



EkaNet[™] Hardware Manual

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Revision 04

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EkaNet™ Hardware Manual

This document describes the node and gateway hardware components of an EkaNet wireless mesh network

1. Introduction

1.1 Overview

1.1.1 Product Highlights

EkaNet's wireless mesh network consists of multiple nodes communicating via a gateway with a server through either an IP connection or phone modem. In this self-configuring, peer-to-peer, multi-hop network, data is intelligently routed between nodes and gateways in the most efficient manner. Figure 1.1 shows the components of an EkaNet wireless mesh network including those supplied by the customer. This document describes the node and gateway hardware that make up the EkaNet wireless mesh network.

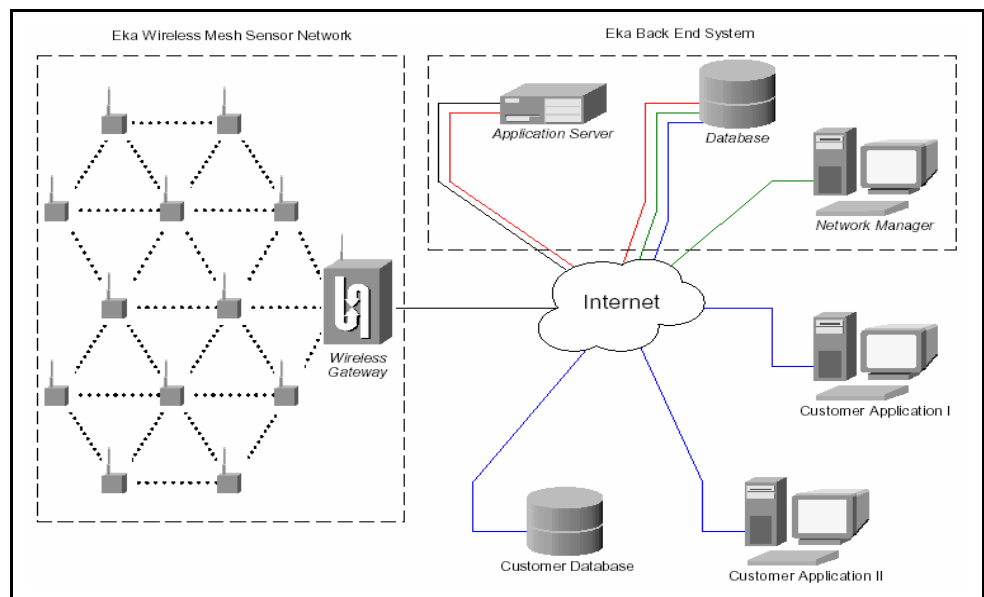


Figure 1.1 The Architecture of the EkaNet Wireless Mesh Network System



1.2 Supporting Documents

The following documents contain supporting details on the operation of your EkaNet wireless mesh network:

- *EkaNet System Description* — describes the system features of EkaNet's wireless mesh network for embedded device networking applications
- *EkaNet Operations Manual* — describes the procedures to plan, deploy, and maintain your EkaNet wireless mesh network
- *EkaNet Field Tool User Manual* — describes the features and use of the EkaNet Field tools
- *Network Manager User Guide* — describes the use of the Network Manager software. Includes sizing, installation, and administration information.

1.3 Version History

Revision Number	Date Released	Comment
01	September 2005	Initial Version - 10156
02	March 2006	Added RESI-MON Node (See "RESI-MON Node Hardware" on page 4 - 1), Elster Node (See "Elster A3/Alpha Plus Node Hardware" on page 3 - 1) sections.
03	May 2006	Updated Gateway section with instructions on gateway configuration (See "Configuring the Gateway Using the Field Tool" on page 5 - 1).
04	July 2006	Updated Radio Specifications (See "Radio Specifications" on page 2-4.) Added FCC Warning (See "Warning" on page 4-1.)

This document was prepared by:

Eka Systems, Inc.

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2. *ECR-2400 Node Hardware*

2.1 Overview

The ECR-2400 node is an under-the-glass board designed for installation in an ECR-2400 meter. The node plugs into the meter and provides an easy and reliable way to enable meters to automatically form a wireless mesh network. This section describes the procedures to integrate an ECR-2400 node with a ECR-2400 meter.



Figure 2.1 ECR-2400 Node

2.1.1 *ECR-2400 Node Features*

ECR-2400 nodes:

- operate in the 2.4 GHz band
- fit “under the glass”
- performs automatic time synchronization
- provide real-time access to interval data
- contain local non-volatile data storage
- provide full wireless routing capability

2.1.2 ECR-2400 Node Layout

Figure 2.2 below is a simple diagram of an ECR-2400 node. The primary components of the node are:

- the meter interface connector - connects the node to the meter
- the AC power connection - supplies power to the node
- the node's serial number - the node's unique identifier
- LEDs - red and green lights displaying node's operating status

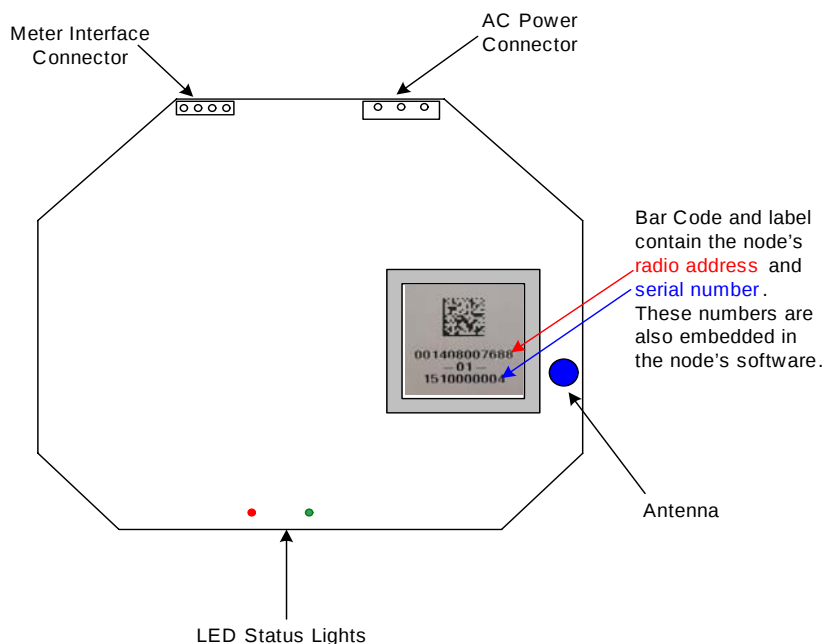


Figure 2.2 ECR-2400 Node Layout

Each ECR-2400 node is uniquely identified with a serial number. This number is displayed on the label and is contained on the bar code. In addition, the number is also embedded in the node's software. This serial number is the number displayed on the Field Tool and Network Manager to identify the node.



