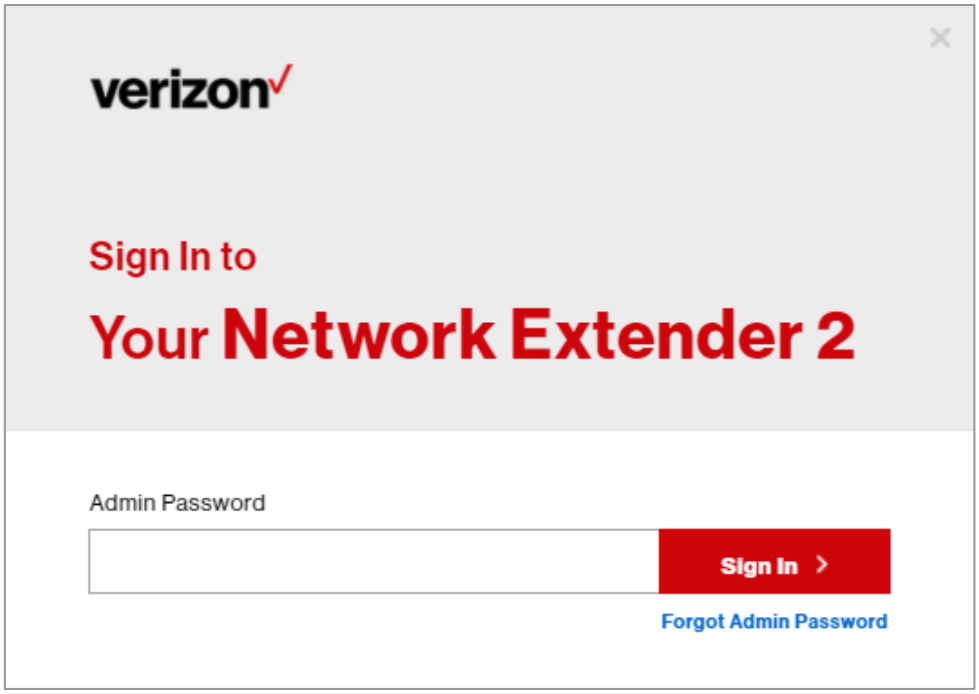
Once you are at the Welcome Page, click **Sign In** in the top right hand corner of the screen.

The default administrator password is LTEFemto + last 4 digits of the MAC ID (e.g., LTEFemto00A3). The MAC ID can be found on the label on the bottom of the Network Extender.



The password is case sensitive. Letters in the last four digits of the MAC ID should be UPPER case. The default password and all Network Extender settings can be set back to default by pressing the reset button located on the back of the extender for more than 10 seconds.

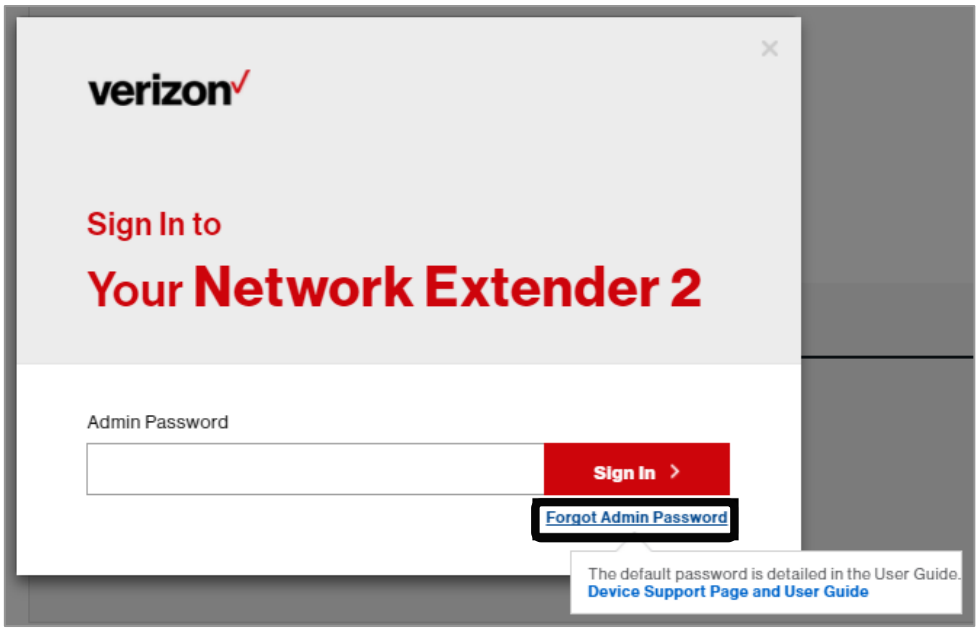
Figure 8. Network Extender Sign In Pop-Up Window



The Forgot Admin Password Link

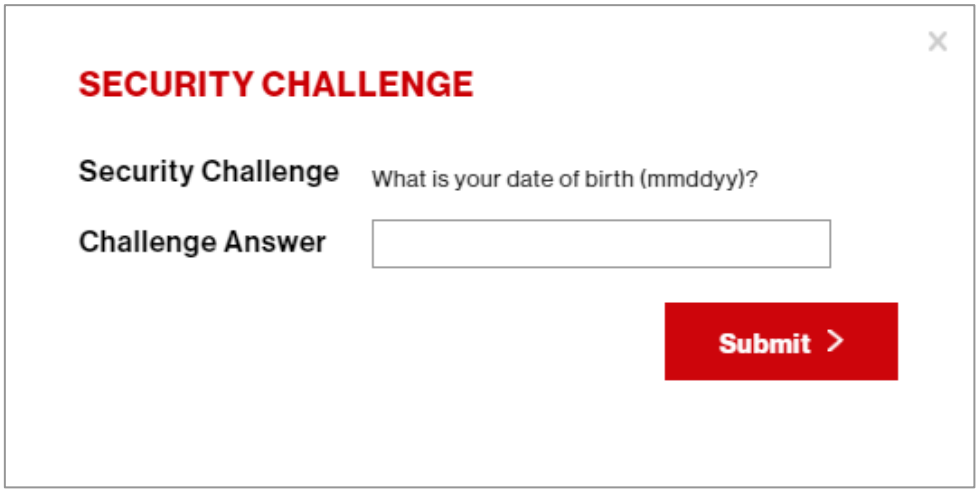
If you haven't changed the admin password yet, clicking the Forgot Admin Password link will show you a link to the Device Support Page and User Guide.

Figure 9. Network Extender Forgot Admin Password Window



If you have already changed your password and forgotten it, clicking the Forgot Admin Password link will take you to the Security Challenge Question you set when you created the password. Answer the question to reset the Password to the Default Password

Figure 10. Network Extender Security Challenge Pop-up Window



Home

Home Window provides all the information about the Network Extender.

Figure 11. The Network Extender Home Page

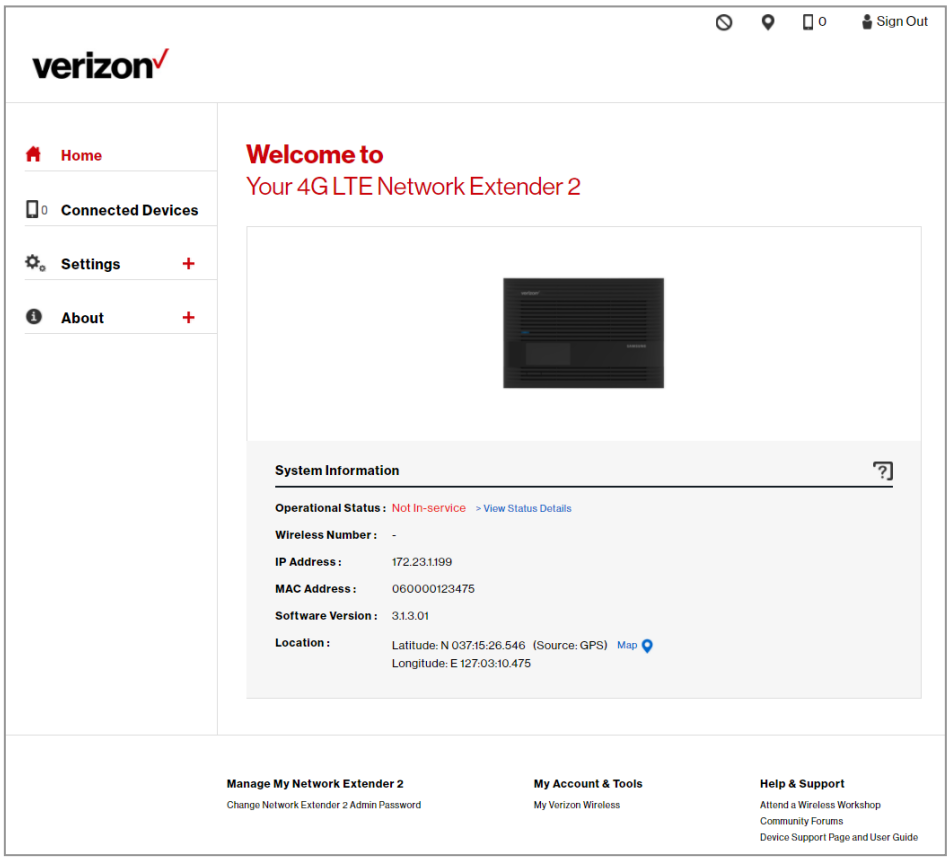


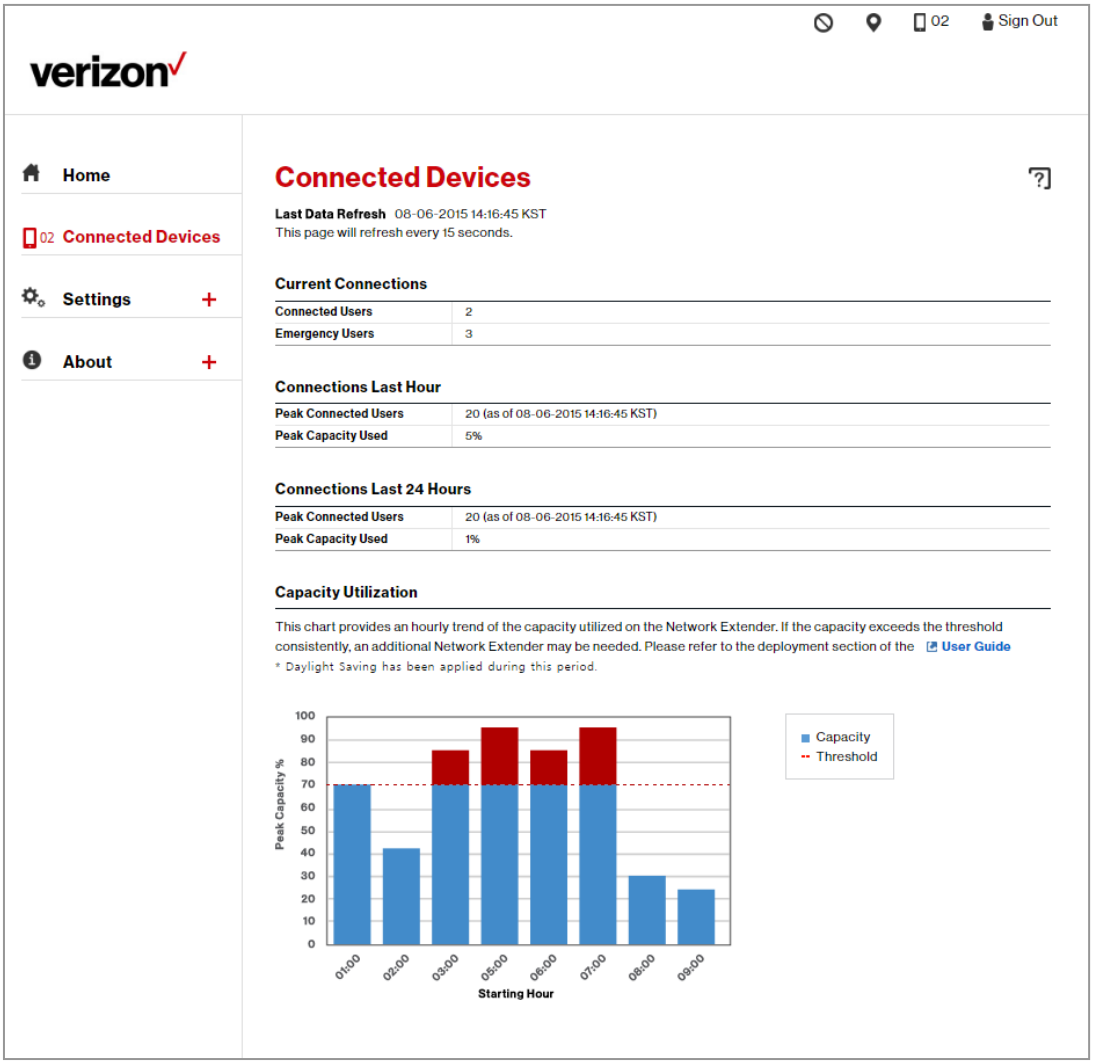
Table 2. The Network Extender Home Page

Items	Descriptions
Operational Status	The current operational state of the Network Extender.
Wireless Number	This is the wireless telephone number associated with this Network Extender's account. Please reference this wireless number when calling Verizon Wireless for support with this Network Extender.
IP Address	The Internet Protocol (IP) address assigned to the Network Extender.
MAC Address	The MAC address associated with the device which can also be found on a sticker attached to the Network Extender.
Software Version	Current version of software installed on the Network Extender.
Location	This is the physical location of the Network Extender as reported by GPS. This location is provided for emergency 911 calls.
Map	Selecting this link plots the location of the Network Extender on a Bing Map. The Bing Map link is available only if the GPS Status is “Location Acquired”.

Connected Devices

The connected devices page shows the current connected users as well as the peak Network Extender capacity utilization over the last hour and 24 hour period. The value reported is the peak for that period.

Figure 12. The Network Extender Connected Devices Page



The capacity utilization chart shows the hourly trend of the device capacity in use over the last 8 hour period.

Table 3. The Network Extender Connected Devices

Item	Description
Connected Users	The number of wireless devices (phone, tablets, or other 4G LTE data devices) currently connected to the 4G LTE Network Extender with an active call or data session.
Emergency Users	The number of wireless devices currently connected to the 4G LTE Network Extender with an active call to 911 emergency services.
Peak Connected Users for last hour	This is the maximum number of simultaneously RRC_CONNECTED users on the 4G LTE Network Extender in the last hour. If this number consistently approaches 15 devices, another Network Extender may be needed to handle the capacity and provide better service.
Peak Capacity Used for last hour	This is the peak percentage of the 4G LTE Network Extender capacity used for the last hour.
Peak Connected Users for last 24 hours	This is the maximum number of simultaneously RRC_CONNECTED users on the 4G LTE Network Extender in the last 24 hours.
Peak Capacity Used for last 24 hours	This is the peak percentage of the 4G LTE Network Extender capacity used for the last 24 hours. If this number consistently approaches 100%, another Network Extender may be needed to handle the capacity and provide better service.
Last Data Refresh	This is the time that the website data was last refreshed.
Capacity Utilization	This is a graph detailing the historical capacity used on the 4G LTE Network Extender.

Settings

Network Settings

From the Network Extender Network Settings tab, you can use the checkbox to turn DHCP on or off. If DHCP is off, you can also set the DNS information, default gateway, IP address and subnet mask. The backhaul limit (affects uplink speeds served by the Network Extender only) and MTU size can also be set here. Information regarding extender settings is in **Chapter 4 Configuring Your Device**.

