C H A P T E R **3**

Battery Backup Unit

A selection of the WPAN advanced range extender models support one battery backup unit (BBU), which provide power to the rang extender if the AC power supply fails or is not available. For more information about the WPAN advanced range extender models that support a BBU, see the "WPAN Range Extender Models Supporting BBUs" section on page 3-1.

This chapter describes the BBU features and installation procedures, and includes the following sections:

- Battery Backup Units, page 3-1
- BBU Configuration during Transportation, page 3-4
- Disabling and Enabling the BBU in the Range Extender, page 3-4
- Installing a BBU in the Range Extender, page 3-5
- BBU Technical Specifications, page 3-5

Battery Backup Units

This section contains information about:

- WPAN Range Extender Models Supporting BBUs, page 3-1
- Battery Backup Operations, page 3-2
- BBU Status, page 3-2
- Battery Backup Mode, page 3-2
- BBU Firmware Upgrade, page 3-3

WPAN Range Extender Models Supporting BBUs

Table 3-1 details the WPAN range extender models that support a BBU.

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Battery Backup Operations

The battery backup unit (BBU) provides the WPAN range extender with an emergency power source if the AC power source is unavailable. The unit is mounted in the range extender housing.

Table 3-2describes the BBU model.

Table 3-2   BBU Models

BBU Model	Description
CGR-BATT-4AH	Battery backup unit, capacity = 48 Watt-hours

BBU Status

The BBU is automatically enabled and begins supplying power when the range extender detects that power is not being received from the AC power supply. The BBU continues to supply power to the range extender until at least one of the following conditions is met:

- BBU is completely discharged
- AC power to the range extender is enabled
- BBU is disabled via the Connected Grid Network Management System (CG-NMS) software application.

Battery Backup Mode

This section describes impact on the range extender configuration and operating capabilities when the range extender switches from AC power to BBU power.

The topics covered include:

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Range Extender Configuration

The range extender software configuration is not impacted when the range extender switches from AC power to BBU power.

Range Extender Interface Operation

When the BBU is operating and powering the range extender, the range extender operates and performs normally. The range extender does not power off any interfaces to conserve power when AC power is not available, and the range extender is being powered by the BBU.

BBU Firmware Upgrade

It is only possible to use the CG-NMS to upgrade the BBU firmware and to show information about the BBU firmware upgrade.

To upgrade the BBU firmware and to show information about the BBU firmware upgrade, use the CG-NMS firmware upgrade option.

The firmware upgrade is executed in background and an output message is generated in the CG-NMS when the BBU firmware upgrade is complete. During the firmware upgrade, you can use the CG-NMS to view the state of the BBU firmware upgrade.

BBU Configuration during Transportation

The BBU configuration during transportation is controlled by a dedicated bit in the BBU NVRAM register called the Transportation bit or (T-bit).

The T-Bit is set at the factory and is used to place the BBU in a disabled (low power) state. This is necessary in order to preserve the battery charge while the WPAN range extender device (with BBU installed) is in storage, or being transported between the factory and the final installation site.

This sections contains:

- Setting the BBU NVRAM Register T-bit, page 3-4
- BBU NVRAM Register T-bit Settings and BBU Status, page 3-4

Setting the BBU NVRAM Register T-bit

The T-bit in the BBU NVRAM register is set to 1 using the CG-NMS.

Note   The T-bit is set to 1 by Cisco manufacturing at the factory. The T-bit is reset to 0 or cleared only by the CG-NMS during ZTD deployment.

BBU NVRAM Register T-bit Settings and BBU Status

Table 3-3   BBU NVRAM T-bit Settings and BBU Status

T-bit Setting	BBU Status
T-bit = 1	• AC ON: BBU enabled automatically (to allow battery to charge) • AC OFF: BBU disabled automatically (to prevent battery from discharging)
T-bit = 0	The BBU can be set to a disabled or enabled status for AC ON or OFF conditions. Note If the BBU is disabled due to being < 5% capacity, it will be enabled automatically when AC power resumes. If the customer disables the BBU, the customer must enable the BBU manually.

Disabling and Enabling the BBU in the Range Extender

In normal operating mode (T-bit is off), the BBU automatically begins to supply power to the range extender when it detects that power is not being received from the AC power supply. You may wish to disable and enable the BBU for the following reasons:

- To inhibit the BBU discharge during storage, shipping or transportation in order to preserve battery life.
- To replace the battery in an installed and operating range extender.

The BBU can be disabled and enabled by using the CG-NMS. These steps are described in the following sections:

- Disabling the BBU, page 3-5
- Enabling the BBU, page 3-5

Disabling the BBU

For information on how to disable the BBU, see the *Cisco Connected Grid Network Management System User Guide*.

Enabling the BBU

For information on how to enable the BBU, see the *Cisco Connected Grid Network Management System User Guide*.

Installing a BBU in the Range Extender

A BBU can only be installed in the WPAN range extender by a Cisco trained technician. Contact your Cisco representative for support.

BBU Technical Specifications

This section describes the specifications and standards supported by the BBU.

- Range Extender Power Path Selection, page 3-5
- Discharge Conditions, page 3-6
- Charge Conditions, page 3-6
- Operating and Storage Temperatures, page 3-7
- Battery Life, page 3-7

Range Extender Power Path Selection

During normal operation, the range extender is powered by the integrated AC power supply. The BBU enters discharge mode and begins providing power to the range extender when the AC power is interrupted outside a range of 85V to 250V for more than 20 ms. The BBU charges or discharges only; it does not support both simultaneously.

Discharge Conditions

Table 3-4   Battery Backup Unit—Discharging Specifications

Discharge Conditions	Description
Power load	4–6 W typical
Duration	8–12 hours typical
Entry to discharge[1]	• AC power (range of 85V to 250V) not detected for more than 20 ms • Remaining BBU capacity >5% • External ambient temperature is within -40 to 122°F (-40 to 50°C)
Exit discharge[2]	• AC power restored in the range of 85V to 250V for more than 20 ms. • Remaining BBU capacity <5% • External ambient temperature is outside of -40 to 122°F (-40 to 50°C)

1. All conditions met.
2. Any condition met and system is detected.

Charge Conditions

Table 3-5   Battery Backup Unit—Charge Specifications

Charge Conditions	Description
Power draw	No more than 20 W when charging
State of charge	No more than 90%
Entry to charging limit[1]	• Charge is enabled • State of Charge (SOC) <85% • AC power detected in the range of 85V to 250V for more than 20 ms. • External ambient temperature is within -4 to 104°F (-20 to 40°C)
Exit charging[2]	• Charge is disabled • AC power (range of 85V to 250V) not detected for more than 20 ms. • External ambient temperature is outside of -4 to 104°F (-20 to 40°C)

1. All conditions are met.
2. Any condition is met

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Operating and Storage Temperatures

Table 3-6   Battery Backup Unit—Operating and Storage Temperatures

BBU State	Local BBU Internal Temperature[1]	External Ambient Temperature
Charging	+32 to 122°F (0 to 50°C)	-4 to 104°F (-20 to 40°C)
Discharging	-4 to 140°F (-20 to 60°C)	-40 to 122°F (-40 to 50°C)
Operation (Idle)	-4 to 140°F (-20 to 60°C)	-40 to 122°F (-40 to 50°C)
Storage and shipping	+14 to 113°F (-10 to 45°C) for 3 months maximum	Short-term: +14 to 113°F (-10 to 45°C) for 3 months maximum Long-term: +27 to 77°F (-3 to 25°C) - 65% Relative Humidity - 40 to 90% SOC

1. Internal BBU heaters allow the outside ambient temperature to drop much lower than the BBU internal temperature, thereby preserving battery life and expanding the operating temperature.

Battery Life

Table 3-7   Battery Backup Unit — Battery Life

Product ID	Battery Life	Charge-Discharge Cycles
CGR-BATT-4AH	5 years	500

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CHAPTER **4**

Antenna

This chapter contains information about the antennas for the Cisco WPAN gateway and WPAN range extender devices. The antennas provide connectivity to the CG-Mesh.

This chapter contains the following sections:

Antennas Overview

WPAN Gateway Antenna Configurations

Gateway Pole Mounted Antenna with Below Grade Conduit Routed Cabling Configuration

Table 4-1   Pole Mounted Antenna with Below Grade Conduit Routed Cabling Configuration for the IR509U-WP-915/K9 Gateway

Antenna Arrangement and Connector(s)	Enclosure Internal Cable	Lightning Arrestor or Adapter	Outdoor Cable	Antenna
Pole mounted antenna, single antenna cable routed through below grade conduit, 1 QMA (f) antenna connector	Select one cable from: • 1 RA-QMA (m) to N (m) cable, LMR-240-FR, 10', Cisco PID[1] CAB-L240-10-Q-N, Cisco PN[2] 37-1351-02 • 1 RA-QMA (m) to N (m) cable, LMR-240-FR, 15', Cisco PID CAB-L240-15-Q-N, Cisco part number 37-1352-02 • 1 RA-QMA (m) to N (m) cable, LMR-240-FR, 20', Cisco PID CAB-L240-20-Q-N, Cisco PN 37-1353-02	—	A single cable routed from inside the enclosure to outside the enclosure	1 900 MHz ISM band, omni stick, 24", 5 dBi, N (f), Cisco PID ANT-WPAN-OM-OUT-N, Cisco PN 07-1163-02

1. PID = Product Identifier

2. PN = Part number

Gateway Enclosure Mounted Antenna Configuration

Table 4-2   Enclosure Mounted Antenna Configuration for the IR509U-WP-915/K9 Gateway