During installation, it is important to note the Eka Serial Number and the serial number of the meter in which it is installed in the event that the node and/or meter require troubleshooting.

2.2 Installation and Operation

Install the ECR-2400 node in the ECR-2400 meter as shown in Figure 2.3.

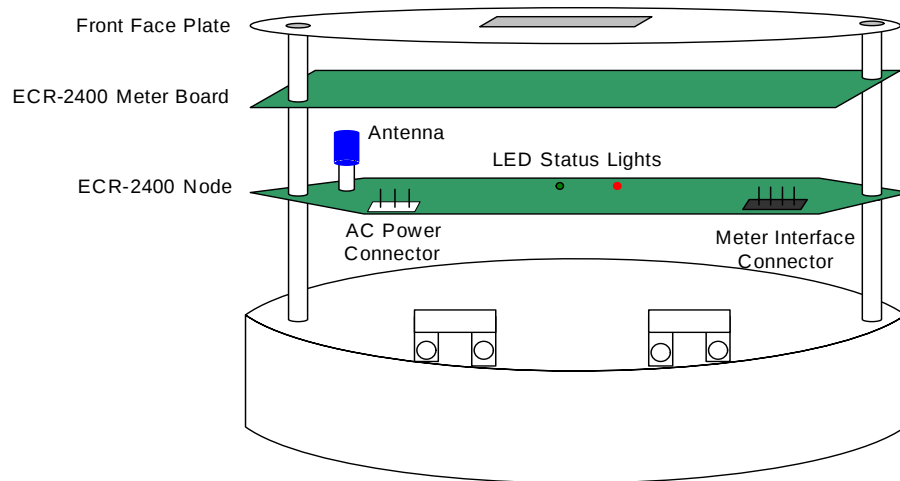


Figure 2.3 Eka Node Placement within a ECR-2400 Meter

1. Connect the ECR-2400 Meter Board to the Meter Interface Connector on the ECR-2400 Node.
2. Connect the AC power connector on the ECR-2400 node to the line and neutral connectors on the base of the ECR-2400 meter.

As soon as the meter is installed and powered on, the ECR-2400 node will begin operation.

2.2.1 What the Blinking Lights Mean

2.2.1.1 The Green LED

During the initial boot up the green LED may blink unevenly. However after 10 seconds the green LED should begin blinking at a steady rate of 1/2 second on and 1/2 second off. This is considered the node's "heartbeat." If the green light fails to come on, is a solid green, or flashes at any other rate, the node has malfunctioned and the node must be replaced.

2.2.1.2 The Red LED

During the initial boot up the red LED may blink unevenly. During system operation the red LED will be a solid red whenever it is communicating with any other Eka node. If the red light flashes continuously, the node has malfunctioned and the node must be replaced.



2.3 ECR-2400 Node Specifications

Application Specifications

Compatibility	ECR-2400 Meter Serial Interface
Data storage	Stores 1 month of data (1 channel @ 15 min. intervals)
Data Integrity	Non-volatile data storage provides extra security in the event of communication failure or power outage
Advanced features	Load profile, remote demand reset, remote connect/disconnect capability

Radio Specifications

Operating frequency	2.400 - 2.4835 GHz
Reliable data transmission	Error detection, correction and retransmission
RF output power (typical)	20 dBm
Data rate	1 Mbps
Receiver sensitivity	Sensitivity -80 dBm (@ 0.1% BER, +85°C)
Range (w/ omni antenna)	
	Outdoor > 400 m (1200 ft.)
	Indoor 25 - 50 m (75 - 150 ft.)
Mode	Frequency hopping spread spectrum

Interface Specifications

Meter manufacturer proprietary protocol

Mechanical

Weight:	45 g (1.6 oz.)
Dimensions:	97 x 80 x 33 mm. (3 ⁷ / ₈ x 3 ¹ / ₈ x 1 ¹ / ₃ in.)

Network Specifications

- No hard limitation on number of meters per Gateway (actual number of meters per Gateway depends on network performance requirements)
- Full peer-to-peer communication
- Fully self-configuring
- Automatic routing
- No network address management required
- Automatic network acquisition
- Automatic time synchronization of all nodes in the network
- 128 bit authentication/encryption

Operating Conditions

<i>Environmental</i>	-40°C to +70°C
	5 - 95% non-condensing humidity
<i>Power Supply</i>	Internal to meter
	110 - 240 VAC
<i>Power Consumption</i>	0.6 Watt typical

3. *Elster A3/Alpha Plus Node Hardware*

3.1 Overview

The Elster A3/Alpha Plus node is an under-the-glass board designed for installation in an Elster A3/Alpha Plus meter. The node plugs into the meter and provides an easy and reliable way to enable meters to automatically form a wireless mesh network.

This section describes the procedures to integrate a Elster A3/Alpha Plus node with an Elster A3/Alpha Plus meter.