Figure 13. The Network Extender Network Settings Tab

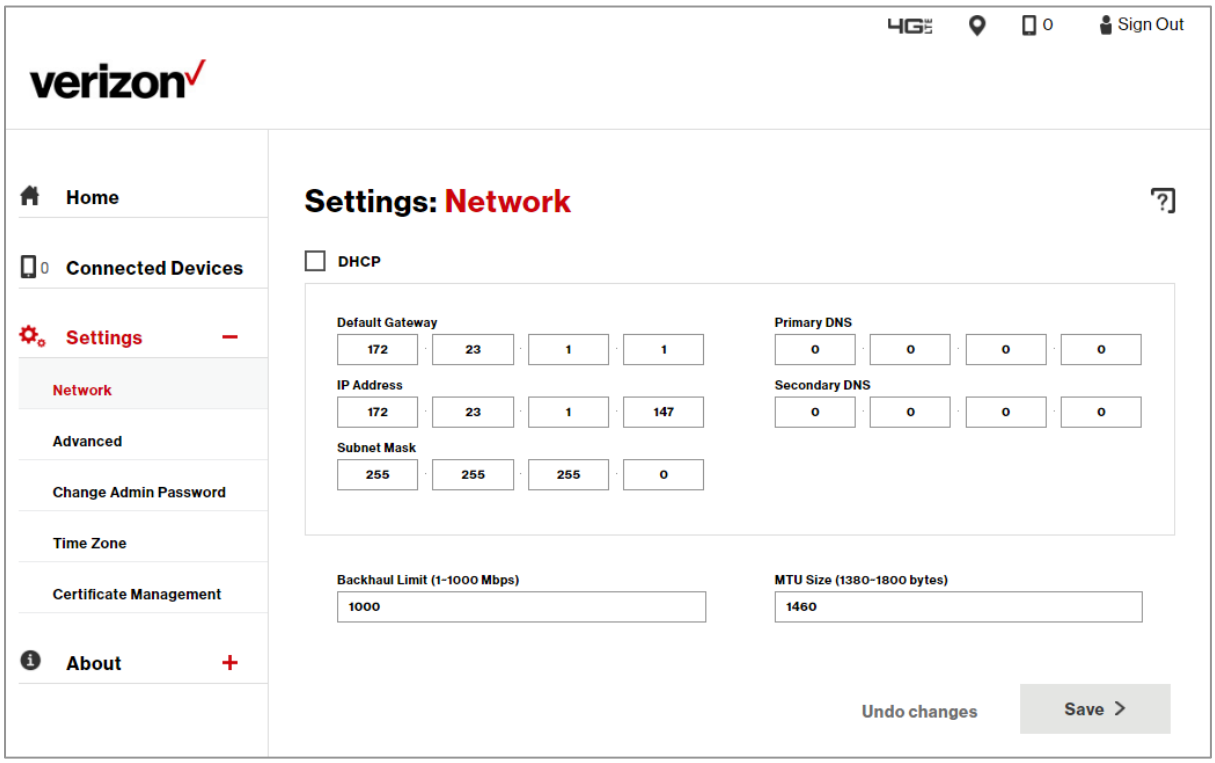


Table 4. The Network Extender Network Settings Tab

Item	Description
DHCP	This is a checkbox. When checked (default), DHCP is on and IP configuration shall be provided by the local DHCP server. The user may uncheck this box in order to specify a static IP configuration.
Default Gateway	If DHCP is on, this field is read-only. It shows the DHCP allocated default gateway IP address. If DHCP is off, this field is read-write and shows the user-defined Default Gateway IP address.
Primary DNS	If DHCP is on, this field is read-only. It shows the DHCP allocated Primary DNS Server's IP address. If DHCP is off, this field is read-write and shows the user-defined Primary DNS Server's IP address.

Item	Description
Secondary DNS	If DHCP is on, this field is read-only. It shows the DHCP allocated Secondary DNS Server's IP address. If DHCP is off, this field is read-write and shows the user-defined Secondary DNS Server's IP address.
IP Address	If DHCP is on, this field is read-only. It shows the DHCP allocated IPv4/IPv6 address. If DHCP is off, this field is read-write and shows the user-defined IPv4/IPv6 address.
Subnet Mask	If DHCP is on, this field is read-only. It shows the DHCP allocated Subnet Mask. If DHCP is off, this field is read-write and shows the user-defined Subnet Mask.
Backhaul Limit	This setting is used to keep the bandwidth consumption rate to under the specified limit by limiting uplink traffic. The maximum 1Gbps value is the default setting and should not be changed unless there is a strong need to limit the amount of data the Network Extender can send. The Network Extender will not allow bandwidth consumption greater than 150 Mbps, regardless of the value set here. The Backhaul limit should never be set under 20 Mbps as it will negatively affect voice call quality
MTU Size	This is the Maximum Transport Unit (MTU) used to create IP Packets. This setting adjusts the maximum packet size for data transmission over the network. The default setting should be used in most cases. If the Maximum Transmission Unit (MTU) size is set too high, users may experience poor voice quality and increased latency in their data service. If set too low, overall bandwidth consumption will be increased and users may experience lower data speeds.
Save Button	A Save button is provided to allow the user to commit the changes.

Public NTP server interaction, used for system time initialization

If DHCP option 42 is provided in the DHCP response from the local DHCP Server, the Network Extender will try to sync with the local NTP server IP address provided in option 42.

If the above is not provided (it's not mandatory), the Network Extender will try to resolve the following public NTP.org FQDNs and attempt to get NTP sync from the public NTP servers.

From the North America NTP Pool

- server 0.north-america.pool.ntp.org
- server 1.north-america.pool.ntp.org

NTP uses UDP/TCP port 123

Advanced

The Network Extender Advanced Settings tab allows you to set the device output power and view neighboring cell towers detected during the boot up scan. This tab provides information on how the device is positioned with other Network Extenders in the network as well as Verizon cell sites.

Figure 14. The Network Extender Advanced Settings Tab

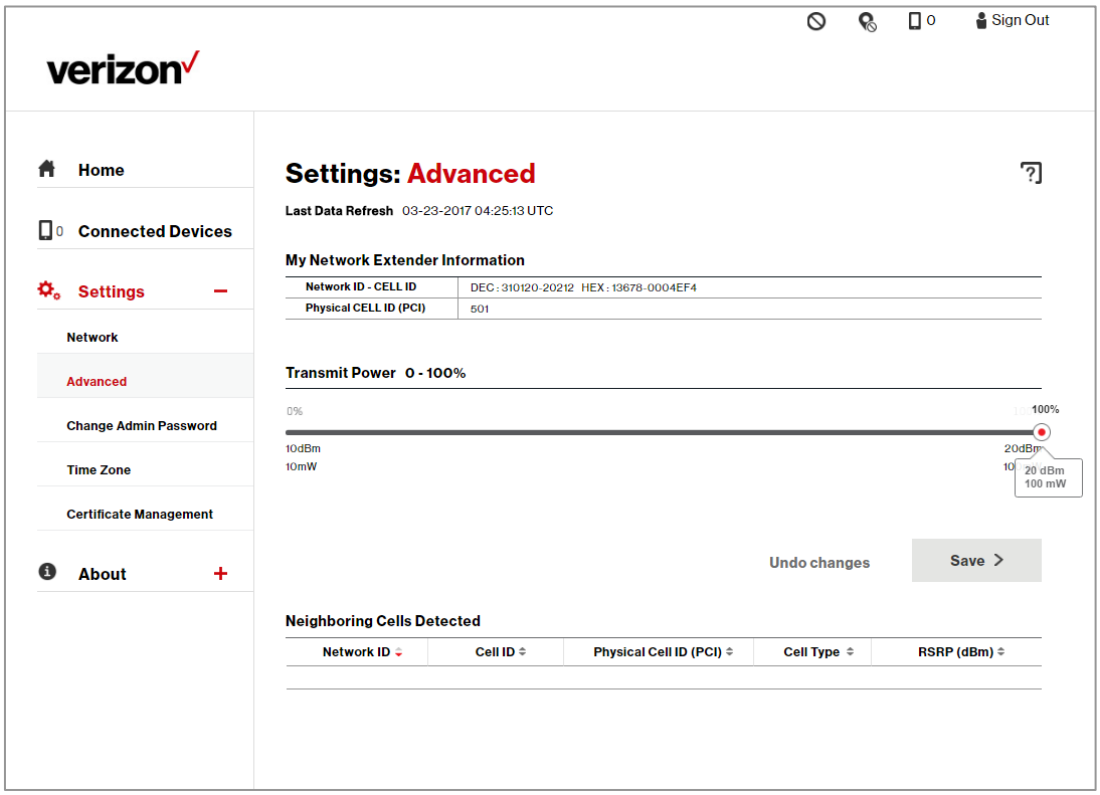


Table 5. The Network Extender Advanced Settings Tab

Item	Description
My Network Extender Information Table	This table shows the network identifier information for the 4G LTE Network Extender. Where: • Network ID: PLMN ID • Cell ID: ECGI • PCI: PCI The Network ID and Cell ID are linked by a hyphen..
Transmit Power	You can use the slider to adjust the power transmitted by the 4G LTE Network Extender from full power (100 % = 20dBm) to lowest power (0 % = 10dBm). This is achieved by applying digital attenuation in 0.1 dB steps from 10dBm to 20dBm.
Refresh Button	This reloads the data on the page and retrieves the latest settings.
Save Button	This commits any user modified values (Transmit Power) and applies it.
Cancel Button	This reloads the original settings and cancels all unsaved modifications.

Item	Description
Neighboring Cells Detected Table	This table shows the OTAR results. It is designed to assist with positioning and power selection of a multi-4G LTE Network Extender cluster. It contains the following columns. Where: • Network ID: This is the PLMN of the detected cell. • Cell ID: This is the ECGI of the detected cell. • PCI: This is the PCI of the detected cell. • Cell Type: This is '4G LTE Network Extender' if the Cell Tower ID is within the range reserved for the 4G LTE Network Extenders. Otherwise, it is set as 'Macro.' • RSRP: This is the measured RSRP in dBm of the detected cell. An icon is provided alongside the RSRP value indicating if the detected cell is too-close (high RSRP) and may be causing interference; or if it is too far (low RSRP) and handover may be an issue. Note – the distance between two 4G LTE Network Extenders using the same band should be at least 170% of the distance of its coverage radius to avoid LTE interference. In other words, if a 4G LTE Network Extender has a 100ft coverage radius in a given environment, the next closest 4G LTE Network Extender using the same band should be at least 170ft away. If two 4G LTE Network Extenders are using different bands from each other, they can be side by side.
Last Data Refresh	This is the time the data on the page was last refreshed.

Change Admin Password

The Network Extender Change Password tab allows you to change the local Admin Password for the extender. In the event of a lost password, pressing the RESET button on the back of the Network Extender for 10 seconds will reset the extender to factory default settings.

Figure 15. The Network Extender Change Admin Password Tab

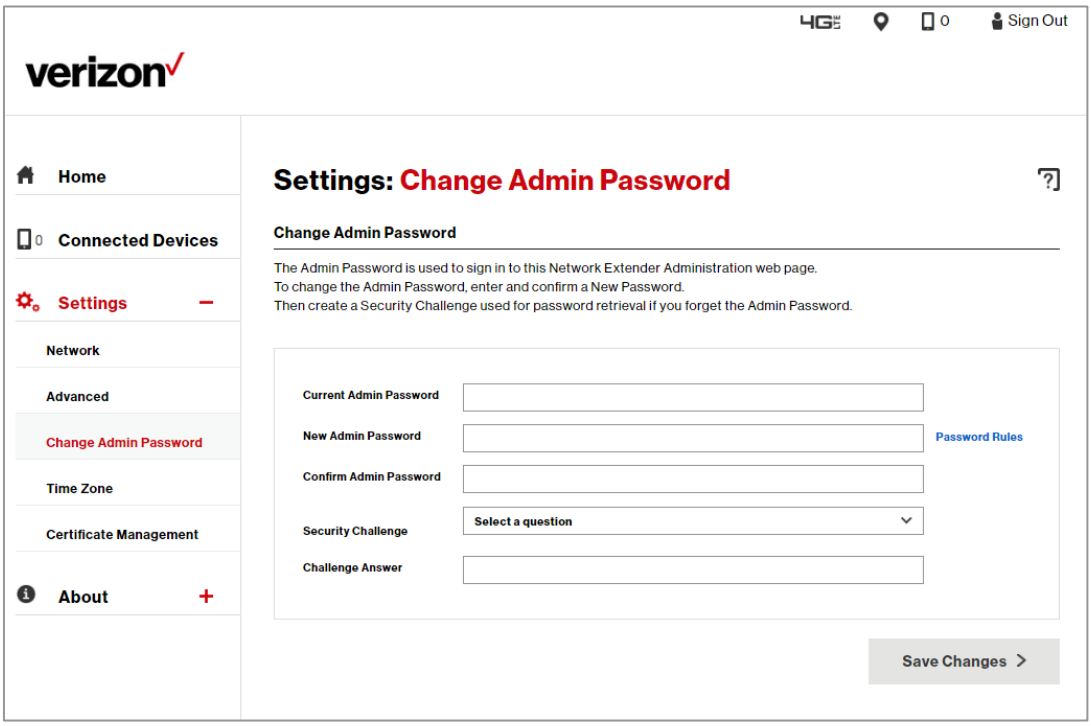


Table 6. The Network Extender Change Admin Password Tab

Item	Description
Current Admin Password	The user must enter the correct, current, password. If this is incorrect, the user cannot change the current password.
New Admin Password	The user may enter a new password in this text box. It should meet all of the validation checks detailed in **A guideline for setting a password** below.
Confirm New Password	The user must re-enter the new password in the text box. Both the 'New Admin Password' and the 'Confirm New Password' text boxes must contain exactly the same value for the password change to be applied.
Security Challenge	The user may select a simple security question to assist with password recovery.
Challenge Answer	The user may select an answer to the simple security question used for password recovery.
Save Changes Button	This button commits the user modifications if the validation checks are successful.

A guideline for setting a password

Set a password following the rules described below.

1. A password should be between 8 and 20 characters long.
2. A password should not include more than three identical characters in a row. (Ex. “111”, “aaa”, “CCC”)
3. A password should include at least one lowercase letter, one uppercase letter and number.
4. A new password should not be identical to the current password.

Security Questions

Select a Security Question among the five given questions listed below.

1. What is your date of birth (mmddyy)?
2. What is your birth place?
3. What was your first car?
4. What is your mother’s maiden name?
5. What is your pet’s name?

A guideline for setting a Security Answer

Set a Security Answer following the rules described below.

1. A Security Answer should be between 1 and 63 characters long.

Time Zone

The 4G LTE Network Extender Time zone tab allows the user to view the current Time Zone (TZ) and Daylight Saving (DS) configuration as well as to configure a different Time Zone and/or Daylight Saving. This only affects the timestamp logs on the Admin Website.

Figure 16. The Network Extender Time Zone Tab

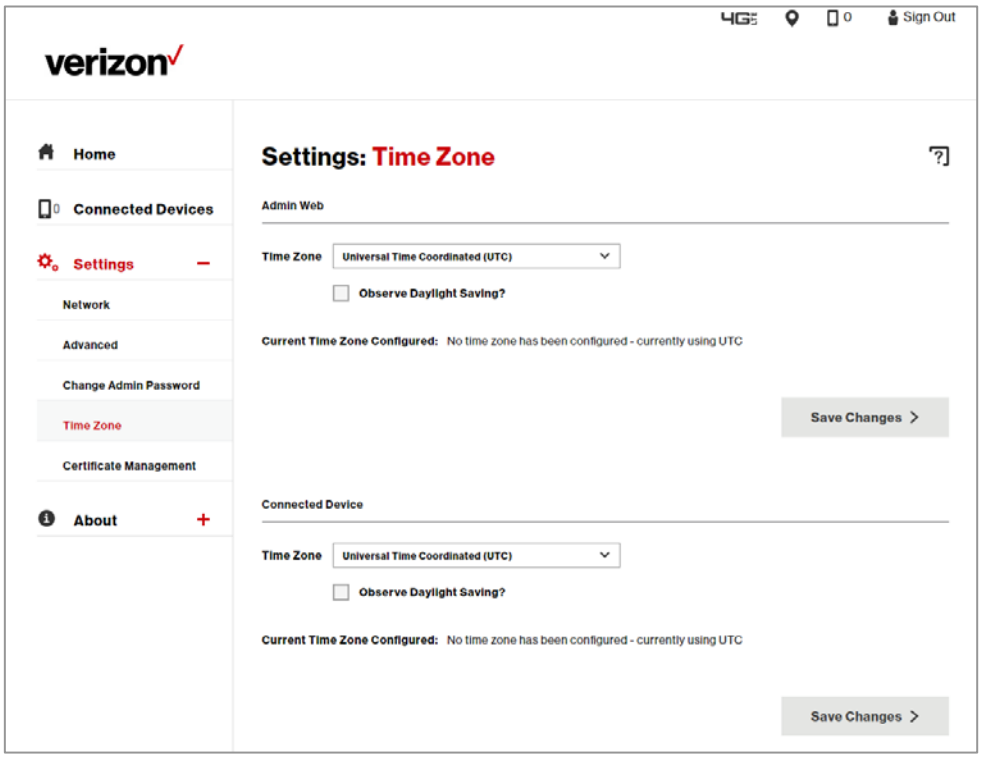


Table 7. The Network Extender Time Zone Tab

Items	Descriptions
Admin Web	The timestamps on this Admin Website will use the selected Time Zone.
Connected Device	Mobile devices attached to this Network Extender will use the selected time zone as their Network Time. This setting may be useful when the Network Extender is located near time zone boundaries.

Time Zone Dropdown Box

This drop-down box presents the supported Time Zones. The default selected Time Zone is the currently configured value.

Observe Daylight Saving Checkbox

This checkbox indicates if Daylight Savings should be applied or not. The default selection is the currently configured value. A checked value indicates that Daylight Saving is observed. An unchecked value indicates that Daylight Saving is NOT observed. If a Selected Time Zone does not support Daylight Savings (e.g., Samoa), then this control is unchecked and greyed-out (disabled).

Current Time Zone Configured Text

This describes the Time Zone currently configured and Daylight Time information.

Table 8. Time Zone Information

Time Zone	Standard Time		Daylight Time	
	Abbreviation	UTC Offset	Abbreviation	UTC Offset
Atlantic (AT)	AST	-4	Not Supported	
Eastern (ET)	EST	-5	EDT	-4
Central (CT)	CST	-6	CDT	-5
Mountain (MT)	MST	-7	MDT	-6
Pacific (PT)	PST	-8	PDT	-7
Alaska (AKT)	AKST	-9	AKDT	-8
Hawaii-Aleutian (HT)	HST	-10	HDT	-9
Samoa (ST)	SST	-11	Not Supported	
Chamorro (ChT)	ChST	+10	Not Supported	
Coordinated Universal Time (UTC)	UTC	0	UTC	0

Certificate Management

The 4G LTE Network Extender Certificate Management tab allows you to upload your own RSA 2048 X 509 certificate and associated private key to the web server on the 4G LTE Network Extender.