Antenna Arrangement and Connector(s)	Enclosure Internal Cable	Lightning Arrestor or Adapter	Outdoor Cable	Antenna
Antenna directly mounted to lightning arrestor at enclosure interface to exterior, 1 QMA (f) antenna connector	Select one cable from: • 1 RA-QMA (m) to N(m) cable, LMR-240-FR, 10', Cisco Product Identifier (PID) CAB-L240-10-Q-N, Cisco PN 37-1351-02 • 1 RA-QMA (m) to N(m) cable, LMR-240-FR, 15', Cisco PID CAB-L240-15-Q-N, Cisco PN 37-1352-02 • 1 RA-QMA (m) to N(m) cable, LMR-240-FR, 20', Cisco PID CAB-L240-20-Q-N, Cisco PN 37-1353-02	1 lightning arrestor, N (f)-N (f), Cisco PID CGR-LA-NF-NF, Cisco PN 07-1158-01	—	1 900 MHz ISM band, omni stick, 8", 1.5 dBi, N (f), Cisco PID ANT-WPAN-OD-OUT-N, Cisco PN 07-1318-01

Gateway Pole Mounted Antenna with Enclosure Interface Lightning Arrestor Configuration

Table 4-3   Pole Mounted Antenna with Enclosure Interface Lightning Arrestor Configuration for the IR509U-WP-915/K9 Gateway

Antenna Arrangement and Connector(s)	Enclosure Internal Cable	Lightning Arrestor or Adapter	Outdoor Cable	Antenna
Pole mounted antenna, lightning arrestor at enclosure interface to exterior, antenna exterior and internal cables used, 1 QMA (f) antenna connector	Select one cable from: • 1 RA-QMA (m) to N(m) cable, LMR-240-FR, 10', Cisco Product Identifier (PID) CAB-L240-10-Q-N, Cisco PN 37-1351-02 • 1 RA-QMA (m) to N(m) cable, LMR-240-FR, 15', Cisco PID CAB-L240-15-Q-N, Cisco PN 37-1352-02 • 1 RA-QMA (m) to N(m) cable, LMR-240-FR, 20', Cisco PID CAB-L240-20-Q-N, Cisco PN 37-1353-02	1 lightning arrestor, N (f)-N (f), Cisco PID CGR-LA-NF-NF, Cisco PN 07-1158-01	Select one option from: • 1 RA-N(m) to N(m) cable, LMR-400-DB, 5', Cisco PID CAB-L400-5-N-N, Cisco PN 37-1436-01 • 1 N(m) to N(m) cable, LMR-400-DB, 5', Cisco PID CAB-L400-5-N-NS, Cisco PN 37-1446-01 • 2 RA-N(m) to N(m) cables, LMR-400-DB, 20', Cisco PID CAB-L400-20-N-N, Cisco PN 37-1392-01 • 2 RA-N(m)-N(m) cables, LMR-600-DB, 30', Cisco PID CAB-L600-30-N-N, Cisco PN 37-1396-01	1 900 MHz ISM band, omni stick, 24", 5 dBi, N (f), Cisco PID ANT-WPAN-OM-OUT-N, Cisco PN 07-1163-02

WPAN Range Extender Antenna Configurations

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Basic Range Extender Antenna Configuration

Table 4-4   Antenna Configuration for the IR529-WP-915S/K9 Basic Range Extender

Antenna Arrangement and Connector(s)	Enclosure Internal Cable	Lightning Arrestor or Adapter	Outdoor Cable	Antenna
Single antenna, 1 N (f) antenna connector	—	Select one option from: • None— when using a 1.5 dBi direct connect antenna • 1 Lightning Arrestor, DC Pass, N (m)-N (f), Cisco PID CGR-LA-NM-NF, Cisco PN 07-1091-01	Select one option from: • None—when using a 1.5 dBi direct connect antenna • 1 RA-N (m) to N (m) cable, LMR-400-DB, 5', Cisco PID CAB-L400-5-N-N, Cisco PN 37-1436-01 • 1 N(m) to N(m) cable, LMR-400-DB, 5', Cisco PID CAB-L400-5-N-NS, Cisco PN 37-1446-01 • 2 RA-N(m) to N(m) cables, LMR-400-DB, 20', Cisco PID CAB-L400-20-N-N, Cisco PN 37-1392-01 • 2 RA-N(m)-N(m) cables, LMR-600-DB, 30', Cisco PID CAB-L600-30-N-N, Cisco PN 37-1396-01	Select one antenna from: • 1 900 MHz ISM band, omni stick, 8", 1.5 dBi, N (m), Cisco PID ANT-WPAN-OD-OUT-N, Cisco PN 07-1318-01 • 1 900 MHz ISM band, omni stick, 24", 5 dBi, N (f), Cisco PID ANT-WPAN-OM-OUT-N, Cisco PN 07-1163-02

Single Antenna Advanced Range Extender—Direct Connect Antenna Configuration

Table 4-5   Direct Connect Antenna Configuration for the IR529-UBWP-915S/K9 Single Antenna Advanced Range Extender

Antenna Arrangement and Connector(s)	Enclosure Internal Cable	Lightning Arrestor or Adapter	Outdoor Cable	Antenna
Direct connect single antenna, 1 N (f) connector	—	None	None	Select one antenna from: • 1 900 MHz ISM band, omni stick, 8", 1.5 dBi, N(m), Cisco PID ANT-WPAN-OD-OUT-N, Cisco PN 07-1318-01

Single Antenna Advanced Range Extender—Pole Mounted Antenna Configuration

Table 4-6   Mast Mounted Antenna Configuration for the IR529-UBWP-915S/K9 Single Antenna Advanced Range Extender

Antenna Arrangement and Connector(s)	Enclosure Internal Cable	Lightning Arrestor or Adapter	Outdoor Cable	Antenna
Pole mounted single antenna, 1 N (f) antenna connector	—	1 Lightning Arrestor, DC Pass, N (m)-N (f), Cisco PID CGR-LA-NM-NF, Cisco PN 07-1091-01	Select one option from: • 1 RA-N (m) to N (m) cable, LMR-400-DB, 5', Cisco PID CAB-L400-5-N-N, Cisco PN 37-1436-01 • 1 N (m) to N (m) cable, LMR-400-DB, 5', Cisco PID CAB-L400-5-N-NS, Cisco PN 37-1446-01 • 2 RA-N (m) to N (m) cables, LMR-400-DB, 20', Cisco PID CAB-L400-20-N-N, Cisco PN 37-1392-01 • 2 RA-N (m)-N (m) cables, LMR-600-DB, 30', Cisco PID CAB-L600-30-N-N, Cisco PN 37-1396-01	1 900 MHz ISM band, omni stick, 24", 5 dBi, N (f), Cisco PID ANT-WPAN-OM-OUT-N, Cisco PN 07-1163-02

Dual Antenna Advanced Range Extender—Dual Antenna Configuration

Note The dual antenna configuration applies to the dual antenna advanced range extender models with and without battery support:
- IR529-UBWP-915D/K9 (with battery support)
- IR529-UWP-915D/K9 (without battery support)

Additional Information for WPAN Gateway Antenna Installations

For all outdoor antenna/WPAN gateway installations, the coax shield should be grounded (earthed) in accordance with ANSI/NFPA 70, the National Electrical Code (NEC), in particular Section 820.93, Grounding of Outer Conductive Shield of a Coaxial Cable.

In addition, please refer to Section 820.93 of the National Electrical Code, ANSI/NFPA 70: 2005; and EN60728-11: 2005, which provide guidelines for proper grounding and, in particular, specify that the coaxial cable shield shall be connected to the grounding system of the building, as close to the point of cable entry as practical.

For indoor antenna/WPAN gateway installations, no additional considerations are required.

Installing or Replacing Antennas

Depending on the configuration you specified, the WPAN gateway and WPAN range extender could be shipped with all required antennas already installed and connected. You may need to install an antenna when you purchase an antenna separately to replace a faulty or damaged antenna.

For procedures and safety information required to install or replace antennas, see the Connected Grid Antenna Installation Guide, at: www.cisco.com/go/cg-modules.

Installing or Replacing Antennas

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<div style="text-align: right;">**C H A P T E R 5**</div>

Operation and Configuration

This chapter describes the operation of the WPAN gateway and WPAN range extender and how to configure the devices:

Information about WPAN Gateway and WPAN Range Extender Operation

WPAN Gateway and WPAN Range Extender and the Cisco Field Area Network

The WPAN gateway and WPAN range extender operate in the Cisco Connected Grid (CG) Field Area Network (FAN).

The FAN solution provides an urban-scale IPv6-based networking solution for connecting and managing a multitude of devices in a smartgrid architecture. The Cisco CG FAN consists of three components:

- Connected Grid Endpoint (CGE) devices
- Connected Grid Router (CGR) devices
- Connected Grid Network Management System (CG-NMS)

CGEs are the CG FAN end points. The CGEs may be electric meters, or Distribution Automation (DA) devices. The CG FAN utilizes low-cost mesh networking technology to connect CGEs. The link technologies may utilize Radio Frequency (e.g. IEEE 802.15.4g) and, or Power Line Communication (e.g. IEEE P1901.2) media.

CGRs provide wide-area connectivity for CGEs. In addition to providing wide-area connectivity, because CGRs typically have more resources than CGEs, CGRs support critical functions for secure network access control, routing, and management of CGEs. In a typical deployment, a single CGR may provide wide-area connectivity for hundreds or thousands of CGEs.

CG-NMS provides the necessary back-end infrastructure for supporting the CGEs and CGRs in the Cisco CG FAN. CG-NMS is responsible for managing secure network access, configurations, and firmware updates for all CGR and CGEs in a CG FAN deployment. Each device registers with the CG-NMS and periodically reports information that assists a network operator in assessing the health of the network and diagnosing any issues that may occur.