Figure 3.1 Elster A3/Alpha Plus Node - Top View



Figure 3.2 Elster A3/Alpha Plus Node - Side View

3.1.1 Elster A3/Alpha Plus Node Features

Elster A3/Alpha Plus nodes:

- operate in the 915 MHz or 2.4 GHz license-free bands
- fit “under the glass”
- perform automatic time synchronization
- provide real-time access to interval data
- contain local non-volatile data storage
- provide full wireless routing capability

3.1.2 Elster A3/Alpha Plus Node Layout

Figure 3.3 below is a simple diagram of an Elster A3/Alpha Plus node. The primary components of the node are:

- the meter interface connector - connects the node to the meter
- the node's serial number - the node's unique identifier
- LEDs - red and green lights displaying node's operating status

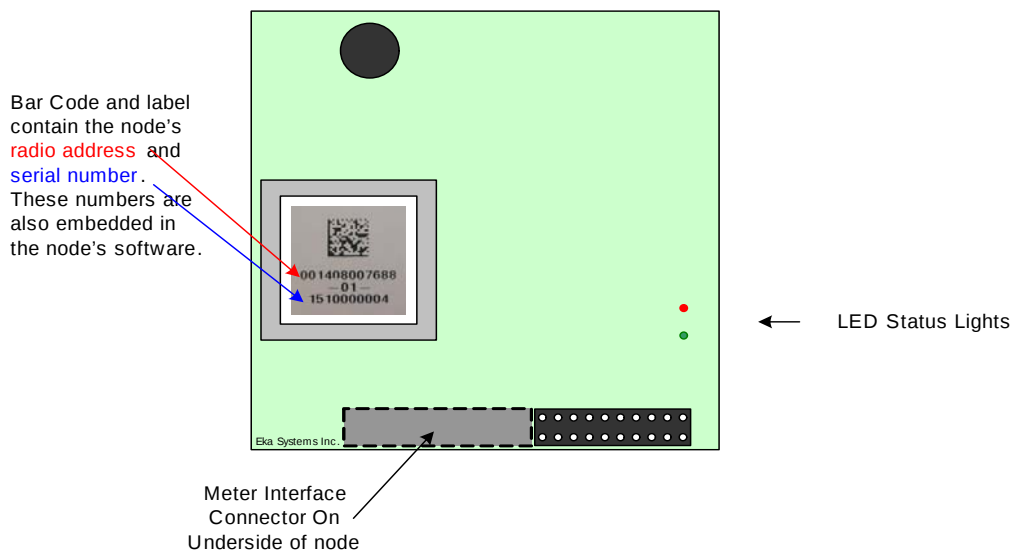


Figure 3.3 Elster A3/Alpha Plus Node Layout

Each Elster A3/Alpha Plus node is uniquely identified with a serial number. This number is displayed on the label and is contained on the bar code. In addition, the number is also embedded in the node's software. This serial number is the number displayed on the Field Tool and Network Manager to identify the node.



During installation, it is important to note the Eka Serial Number and the serial number of the meter in which it is installed in the event that the node and/or meter require troubleshooting.

3.2 Installation and Operation

Install the Eka Elster A3/Alpha Plus node in the Elster A3/Alpha meter as shown in Figure 3.4.

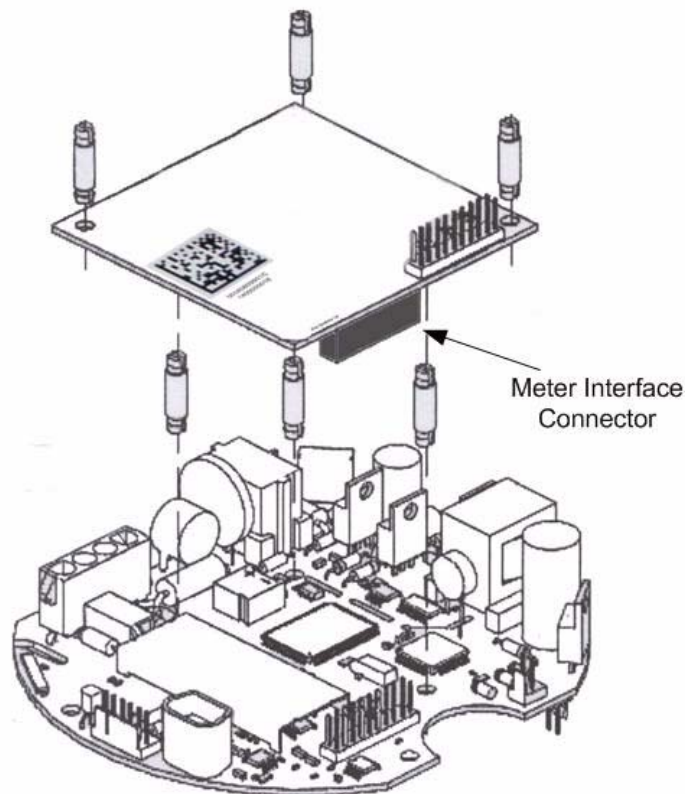


Figure 3.4 Eka Node Placement within an Alpha Meter

Connect the Elster A3/Alpha Plus Meter Board to the Meter Interface Connector on the Elster A3/Alpha Plus Node.

As soon as the meter is installed and powered on, the Elster A3/Alpha Plus node will begin operation.

Because the EkaNet node communicates with the A3 meter at 9600 baud, the meter must be configured to ensure that it communicates at 9600 baud. Please refer to the A3 meter documentation for configuration procedures.

3.2.1 What the Blinking Lights Mean

3.2.1.1 The Green LED

During the initial boot up the green LED may blink unevenly. However after 10 seconds the green LED should begin blinking at a steady rate of 1/2 second on and 1/2 second off. This is considered the node’s “heartbeat.” If the green light fails to come on, is a solid green, or flashes at any other rate, the node has malfunctioned and the node must be replaced.

3.2.1.2 The Red LED

During the initial boot up the red LED may blink unevenly. During system operation the red LED will be a solid red whenever it is communicating with any other Eka node. If the red light flashes continuously, the node has malfunctioned and the node must be replaced.

3.3 Elster A3/Alpha Plus Node Specifications

Application Specifications		
<i>Compatibility</i>	Elster A3/Alpha Plus Meter Pulse Interface	
<i>Data storage</i>	Stores 1 month of data (1 channel @ 15 min. intervals)	
<i>Data Integrity</i>	Non-volatile data storage provides extra security in the event of communication failure or power outage	
<i>Advanced features</i>	Load profile, remote demand reset	

Radio Specifications		
<i>Operating frequency</i>	902 - 928 MHz	2.400-2.4835 GHz
<i>Reliable data transmission</i>	Error detection, correction and retransmission	Error detection, correction and retransmission
<i>RF output power (Max.)</i>	20 dBm	20 dBm
<i>Data rate</i>	76.8 Kbps	1 Mbps
<i>Receiver sensitivity</i>	-93 dBm (@ 0.1% BER, +25°C)	Max transmit power 20 dBm Sensitivity -80 dBm (@ 0.1% BER, +85°C)



Radio Specifications

Range (w/ omni antenna)		> 400 m (1200 ft.) 25 - 50 m (75 - 150 ft.)
Outdoor	> 1,000 m (3,200 ft.)	Frequency hopping spread spectrum
Indoor	75 - 150 m (225 - 490 ft.)	
Mode		Frequency hopping spread spectrum

Interface Specifications

ANSI C12.18/C12.19 for the A3
Meter manufacturer proprietary protocol for the Alpha Plus

Mechanical

Weight:	31 g (1.1 oz.)
Dimensions:	76 x 76 mm. (3 x 3 in.)