Figure 17. The Network Extender Certificate Management Tab

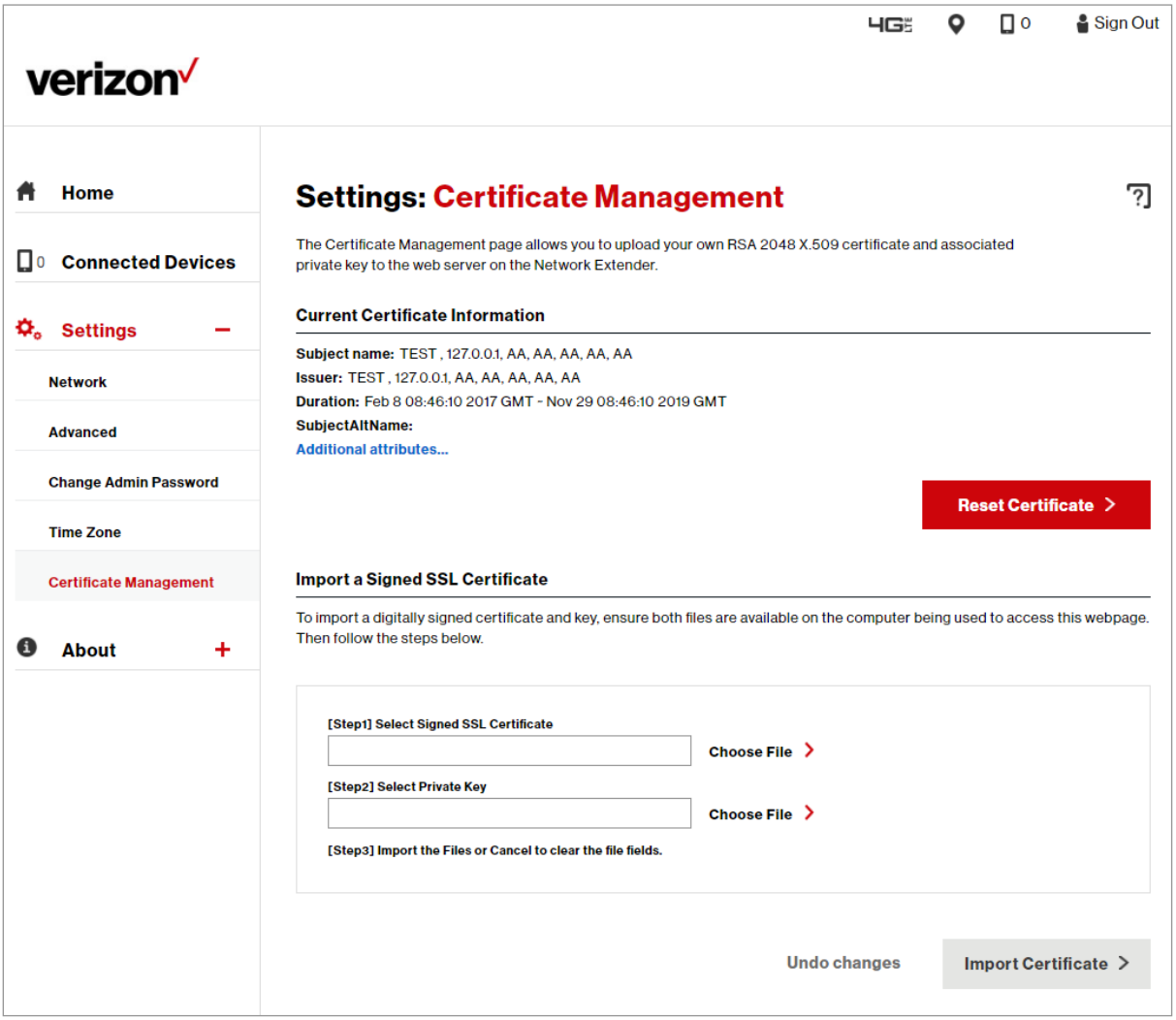


Table 9. The Network Extender Certificate Management Tab

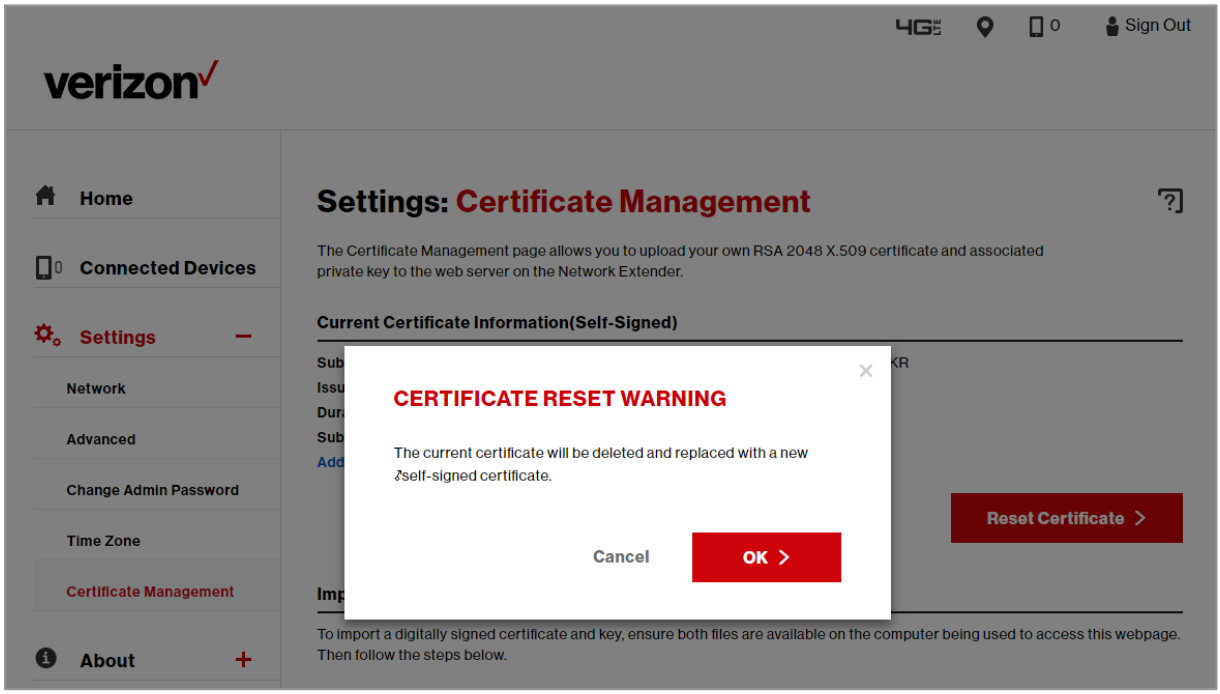
Items	Descriptions
Current Certificate Information	This describes the information of the certificate which is set up in the current server.
Reset Certificate	By clicking the Certificate Reset button, the current certificate files are deleted and a new self-signed certificate will be generated.
Additional attributes…	Click this link to see detailed information on the certificate that is set up in the current server.
Import a Signed SSL Certificate	This provides the setting interface of the certificate to be uploaded and Private Key.

Reset Certificate

Current certificate files are deleted and a new self-signed certificate will be generated.

Clicking the Reset button brings up a pop-up warning window. Clicking OK will reset the certificate.

Figure 18. Settings-Certificate Management-Reset Certificate Popup Window



Import a Signed SSL Certificate

- Introduction

  The Certificate Management page allows you to upload your own RSA 2048 X.509 Certificate and associated Private Key to the web server on the Network Extender. By installing your own certificate, security warning prompts such as "Warning Invalid Certificate" in your web browser will be prevented when attempting to access the Network Extender's website.

- Obtaining and Installing Certificates

  Installing a certificate involves the following steps:

  a Generating a Private Key

  Generate an RSA 2048 private key in PEM format with a ".prv" extension type. The Certificate Authority you choose to use will provide specific instructions on how to generate the private key.

  b Generating a CSR (Certificate Signing Request)

  Generate a CSR for an RSA 2048 certificate in PEM format with the ".PEM" extension type using the private key created in Step A. The Certificate Authority you choose to use will provide specific instructions on how to generate the CSR.

The "common name" field in the CSR must match the FQDN you put in the internal DNS (Domain Name Service) and the Network Extender will need to be configured with a static IP address matching the DNS entry in your server.

  c Send the CSR to the Certificate Authority to receive a signed certificate file.

  The Certificate Authority you choose to use will provide instructions on how to send the CSR for signing and receiving the signed RSA 2048 certificate in PEM format. It is important to let the Certificate Authority know that the full concatenated chain of certificates must be included in your certificate file.

  When the signed certificate is received from the Certificate Authority, ensure it and the private key files are placed on the computer connected directly to the Network Extender.

  d Follow the steps on the Certificate Management page to install the certificate and private key files.

  Below are instructions on installing the certificate and private key file. There should be two files prepared on your connected computer before uploading.

- File Verification Process

  After the files are uploaded, the certificates are verified.

  If verification fails, the Certificate Management page will reappear and the import can be tried again.

  If verification is successful, you will be prompted to sign back in to the network extender's home page using https and the newly installed certificate.

- **Certificate File**
  This file contains the entire concatenated certificate which includes your RSA 2048 certificate followed by all intermediate signing certificates and ending with the root certificate. This certificate file must be in PEM format and have a ".PEM" extension type.

- **Private Key File**
  This file contains the RSA 2048 private key in PEM format and uses a ".prv" extension type.

The About Page

The Status & Alarms Tab

The Status & Alerts tab on the About page shows the connectivity status, operational status and alerts that can be used for diagnostics and troubleshooting. If the connectivity status shows a server as “Not Reachable”, confirm that the Network Extender is properly connected to the router and has acquired an IP Address. For LAN/Routers with a firewall enabled, please see **Chapter 4 Configuring Your Device**.

Figure 19. The Network Extender Status & Alerts Tab

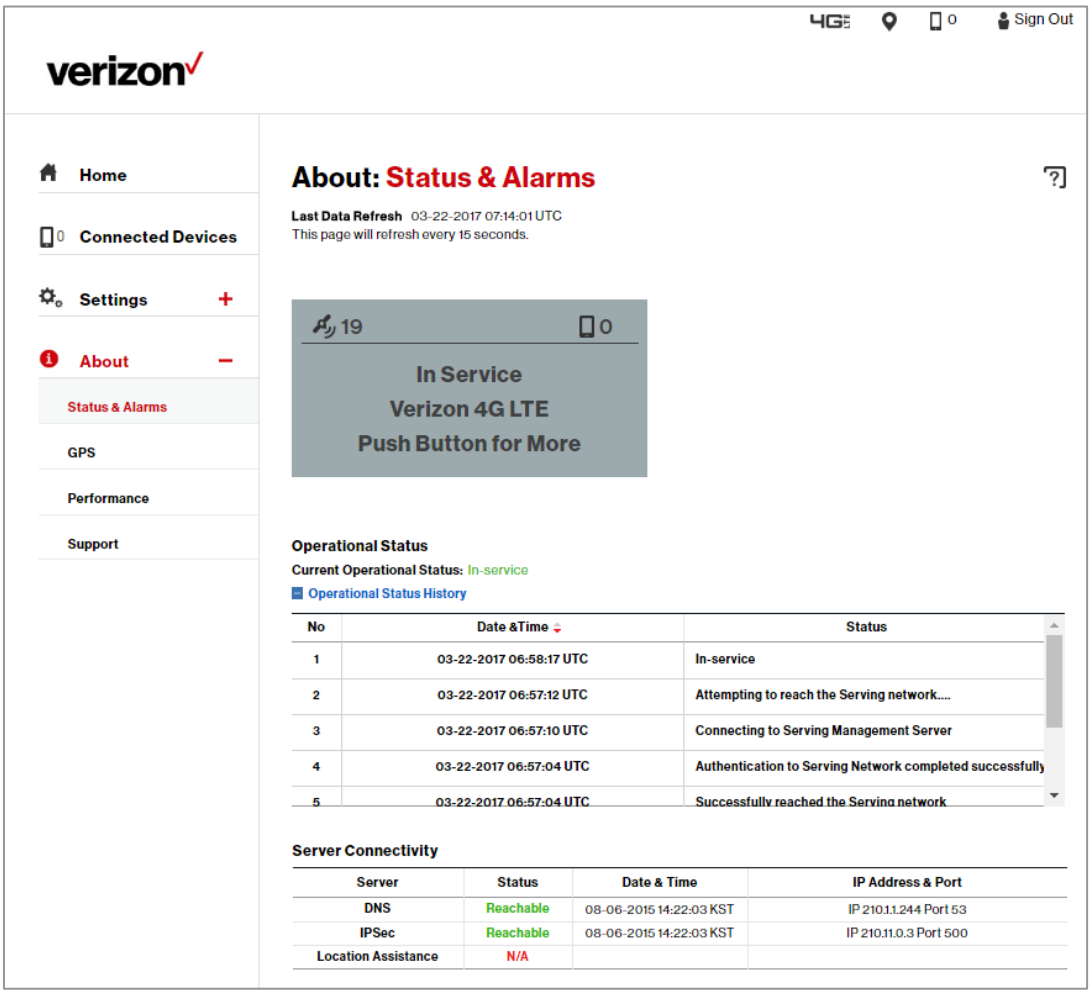


Table 10. The Network Extender Status & Alerts Tab

Items	Descriptions
Last Data Refresh	The local time when this page was last refreshed.
DNS Server	This field indicates connectivity status with the DNS Server and whether it is Reachable or Not Reachable by your Network Extender. If Not Reachable, please check network firewall settings or contact your network administrator.
IPsec Server	This field indicates connectivity status with the IPSEC Server and whether it is Reachable or Not Reachable by your Network Extender. If Not Reachable, please check network firewall settings or contact your network administrator.
Location Assistance Server	This field indicates connectivity status with the Location Assistance Server and whether it is Reachable or Not Reachable by your Network Extender. If Not Reachable, please check network firewall settings or contact your network administrator.
Operational Status	The current operational state of the Network Extender.
Operational Status History	The log of the last 100 recent events for the Network Extender.
Active Alarms	These are the currently active alarms on the Network Extender. Certain alarms may prevent the Network Extender from coming into service. Please refer to the Description & Troubleshooting column for details and next steps for each event.
Alarm History	The log of the last 100 currently active and cleared alarms for the Network Extender.

The GPS Tab

This tab shows GPS status including GPS Satellite ID, signal quantities, description, etc.

Figure 20. Network Extender GPS Tab

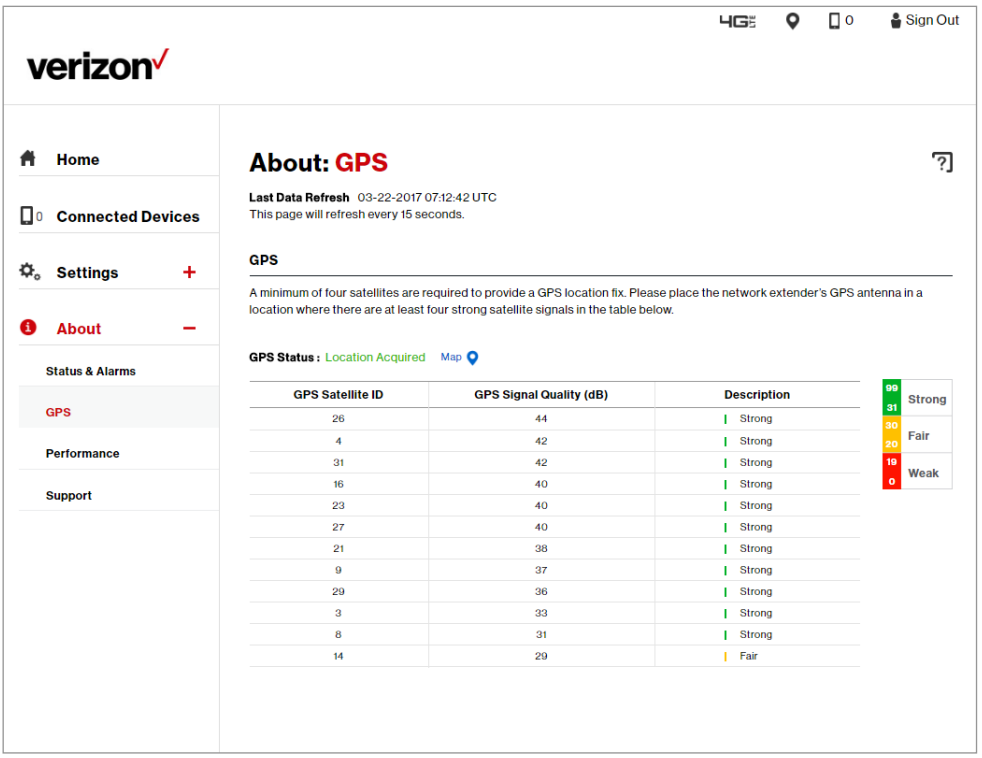


Table 11. The Network Extender GPS Tab

Items	Descriptions
Last Data Refresh	The local time when this page was last refreshed.
GPS Status	This indicates if the Network Extender has acquired GPS signals or not. The Network Extender will not come into service if the status does not say "Location Acquired".
GPS Satellite ID	The list of GPS satellites identifies how many satellites are currently being detected along with each satellite's unique identifier.
GPS Satellite Quality (dB)	This value describes the signal-to-noise ratio for the GPS signal. A higher value means better quality. If the description is either Fair or Weak, you should consider repositioning the unit or GPS antenna. If the signal quality does not improve, an external GPS antenna may be required.
Description	Describes the quality level of the satellite signal as either: Strong, Fair or Weak. Refer to the legend for the mapping.