The Cisco Industrial Routers (IR) 500 Series WPAN Gateway and WPAN Range Extender provide unlicensed 902-to-928 MHz ISM-band wireless personal area network (WPAN) communications to diverse Internet of things (IoT) applications. Among the IoT applications supported are smart grid, distribution automation (DA), and supervisory control and data acquisition (SCADA).

The devices supply radio frequency (RF) mesh connectivity to one IPv4/Ethernet and serial IoT device, including recloser control, cap bank control, voltage regulator controls, and other remote terminal units (RTUs).

The devices provide an open standards RF mesh solution based on the following standards:

- IEEE 802.15.4 g/e
- IETF 6LoWPAN
- IETF Routing Protocol for Low Power and Lossy Networks (RPL)
- IETF Mapping of Address and Port—Translation (MAP-T)
- IETF Constrained Application Protocol (CoAP)

Role of the WPAN Gateway and WPAN Range Extender in the Cisco FAN

Role of the WPAN Gateway

The WPAN Gateway provides IPv4/IPv6 connectivity to DA Devices. The gateway connects to DA Devices using serial ports (RS232/RS485) and, or an Ethernet port using IPv4. The gateway provides remote connectivity to:

- serial DA devices over CG-Mesh by transporting serial data in TCP/IP
- IPv4 DA devices over the IPv6-based CG-Mesh by using Mapping of Address and Port using Translation (MAP-T), as specified in *draft-ietf-software-map-t*

WPAN Gateway and Serial-based DA Devices

The CGR800-WPAN connects serial-based DA devices and exports them over the IPv6-based Field Area Network by the following means:

- RS232/RS485 Port—the gateway RS232/RS485 serial port is used to connect RS232/RS485-based DA devices and transport serial data traffic over TCP. The gateway configuration and management of the serial port is done via CSMP and the CG-NMS.

- RS232 Port—the gateway RS232 serial port is used to connect RS232-based DA devices and transport serial data traffic over TCP. The gateway configuration and management of the serial port is done via CSMP and the CG-NMS.
- Raw TCP Serial Transport—the CGR800-WPAN makes the bi-directional serial data stream for the serial ports available over IPv6 via the IEEE 802.15.4g interface.

WPAN Range Extender and Ethernet-based DA Devices

The WPAN gateway connects IPv4-based DA devices to the IPv6-based FAN by the following means:

- Ethernet Port—the gateway Ethernet port is used to provide IPv4 connectivity to DA devices. The gateway exports configuration and management of the Ethernet port via CSMP and the CG-NMS.
- DHCP—the CGR800-WPAN implements a DHCP Server to support dynamic configuration of IPv4-based DA devices. The CGR800-WPAN exports DHCP configuration and management via CSMP.
- Mapping of Address and Port using Translation (MAP-T)—The gateway provides shared or uniquely addressed IPv4 host connectivity to and across an IPv6 domain using MAP-T. The gateway implements the MAP Customer Edge (CE) functionality, as described in *draft-ietf-software-map-t*. Each MAP domain must also include a device that implements the MAP Border Router (BR) functionality (e.g. ASR-1000). The gateway configuration and management of MAP-T is done via CSMP and the CG-NMS.
- NAT44—The gateway uses NAT44 to translate private IPv4 addresses used by DA devices connected to the Ethernet port to public IPv4 addresses used with MAP-T.

Role of the WPAN Range Extender

The WPAN range extender is an IEEE 802.15.4g-2012 IPv6 router device that allows additional flexibility in locating IEEE 802.15.4g devices, resulting in extra connectivity among CG-Mesh devices. For example, while CG-Mesh electric meters must be placed where electric metering occurs, the range extender may be placed anywhere AC power is available. The range extenders support the full CG-Mesh network platform, including IEEE 802.15.4g, IEEE 802.1X, IPv6, and RPL.

WPAN Gateway and WPAN Range Extender Data Flow

Data Flow Prerequisites

The mandatory components for a Cisco IR 500 Series WPAN gateway and WPAN range extender deployment are:

- Cisco ASR 1000 router configured as a MAP-T border router
- Cisco CGR 1000 router configured as a WPAN router (a WPAN module is installed)
- Cisco IR 500 series WPAN gateway and WPAN range extender configured and installed


Data Flow Paradigms

There are two potential data flow paradigms with the WPAN gateway and WPAN range extender devices:

- Serial DA device remote connectivity over CG-Mesh by transporting serial data in TCP/IP—this is achieved by routing traffic between a WPAN gateway serial port attached DA device and an application server through a Raw Socket connection

- IPv4 DA device remote connectivity over the IPv6-based CG-Mesh by using Mapping of Address and Port using Translation (MAP-T)—this is achieved by routing traffic between a WPAN gateway Ethernet port connected IPv4 DA device and an application server

Both traffic flows involves MAP-T enabling non-IPv6 traffic to be transparently forwarded over 6LoWPAN, or the mesh network that is IPv6 only.

Figure 5-1 shows the deployment of the WPAN gateway and WPAN range extender devices and the role of Raw Socket and MAP-T.

Figure 5-1   WPAN Gateway and WPAN Range Extender Deployment
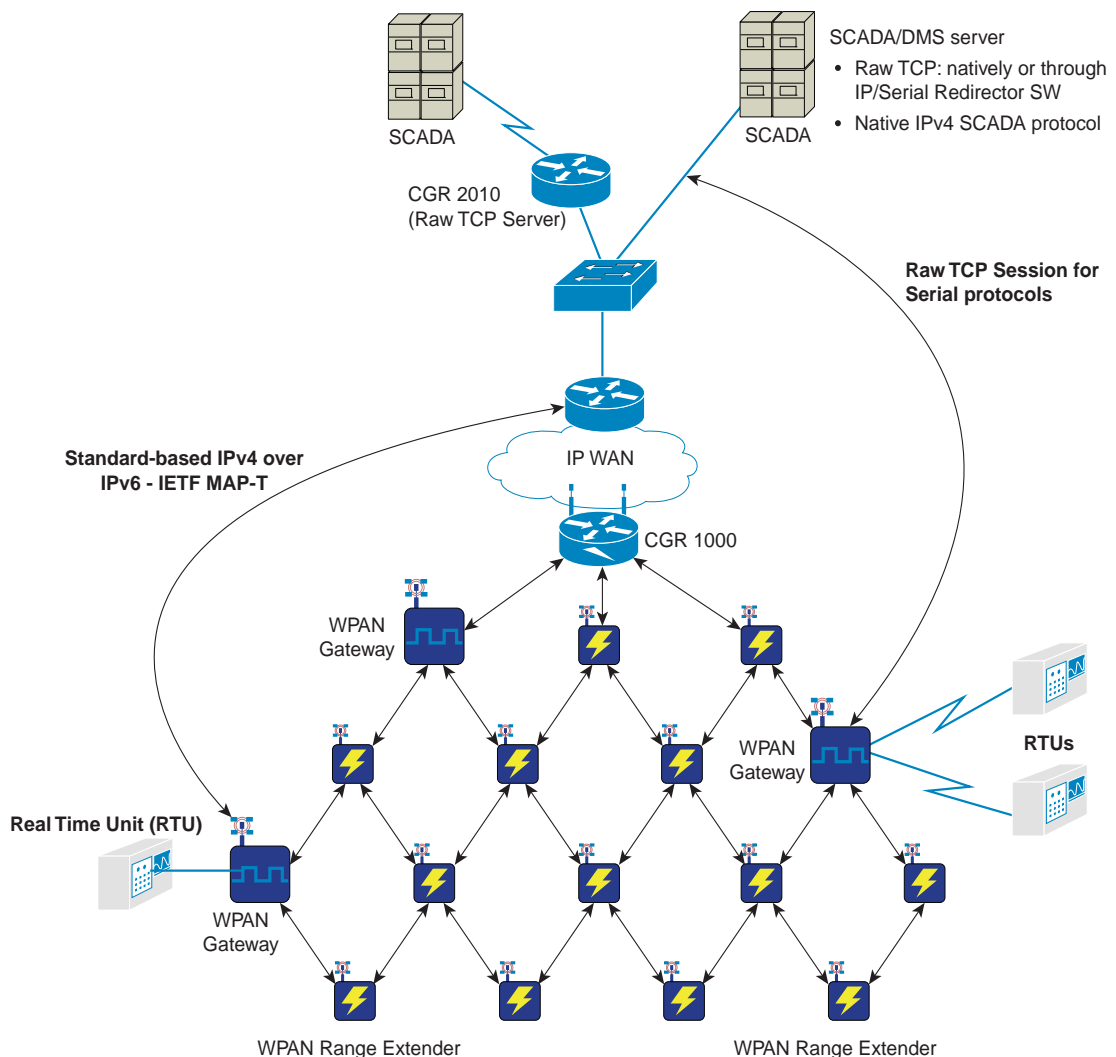
For more information about Raw Socket and MAP-T, see the "Information about Raw Socket Transport and MAP-T" section on page 5-5.

Information about Raw Socket Transport and MAP-T

Raw Socket

Raw Socket is a method for transporting serial data through an IP network. It transports streams of characters from one serial interface to another over an IP network for utility applications.The feature can be used to transport Supervisory Control and Data Acquisition (SCADA) data from Remote Terminal Units (RTUs). For the WPAN gateway and WPAN range extender deployment, Raw Socket Transport uses TCP as the transport protocol.

Raw Socket Transport supports the following for each asynchronous serial interface:

- TCP as the transport protocol, with built-in auto TCP connection retry mechanism.
- Interface configuration as either a server or a client. The WPAN gateway can only be set up as a server or as a client but not both simultaneously.
- One server per interface, but multiple clients.

Note   For the one server per interface with multiple clients arrangement, the number of clients may be limited to one or two. Contact Cisco for more information.