Network Specifications

No hard limitation on number of meters per Gateway (actual number of meters per Gateway depends on network performance requirements)
Full peer-to-peer communication
Fully self-configuring
Automatic routing
No network address management required
Automatic network acquisition
Automatic time synchronization of all nodes in the network
128 bit authentication/encryption

Operating Conditions

Environmental	-40°C to +70°C 5 - 95% non-condensing humidity
Power Supply	Internal to meter
Power Consumption	0.6 Watt typical

4. *RESI-MON Node Hardware*

FCC Notice

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.



Warning

The Original Equipment Manufacturer (OEM) must ensure that FCC Labeling requirements are met. This includes a clearly visible label on the outside of the OEM enclosure specifying the appropriate EKA Systems FCC identifier for this product as well as the FCC Notice below.



Warning

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference, and
- (2) This device must accept any interference received, including interference that may cause undesired operation.



Warning

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

4.1 Overview

The RESI-MON node is an under-the-glass board designed for installation in an RESI-MON meter. The node plugs into the meter and provides an easy and reliable way to enable meters to automatically form a wireless mesh network.

This section describes the procedures to integrate a RESI-MON node with a RESI-MON meter.



Figure 4.1 RESI-MON Node

4.1.1 RESI-MON Node Features

RESI-MON nodes:

- operate in 915 MHz license-free bands
- fit “under the glass”
- perform automatic time synchronization
- provide real-time access to interval data
- contain local non-volatile data storage
- provide full wireless routing capability

4.1.2 RESI-MON Node Layout

Figure 4.2 below is a simple diagram of a RESI-MON node. The primary components of the node are:

- the pulse interface connector - connects the node to the meter
- the DC power connection - supplies power to the node
- the node's serial number - the node's unique identifier
- LEDs - red and green lights displaying node's operating status

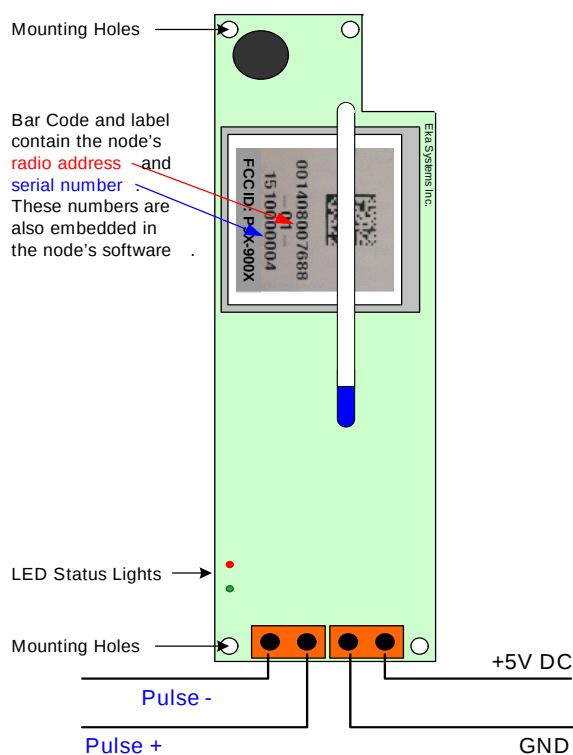


Figure 4.2 RESI-MON Node Layout

Each RESI-MON node is uniquely identified with a serial number. This number is displayed on the label and is contained on the bar code. In addition, the number is also embedded in the node's software. This serial number is the number displayed on the Field Tool and Network Manager to identify the node.



During installation, it is important to note the Eka Serial Number and the serial number of the meter in which it is installed in order to map billing data from the Eka serial number to the meter serial number at the database.



4.2 Installation and Operation

To install the RESI-MON node in the RESI-MON meter:

1. Connect the RESI-MON Meter Board to the Pulse Interface Connector on the RESI-MON Node.
2. Connect the DC power connector on the RESI-MON node to 5V DC power and ground.
3. Verify that the power polarity is correct before applying power to the device.

As soon as the meter is installed and powered on, the RESI-MON node will begin operation.

4.2.1 *What the Blinking Lights Mean*

4.2.1.1 The Green LED

During the initial boot up the green LED may blink unevenly. However after 10 seconds the green LED should begin blinking at a steady rate of 1/2 second on and 1/2 second off. This is considered the node's "heartbeat." If the green light fails to come on, is a solid green, or flashes at any other rate, the node has malfunctioned and the node must be replaced.

4.2.1.2 The Red LED

During the initial boot up the red LED may blink unevenly. During system operation the red LED will be a solid red whenever it is communicating with any other Eka node. If the red light flashes continuously, the node has malfunctioned and the node must be replaced.

4.3 RESI-MON Node Specifications

Application Specifications

Compatibility	RESI-MON Meter Pulse Interface
Data storage	Stores 1 month of data (1 channel @ 15 min. intervals)
Data Integrity	Non-volatile data storage provides extra security in the event of communication failure or power outage
Advanced features	Load profile

Radio Specifications

Operating frequency	902 - 928 MHz
Reliable data transmission	Error detection, correction and retransmission
RF output power (Max.)	20 dBm
Data rate	76.8 Kbps
Receiver sensitivity	-93 dBm (@ 0.1% BER, +25°C)
Range (w/ omni antenna)	
	Outdoor > 1,000 m (3,200 ft.)
	Indoor 75 - 150 m (225 - 490 ft.)
Mode	Frequency hopping spread spectrum

Interface Specifications

Dry contact closure pulse interface

Mechanical

Weight:	34 g (1.2 oz.)
Dimensions:	38 x 127 mm. (1 1/2 x 5 1/4 in.)