The Performance Tab

The Performance tab on the About page shows bandwidth utilization charts. There are two graphs for bandwidth utilization:

- The first graph is a 15 minute trend, updated every 30 seconds. This graph starts populating when you arrive on this screen. It will start over if you move to another screen and then come back to this one. Every data point on the graph represents the peak value for a 30 second interval.
- The second graph is an eight hour trend, updated every hour. This graph will maintain the history whether you stay on this screen or not. Every data point represents the peak value for that hour.

Figure 21. The Network Extender Performance Tab

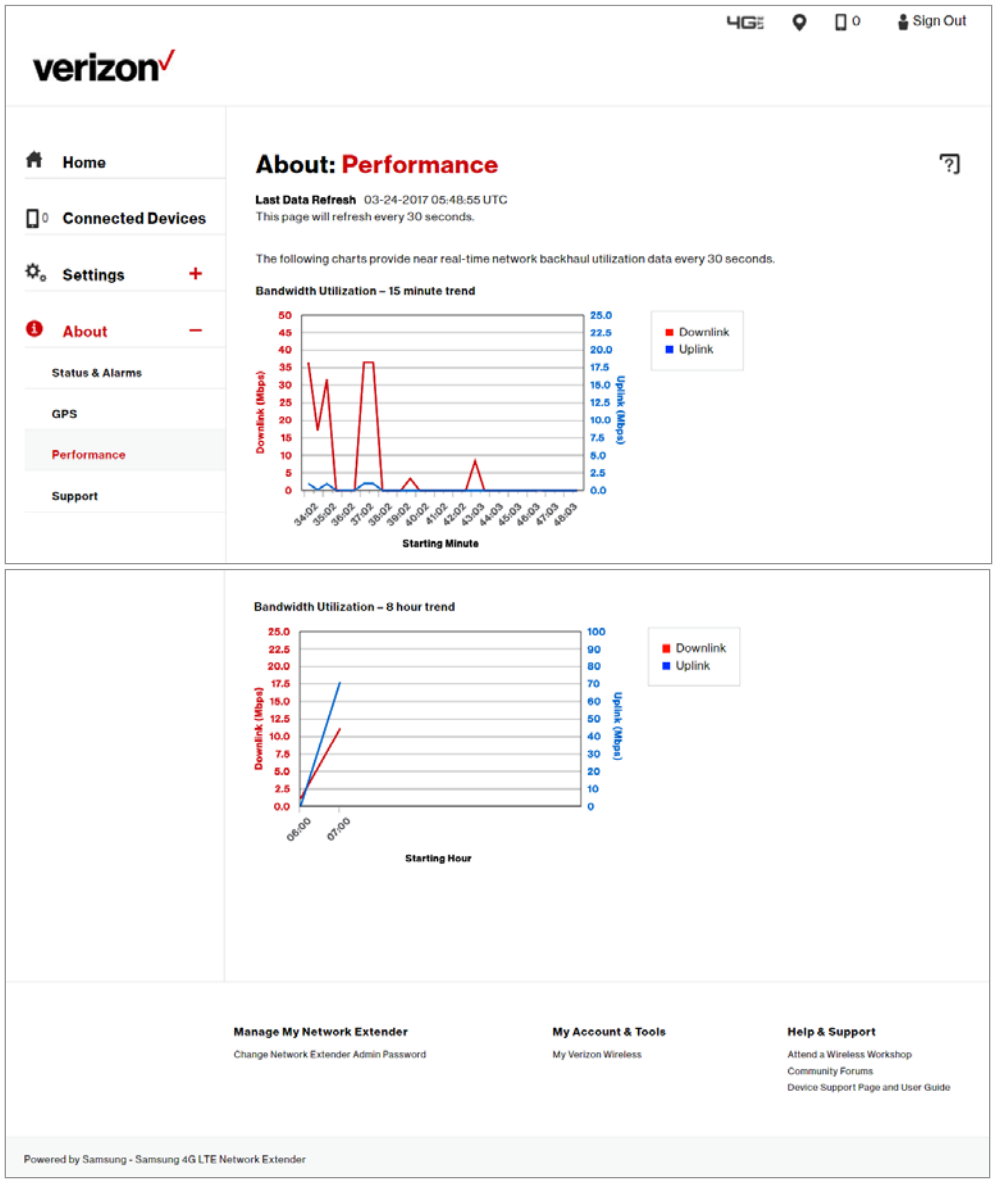


Table 12. The Network Extender Performance Tab

Item	Description
Bandwidth Utilization 15 minute trend graph	This shows the Downlink and Uplink bandwidth utilization for a rolling period of 15 minutes. It is updated every 30 seconds.
Bandwidth Utilization 8 hour trend graph	This shows the Downlink and Uplink bandwidth utilization for up to the previous 8 hours. This is updated hourly.
Last Data Refresh	This is the time the data was last refreshed.

The Support Tab

The Support tab on the About page contains the contact information for customer support.

Figure 22. The Support Tab

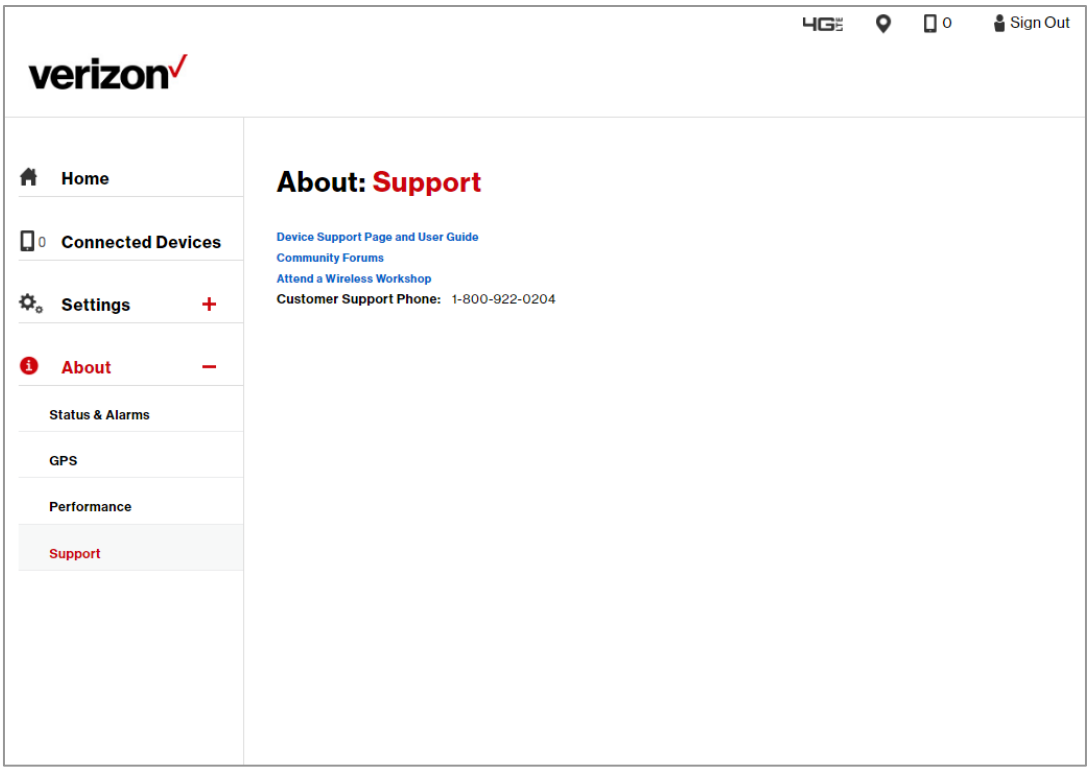


Table 13. The Support Tab

Item	Description
Customer Support Phone	This is the phone number for the operator's customer support.
Community Forums	This is a hyperlink to the operator's community forums.
Device Support Page and User Guide	This is a hyperlink to the operator's support pages.
Attend a wireless workshop	This is a hyperlink to the operator's wireless workshops.

Chapter 4 Configuring Your Device

Firewall Settings

The 4G LTE Network Extender is designed to connect and automatically configure with minimal user involvement, though in some cases, depending on the firewall settings, some settings may need to be adjusted on the local LAN. This section contains detailed information regarding the firewall settings that are applicable for network administrators.

Table 14. Destination Ports

Source	Destination	Protocol	Destination Port	Notes
Network Extender	GPS Assistance Server	UDP	52428	
Network Extender	DNS Server	UDP/TCP	53	
Network Extender	NTP Server	UDP/TCP	123	
Network Extender	VzW SeGW	UDP	500/4500	More than one port may be used for multiple device installation
Network Extender	VzW SeGW	ESP/50	NA	When NAT/PAT is not present
VzW SeGW	Network Extender	ESP/50	NA	When NAT/PAT is not present

The following table lists the IP addresses of each of the network elements that need to be included.

Table 15. Firewall Settings

Network Element	IP Address	Fully Qualified Domain Name (FQDN)
GPS Server	209.210.15.73	gps.vzwfemto.com
Security Gateway	69.78.145.119 69.78.145.122 69.78.34.151 69.78.34.154 69.78.82.87 69.78.82.90 69.78.226.55 69.78.226.58	sg.vzwfemto.com
Private DNS	108.61.73.243 192.95.20.208	0.north-america.pool.ntp.org 1.north-america.pool.ntp.org

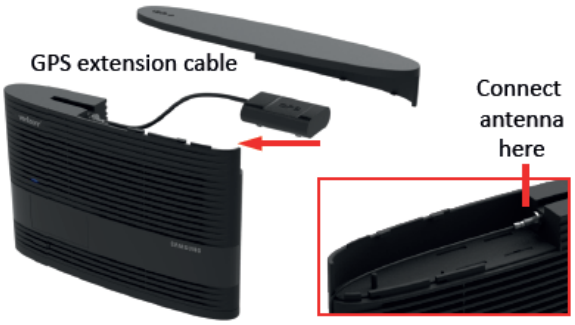
Indoor GPS Antenna Using Extension Cable

If your 4G LTE Network Extender LCD display still shows “Searching for GPS after one hour, or you get a GPS error message, it may be necessary to improve the reception by installing the extension cable and then repositioning the GPS antenna close to a window. This section outlines the installation and relocation of the external GPS antenna.

To relocate the GPS antenna of the Network Extender, follow these steps:

1. Turn off the Network Extender.
2. Firmly slide the GPS antenna cover off, as shown, to expose the rectangular GPS antenna.

3. Disconnect the GPS antenna. Connect one end of the extension cable to the antenna and connect the other end to the Network Extender where the antenna was originally connected.



4. Replace the cover, being careful to position the cable through the notch provided. Then, extend the cable with the antenna on the end and place the antenna close to a window. You can use double-sided tape to secure the bottom of the GPS antenna to its new location. Do not cover the antenna with tape.
5. Turn on the Network Extender to allow the detection of available GPS satellite signals. Note, four GPS satellites (strong signals) are needed to acquire a GPS location fix and may take up to 60 minutes.
6. If a GPS fix still cannot be acquired, check the GPS signal on the Admin Website’s GPS status page. If the device does not consistently track 4 or more strong GPS satellite signals, place the GPS antenna in another location to receive a stronger signal. In some scenarios, an outdoor GPS antenna (not included) may be needed if an adequate GPS signal is not available indoors.

Outdoor GPS Antenna

If your 4G LTE Network Extender cannot receive a Global Positioning System (GPS) signal by using the supplied Indoor GPS antenna and extension cable, it may be necessary to improve the reception by installing and then positioning the outdoor GPS antenna. This section outlines the installation of outdoor GPS antenna.

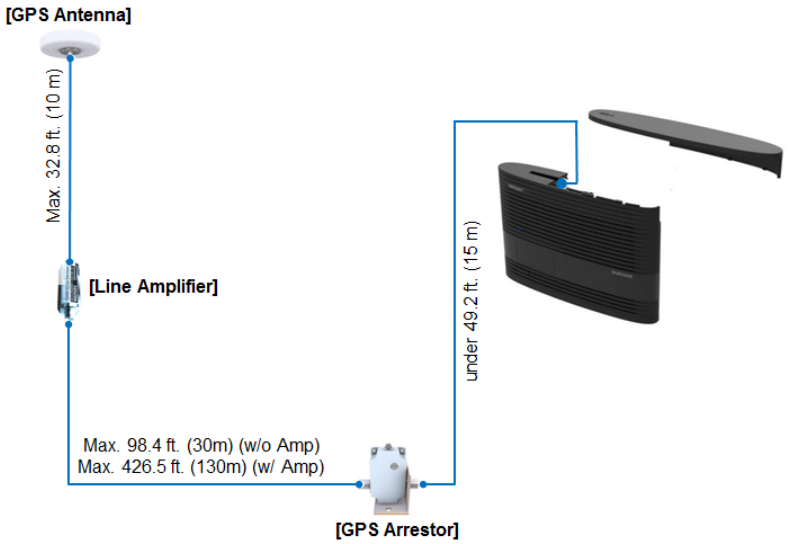
An outdoor GPS antenna system requiring longer cable runs is configured as shown below.

- If needed, a Line Amplifier can be installed within 32.8 ft. (10 m) from the GPS antenna. As an alternative, a high gain GPS antenna can be installed instead of Line Amplifiers to help overcome cable losses. One potential manufacturer that has been used in the past is Gilsson. A receive signal strength of -152dBm is sufficient at the GPS port for the 4G LTE Network Extender.

For outdoor GPS antenna installation details, please refer to **Appendix A Outdoor GPS Antenna Installation** in this guide.

For actual GPS related parts purchase, Please refer to Gilsson URL in below.
http://www.gilsson.com/smart_devices/verizon_net_extender.htm

Figure 23. Connect the GPS Arrestor and Line Amplifier



Chapter 5 Troubleshooting

This section provides some troubleshooting tips for the Network Extender.

Power/Status Indicator Light is Not Turning On

- Make sure the power adapter is securely connected to a working power outlet.
- Make sure the power adapter's connector is securely inserted into the 12V DC port on the back of the Network Extender.

Network Extender Has Not Acquired a GPS Fix Even After an Hour

- Make sure that your Network Extender is at least 10 feet away from any communication devices or appliances that generate electromagnetic radiation (e.g., Wi-Fi routers or microwave ovens)
- If you have another Network Extender, make sure their GPS antennas are at least 150 mm apart.
- If possible, move the Network Extender to a new location with fewer surrounding obstructions. The new location should be in an open area and closer to a window.
- If the GPS signal is not detected even in the new location, install the 23' GPS extension cable and reposition the GPS antenna for optimal signal like near a window, as shown in the Configuring Your Device section.
- The GPS antenna must stay connected to the Network Extender at all times for operation. Make sure that the GPS antenna is connected properly.
- If repositioning the GPS antenna does not clear the issue, you may need to purchase and install an external outdoor antenna. Please refer to the "Outdoor GPS Antenna" section in **Chapter 4 Configuring Your Device**.

Unable to Place Call Using Network Extender

- Verify the extender is powered on and in service.
- Check that the router is communicating properly with your ISP. The Internet activity LED on your router and on the back of the Network Extender should be blinking.
- Check that that your phone has Advanced Calling turned on as shown in **Chapter 2 Device Setup.**.
- Verify that your phone is connected to the Network Extender by dialing #48.

Power/Status LED Indicator is Blinking

A blue blinking LED indicates the Network Extender is not operational. It may be starting up, attempting to connect to the Verizon Wireless Network or waiting for GPS. Please check the LCD display and status page on the Admin Website to narrow the problem.

Confirm your Network Extender was activated at the time of purchase. If your Network Extender has not already been activated, call Verizon Wireless Customer Service at (800) 922-0204 or call *611 from your Verizon Wireless mobile phone and select the option for technical support.

Before contacting Verizon Wireless Customer Service, confirm the following:

- Is the Internet activity LED on your router blinking?

  If it is not, then there may be a communication problem between your Network Extender and the router. Check that the router is communicating properly with your ISP. For further router troubleshooting tips, please review either the router manufacturer's printed or online documentation.

- Does the GPS icon show the GPS is tracking one or more satellites?

  If not, the Network Extender may not be receiving a GPS signal. Move the GPS antenna as shown in **Chapter 4 Configuring Your Device**.

Startup Sequence and Troubleshooting

The following messages may appear on the display of the Network Extender during the startup process.