For more information about the Raw Socket deployment read the following sections:

TCP Transport

The TCP transport CG FAN scenario is that one router acts as a Raw Socket server, listening for TCP connection requests from the other CG FAN routers, which are configured as Raw Socket clients. in Figure 5-1, for example, the CGR 2010 acts as the Raw socket server, and it listens for TCP connection requests from the WPAN gateways, which are configured as Raw Socket clients.

A Raw Socket client receives streams of serial data from the RTUs and accumulates this data in its buffer, then places the data into packets, based on user-specified packetization criteria. The Raw Socket client initiates a TCP connection with the Raw Socket server and sends the packetized data across the IP network to the Raw Socket server, which retrieves the serial data from the packets and sends it to the serial interface, and on to the utility management system.

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Raw Socket Configurations

Raw Socket transport uses a client-server model on the WPAN gateway. The WPAN gateway can be either a server or a client but not both. At most one server and multiple clients can be configured on a single asynchronous serial line.

Figure 5-2, Figure 5-3, and Figure 5-4 show three different Raw Socket configurations and scenarios involving the WPAN gateway. In these examples, serial data is transferred between RTUs and a utility management system across an IP network that includes several CGR 1000 and CGR 2010 routers.

Figure 5-2   Raw Socket and Client/Server Setup on Routers
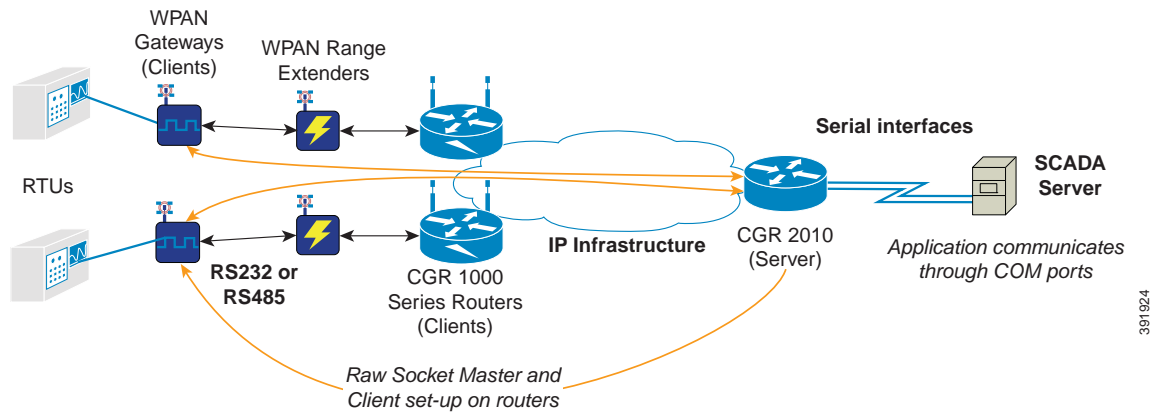
In Figure 5-2, a Raw Socket CGR1000 router client receives streams of serial data from the WPAN gateway attached RTUs and accumulates the data before placing it into packets. The CGR 2010 router acts as a Raw Socket server, listening for TCP connection requests from the WPAN gateway, which are configured as Raw Socket clients.The WPAN gateway Raw Socket client initiates a TCP connection with the CGR2010 Raw Socket server, and sends the packetized data across the IP network to the CGR2010 Raw Socket server, which retrieves the serial data from the packets and sends it to the serial interface, and on to the SCADA server.

Figure 5-3   Raw Socket Client/Server Setup between Routers and SCADA Server with IP/Serial Redirector Software
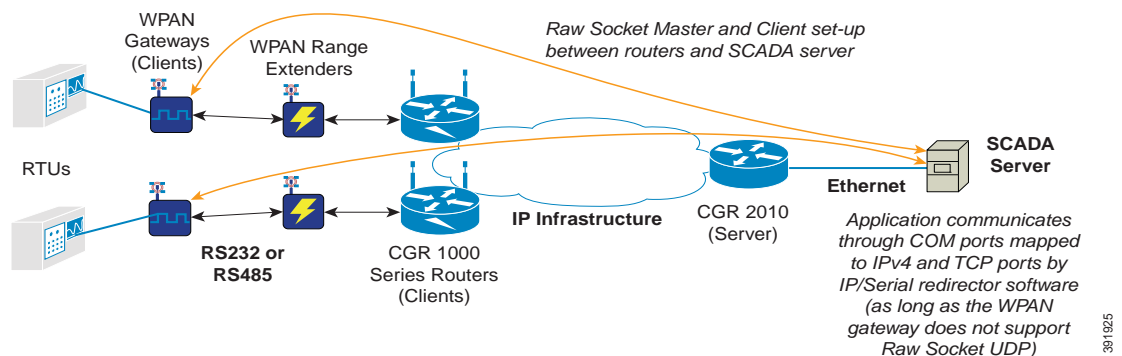
In Figure 5-3, a Raw Socket CGR1000 router client receives streams of serial data from the WPAN gateway attached RTUs and accumulates the data before placing it into packets. The CGR1000 Raw Socket clients initiates a TCP connection with the SCADA server, and sends the packetized data across the IP network to the SCADA server. The SCADA server communicates through COM ports mapped to IP and TCP/UDP ports, by IP/Serial Redirector software.

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Figure 5-4   **Raw Socket Client/Server Setup between Routers and SCADA Server with Direct RAW Socket Communication**
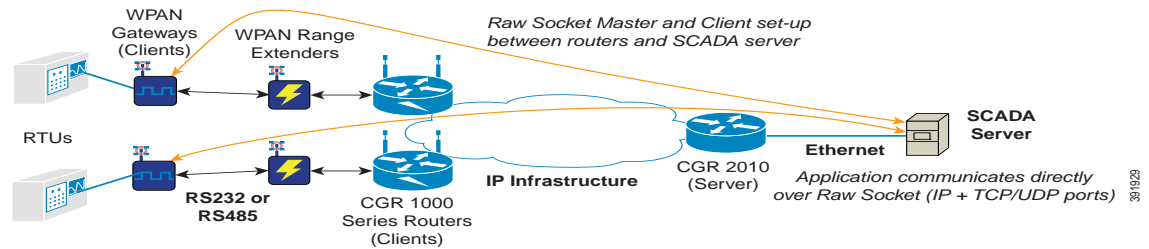

In Figure 5-4, a Raw Socket CGR1000 router client receives streams of serial data from the WPAN gateway attached RTUs and accumulates the data before placing it into packets. The CGR1000 Raw Socket clients initiates a TCP connection with the SCADA server, and sends the packetized data across the IP network to the SCADA server. The SCADA server communicates directly over Raw Socket IP and TCP/UDP ports.

Raw Socket and Serial Protocol Operation

Figure 5-5 shows a Raw Socket DA deployment scenario involving a SCADA server, WPAN range extenders, and WPAN gateways with RTUs attached to the serial ports.

Figure 5-5   **Raw Socket and Serial Protocol**
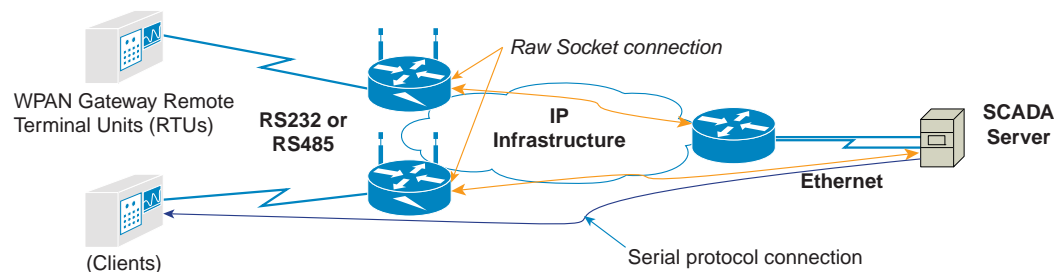
When running a serial protocol over a Raw Socket, there are two different layers that establish their own connectivity:

- Raw Socket layer—Assuming the SCADA server handles the Raw Socket session (the other alternative is the Raw Socket is handled by a router), the Raw Socket session is established between the SCADA server and the WPAN gateway. One side is the listener (Raw Socket TCP server), the other is the client (Raw Socket TCP client).

- Serial protocol layer—The serial protocol session, i.e. DNP3, IEC 60870-5-101, Modbus, etc., runs on the serial protocol layer, and this also has server/master and client sides. This serial protocol session runs from the SCADA server to the attached device (RTU).

MAP-T

6LoWPAN is an IPv6-only adaptation layer for the physical (PHY) and media access control (MAC) layer technologies implementing it. No IPv4 adaptation layer is defined for these PHY and MAC layers, so the Mapping of Address and Port using Translation (MAP-T) architecture is used as an IPv4-IPv6 translation mechanism. The "mapping of address and port" mechanism defines how IPv4 nodes can communicate over an IPv6-only infrastructure.

MAP-T was developed as a transition mechanism due to IPv4 address exhaustion, MAP-T is based on a double stateless NAT64 translation. It specifies a stateless algorithmic address and transport layer port mapping scheme, and allows embedding of IPv4 address and port numbers in an IPv6 address when forwarding the IPv4 traffic across an IPv6-only network.

The use of MAP-T in the WPAN gateway enables the use of a same address, if required by a customer, on the attached field devices since IPv4 traffic coming through the Ethernet port will go through NAT44. By using MAP-T, the WPAN gateway is using an open standard to integrate non-IP and IPv4 communications over 6LOWPAN/RPL networks.

In a Field Area Network (FAN) scenario, where hundreds of WPAN gateways are deployed across multiple Field Area Routers (FARs), such as CGR 1000, a MAP-T domain begins at the WPAN gateway level and ends with the head-end aggregation routers, such as ASR1000 as shown in Figure 5-6.