Network Specifications

No hard limitation on number of meters per Gateway (actual number of meters per Gateway depends on network performance requirements)

Full peer-to-peer communication

Fully self-configuring

Automatic routing

No network address management required

Automatic network acquisition

Automatic time synchronization of all nodes in the network

128 bit authentication/encryption

Operating Conditions

<i>Environmental</i>	-40°C to +70°C
	5 - 95% non-condensing humidity
<i>Power Supply</i>	Internal to meter
	5 volt DC
<i>Power Consumption</i>	0.5 Watt typical

5. Gateway Hardware

5.1 Overview

The EkaNet gateway is a reliable, fully bidirectional interface between the Internet/backbone network and the nodes on the local EkaNet wireless network.

5.1.1 EkaNet Gateway Features

EkaNet gateways:

- operate in 2.4 GHz and 915 MHz license-free bands
- act as a bi-directional interface between the Internet and the wireless Eka nodes
- maintain status information for each node
- contain local storage for up to 45 days of interval data for each node
- provide simple remote configuration of the EkaNet wireless devices
- are available for installation indoors (See Installing an Indoor Gateway) or a weather-proof version is available for installation outdoors (See Installing an Outdoor Gateway)

5.2 Configuring the Gateway Using the Field Tool

Before installing the gateway, you must first configure the gateway using the PDA (Field Tool Survey kit) provided. Complete details on the use of the Field Tool are provided in the *EkaNet Field Tool User Manual*.

The instructions below describe the procedures to configure the gateway IP, NTP server, and user parameters on the compact flash card prior to installation of the gateway.



Place the gateway's compact flash card (See "The Compact Flash Card" on page 5 - 5) into the compact flash slot on the PDA (Field Tool) before performing this function as all changes made on this tab will be written directly to the compact flash card.

Select **EKA** → **Gateway Mx Manager** → **Config** on the Field Tool.

Use the **Config** tab to:

- configure gateway IP, NTP Server, and user parameters on the compact flash card
- verify gateway settings on the compact flash card
- change gateway settings on the compact flash card

5.2.1 IP Config Settings

Tap the **Config** tab to configure gateway IP and user parameters. The information displayed is dependent upon the configuration type (IP or User) selected.

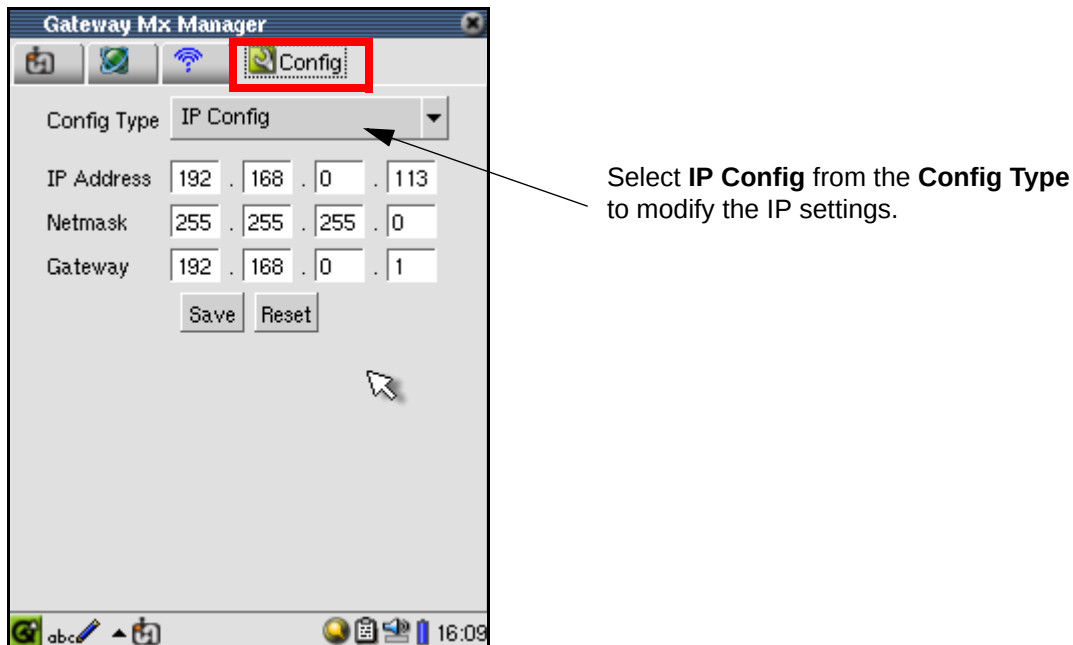


Figure 5.1 Gateway Maintenance IP Configuration

5.2.2 User Config Settings

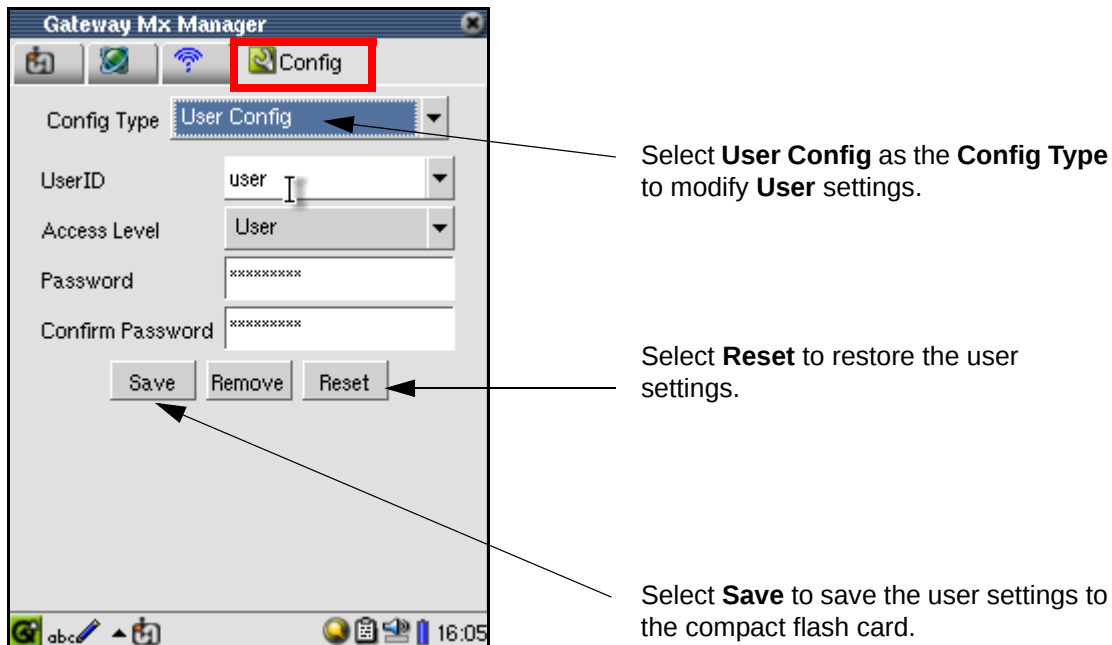


Figure 5.2 Gateway Maintenance User Configuration

To modify a user, select the **UserID** from the drop-down list and make the necessary changes.