LCD Display	Possible error message	Troubleshooting
Starting Up… (Step 2 of 14)	Hardware Failure (Step 3 of 14) See User Guide	The Network Extender has a Hardware failure preventing it from loading it's software. If Network Extender doesn't turn on, please restart the Network Extender. If trouble continues, call Customer Service.
Starting Up… (Step 4 of 14)	Software Failure (Step 5 of 14) See User Guide	The Network Extender has an error preventing the software from being executed. If Network Extender doesn't turn on, please restart the Network Extender. If trouble continues, call Customer Service.
Starting Up… Acquiring IP address (Step 6 of 14)	No Ethernet Detected (Step 7 of 14) Check Connections	Make sure that the Ethernet cable is not defective and is connected at both ends. If the Network Extender isn't able to acquire an IP address, please check your router or LAN setting or contact your network administrator to explore why an IP address is not assigned.
Connecting to the Verizon Network (Step 8a of 14)	Device Not Activated (Step 9 of 14) Call Verizon Support	The Network Extender has a failure with initial/serving SeGW for IPSec setup. If unable to connect to the Verizon Network, go to the Admin Website to see if the server connectivity status is reachable or not. If not reachable, please check the LAN/firewall setting or contact your network administrator before calling Customer Service.
Connecting to the Verizon Network (Step 8b of 14)		
Connecting to the Verizon Network (Step 8c of 14)		
Connecting to the Verizon Network (Step 8d of 14)		
Setting up Device Please Wait… (Step 11a of 14)	Setup Failure (Step 11a of 14) See User Guide	The Network Extender has a failure to connect to Initial management server for downloading software and configuration parameter. If the Network Extender does not proceed beyond this step, then restart the Network Extender. If trouble continues, call Customer Service.
Searching for GPS Please Wait… (Step 10 of 14)	GPS Failure See User Guide	The Network Extender has a GPS locking issue. Please refer to the "Network Extender Has Not Acquired a GPS Fix Even After an Hour" in **Chapter 5 Troubleshooting.**

LCD Display	Possible error message	Troubleshooting
Connecting to the Verizon Network (Step 8e of 14)	Device Not Activated (Step 9 of 14) Call Verizon Support	The Network Extender has a failure with initial/serving SeGW for IPSec setup. If unable to connect to the Verizon Network, go to the Admin Website to see if the server connectivity status is reachable or not. If not reachable, please check the LAN/firewall setting or contact your network administrator before calling Customer Service.
Connecting to the Verizon Network (Step 8f of 14)		
Connecting to the Verizon Network (Step 8g of 14)		
Setting up Device Please Wait… (Step 11b of 14)	Setup Failure (Step 11b of 14) See User Guide	The Network Extender has a failure to connect to Serving management server for downloading software and configuration parameter. If the Network Extender does not proceed beyond this step, then restart the Network Extender. If trouble continues, call Customer Service.
Setting up Device Please Wait… (Step 11c of 14)	-	Configuration download in progress. If the Network Extender does not proceed beyond this step, then restart the Network Extender. If trouble continues, call Customer Service.
Setting up Device Please Wait… (Step 11e of 14)	Setup Failure (Step 11e of 14) See User Guide	Software download in progress. Please do not unplug your Network Extender until download completed. If the Network Extender does not proceed beyond this step, then restart the Network Extender. If trouble continues, call Customer Service.
Setting up Device Please Wait… (Step 11d of 14)	-	Parameter download in progress. If the Network Extender does not proceed beyond this step, then restart the Network Extender. If trouble continues, call Customer Service.
In Service Verizon 4G LTE Push Button for More	-	-

Other Messages and Troubleshooting

The following alarms may appear on the display of the Network Extender during startup process and operation. These messages will be displayed on the Network Extender Admin website (local).

Table 16. Other Messages in the Network Extender Display

Alarm	Description	Troubleshooting
“Resetting Device Please Wait…”	The Network Extender is restarting automatically	-
“Factory Reset Restarting Device Please Wait…”	The Network Extender is restarting as part of a factory reset	-

Alarm	Description	Troubleshooting
“No Ethernet Detected Check Connections”	The Ethernet port or connection is not working.	The port connecting your device to the internet is not operational. Please check that your Ethernet cable is connected correctly at both ends and the switch, router, or internet gateway is turned on.
“Not in-Service MME Communication Failure”	The Network Extender has a communication failure with the Verizon network.	There is a communication failure preventing your device from functioning correctly. Please unplug your device and then plug it back in again. If the problem persists for an hour, please contact Customer Service.
“Not In-service GPS Failure See User Guide”	The Network Extender has not acquired the initial GPS location or has lost GPS signal for more than 24 hours due to poor or inadequate GPS signals. The Network Extender is Not In-service.	The Network Extender has not acquired the initial GPS location or has lost GPS signal for more than 24 hours. The initial GPS fix can take up to 60 minutes in poor conditions. Resetting the Network Extender in this condition is not recommended as it may prolong the acquisition of the initial GPS fix. Make sure that the GPS antenna is connected properly. Use the extension cable to install the GPS antenna for optimal signal like near a window. If repositioning the GPS antenna does not clear the issue, you may need to purchase and install an external outdoor antenna. Please refer to the “Outdoor GPS Antenna” in **Chapter 4 Configuring Your Device.**
“Not in-service Lost IP address”	The Network Extender has an IP address acquisition failure.	Please check the Modem/Router settings, or contact your Internet Service Provider or Network Administrator.
“Not in-service Network Extender Overheated”	The Network Extender has overheated.	Your device is overheating. Please move the unit to an area with an ambient temperature between 0-50 degrees Celsius (32 -122 degrees Fahrenheit) and make sure the device is in a well ventilated location.
“Not In-Service Excessive Interference”	The Network Extender is exposed to a high level of radio interference from nearby Network Extender	If the problem persists after 10 minutes, please unplug the Network extender and look for a location to place it with weak existing coverage using your Verizon phone. If this location is using multiple Network Extenders, make sure there is at least 85 feet away from closest adjacent Network extender (170% of coverage radius distance).
“Not In-service Clock Failure”	The Network Extender internal clock signal is abnormal.	Please restart the Network Extender. If trouble continues, please contact Customer Service.
“Not In-service Excessive attempts To Verizon Network”	The Network Extender is automatically locked due to excessive warm/cold start attempts.	If restarting the Network Extender does not clear the issue, please contact Customer Service.
“Not In-service Excessive Alarms”	The Network Extender is automatically locked due to excessive alarms.	If restarting the Network Extender does not clear the issue, please contact Customer Service.
“Not In-service Admin Lock”	The Network Extender is locked by the administrator for maintenance.	If this situation persists, please contact Customer Service.
“Device Not Activated Call Verizon Support”	The Network Extender fails to authenticate to Verizon network.	The device might not be provisioned in the Verizon network yet. Please unplug your device and then plug it back in again. Wait for 10 minutes and check if the alarm is cleared. If the problem persists, please contact Customer Service.

Alarm	Description	Troubleshooting
“Out of Verizon’s Service Area”	The Network Extender fails to come into service due to unlicensed area.	You might be located in an area where no Verizon service is allowed. Please unplug your device and then plug it back in again. Wait for 10 minutes and check if the alarm is cleared. If the problem persists, please contact Customer Service.

Alarms and Troubleshooting

The following table lists alarms that can halt the functioning of the Network Extender. These alarms will be displayed in The Network Extender Admin Website (Local).

Table 17. Alarms in the Network Extender Admin Website (Local)

Alarm	Description	Troubleshooting
PROCESS_DOWN	An application block is deactivated/terminated.	There is a temporary process alert but your device is still functioning correctly. No action is needed and the alert should clear itself. If the alert persists, please contact Verizon Wireless Customer Service.
DISK_FULL	Disk usage has exceeded a threshold.	There is a temporary disk usage alert but your device is still functioning correctly. This alert should clear itself. If the alert persists for a long time, please contact Verizon Wireless Customer Service.
MEMORY_FULL	Memory usage has exceeded a threshold.	There is a temporary memory usage alert but your device is still functioning correctly. This alert should clear itself. If the alert persists for a long time, please contact Verizon Wireless Customer Service..
OVERLOAD	Average CPU load has exceeded a threshold.	There is a temporary CPU load alert but your device is still functioning correctly. This alert should clear itself. If the alert persists for a long time, please contact Verizon Wireless Customer Service.
CLOCK_FAIL	The clock is abnormal.	There is a failure preventing your device from functioning correctly. If you are using GPS, please ensure that the GPS antenna is installed in a location near the window. If you are not able to receive GPS information after repositioning the antenna, you may need to purchase and install an external outdoor antenna. If you still experience an issue after checking your GPS installation, please contact Verizon Wireless Customer Service.
PORT_DOWN	Outer Ethernet port is down.	The port connecting your device to the internet is not operational. Please check that your Ethernet cable is connected correctly and the switch, router, or internet gateway is powered-on.
RU FUNCTION_FAIL	All RU paths are disabled.	There is a failure preventing your device from functioning correctly. Please restart your device. If the problem still persists, please contact Verizon Wireless Customer Service.

Alarm	Description	Troubleshooting
RX_PATH_FAIL	RSSI measurement is below the threshold	This may occur when RF antenna is not attached properly or a non-Samsung antenna is used. Please restart the Network extender. If the problem persists, please contact Verizon Wireless Customer Service.
LOCKING_FAIL	No GPS signal can be received.	The device is not receiving GPS information. Please make sure that the GPS antenna is installed in a location near the window. If you are not able to receive GPS information after repositioning the antenna, you may need to purchase and install an external outdoor antenna. Please see the “Outdoor GPS Antenna” in **Chapter 4 Configuring Your Device**
GPSR FUNCTION_FAIL	GPSR module failure due to e.g. self test failure, power failure, EPC (Electronic Power Control) exceeding normal operation range, OCXO/TCXO failure, etc.	The device is attempting to receive GPS information. If the issue persists for more than one hour, please make sure that the GPS antenna is installed in a location near the window. If you are not able to receive GPS information after repositioning the antenna, you may need to purchase and install an outdoor GPS antenna. Please see the “Outdoor GPS Antenna” in **Chapter 4 Configuring Your Device**.
FREQUENCY_ HOLDOVER_EXCEED	GPS signal has been lost for 24 hours.	The device has lost GPS signal for 24 hours and can no longer provide service. Please make sure that the GPS antenna is installed in a location near the window. If you are not able to receive GPS information after repositioning the antenna, you may need to purchase and install an external outdoor antenna. Please see the “Outdoor GPS Antenna” in **Chapter 4 Configuring Your Device**.
HOLDOVER_EXCEED	GPS signal has been lost.	The device has lost GPS signal can no longer provide service. Please ensure that the GPS antenna is installed in a location near the window. If you are not able to receive GPS information after repositioning the antenna, you may need to purchase and install an external outdoor antenna. Please see the “Outdoor GPS Antenna” in **Chapter 4 Configuring Your Device**.
TEMPERATURE_HIGH	Temperature has exceeded a threshold.	Your device is over-heating. Please locate the unit in an area with an ambient temperature between 0-50 degrees Celsius inline with the user guide.
SERVICE_OFF	Service cannot be provided due to abnormal service condition.	The Network Extender is currently not in service. Please check the System Status, System History, GPS Status or any other alerts to determine if the unit is in the process of starting up or if there is any other condition preventing it from coming into service.
MME_ COMMUNICATION_ FAIL	The 4G Network Extender cannot communicate with backend servers.	The Network Extender cannot communicate with Verizon’s Network. Please check the LAN/Firewall settings, connectivity status and available bandwidth to see if any LAN or internet issue may be preventing the unit from communicating with backend servers. If the problem persists, please contact Verizon Wireless Customer Service.

Appendix A Outdoor GPS Antenna Installation

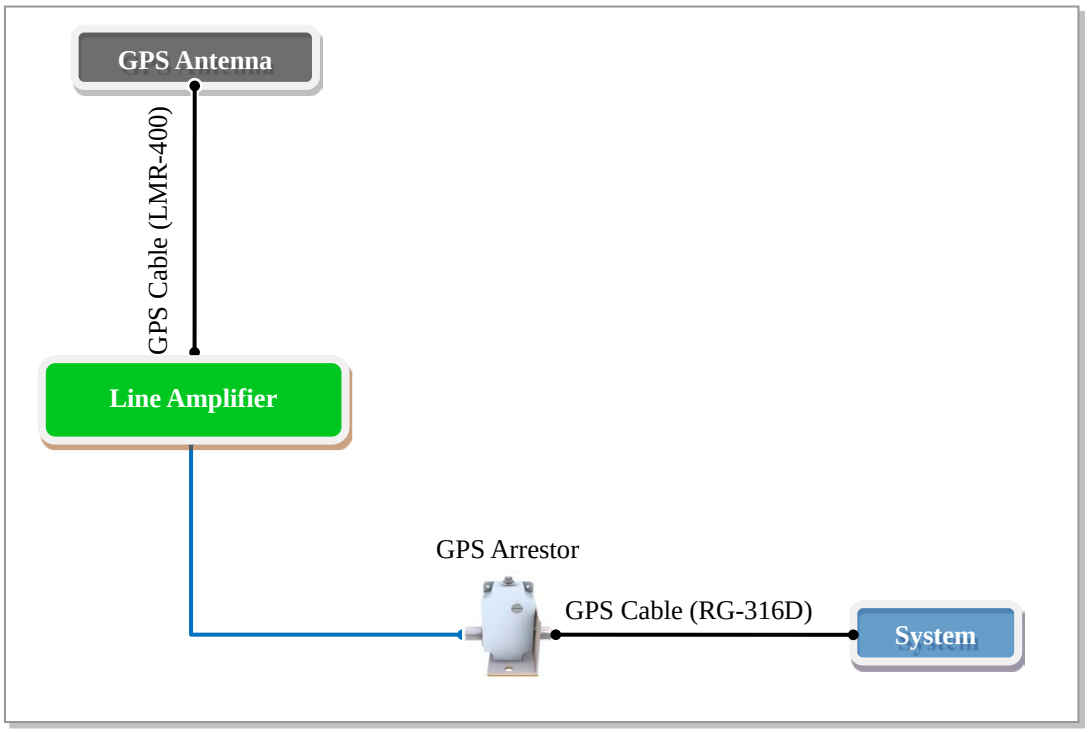
GPS Antenna System Configuration

A GPS antenna system requiring outdoor installation or longer cable runs is configured as shown below.

Table 18. GPS Antenna System Configuration

Category	Description
GPS antenna	Device receiving a signal from a GPS satellite
GPS line amplifier (option)	Device amplifying the GPS signal received from the GPS antenna (used to compensate the GPS signal loss caused by GPS antenna, GPS arrestor, cable and connector)
GPS (lightning) arrestor	Device protecting people or system from lightning

Figure 24. Example of a Common GPS Antenna System Configuration



To satisfy the GPS specifications and operate the GPS antenna in a stable manner, the following GPS antenna configuration and installation requirements must be met.

GPS Antenna

Follow the steps below to connect the GPS cable.

Table 19. GPS Cable Connection

Classification	Description		
Installation section	The Network Extender, GPS arrestor, GPS antenna		
Cable	The Network Extender GPS arrestor	9.84 ft. (3 m) or less	RG-316D
		More than 9.84 ft. (3 m)	RG-316D (9.84 ft. or less) +LMR-400
	GPS arrestor GPS antenna (or line amplifier)	LMR-400	
Connector	The Network Extender	SMB-male	
	Connection part between RG-316D and LMR-400	RG-316D	N type-male
		LMR-400	N type-female
	GPS arrestor	N type-male	
	Line amplifier	N type-male	
	GPS antenna	TNC-male	
Recommended torque value	SMA-male	0.18 ft.lb. (2.5 kgf.cm)	
	N type-male	1.45 ft.lb. (20 kgf.cm)	
	TNC-male	0.65 ft.lb. (9 kgf.cm)	
Working tools	Cable cutter, wire stripper, nipper, torque wrench, spanner, knife, soldering iron, and lead		

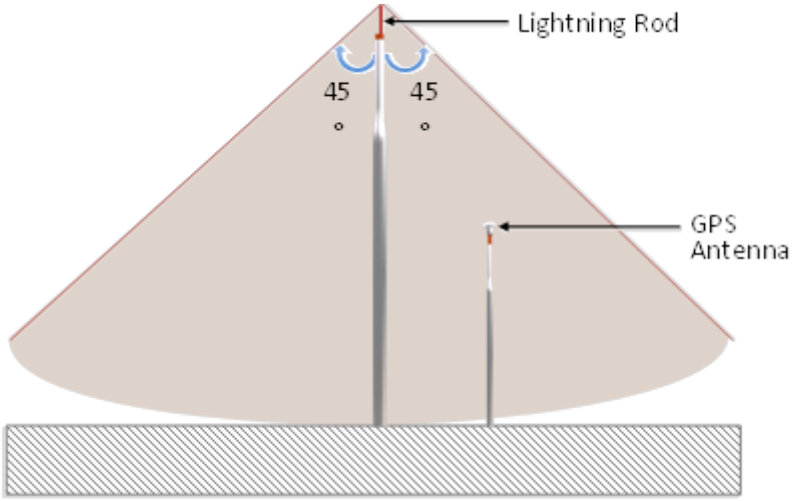
Installing GPS Line Amplifiers
The allowed length of a cable is limited depending on the GPS cable configuration. You must compensate for the loss by installing a line amplifier if the cable exceeds the length allowed. Because the required number of line amplifiers and installation method may vary depending on the extended length of the LMR-400 cable and line amplifier specifications, you must refer to the installation instructions provided with the line amplifier.

In addition, you must install the line amplifier within 32.8 ft. (10 m) from the GPS antenna.