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Figure 5-6   MAP-T in a FAN and WPAN Gateway Scenario
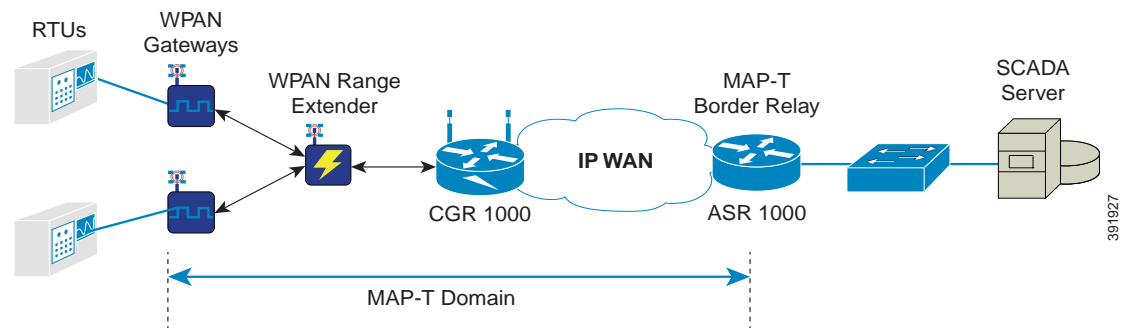
There are defined IPv6 and IPv4 MAP-T prefixes inside the MAP-T domain enabling the NAT64 translation process to identify addresses to be translated, as well as get proper reachability and routing through the MAP-T domain.

NAT44 is a component of the MAP solution, but the NAT44 in MAP differs from traditional NAT44 deployments in that instead of assigning a public IPv4 address range to each field device for translation (in the case of NAT), or a single public IPv4 address for translation (in the case of Port Address Translation (PAT)) to each field device, it extends the granularity beyond a single public IPv4 address, by being able to assign a port range to each of the field devices sharing the same IPv4 public address. This unique address and port range combination is then translated into the IPv6 address space when transitioning into the IPv6 domain using the MAP field device. The MAP algorithm still retains the ability to assign the full IPv4 address or an IPv4 prefix to the MAP field device, but the WPAN gateway only leverages the full IPv4 address to be allocated on a per WPAN gateway basis.

MAP-T Mapping Rules and Map Domain Parameters

Inside the MAP-T domain are defined IPv6 and IPv4 MAP-T prefixes enabling the NAT64 translation process to identify addresses to be translated as well as get proper reachability and routing through the MAP-T domain. Those are known as:

- MAP-T Default Mapping Rule (DMR): an IPv6 prefix used to address all destinations outside the MAP-T domain.

   - DMR IPv6 prefix and prefix length embeds any IPv4 addresses outside the MAP-T domain. For example, within a MAP-T domain using a DMR IPv6 prefix = 2610:D0:1200:CAFE::/64, all IPv4 translated packet sources and destinations outside the MAP-T domain have an IPv6 address based on this prefix, i.e. sending packets to IPv4 100.1.1.2 translated to IPv6 2610:d0:1200:cafe:64:101:200:0. The SCADA server IPv4 address is an example of a destination outside of the MAP-T domain.

- MAP-T Basic Mapping Rule (BMR): the IPv6 and IPv4 prefixes used to address MAP-T nodes inside the MAP-T domain

   - BMR IPv4 prefix and prefix length are the IPv4 subnet selected to address all IPv4 nodes in a MAP-T domain. For example, a MAP-T domain set-up with 153.10.10.0/24 as IPv4 subnet has all IPv4 nodes configured with IPv4 address from this subnet, BMR IPv4 prefix = 153.10.10.0 and prefix length = 24

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– BMR IPv6 prefix and prefix length are used to embed the IPv4 address of nodes inside the MAP-T domain. For example, a MAP-T domain is configured with a MAP-T IPv6 BMR = 2031:6f8:147e:10::/56. Packets sent or received from IPv4 nodes inside the MAP-T domain have a translated IPv6 address based on this prefix, i.e. 2031:6f8:147e:10fe:99:a0a:fe00:0 for a MAP-T IPv4 node set-up with IPv4 153.10.10.254.

– BMR Share ratio: MAP-T being designed for various deployment scenarios, it could be feasible to allocate to a MAP-T node either an IPv4 prefix (smaller than the MAP-T BMR IPv4 prefix), or a single IPv4 address (/32) or share a single IPv4 address (/32) between several nodes. In the later case, it requires indicating how many bits for port numbers are assigned, which is called "BMR share ratio". In case of IR 500 deployment, it is recommended to use a single IPv4 address (/32) per IR 500 with a share ratio = 1 to keep the addressing simple.

– BMR Embedded Address (EA) bits indicate – in the case of share ration = 1 – the length of the IPv4 suffix embedded in the MAP-T IPv6 End-user IPv6 prefix. For example, in case of an IPv4 /24 prefix allocated to a MAP-T domain, the BMR EA value derived from it is 8.

MAP-T Addressing Rules Example

Figure 5-7 is an example of a MAP-T domain, and the domain parameters are provided in Table 5-1. The Table 5-2 details the translated addresses.

Figure 5-7   MAP-T Domain
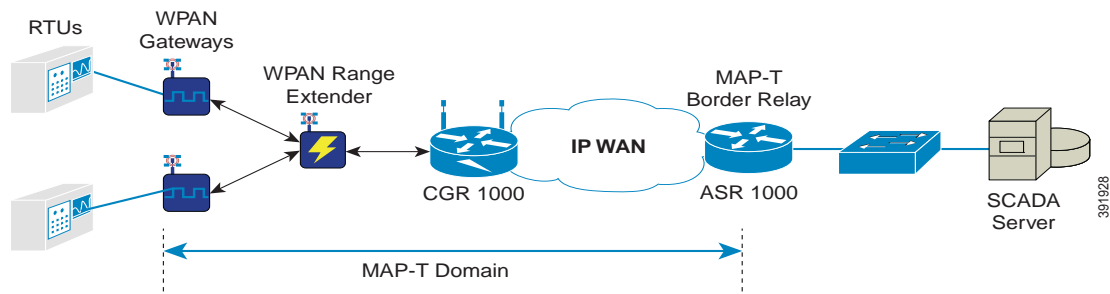
The Default Mapping Rule is 2610:D0:1200:CAFE::/64.

Table 5-1   MAP-T Domain Parameters

MAP-T Domain Parameter	Setting
Rule IPv6 Prefix	2031:6F8:147E:1000::
Rule IPv6 Prefix length	/56
Rule IPv4 Prefix	153.10.10.0
Rule IPv4 Prefix Length	/24
Share Ratio	1
EA bits length	8

Note   If EA bits + Rule IPv4 prefix lengths are equal to 32, then a full IPv4 address is to be assigned. The address is created by concatenating the Rule IPv4 prefix and the EA-bits.

> **Note**   End-user IPv6 prefix = Rule IPv6 Prefix + IPv4 Suffix (EA bits field)

Table 5-2   Translated Addresses

Case No.	MAP IPv4 address	End-user IPv6 prefix	MAP IPv6 address
1	153.10.10.1	2031:6f8:147e: 1001::	2031:6f8:147e:1001:99:a0a:100:0
2	153.10.10.2	2031:6f8:147e:1002::	2031:6f8:147e:1002:99:a0a:200:0
3	153.10.10.32	2031:6f8:147e: 1020::	2031:6f8:147e:1020:99:a0a:2000:0
4	153.10.10.254	2031:6F8:147E:10fe::	2031:6f8:147e: 10fe:99:a0a:fe00:0

Information about WPAN Gateway and WPAN Range Extender Configuration

- Role of CG-NMS, page 5-11
- CG-NMS Device Classification, page 5-11
- CSMP Client, page 5-12
- Role of CG-DM, page 5-12

Role of CG-NMS

The IR500 series WPAN gateway and WPAN range extender are managed and configured by the Connected Grid Network Management System (CG-NMS) application.

CG-NMS Device Classification

CG-NMS uses groups to manage devices. Each device must be classified into a group.

For CG-NMS based management and configuration, the WPAN gateway and WPAN range extender are classified according to the device category, device type, and group information in Table 5-3.

Table 5-3   Classification Information for IR 500 Series Devices

Classification Entity	Classification Information
DeviceCategory	Endpoint
deviceType	ir500
default config group	default-ir500
default firmware group	default-ir500
tunnel provisioning group	Not applicable

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CSMP Client

CSMP Client is a GUI field tool used to manage and monitor the WPAN gateway and WPAN range extender hardware and networking information.

The "GET" function in the field tool is used to obtain status and performance information about the devices in real time. The "POST" function is used to set device parameters in real time.CSMP Client can be used as a diagnostic tool to check a single device or the whole mesh network.

The field tool has two connection modes to connect a WPAN gateway or WPAN range extender:

- Point-to-Point Protocol (PPP) over Serial console port
- IPv6 through WPAN network

Role of CG-DM

CG-DM is a GUI field tool used to troubleshoot, configure and to update firmware images on WPAN Gateway devices.

Configuring the WPAN Gateway and WPAN Range Extender

Accessing the Configuration through the Console Port

You can access the WPAN gateway or WPAN range extender configuration by connecting to the console port on either device.

Warning   **Do not connect or disconnect cables to the ports while power is applied to the switch or any device on the network because an electrical arc can occur. This could cause an explosion in hazardous location installations. Be sure that power is removed from the switch and cannot be accidentally be turned on, or verify that the area is nonhazardous before proceeding.** Statement 1070

Warning   **If you connect or disconnect the console cable with power applied to the switch or any device on the network, an electrical arc can occur. This could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding.** Statement 1080

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Connecting to the WPAN Gateway Console Port

To connect to the WPAN gateway console port:

Step 1   Connect the RJ-45-to-DB-9 adapter cable to the 9-pin serial port on the PC. Connect the other end of the cable to the WPAN gateway console port.