To create a new user:

1. Type the new **User Id** in the **UserID** text area
2. Select the **Access Level** from the drop-down list
3. Complete the **Password**
4. Reenter the password
5. Tap the **Save** button.



You may create multiple users before hitting the **Save** button.

On the Configuration screens, labels will change to a **red** font when changes are made to the associated values.

A confirmation dialog (Figure 5.3) will be displayed after you have successfully updated the user information.

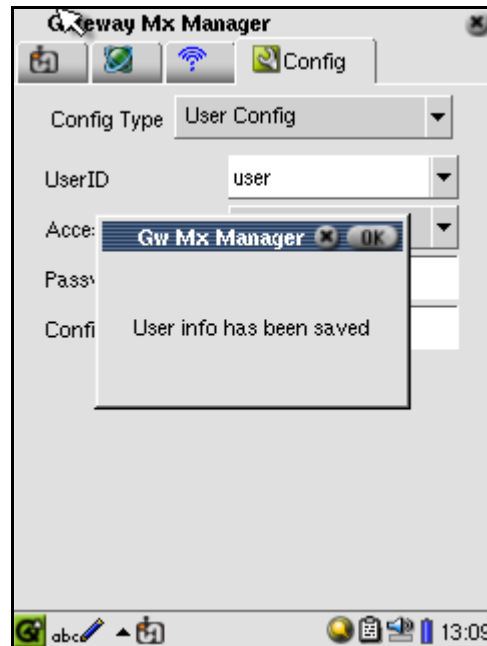


Figure 5.3 Successful Update to User Information

5.2.3 NTP Config Settings

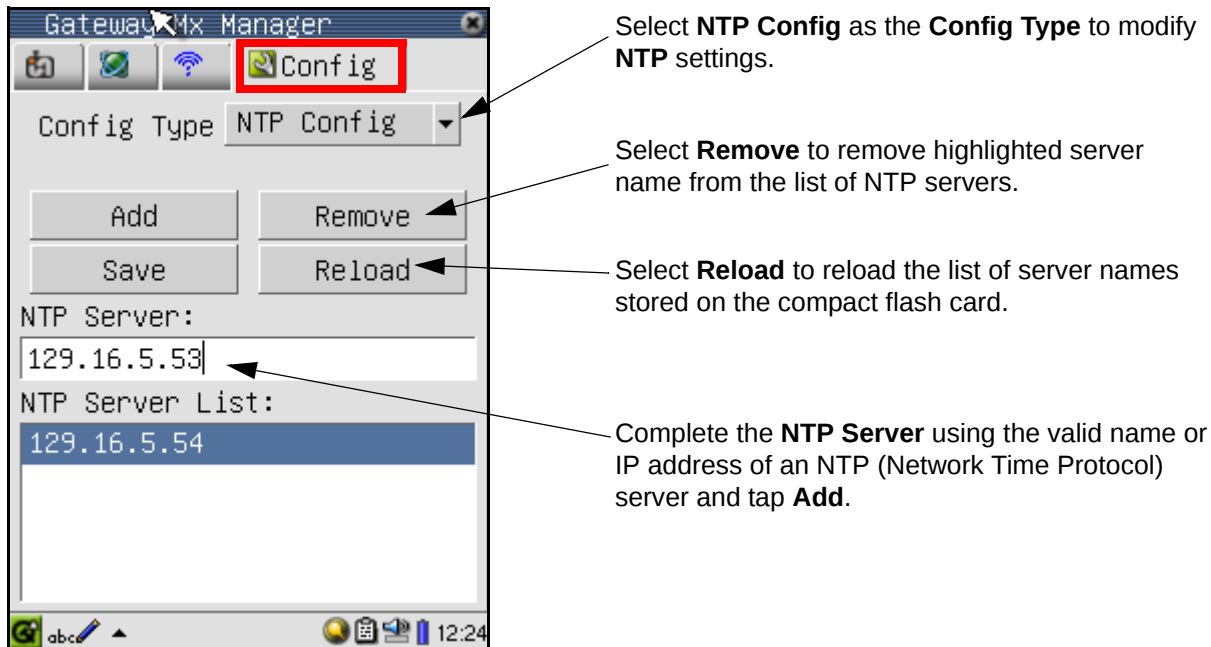


Figure 5.4 Gateway Maintenance NTP Configuration

5.3 The Compact Flash Card

The compact flash card on the gateway contains the EkaNet gateway software and data collected from the nodes on the network. It may be necessary during system operation to remove and replace the compact flash card with a new card supplied by Eka.



Power to the gateway must be turned off before removing and/or replacing the compact flash card.

To remove the flash card, press the release button next to the compact flash card. The card will pop out and may be removed. To re-insert the card, slide it securely back into the slot.

Once the compact flash card has been removed from the gateway it may be inserted into the Field Tool. Refer to the *EkaNet Field Tool User Manual* for instructions on troubleshooting problems with the gateway using the Field Tool.

5.4 Installing an Indoor Gateway

Your EkaNet Gateway suitable for indoor installation will be enclosed in a plastic housing as shown in Figure 5.5.



This housing is not suitable for outdoor installation.

To install an indoor gateway:

1. Attach your ethernet cable to the LAN connection on the gateway.



Figure 5.5 Indoor Gateway

2. Attach the gateway's power supply to the 5V connection on the gateway.
3. Plug the power supply into an electrical outlet.