Line Amplifier Usage Guideline for GPS Cable Configuration
The total length of the LMR-400 cable should be no longer than 328.08 ft. (100 m).

Installing the Antenna

When you install the antenna, the antenna must be within the protective angle (left/right side 45° each from the central axis) to prevent the antenna from lightning damage.



Installing GPS Antenna

When installing the GPS antenna, you must check the antenna installation location, restriction and installing method.

Checking the Specifications of Antenna/Arrestor/Line Amplifier Connector

Depending on the supplier or manufacturer of the antenna/arrestor/line amplifier, the connector type may be different. Also, the detail specifications of a connector may be different depending on the cable type even for the same connector type.

Therefore, check the detail specifications of a connector before preparing parts (for example, N Type-Male: N Type-Male connector for CNT-400, N Type-Male connector for RG-316D).

Specification of GPS Line Amplifier

The GPS line amplifier specification is ‘Symmetricom-58529A’ or equivalent. (http://www.symmetricom.com/products/gps-solutions/accessories/58529A-GPS-Line-Amplifier-with-L1-Bandpass-Filter/)

GPS Antenna Specifications

For the GPS antenna, ACE technology GA-1575 or equivalent must be used. (http://www.aceteq.com/)

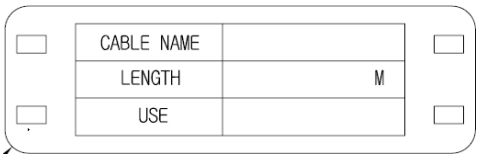
Parameters	Specifications
Frequency Range	1575.42 ± 5 MHz
Gain	38 dBi (Min.)
VSWR	2.0 (Max.)
Noise Figure	1.5 dB (Max.)
Polarization	RHCP
IN/OUT Impedance	50 Ω (Nominal)
DC Power	5.0 ± 0.5 V
Current	45 mA (Max.)
Operating Environment	-40~+80 °C

GPS Cable Identification Tag Installation

Attach the identification tape specified in the following table to the GPS cable.

Table 20. Identification Tag of GPS Cable

Classification	Description
Installation position	Attach the identification tag to the ends of the GPS antenna and arrestor.
Materials	Aluminum coated by vinyl identification tags are recommended.
Fixing method	Fix the GPS cable to the two holes on the identification tag with the black cable tie.
Identification method	The markings must be prevented from being erased by using relief engraving or coated labels.



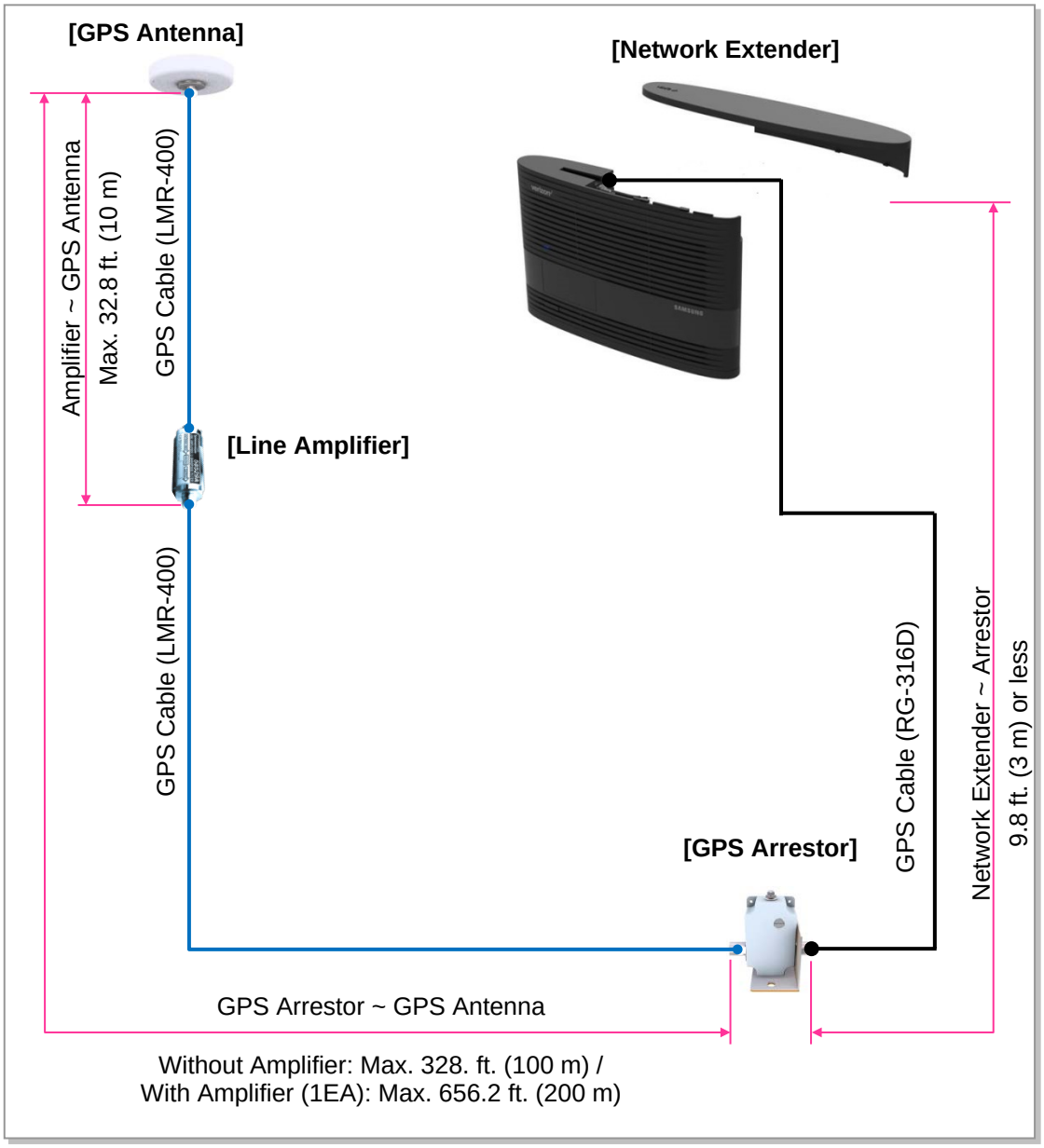
1. CABLE NAME: Cable name
2. LENGTH: Cable length (m)
3. USE: Cable usage purpose

[Identification Tag Example]

GPS Cable Configuration (Case #1)

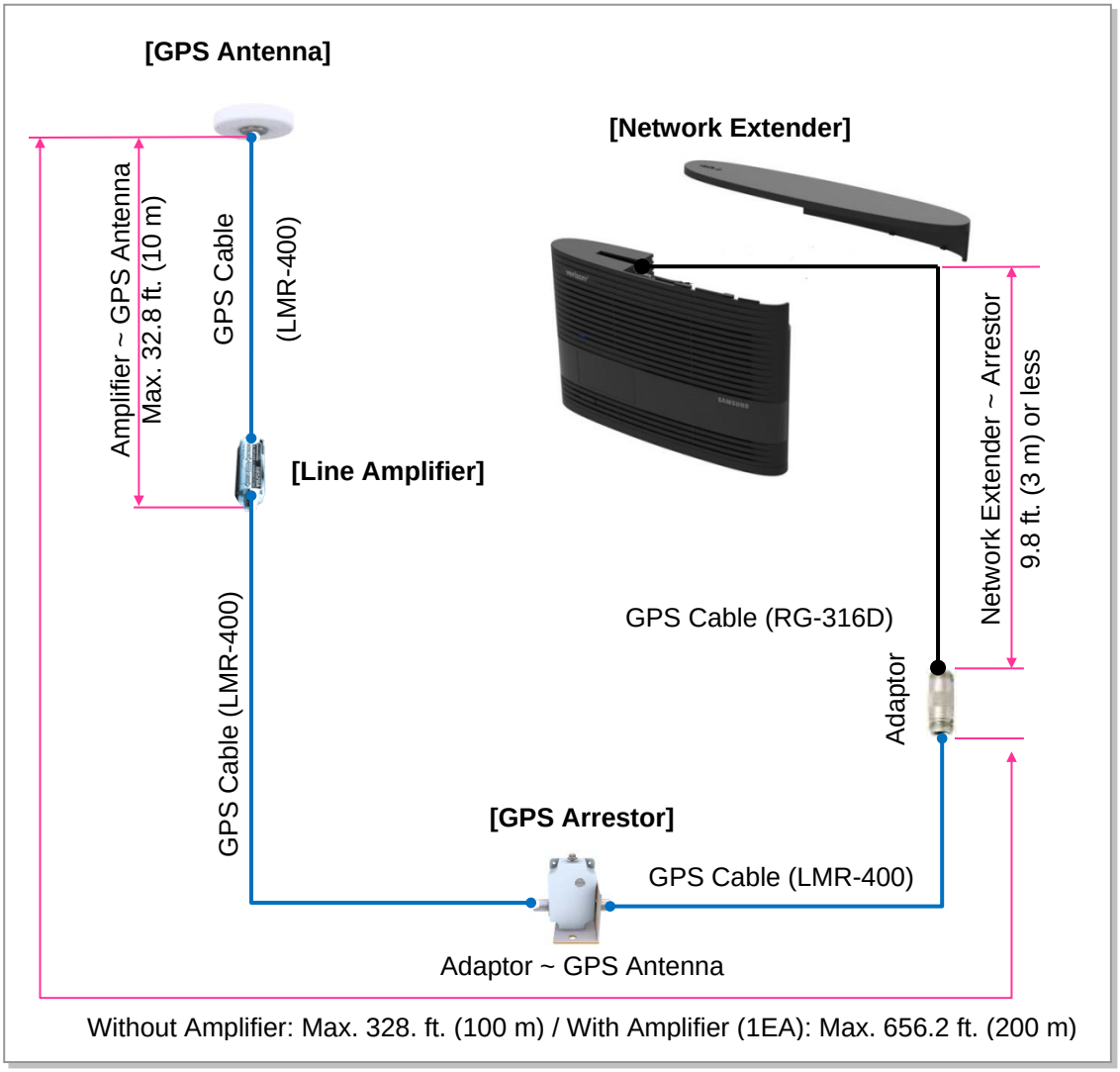
The configuration of the GPS cable is shown in the following figure.

Figure 25. GPS Cable Configuration Case #1



GPS Cable Configuration (Case #2)

Figure 26. GPS Cable Configuration Case #2



GPS Cable Length

The length of the GPS cable is limited for each section as shown below.

1. The Network Extender GPS arrestor: 9.84 ft. (3 m) or less
If the distance between the Network Extender and the GPS arrestor is longer than 9.84 ft. (3 m), use the straight adapter for extension. Connect the RG-316D cable up to 9.84 ft. (3 m) to the straight adapter and then extend the connection to the GPS arrestor using the LMR-400 cable.
2. RG-316D~GPS arrestor GPS antenna (LMR-400 cable installation section)
- Total length of the LMR-400 cable: 328.08 ft. (100 m) or less
- If the total length of the LMR-400 cable is longer than 328.08 ft. (100 m), compensate the loss by installing a line amplifier.
Because the required number of line amplifiers and installation method may vary depending on the extended length of the LMR-400 cable and line amplifier specifications, you must refer to the installation instructions provided with the line amplifier. In addition, you must install the line amplifier within 32.8 ft. (10 m) from the GPS antenna.

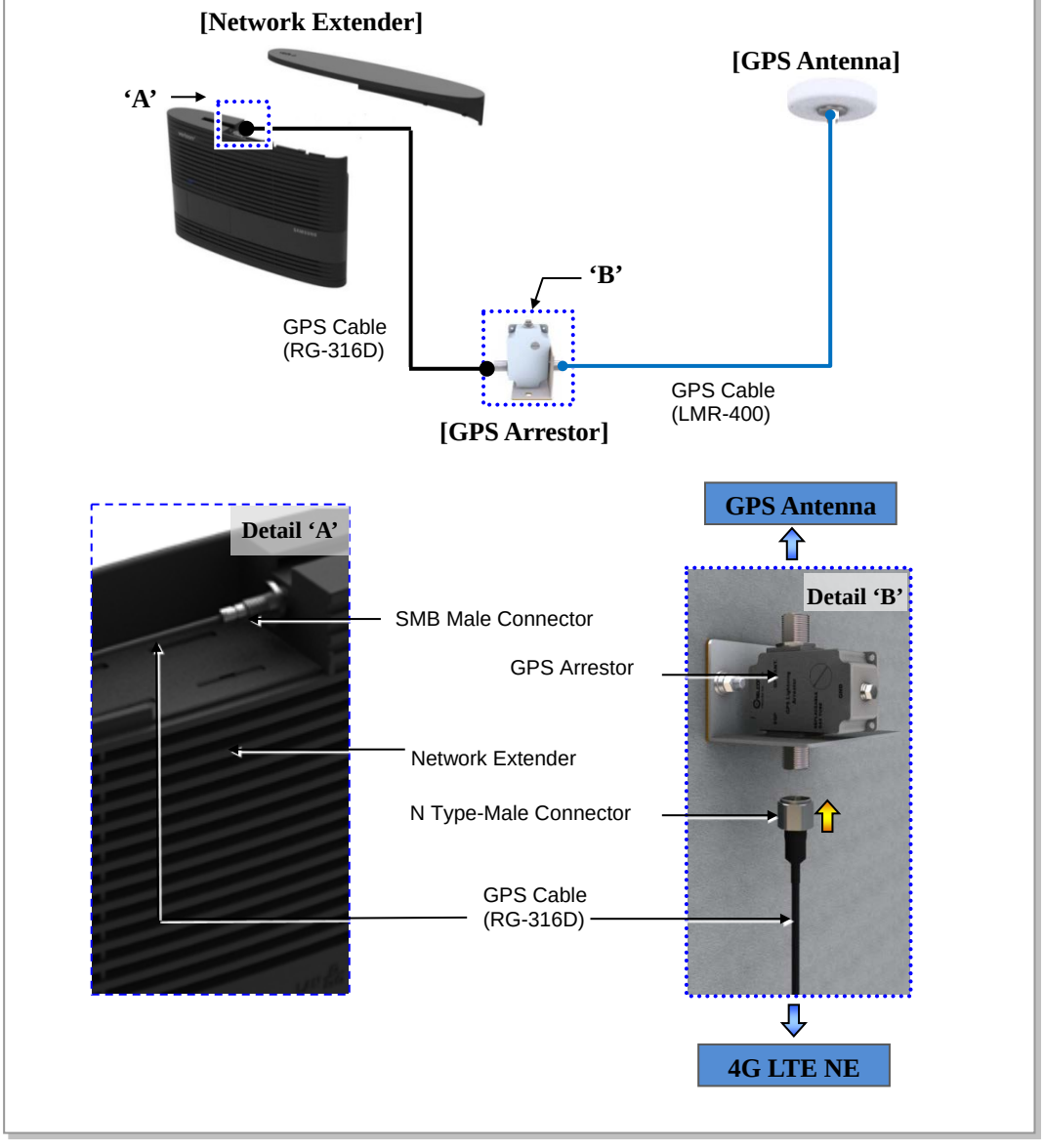
For example, when using a line amplifier (Symmetricom-58529A) × 1 EA → Total length of the LMR-400 cable: 656.17 ft. (200 m) or less.

The Network Extender GPS Arrestor Cable Connection (Case #1)

Follow the steps below to connect the GPS cable from the Network Extender to the GPS arrestor.