Figure 5-8   Connecting the Console Cable
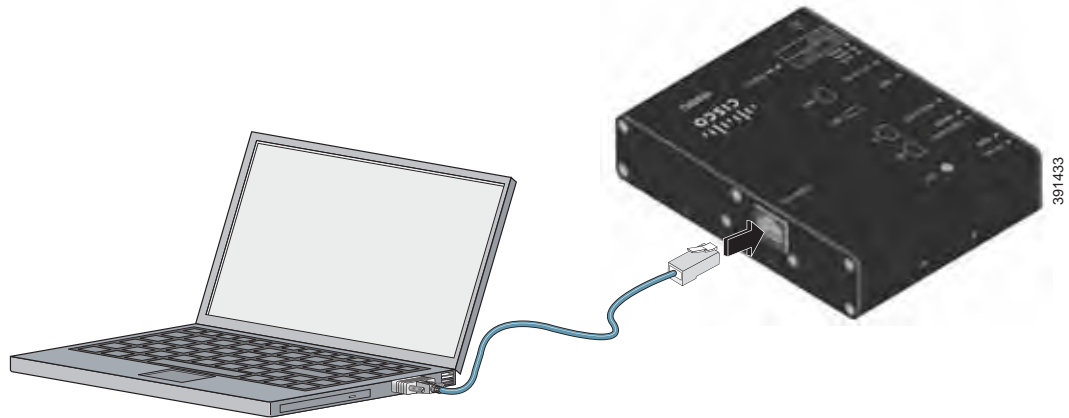
Connecting to the WPAN Range Extender Console Port

To connect to the WPAN gateway range extender:

Step 1   Use a 0.5 in. (13 mm) socket wrench to remove the console port cover. See Figure 5-9.

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Figure 5-9   *Removing the Console Port Cover*

1	Console port cover	1	0.5 in. (13 mm) Socket wrench

Step 2   Connect the RJ-45-to-DB-9 adapter cable to the 9-pin serial port on the PC. Connect the other end of the cable to the WPAN range extender console port. See Figure 5-10.

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Figure 5-10   Connecting the Console Cable
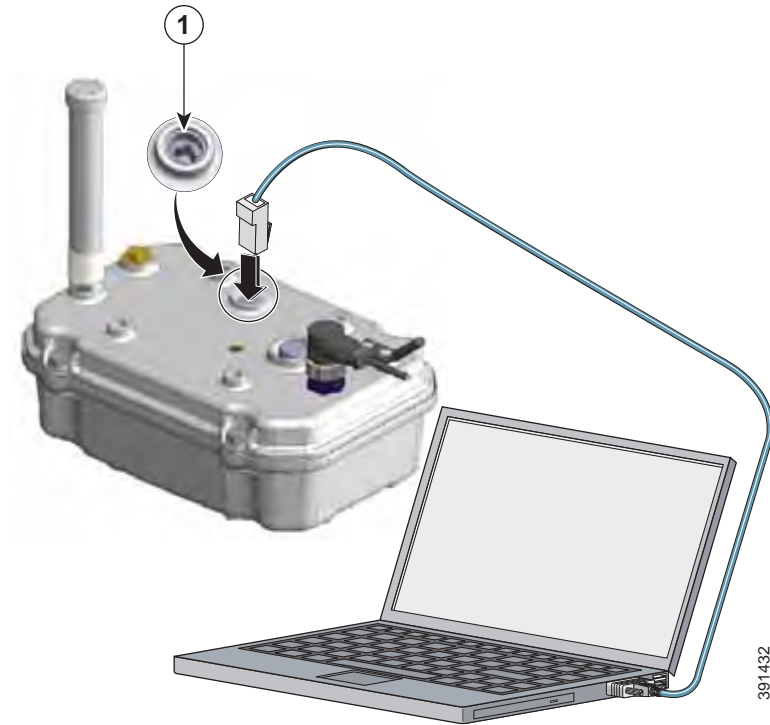
1	Console port

Step 3   When you are finished configuring the WPAN range extender, disconnect the cable from the console port, and place the console port cover back on the console port to cover it. Use a 0.5 in. (13 mm) socket wrench to torque the console port cover to 6-7 ft-lbs (8.13-9.49 N-m). See Figure 5-11.

Figure 5-11   Covering the Console Port
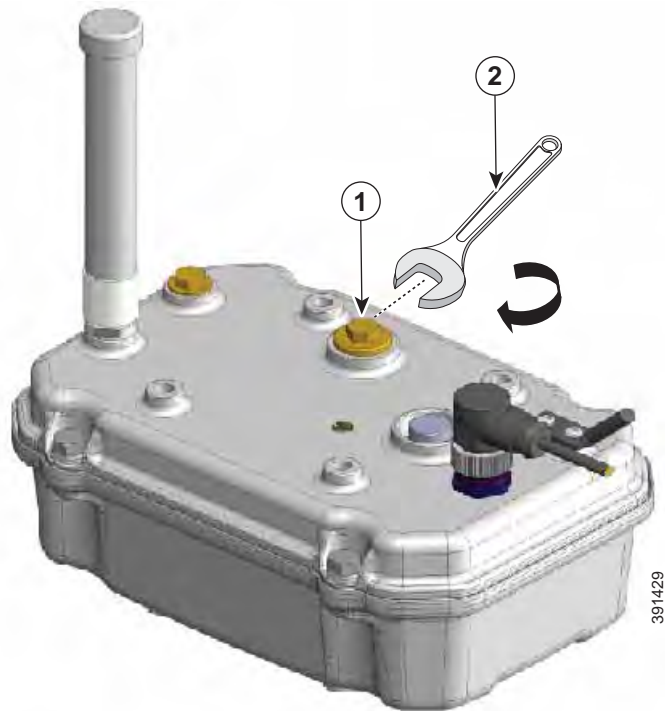
1	Console port cover	2	0.5 in. (13 mm) Socket wrench

Uploading a Device to CG-NMS

WPAN gateway and WPAN range extender devices can be uploaded to CG-NMS using a Device Properties CSV file. For more information see the "Common Device Operations" section of the *Cisco Connected Grid Network Management System User Guide.*

A sample file content for a WPAN gateway device is:

```
eid, deviceType, endUserIPv6Prefix, endUserIPv6PrefixLen, lat, lng
00173b12003d003b, ir500, 2001:dead:beaf:2::,64,12,12
```

A sample file for a WPAN range extender is:

```
eid, deviceType, lat, lng
00173b12003d003b,ir500,12,12
```

Note   The WPAN range extender does not require an endUserIPv6Prefix.

Note   eid: Is the EUI64 version of the MAC of WPAN interface of the device

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endUserIPv6Prefix and endUserIPv6PrefixLen are described in the configuration section below.

Every uploaded WPAN gateway and WPAN range extender device is put in the "default-ir500" config and firmware groups if a group name is not specified in the csv.

Registering with CG-NMS

WPAN gateway and WPAN range extender devices use CSMP for communicating with CG-NMS. The registration process involves handshaking between the devices and the CG-NMS.

During registration, CG-NMS pushes a configuration file from a user defined CG-NMS configuration file to each device.

You use a configuration template to define the configuration file for each group dedicated to the WPAN gateway and WPAN range extender devices. The configuration file and its contents are pushed to the devices when they register with CG-NMS.

Configuring an IR 500 Series Device with CG-NMS

During registration, CG-NMS pushes the user defined configuration from the "template" to each device. You can also initiate an on demand configuration push to all devices in the group using a "Push Configuration" option in CG-NMS.

For more information see the "Editing the ENDPOINT Configuration Template" and the "Pushing Configurations to Endpoints" sections of the *Cisco Connected Grid Network Management System User Guide*.

The configuration tasks include:

- Configuring Serial Interface Settings, page 5-17
- Configuring MAP-T Settings, page 5-18
- Configuring Raw Socket Settings, page 5-18
- Configuring Mesh Link Settings, page 5-19
- Configuring NAT44, page 5-19

Configuring Serial Interface Settings

The WPAN gateway serial interface settings include:

- Media Type (RS232 or RS485)
- Parity
- Baud Rate
- Stop Bit
- Data bits
- Flow control

For more information see the "Editing the ENDPOINT Configuration Template" section of the *Cisco Connected Grid Network Management System User Guide*.

Configuring MAP-T Settings

The MAP-T settings for the WPAN gateway are:

- DefaultMapping IPv6 Prefix
- IPv4 Prefix
- IPv6 Prefix Length
- IPv4 Prefix Length
- EA Bits Length

For more information see the "Editing the ENDPOINT Configuration Template" section of the *Cisco Connected Grid Network Management System User Guide.*

MAP-T Settings for a WPAN Gateway in FAN

Note On the Cisco IOS ASR1000 and CGR1000, MAP-T rules are set-up by indicating the following MAP-T domain rules:
- IPv6 BMR
- IPv4 BMR
- IPv6 DMR

On the WPAN gateway, the MAP-T IPv6 is an End-user IPv6 prefix that integrates the MAP-T BMR IPv6 rules + IPv4 suffix value, the length being based on the BMR EA length value.