Figure 5.6 Indoor Gateway - Power Connection

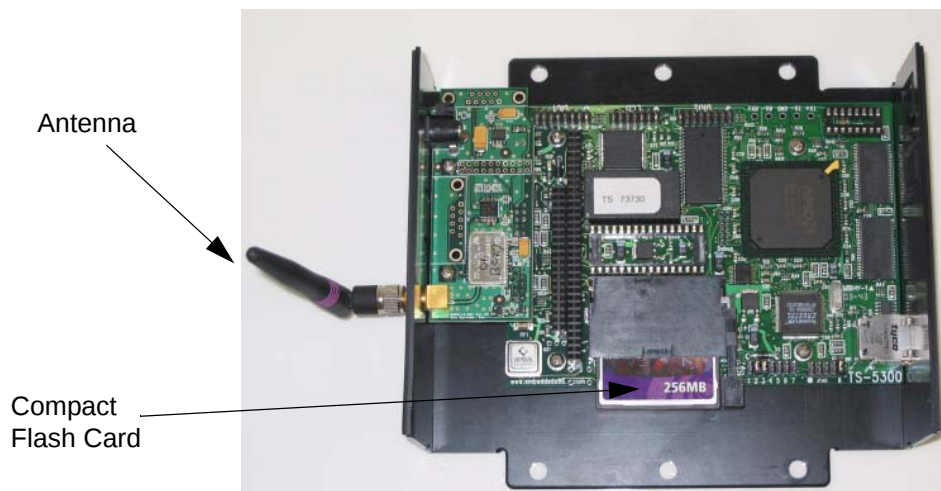


Figure 5.7 Indoor Gateway - Cover Removed

5.5 Installing an Outdoor Gateway

Your EkaNet Gateway suitable for outdoor installation will be enclosed in a plastic water-proof housing as shown in Figure 5.8.



Figure 5.8 Weather Proof Outdoor EkaNet Gateway - Closed

To install an outdoor gateway:

1. Open both latches on the side of the housing to reveal the gateway hardware inside.

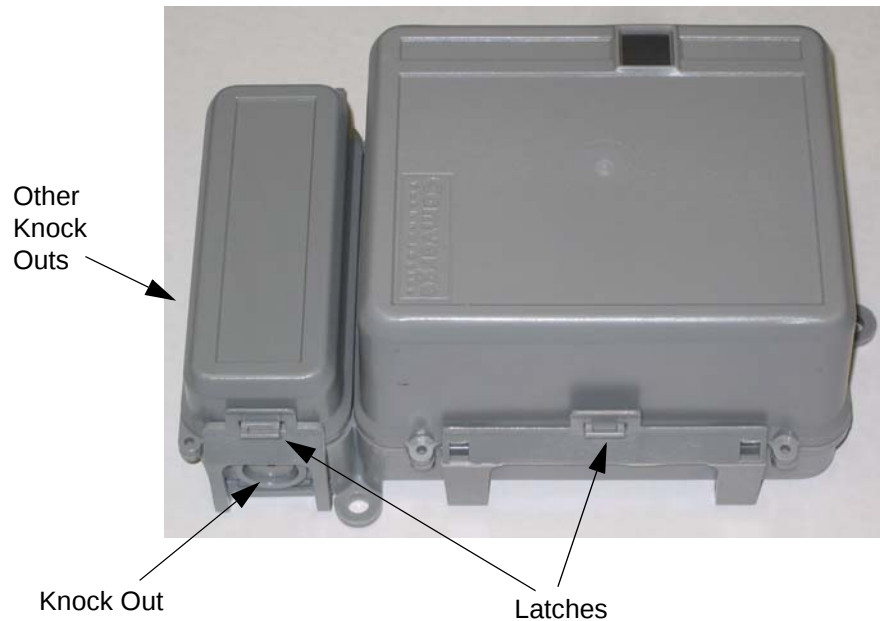


Figure 5.9 Weather-Proof Outdoor Gateway - Latches

2. Remove the Compact Flash Card from the gateway. (See Figure 5.10)
3. Use the PDA (Field Tool Survey kit) provided to configure the gateway IP, NTP server, and user parameters on the compact flash card. (See “Configuring the Gateway Using the Field Tool” on page 5 - 1.)
4. Reinstall the Compact Flash Card in the gateway.



After the gateway is powered up, the compact flash card cannot be removed for configuration.

5. In order to attach the ethernet cable and the power cable to the gateway you will first need to remove the knock out through which these cables will access the electronics inside the housing. There are various knock out locations on the housing. Use the one that best fits the environment in which the gateway will be installed.