Figure 27. The Network Extender GPS Arrestor Cable Connection Case #1

1 Install the GPS cable from the GPS antenna port of the Network Extender to the GPS arrestor.
2 Connect the assembled connectors of the cable to the GPS antenna port.
- o RG-316D Cable: SMB Male (Network Extender), N Type-Male (GPS Arrestor)
- o LMR-400 Cable: N Type-Male (GPS Arrestor EQP)



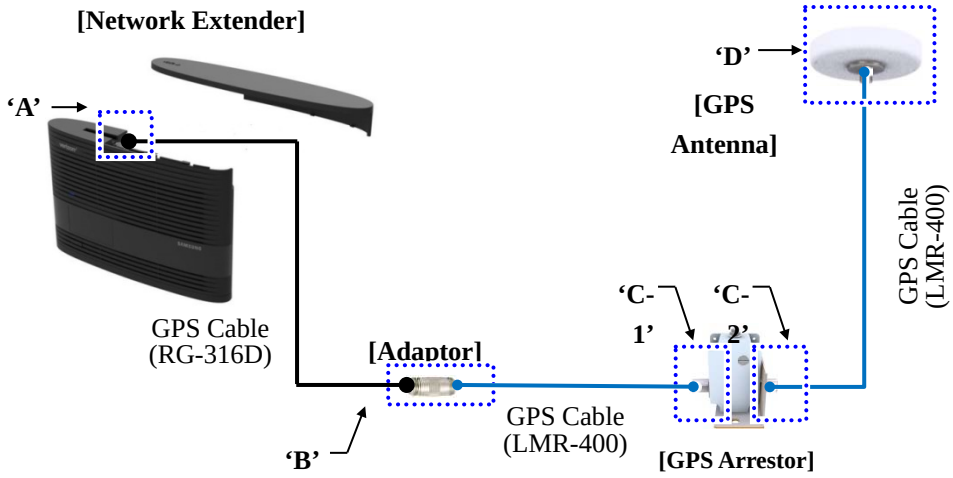
The Network Extender GPS Arrestor Cable Connection (Case #2)

Figure 28. The Network Extender GPS Arrestor Cable Connection Case #2

1 Install the GPS cable from the GPS antenna port of the Network Extender to the GPS arrestor.

2 Connect the assembled connectors of the cable to the GPS antenna port.

- o RG-316D Cable: SMB Male (Network Extender), N Type-Male (Straight Adaptor)
- o LMR-400 Cable: N Type-Male (GPS Arrestor EQP)



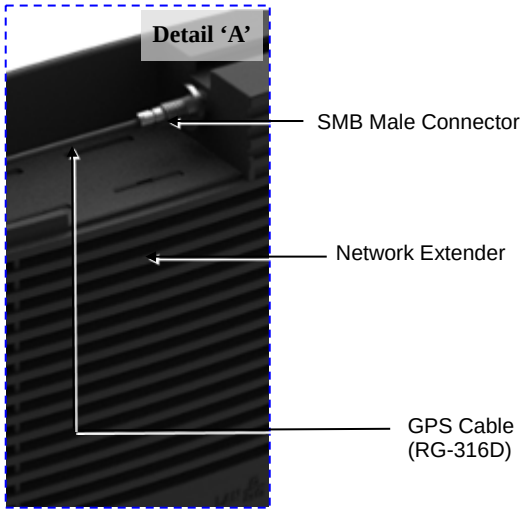


Figure 29. The Network Extender GPS Arrestor Cable Connection Details

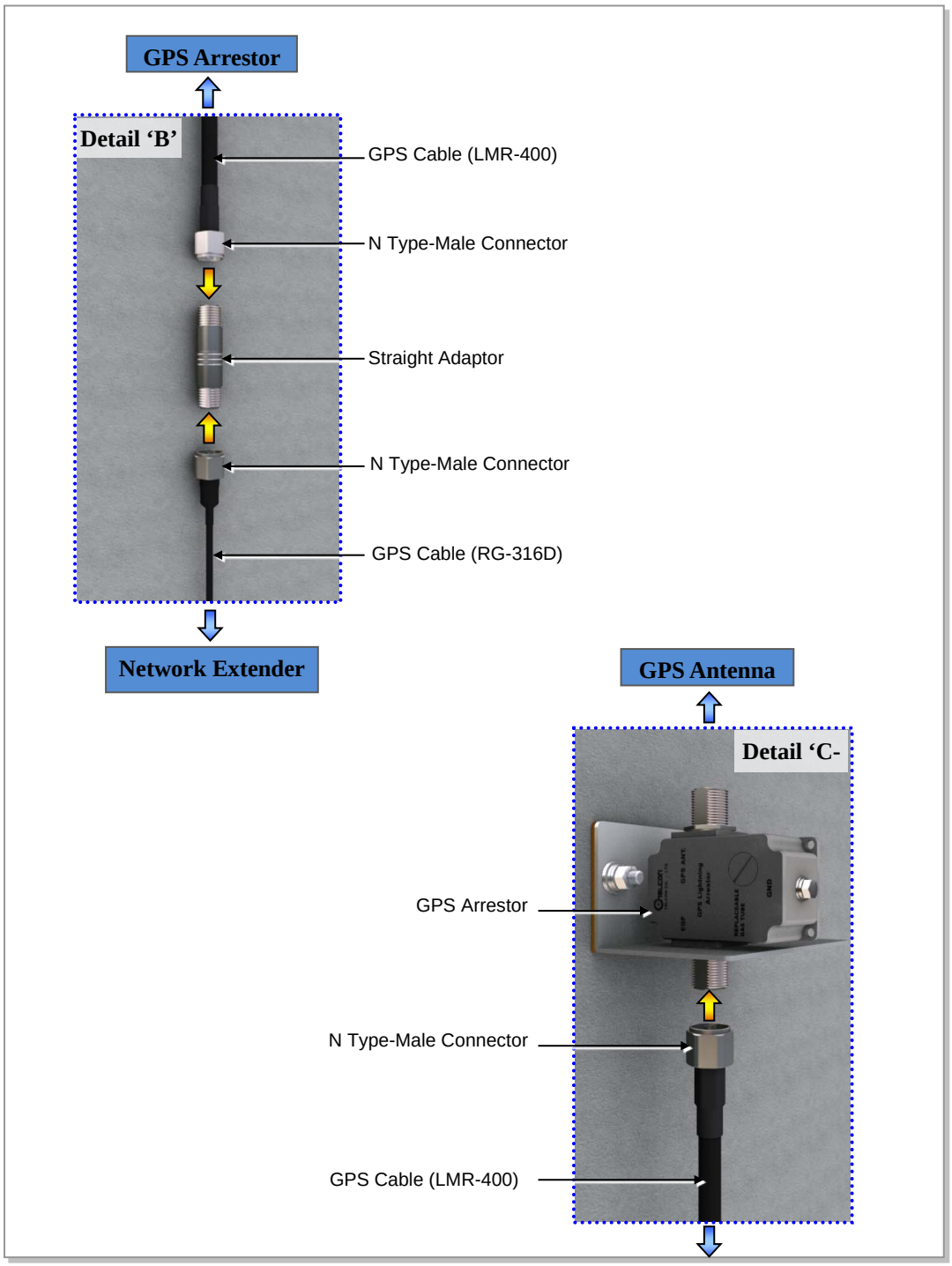
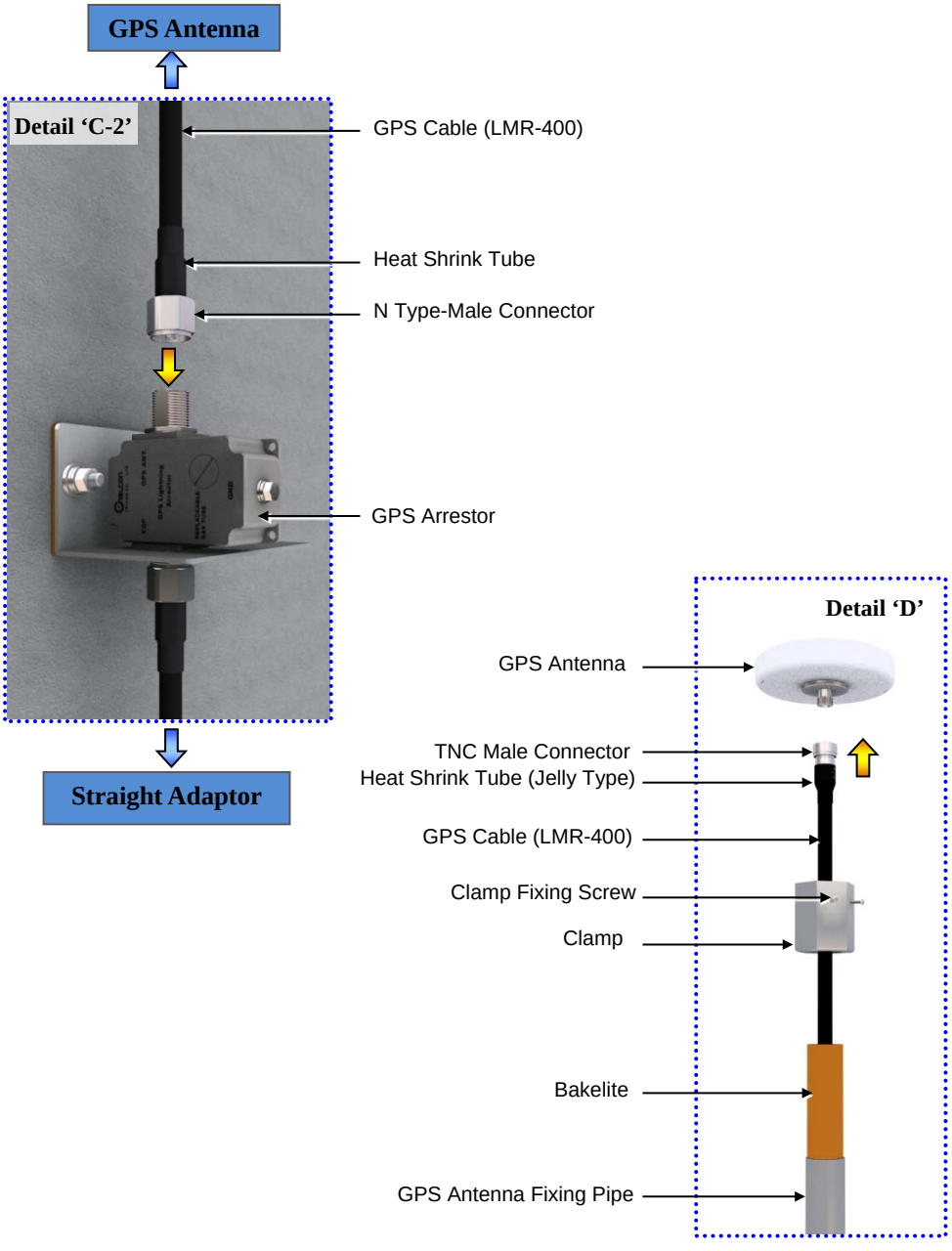


Figure 30. GPS Arrestor GPS Antenna Cable Connection Detail

1 Install the GPS cable from the GPS ANT. port of the GPS arrestor to the GPS antenna.

2 Connect the assembled connectors of the GPS cable (LMR-400) to the GPS arrestor and antenna port.

LMR-400 Cable: N Type-Male (GPS Arrestor EQP)
TNC Type-Male (GPS Antenna)



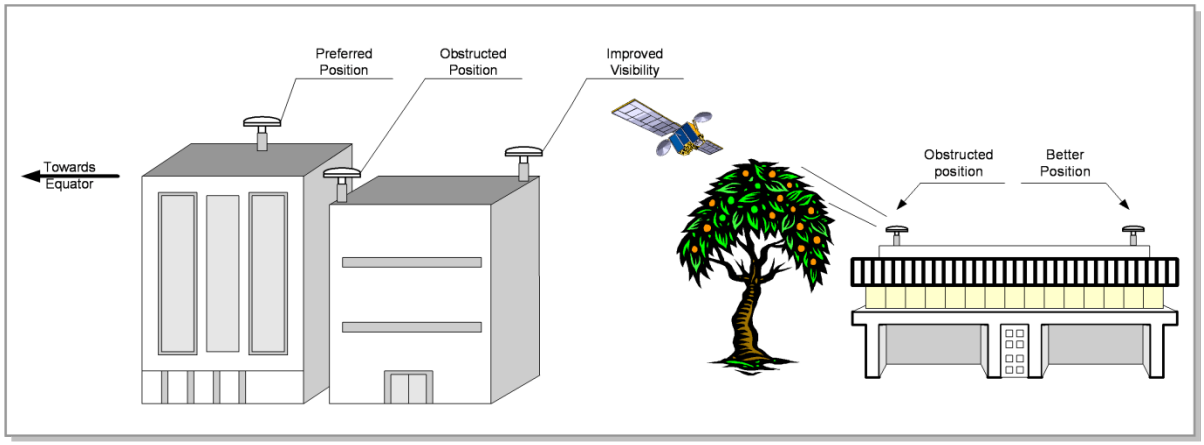
GPS Satellite Tracking and Position Hold
The survey of an object's position using GPS satellites is based on triangulation. Three satellites are enough to survey the position of an object by triangulation. However, to calculate the correct time deviation, a total of four satellites are required.

Usually, the GPS antenna is installed in a high place, such as on a roof. It must be installed away from protruding objects, such as trees or buildings. In addition, it must be positioned away from any obstacle that covers part of the sky around the horizon of the building where it is installed.

If it is impossible to ensure a completely open sky, you should install the GPS antenna facing the equator providing a maximum view of the southern sky (northern sky in the southern hemisphere).

Furthermore, when installing the GPS antenna using a steel cylinder structure shared by other RF antennas, it must be separated by more than 1 m from that steel structure.

Figure 31. GPS Antenna Installation



Lightening Arrestor

A lightning arrestor is required when there is a danger of lightning striking a cable or related part. The lightning arrestor must be installed in a place where the antenna cable or set of combined cables enters a building or station, or a place inside the building or station. The purpose of this is to protect the people and equipment inside the building or station.

If struck directly by lightning, the lightning arrestor, antenna, or cable must be replaced. Furthermore, you must inspect the lightening arrestor periodically, and replace the antenna and cable periodically to ensure protection if lightning occurs frequently at the site.

The lightning arrestor must be well grounded so that it can transmit a large current quickly.

Signal Interference

The GPS system is designed so that it has a strong immunity to noise and can endure interference.

The Samsung GPS receiver provides a quality timing clock in most installations.

However, to ensure that the GPS receiver performs locking successfully and guarantees uninterrupted timing performance, an interference-free environment is required for frequencies near the GPS L1 frequency (1575.42 ± 1 MHz).

Interference Types

There are two types of interference which affect the GPS L1 frequency:

- Narrow band (inband) interference

  When a frequency deviation (3.5 kHz), such as an FM wave, inflows in around the GPS L1 frequency (1575.42 MHz), it is called narrow band (inband) interference. Narrow band interference is monitored by the spectrum analyzer. Because it has a time lag, a locking failure or a different type of alarm can occur.

- Wideband interference

  When around the GPS L1 frequency (1575.42 MHz) and the frequency deviation is more than 7 kHz, this is called wide band interference.

  Wideband interference includes the interference induced by the harmonics from a communication service with a different frequency bandwidth, increased thermal noise from communication services around the L1 band, inflow of interference due to unauthorized communication, saturation due to oscillation of an accessory device, and so on.

  You cannot monitor these kinds of interferences with a device such as a spectrum analyzer. If the system has a wideband interference problem, you should consult an expert in this area.

For other bandwidths, except the GPS L1 frequency (1575.42 ± 1 MHz), a GPS Band Pass Filter (BPF) must be included within the GPS antenna to remove the interference from the GPS bandwidth. No outband interference must affect the GPS signals.

Avoiding Interferences

If more than one antenna for other communications, such as an antenna for a base station or satellite communication, is installed in the surroundings, the GPS antenna must be installed in a location to which no interference signals flow in.

If interference exists within the GPS L1 frequency bandwidths (1575.42 ± 1 MHz), you should use a band pass filter to prevent them from affecting it.

Furthermore, if the GPS antenna is installed by a transmitter which operates with a bandwidth similar to the GPS L1 frequency, the possibility of interference increases (in this case, interference is caused by harmonics). If the GPS antenna has a problem due to interference, you must move it to a different location where interference signals can be avoided or minimized in strength.

Inband Noise
Inband noise includes narrow band noise and wide band noise that occur in an inband width. (L1, 1575.42 ± 1 MHz)
- Narrow band noise in an inband width: If it is higher than 108dBm, it can affect the operation of the GPS receiver.
- Wideband noise in an inband width: It may not be detected by a measuring instrument and impair the sensitivity of the GPS receiver, and thus affect its operation.

If there is an outband interference problem, you can reduce the effects of interference on the GPS receiver by applying one or more L1 GPS band pass filters.

The filter should be installed at the following locations:

- The input connector of the Samsung GPS receiver
- Behind the antenna or the front end of a line amplifier

The filters above are used to reject jamming tones for outband signals. If interferences actually occur in the inband signals, they will result in serious consequences.

GPS Antenna Installation

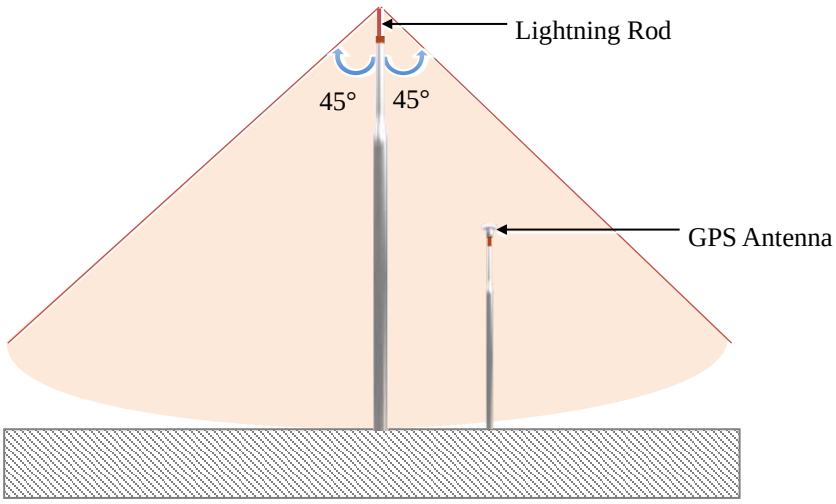
The GPS antenna can be fixed to a wall, floor, tower, pole, and so on. Ensure that you are safe when fixing an anchor bolt to a wall and treat the anchor bolt fixing area with a silicon or waterproof finishing material.

Installing the Concrete Block

A concrete block should be installed that satisfies the specification regarding size and strength. When installing the concrete block, and before forming the concrete, steel reinforcement bars should be arranged in a mesh layout at 3.93 in. (100 mm) intervals before forming the concrete. (Either an anchor bolt assembly or a concrete anchor can be used.)

Installing the Antenna

When you install the antenna, the antenna must be within the protective angle (left/right side 45° each from the central axis) to prevent the antenna from lightning damage.