For example, a CG-NMS CSV file for a WPAN gateway contains:

```
eid,devicetype,lat,lng,meshPanid,status,endUserIPv6Prefix,endUserIPv6PrefixLen
00173B1500340036,ir500,37.4187911,-121.9196689,10,unheard,2019:1111:2222:1000::,48
```

The file content can be read as:

- IPv6 BMR = 2019:1111:2222::
- IPv6 BMR prefix length = 48
- IPv6 End-User prefix = IPv6 BMR = 2019:1111:2222:1000:: giving the WPAN gateway an IPv4 address = MAP-T IPv4 prefix = CG-NMS set-up + IPv4 suffix = 10 (or .16 decimal)

Configuring Raw Socket Settings

The Raw Socket settings for the WPAN gateway are:

- Initiator—Designates the device as the client or server (initiator = 0—denotes server; initiator = 1, 2, 3 etc—denotes client)
- TCP idle timeout (min)—Sets the time to maintain an idle connection
- Local port—Sets the port number of the device
- Peer port—Sets the port number of the client/server connected to the device
- Peer IP address—Sets the IP address to the host connected to the device
- Connect timeout—Sets the TCP client connect timeout for Initiator DA Gateway devices

For more information, see the "Editing the ENDPOINT Configuration Template" and the "Raw Sockets Metrics and Sessions" sections of the *Cisco Connected Grid Network Management System User Guide.*

Configuring Mesh Link Settings

For configuring mesh link settings such as 'Mesh SSID' and 'Transmit Power' see the "Managing Devices" chapter of the *Cisco Connected Grid Network Management System User Guide.*

Configuring NAT44

> **Note**   This section only applies to the WPAN gateway.

NAT44 settings for the WPAN gateway can be configured. In order to configure NAT44 properties you can edit the device template or use the import a CSV file method.

For more information see the "Editing the ENDPOINT Configuration Template" or "Adding a File to CG-NMS" sections of the *Cisco Connected Grid Network Management System User Guide*

The following fields can be specified:

- nat44InternalAddress0
- nat44InternalPort0
- nat44ExternalPort0

where 0-3 are four valid map index.

You must make sure that the config group that the device belongs to has Ethernet enabled. You can select the Enable Ethernet checkbox and save the config template for the config group before the config push.

Because all three fields for a map index are required values, all three fields must be specified for the Nat44 configuration to be applied.

Default values of 127.0.0.1, 0, 0 respectively have to be explicitly specified from CSV for a device in case any of the other settings for a particular map index need not be configured.

If an invalid IPv4 address or other invalid values for a port is specified then NAT44 settings for that particular map index will be ignored during config push.

Related CGR 1000 and ASR 1000 Configurations

- Configuring Raw Socket Configuration on CGR 1000 Series and CGR 2010 Routers, page 5-19
- Configuring the WPAN Settings on CGR 1000 Series Routers, page 5-20
- Configuring an IPv6 DHCP Address Pool on CGR 1000 Series Routers, page 5-20
- Configuring MAP-T on ASR 1000 Routers, page 5-20
- Configuring IPv6 Routing on the CGR 1000 Series and ASR 1000 Routers, page 5-20

Configuring Raw Socket Configuration on CGR 1000 Series and CGR 2010 Routers

For information about configuring Raw Socket on the CGR 1000 series and ASR 1000 routers, see the following guides:

- *Raw Socket Transport Software Configuration Guide for Cisco 1000 Series Connected Grid Routers (Cisco IOS)*

- "Raw Socket Transport" chapter of *Cisco 1000 Series Connected Grid Routers SCADA Software Configuration Guide*
- *Configuring Raw Socket Protocol on the CGR 2010 Router*

Configuring the WPAN Settings on CGR 1000 Series Routers

An SSID and PAN ID must be configured on the CGR1000 series router. For information about configuring and SSID and PAN ID, see the *Cisco Connected Grid WPAN Module for CGR 1000 Series Installation and CG-Mesh Configuration Guide* on Cisco.com.

Configuring an IPv6 DHCP Address Pool on CGR 1000 Series Routers

The IPv6 addresses of the WPAN gateway and WPAN range extender are allocated from a central DHCPv6 server during the process of joining the mesh. The CGR1000 router only needs to be configured as a DHCPv6 Relay.

For information about configuring the CGR 1000 series router as a DHCP relay, see the "Configuring IPv6 DHCP Relay" section of the *Cisco Connected Grid WPAN Module for CGR 1000 Series Installation and CG-Mesh Configuration Guide.*

Configuring MAP-T on ASR 1000 Routers

MAP-T must be configured on the ASR 1000 router.

For information about configuring MAP-T on the ASR 1000 series router, see the "Mapping of Address and Port Using Translation" chapter of the *IP Addressing: NAT Configuration Guide, Cisco IOS XE Release 3S (ASR 1000).*

Configuring IPv6 Routing on the CGR 1000 Series and ASR 1000 Routers

IPv6 routing needs to be configured on the CGR 1000 series and ASR 1000 routers. For information about configuring IPv6 on the CGR 1000 series and ASR 1000 routers, see the following guides:

- "Configuring IPv6 Multicast Agent" chapter of *Cisco Connected Grid WPAN Module for CGR 1000 Series Installation and CG-Mesh Configuration Guide*
- "IPv6 Routing: OSPFv3" chapter of *IP Routing: OSPF Configuration Guide, Cisco IOS XE Release 3S (Cisco ASR 1000)*
- "IPv6 Policy-Based Routing" chapter of *IP Routing: Protocol-Independent Configuration Guide, Cisco IOS XE Release 3S (ASR 1000)*
- *IP Routing: BGP Configuration Guide, Cisco IOS XE Release 3S (Cisco ASR 1000)*
- "IPv6 Routing: Static Routing" chapter of *IP Routing: Protocol-Independent Configuration Guide, Cisco IOS XE Release 3S (ASR 1000)*

CG-NMS WPAN Device Management Related Operations

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Performing Periodic Inventory

Depending on the report periodic interval set in the configuration template, devices report regular inventory metrics to CG-NMS using CSMP. CG-NMS stores the reported properties and metrics.

For more information, see the "Configuring Rules" section of the *Cisco Connected Grid Network Management System User Guide*.

The properties and metrics of a sample WPAN device reported include:

- Inventory
    - Name
    - EID
    - Device Category
    - Manufacturer
    - Status
    - IP Address
    - Last Heard
    - Last Property Heard
    - Last Metric Heard
    - Model Number
    - Serial Number
    - Firmware Version
    - Config Group
    - Firmware Group
    - Location
    - Labels
    - Meter Certificate
- Mesh Device Health
    - Uptime
- Mesh Link Settings
    - SSID
    - PANID
    - Transmit Power
    - Security Mode
- Mesh Link Metrics
    - Mesh Link Transmit Speed
    - Mesh Link Receive Speed
    - Mesh Link Transmit Packet Drops
    - Mesh route RPL Hops
    - Mesh Route RPL Link Cost

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- – Mesh Route RPL Path Cost
- – Mesh Route RSSI
- – Mesh Route Reverse RSSI
- Network Routes Metrics
- Routing Path Metrics
- Raw Socket Metrics
- MAP-T Information

Uploading Firmware

Uploading of firmware to WPAN gateway and WPAN range extender devices can be performed by the CG-NMS. You can:

- Upload ir500 firmware images to CG-NMS via the GUI.
- Execute a firmware upload to a specific group of devices.
- Perform "Set Backup" and "Schedule Reload" operations.

For more information, see the "Configuring Devices" and "Pushing Configurations to Endpoints" sections of the *Cisco Connected Grid Network Management System User Guide*.

Creating Rules and Events

You can create rules and events for WPAN gateway and WPAN range extender devices using CG-NMS.

For more information, see the "Configuring Rules" section of the *Cisco Connected Grid Network Management System User Guide*.

APPENDIX **A**

Technical Specifications

This appendix provides the technical specification for the Cisco WPAN gateway and Cisco WPAN range extender devices. The sections include:

- Environmental and Operational Specifications, page A-1
- Power Specifications, page A-3
- Alarm Ratings, page A-3
- Mechanical Specifications, page A-4
- Hazardous Location Specifications, page A-5
- Declaration of Conformity for RF Exposure, page A-5

Environmental and Operational Specifications

- WPAN Gateway Environmental and Operational Specifications, page A-1
- WPAN Range Extender Environmental and Operational Specifications, page A-2

WPAN Gateway Environmental and Operational Specifications

Table A-1   Environmental and Operating Specifications for WPAN Gateway

Description	Specification
Operating Temperature	–40 to 158 °F (–40 to 70 °C)
Altitude	3000 M
Humidity	IP30 Rated, Non-condensing
Storage Temperature	-40C to +85C
Storage Altitude	3000 M
Vibration	Per IEEE 1613 and IEC 61850
Shock	Per IEEE 1613 and IEC 61850
Seismic	Per IEC 61850

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WPAN Range Extender Environmental and Operational Specifications

Basic Range Extender

Table A-2 describes the environmental and operating specifications for the basic range extender model (IR529-WP-915S/K9).

Table A-2   Environmental and Operating Specifications for Basic WPAN Range Extender

Description	Specification
Operating Temperature	–40 to 140 °F (–40 to 60 °C)
Altitude	3000 M
Humidity	IP67 Rated
Storage Temperature	-40C to +85C
Storage Altitude	3000 M
Vibration	Per IEEE 1613 and IEC 61850
Shock	Per IEEE 1613 and IEC 61850
Seismic	Per IEC 61850

Advanced Range Extender

Table A-3 describes the environmental and operating specifications for the following advanced range extender models:

- IR529-UBWP-915S/K9
- IR529-UBWP-915D/K9
- IR529UWP-915D/K9

Table A-3   Environmental and Operating Specifications for Advanced WPAN Range Extender

Description	Specification
Operating Temperature	–40 to 158 °F (–40 to 70 °C)
Altitude	3000 M
Humidity	IP67 Rated
Storage Temperature	-40C to +85C
Storage Altitude	3000 M
Vibration	Per IEEE 1613 and IEC 61850
Shock	Per IEEE 1613 and IEC 61850
Seismic	Per IEC 61850

Power Specifications

- WPAN Gateway Power Requirements, page A-3
- WPAN Range Extender Power Requirements, page A-3

WPAN Gateway Power Requirements

Table A-4   WPAN Gateway Power Requirements

Description	Specification
DC Input Voltage	• Maximum Operating Range: 2.3 A @ 9.5 VDC to 0.33 A @60 VDC • Nominal: 12, 24, or 48 VDC
Maximum DC Input Voltage Rating	• 0.33 A@ 60 VDC • 0.4 A @ 48 VDC • 0.75 A @ 24 VDC • 1.5 A @ 12 VDC

WPAN Range Extender Power Requirements

Table A-5   WPAN Range Extender Power Requirements

Description	Specification
AC Input Voltage	90–264 VAC
Maximum Rated Current Draw	• IR529-WP-915S/K9: 1 A • IR529-UBWP-915S/K9: 1 A • IR529-UBWP-915D/K9: 1 A • IR529UWP-915D/K9: 1 A
Maximum Power Consumption	• IR529-WP-915S/K9: 12 W • IR529-UBWP-915S/K9: 18 W • IR529-UBWP-915D/K9: 18 W • IR529UWP-915D/K9: 12 W

Alarm Ratings

Table A-6 lists the alarm ratings for the Cisco WPAN gateway.