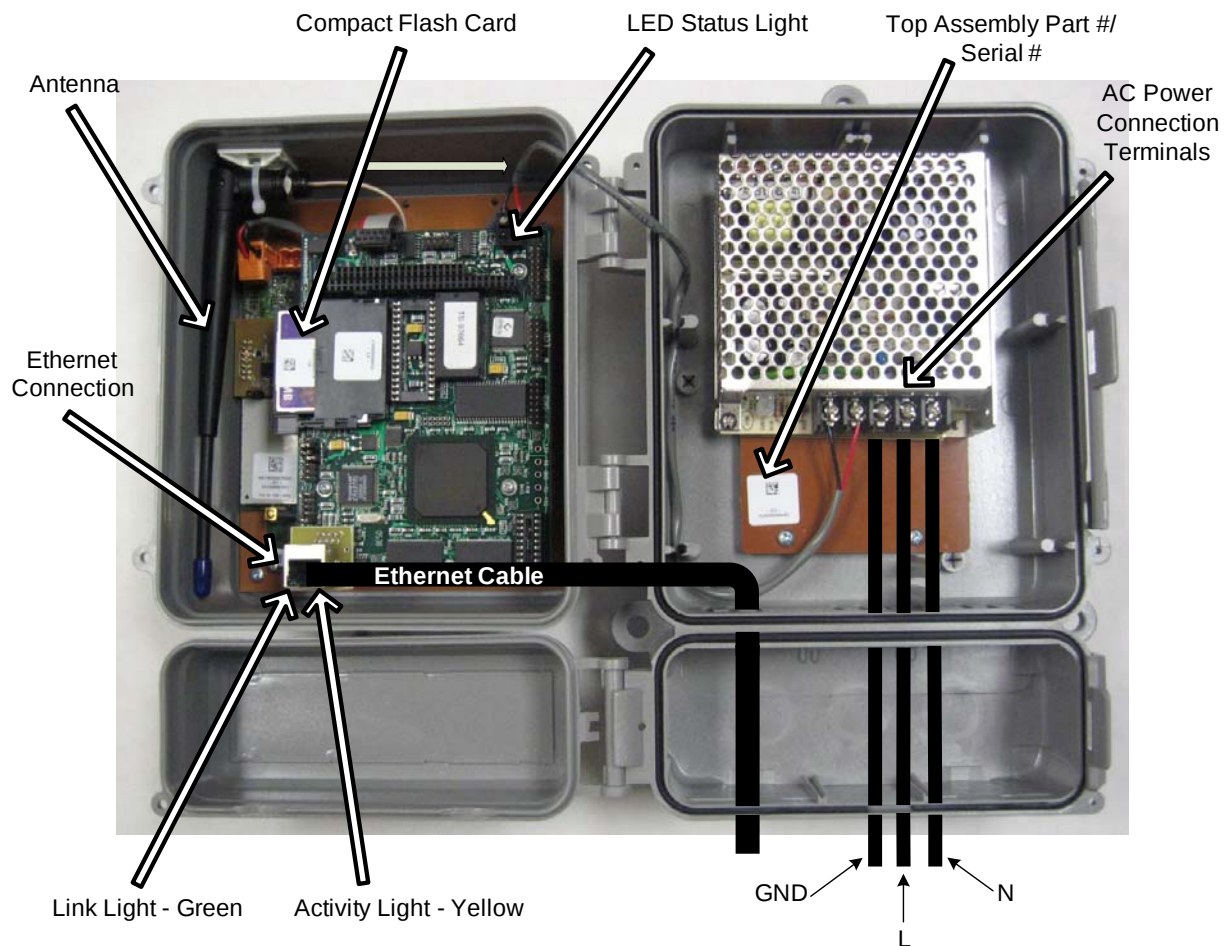
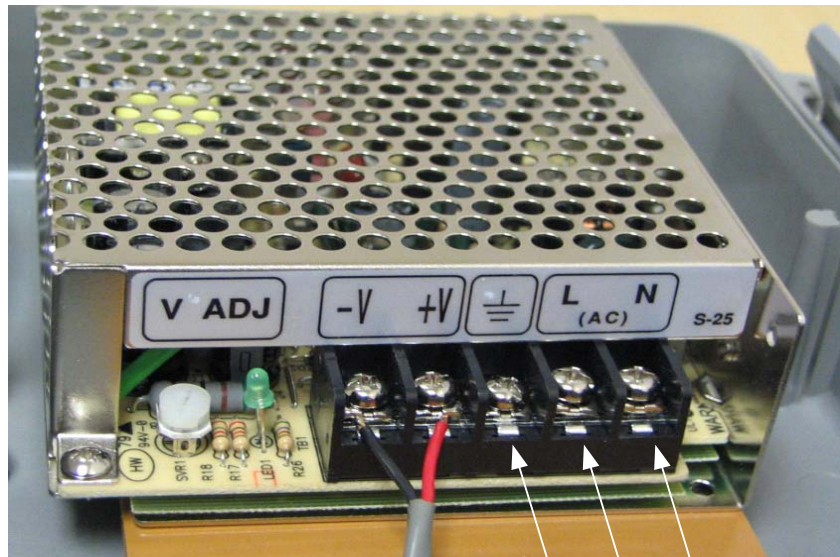


Figure 5.10 Internal Components of an Outdoor Gateway

6. Connect your ethernet cable to the ethernet connection in the gateway. During normal system operation the Activity light (yellow) on the ethernet connection will blink occasionally and the Link light (green) will be illuminated at all times.

7. Connect the input power wires (line marked L, neutral marked N, and ground marked $\perp$) to the appropriate power input terminals in the gateway.
8. Install the gateway at its predetermined location.



AC Power Connection
Terminals

Figure 5.11 Power Input Terminals on an Outdoor Gateway

5.6 Verifying Gateway Connectivity

A crossover ethernet cable was supplied with your EkaNet Field Tool.

To use this cable to verify that the gateway is reachable:

1. Remove your ethernet cable from the gateway.
2. Plug in one end of the crossover cable into the ethernet connection on the gateway.
3. Plug the other end of the crossover cable into the ethernet adapter on the Field Tool.

Refer to the *EkaNet Field Tool User Manual* for instructions on troubleshooting problems with the gateway using the Field Tool.



5.7 Gateway Specifications

Application Specifications

TCP/IP Ethernet 10 BaseT
 AMD SC-520 microprocessor
 128MB flash (1 channel @15 min. interval for 1000 meters for 1 month)
 Linux Operating System
 Secure Sockets Layer (SSL) communications

Radio Specifications

Operating frequency	2.400-2.4835 GHz	903-928 MHz
Reliable data transmission	Error detection, correction and retransmission	Error detection, correction and retransmission
RF output power (Max.)	20 dBm	20 dBm
Data rate	1 Mbps	76.8 kbps
Receiver sensitivity	Max transmit power 20 dBm Sensitivity -80 dBm (@ 0.1% BER, +85°C)	Max transmit power 20 dBm Sensitivity -93 dBm (@ 0.1% BER, +25°C)
Range (w/ omni antenna)		
Outdoor	> 400 m (1200 ft.)	> 1000 m (3000 ft.)
Indoor	25 - 50 m (75 - 150 ft.)	75 - 150 m (225 - 450 ft.)
Mode	Frequency hopping spread spectrum	Frequency hopping spread spectrum

Interface Specifications

Hardware interface: RJ-45 - 468B

Mechanical

Indoor	Weight: 382 g. (13.5 oz.) Dimensions: 17.1 x 13.3 x 5.7 cm. (6 ¾ x 5 ¼ x 2 ¼ in.)
Outdoor	Weight: 1492 g. (52.6 oz.) Dimensions: 27.9 x 19 x 12 cm. (11 x 7.5 x 4¾ in.)

Network Specifications

No hard limitation on number of meters per Gateway (actual number of meters per Gateway depends on network performance requirements)

Full peer-to-peer communication

Fully self-configuring

Automatic routing

No network address management required

Automatic network acquisition

Automatic time synchronization of all nodes in the network

128 bit authentication/encryption

Operating Conditions

Environmental	-40°C to +85°C
	5 - 95% non-condensing humidity
Power Supply	110 - 240 VAC, 12W