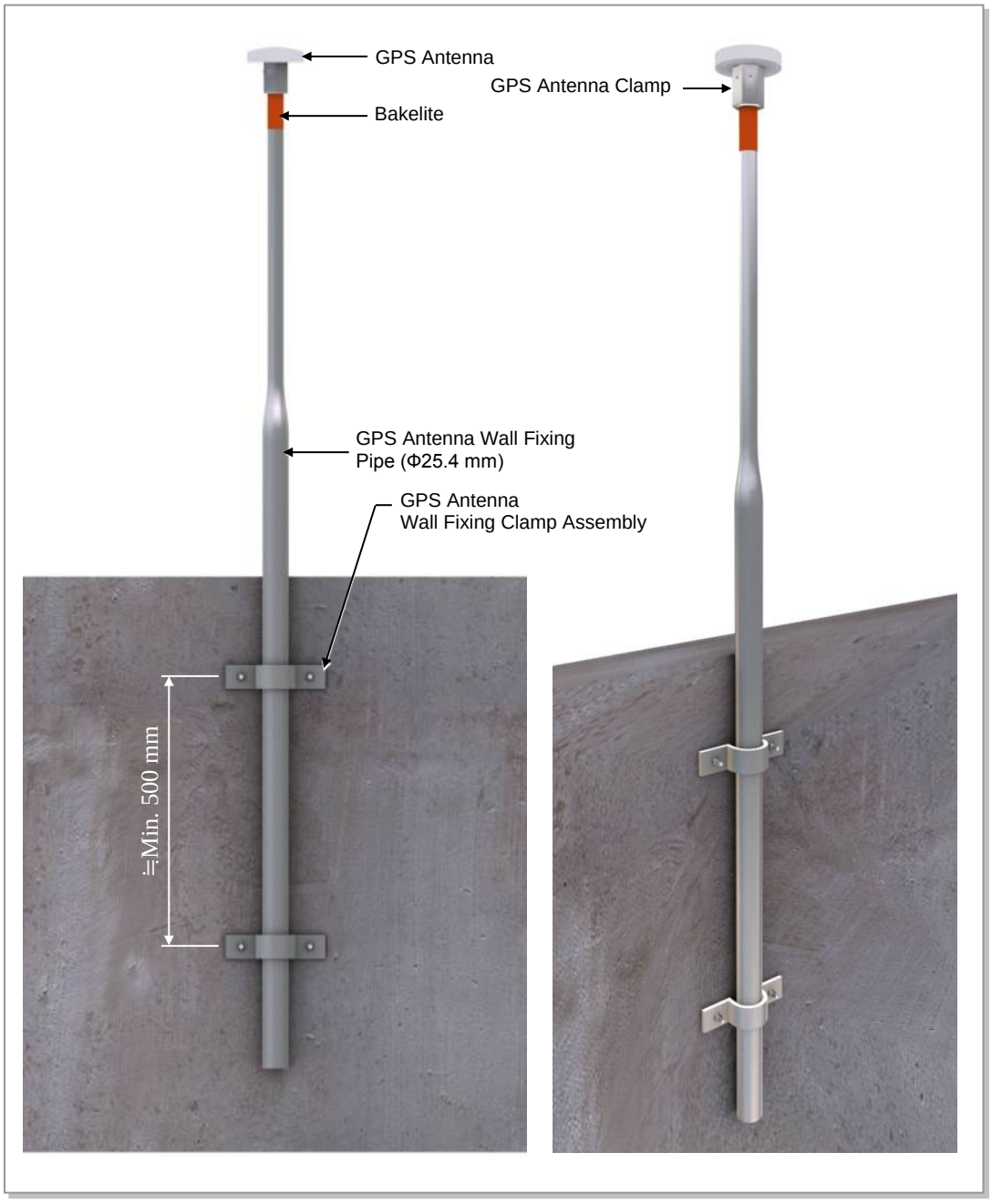


Distance between the Antennas

When installing an antenna, a 3.28~4.92 ft. (1~1.5 m) distance must be secured between the antennas to prevent interference.

Wall Mount GPS Antenna

Figure 32. GPS Antenna Installation (Wall)



Floor Mount GPS Antenna

Figure 33. GPS Antenna Installation (Floor)

Installing Optional GPS Arrestor

Fixing GPS Bulkhead

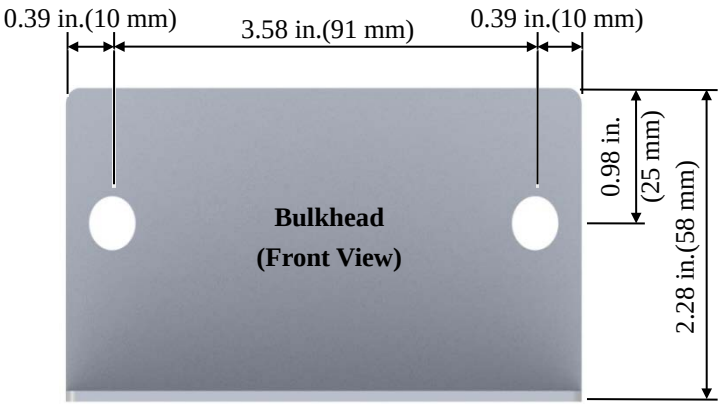
The method to fix the GPS bulkhead is as follows.

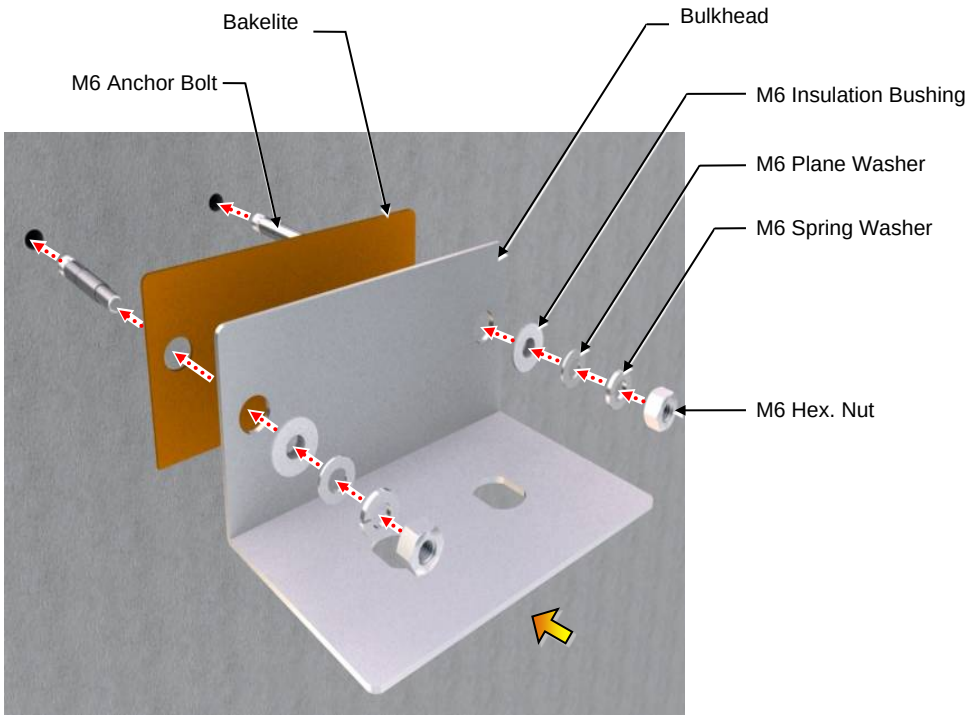
Table 21. Optional GPS Bulkhead Fixing Parts and Tools

Classification	Description		
Installation position	• An arrestor must be installed within the lightning rod protection angle. • The arrestor must be installed to prevent a person or system being affected by lightning induced currents.		
Parts	• Bulkhead • Bakelite		1 EA 1 EA
	Fastener	M6 anchor bolt assembly • M6 anchor bolt • M6 hex. nut • M6 spring washer • M6 plane washer	2 sets 1 EA/set 1 EA/set 1 EA/set 1 EA/set
		M6 insulation bushing	2 EA
Recommended torque value	M6 hex. nut		2.41~3.61 ft.lb. (33.28~49.92 kgf.cm)
Working tools	Drill, hammer, torque wrench, and level		

Figure 34. Fixing GPS Bulkhead

1 Fix the anchor bolts to the holes marked and drilled.
Drill bit: 0.39 in.(10 mm) / Hole depth: 1.3 in.(33 mm)
2 Place the Bakelite and bulkhead along with the fixed anchor bolts. Secure firmly using fasteners.





Check the Configurations of GPS Arrestor and Bulkhead
The fixing methods and fasteners vary for the configurations of the GPS arrestor and bulkhead. Thus, check the installation methods and configurations enclosed with the GPS arrestor and bulkhead.

Fixing GPS Arrestor

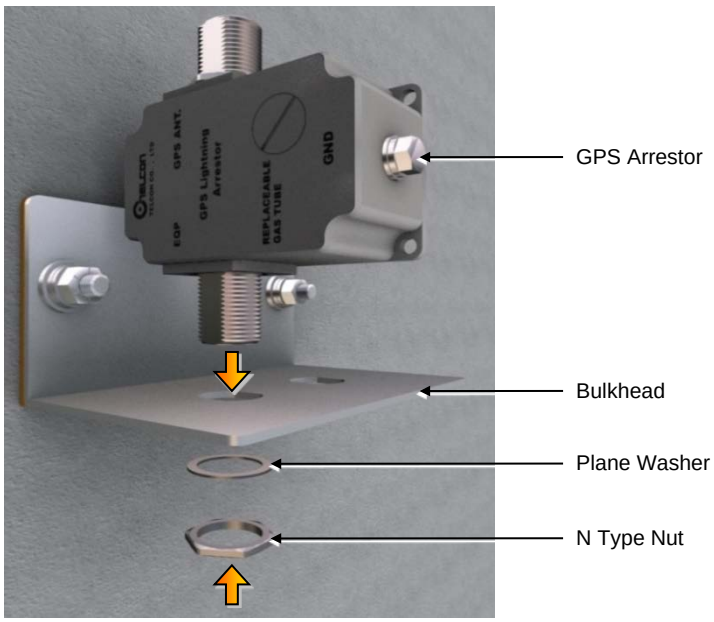
The method to fix the GPS arrestor is as follows.

Table 22. GPS Arrestor Fixing Parts and Tools

Classification	Description			
Parts	GPS arrestor/1 set	GPS arrestor unit		1 EA/GPS arrestor
		Fastener	N type nut	1 EA/GPS arrestor
			Plane washer	1 EA/GPS arrestor
Recommended torque value	N type nut			3.25~3.61 ft.lb. (44.93~49.91 kgf.cm)
Working tools	Torque wrench and spanner			

Figure 35. Fixing the GPS Arrestor

1 Insert the connector for the GPS arrestor along with the bulkhead fixing hole.
2 Secure the GPS arrestor with the bulkhead using fasteners. Make sure that the system-side and antenna-side connector directions are not changed.



Grounding the Optional GPS Arrestor

The way to connect the ground cable with the GPS arrestor is as follows.

Table 23. Grounding the GPS Arrestor (MGB GPS Arrestor)

Classification	Description	
Installation section	MGB ground terminal of arrestor	
Cable	AWG8, F-GV 6 mm2 × 1C/1 EA	
Heat shrink tube (spec/color/length)	Φ 0.4 in. (10 mm)/Green/1.97 in. (50 mm)	
Pressure terminal	MGB	Checking the MGB specifications per site and preparing fasteners
	Arrestor	6 mm2, ring type, hole dia.: 0.21 in. (5.3 mm)
Fastener	MGB	Checking the MGB specifications per site and preparing fasteners
	Arrestor	M5 hex. bolt/1 EA M5 spring washer/1 EA M5 plane washer/1 EA (attached at the GPS arrestor)
Recommended torque value (kgf.cm)	M5 hex. bolt	1.45~2.17 ft.lb. (20 ~ 30 kgf.cm)
Working tools	Cable cutter, wire stripper, compressor, heating gun, torque driver (+), torque wrench, and nipper	

Pressure Terminal for Grounding

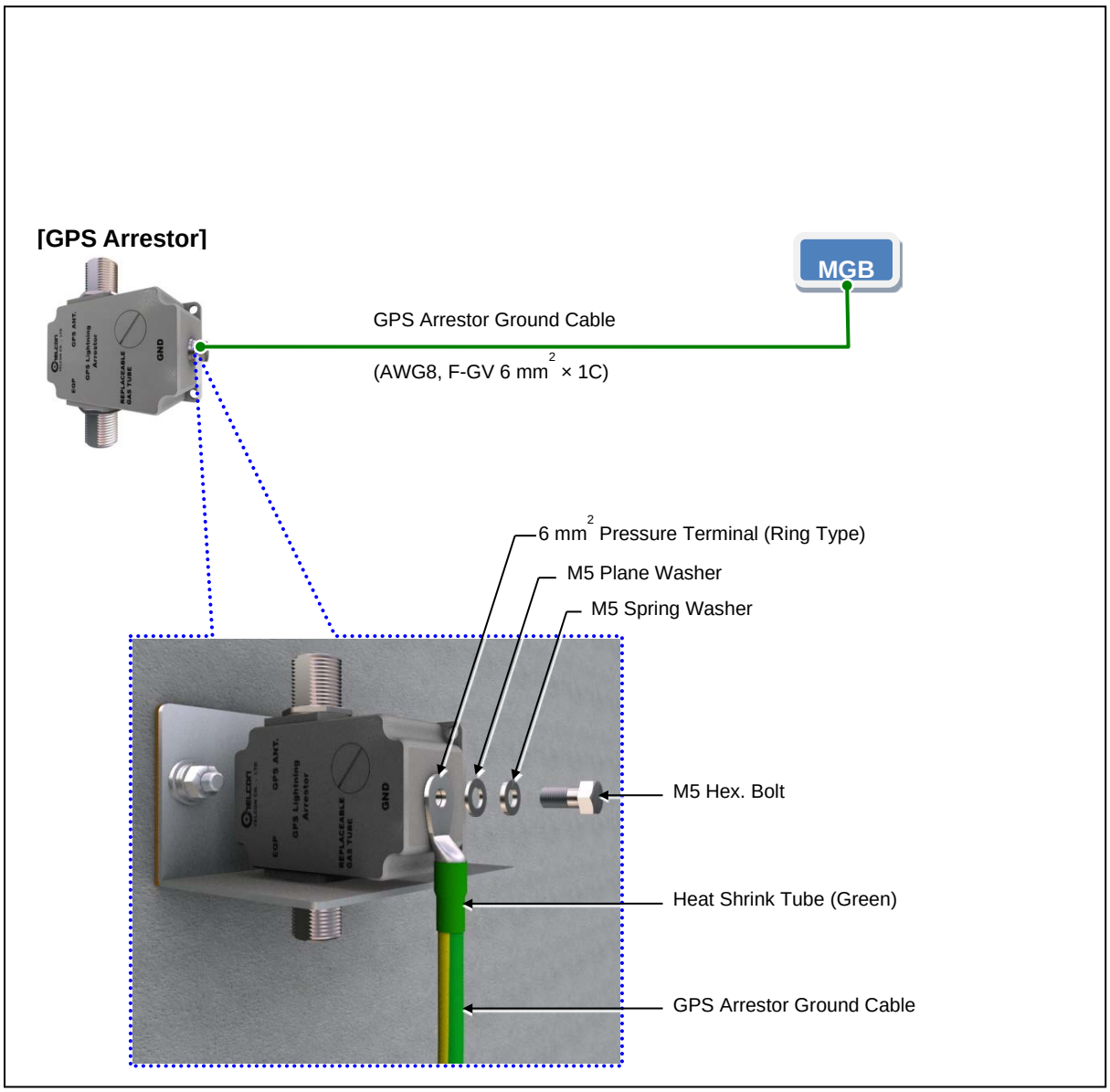
As for the pressure terminal or the cable, the UL listed products or equivalent should be used.

For example:

Manufacturer: JEONO Electric

GPS Arrestor: 6 mm2 Pressure Terminal (JOR 6-5)

Figure 36. Connection of the GPS Arrestor Ground Cable



Appendix B Acronyms

AC	Alternating Current
B/H	Backhaul
CPU	Central Processing Unit
CSG	Closed Subscriber Group
DC	Direct Current
DHCP	Dynamic Host Configuration Protocol
DNS	Domain Name System
ESP	Enhanced Security Payload Protocol
FCC	Federal Communications Commission
FQDNs	Fully Qualified Domain Names
GPS	Global Positioning System
GPSR	GPS Receiver
HD	High Definition
HTTP	HyperText Transport Protocol
ID	Identifier
IP	Internet Protocol
IPSEC	Internet Protocol Security - System of Protocols
ISP	Internet Service Provider
LAN	Local Area Network
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LTE	Long Term Evolution
MAC	Media Access Control
MTU	Maximum Transmission Unit
NAT	Network Address Translator
PAT	Port Address Translation
RF	Radio Frequency
RU	Radio Unit
SeGW	Security Gateway
SIM	Subscriber Identity Module
TCP	Transmission Control Protocol
TCXO	Temperature Controlled Oscillator
TOD	Time Of Day
UDP	User Datagram Protocol

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User Guide

Document Version 1.1