Mechanical Specifications

- WPAN Gateway Mechanical Specifications, page A-4
- WPAN Range Extender Mechanical Specifications, page A-4

WPAN Gateway Mechanical Specifications

Table A-7   WPAN Gateway Mechanical Specifications

Characteristic	Specification
Enclosure Type	IP30 enclosure
Dimensions (Height x Width x Depth)	1.125 x 4.0 x 5.0 in. (2.86 x 10.16 x 12.7 cm)
Weight	IR509U-WP-915/K9: 0.82 lbs (0.37 kg)

WPAN Range Extender Mechanical Specifications

Table A-8   WPAN Range Extender Mechanical Specifications

Characteristic	Specification
Enclosure Type	IP67 sealed enclosure
Dimensions (Height x Width x Depth)	The model dimensions are: • IR529-WP-915S/K9 model: 3.57 x 5.70 x 7.59 in. (9.08 x 14.49 x 19.29 cm) • IR529-UBWP-915S/K9 model: 4.85 x 7.23 x 10.37 in. (12.32 x 18.37 x 26.34 cm) • IR529-UBWP-915D/K9 model: 4.85 x 7.23 x 10.37 in. (12.32 x 18.37 x 26.34 cm) • IR529UWP-915D/K9 model: 4.85 x 7.23 x 10.37 in. (12.32 x 18.37 x 26.34 cm)
Weight	• IR529-WP-915S/K9: 3.08 lbs (1.40 kg) • IR529-UBWP-915S/K9: 8.40 lbs (3.81 kg) • IR529-UBWP-915D/K9: 8.48 lbs (3.85 kg) • IR529UWP-915D/K9: 7.03 lbs (3.19 kg)

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Hazardous Location Specifications

The hazardous location standards for the WPAN gateway are listed in Table A-9.

Note   There are no hazardous location standards for the WPAN range extender.

Table A-9   Hazardous Locations Standards for the WPAN Gateway

Hazardous Locations	Standards
IECEx Test Report:	IEC 60079-0 6th Edition
	IEC 60079-15 4th Edition
ATEX	EN 60079-0:2012
	EN 60079-15:2010+A11:2013
North American divisions:	ANSI/ISA 12.12.01-2013
	CSA C22.2 No. 213-M1987
North American zones:	UL 60079-0, 5th Ed, 2009-10-21
	UL 60079-15, 3rd Ed, 2009-7-17
	CAN/CSA C22.2 No. 60079-15-12 Ed. 1
	CAN/CSA C22.2 No. 60079-0-11 Ed. 2

Declaration of Conformity for RF Exposure

United States

This system has been evaluated for RF exposure for Humans in reference to ANSI C 95.1 (American National Standards Institute) limits. The evaluation was based on ANSI C 95.1 and FCC OET Bulletin 65C rev 01.01. The minimum separation distance from the antenna to general bystander is 9 inches (23 cm) to maintain compliance.

Canada

This system has been evaluated for RF exposure for Humans in reference to ANSI C 95.1 (American National Standards Institute) limits. The evaluation was based on RSS-102 Rev 2. The minimum separation distance from the antenna to general bystander is 9 inches (23cm) to maintain compliance.

Declaration of Conformity for RF Exposure

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APPENDIX **B**

Cable and Connectors

- • Connector Specifications, page B-1
- • Cables and Adapters, page B-5

Connector Specifications

- • WPAN Gateway Power and Alarm Connector, page B-1
- • WPAN Gateway Console Port, page B-2
- • WPAN Gateway RS232/RS485 DCE Serial Port, page B-2
- • WPAN Gateway RS232 DTE Serial Port, page B-3
- • WPAN Gateway USB Port, page B-3
- • WPAN Gateway 10/100 Fast Ethernet Port, page B-4
- • WPAN Range Extender Power Connector, page B-4
- • WPAN Range Extender Console Port, page B-5

WPAN Gateway Power and Alarm Connector

Figure B-1 shows the WPAN gateway power and alarm connector. The connector is a 4 way screw terminal header. Table B-1 describes the connector pinouts.

Figure B-1   WPAN Gateway Power and Alarm Connector
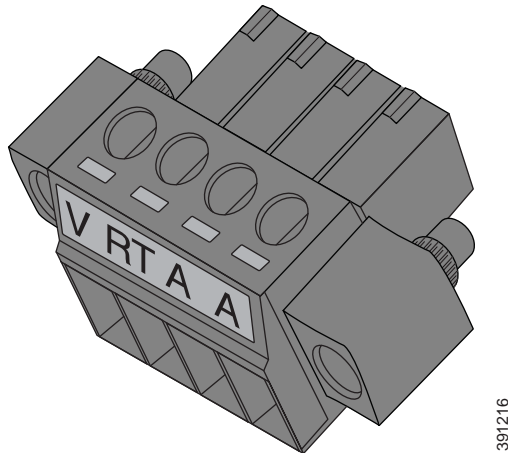
Table B-1   WPAN Gateway Power and Alarm Connector Pinouts

Pin	Label	Signal Description
1	V	Positive DC power connection
2	RT	Return DC power connection
3	A	Alarm reference or Alarm in
4	A	Alarm reference or Alarm in

WPAN Gateway Console Port

The console port on the WPAN gateway uses an RJ-45 connector. The console port is an RS232 serial port. Table B-7 describes the pinouts.

Table B-2   WPAN Gateway Console Port Pinouts

Pin	Signal
1	RTS output
2	DTR input
3	TxD output
4	GND
5	GND
6	RxD input
7	DSR output
8	CTS input

WPAN Gateway RS232/RS485 DCE Serial Port

The WPAN Gateway RS232/RS485 serial port uses an RJ45 connector. Table B-3 shows the pinouts, depending on whether the user selects RS232 or RS485.

WPAN Gateway RS232 DTE Serial Port

The WPAN gateway RS232 DTE serial port uses and RJ-45 connector. Table B-4 describes the pinouts.

Table B-4   WPAN Gateway RS232 DCE Port Pinouts

Pin	Signal
1	DSR (in)
2	DCD (in)
3	DTR (out)
4	SGND
5	RXD (in)
6	TXD (out)
7	CTS (in)
8	RTS (out)

WPAN Gateway USB Port

The WPAN gateway USB port uses a Standard A connector. Table B-5 describes the pinouts.

Table B-5   WPAN Gateway USB Port Pinouts

Pin	Name	Description
1	V	+5 VDC
2	D-	Data-
3	D+	Data+
4	GND	Ground

WPAN Gateway 10/100 Fast Ethernet Port

The 10/100 Fast Ethernet port uses an RJ-45 connector. Figure B-2 shows the pinouts. This port supports Auto-MDIX (Automatic TX/RX crossover) and Auto-Polarity (Auto +/- polarity detection and correction).

Figure B-2   WPAN Gateway 10/100 Fast Ethernet Port Pinouts

Pin	Label	1 2 3 4 5 6 7 8
1	RD-	
2	RD+	
3	TD-	
4	NC	
5	NC	
6	TD+	
7	NC	
8	NC	

WPAN Range Extender Power Connector

Figure B-3 shows the WPAN range extender 3 pin power connector. The pinouts are described in Table B-6.

Figure B-3   WPAN Range Extender Power Connector

Notch

Table B-6   WPAN Range Extender Power Connector Pinouts

Pin	Signal Name	Signal Description
1	L	AC line
2	N	AC neutral
3	Chassis	Chassis ground

WPAN Range Extender Console Port

The console port on the WPAN range extender uses and RJ-45 connector. The console port is an RS232 serial port. Table B-7 describes the pinouts.

Table B-7   WPAN Range Extender Console Port Pinouts

Pin	Signal
1	RTS
2	DTR
3	TxD
4	GND
5	GND
6	RxD
7	DSR
8	CTS

Cables and Adapters

- WPAN Gateway and WPAN Range Extender Console Port Adapter Pinouts, page B-5

WPAN Gateway and WPAN Range Extender Console Port Adapter Pinouts

The console port uses an 8-pin RJ-45 connector. If you did not order a console cable, you need to provide an RJ-45-to-DB-9 adapter cable to connect the console port to a PC console port. You can order an adapter (part number ACS-DSBUASYN=).

Table B-8 lists the pinouts for the console port, the RJ-45-to-DB-9 adapter cable, and the console device.

Table B-8   Console Port Signaling Using a DB-9 Adapter

Device Console Port (DTE)	RJ-45-to-DB-9 Terminal Adapter	Console Device
Signal	DB-9 Pin	Signal
RTS	8	CTS
DTR	6	DSR
TxD	2	RxD
GND	5	GND
RxD	3	TxD
DSR	4	DTR
CTS	7	RTS

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