

Application Note

KAS-20E_Indoor Location Features Setup Guide

KAS-20SE/CE V1.00
NX-5000 Series K5.30
NX-3000 Series K4.30
NXR-1000 Series V2.40
KPG-D1/D1N V5.30
KPG-D3/D3N V4.30

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目次

1. OVERVIEW	- 2 -
1.1. Outline Features	- 2 -
1.1.1. What is Indoor Location	- 2 -
1.1.2. Configuration of Indoor Location	- 3 -
1.1.3. About BLE Beacons	- 4 -
1.1.4. About BLE Gateway	- 5 -
1.1.5. BLE Beacon Identification Method by Portable Radios and KAS-20E	- 5 -
1.1.6. How Indoor Location Works	- 6 -
1.1.7. Indoor Location System Diagram	- 7 -
1.1.8. Features of Indoor Location in KAS-20E	- 9 -
2. ABOUT BLE BEACON AND BLE GATEWAY DEVICES	- 10 -
2.1. Verified BLE Beacon and BLE Gateway Devices	- 10 -
3. BASIC CONFIGURATION	- 11 -
3.1. KAS-20E Configuration Method (Indoor Location).....	- 12 -
3.1.1. Indoor Location Window	- 12 -
3.1.2. Indoor Location License KWD-20C-IL	- 12 -
3.1.3. Setting Console ID, Type, and Group ID in KAS-20SE	- 12 -
3.1.4. Selecting the Protocol in KAS-20CE (Setup>Setting>System>Protocol)	- 12 -
3.1.5. Setting Console ID and IP Gateway IP Address (Setup>Setting>System>IP Network)	- 13 -
3.1.6. Registering Radios in the Radio Resource List (Setup>Setting>System>Radio Resource List). - 13 -	
3.1.7. Building Setting(Setup>Setting>Indoor>Building)	- 13 -
3.1.8. Floor Setting(Setup>Setting>Indoor>Floor)	- 14 -
3.1.9. Floor Map Options(Setup>Setting>Indoor>Floor>...)	- 14 -
3.1.10. BLE Beacon(Setup>Setting>Indoor>BLE Beacon).....	- 14 -
3.1.11. BLE Beacon Position(Setup>Setting>Indoor>BLE Beacon>Position...)	- 15 -
3.1.12. BLE Gateway (Bluetooth System only) (Setup>Setting>System>Radio Resource List)	- 15 -
3.1.13. Displaying Mobile Station Information	- 16 -
3.2. Radio/Repeater Configuration (Referring to NX-3000/NXR-1000).....	- 17 -
3.2.1. Indoor Location License KWD-3020-IL (Radio).....	- 17 -
3.2.2. Built-in Device Activation (Radio Configuration>Global Options>Basics>GPS/Bluetooth)	- 17 -
3.2.3. Beacon List (Radio Configuration>Global Options>Indoor Location>General)	- 18 -
3.2.4. Base Station ID (RF System only) (Radio Configuration > System Properties > Systems > GPS/BLE>Base Station).....	- 19 -

3.2.5.	BLE Report Mode (RF System only) (Radio Configuration>System Properties>Systems>GPS/BLE>GPS/BLE Report Mode)	- 19 -
3.2.6.	Send the Location Data (RF System only)	- 20 -
3.2.7.	Bluetooth System (Bluetooth System only) (Radio Configuration > System Properties > Systems > Indoor Location>Bluetooth System)	- 21 -
3.2.8.	BLE Scan.....	- 22 -
3.2.9.	BLE Beacon Display	- 22 -
3.2.10.	Console List (Repeater).....	- 23 -
3.3.	Device Initial Setup Procedure.....	- 23 -
3.3.1.	Power On the E1000	- 23 -
3.3.2.	Connect to the SSID	- 23 -
3.3.3.	Connect to the Device from the PC	- 24 -
3.3.4.	Gateway Name	- 24 -
3.3.5.	Gateway Mode(Basic Tab)	- 24 -
3.3.6.	Wired(Basic Tab)	- 25 -
3.3.7.	Click 'Apply' to save the settings.	- 25 -
3.3.8.	Confirming BLE Gateway Functionality	- 25 -
4.	REVISION HISTORY	- 26 -

1. Overview

This document outlines the indoor location features of the KAS-20E.

It introduces the basic concepts of indoor positioning and *BLE beacon/gateway technology and explains the configuration methods for each device used to operate the indoor location system within a DMR Conventional System that utilizes the NX-3000/5000 series, NXR-1000/5000 series, and KAS-20E, together with BLE beacons and BLE gateways.

* Bluetooth Low Energy

1.1. Outline Features

1.1.1. What is Indoor Location

Indoor location refers to technologies and systems used to identify and track the location of people or objects inside buildings. While GPS provides highly accurate positioning outdoors, its signals are often unable to effectively penetrate buildings, making precise indoor positioning difficult.

In such cases, indoor location technology becomes essential, enabling users to determine the location of radios in use within a building and manage the radio system more efficiently.

To enable the indoor location function, BLE beacons are installed at various points throughout the building.



1.1.2. Configuration of Indoor Location

To use the indoor location feature with the KAS-20E, the system is composed of the following components:

- BLE Beacon (iBeacon protocol)
- BLE Gateway
- Portable Radio (NX-3000/5000 series)
- Radio Communication System (NXR-1000/5000 series)
- KAS-20SE (Location Server Software)
- KAS-20CE (AVL Client Software)
- Indoor Location License

KWD-3020-IL: New License for NX-3000 series to be used Indoor Location Feature

KWD-5020-IL: New License for NX-5000 series to be used Indoor Location Feature

KWD-20C-IL: New License for KAS-20CE to be used Indoor Location Feature

BLE Beacon(iBeacon)



BLE Gateway



Portable Radio



Radio Communication System



KAS-20SE/CE



1.1.3. About BLE Beacons

Our indoor location system operates using the iBeacon protocol, which includes identifiers necessary to recognize BLE beacon devices: UUID, Major value, and Minor value.

Depending on the device, it may be possible to configure the transmission power and communication interval of the BLE beacon.

iBeacon is a beacon standard developed by Apple.

- **UUID:** An ID used to identify the entire group of beacons
- **Major:** A number representing a subgroup, such as a building or floor
- **Minor:** A number representing the individual beacon unit

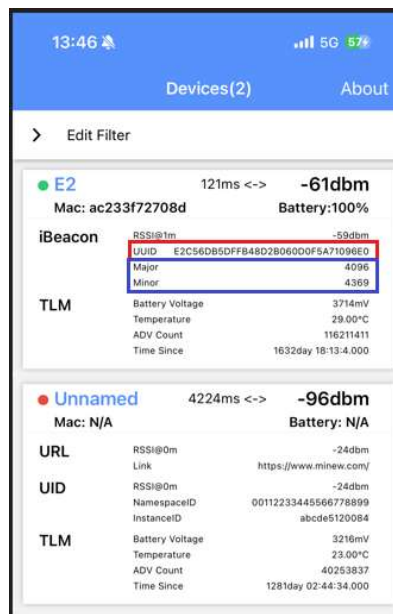
BLE Beacon



The configuration and verification methods for a beacon device's UUID, Major, Minor, transmission power, and communication interval may vary depending on the manufacturer.

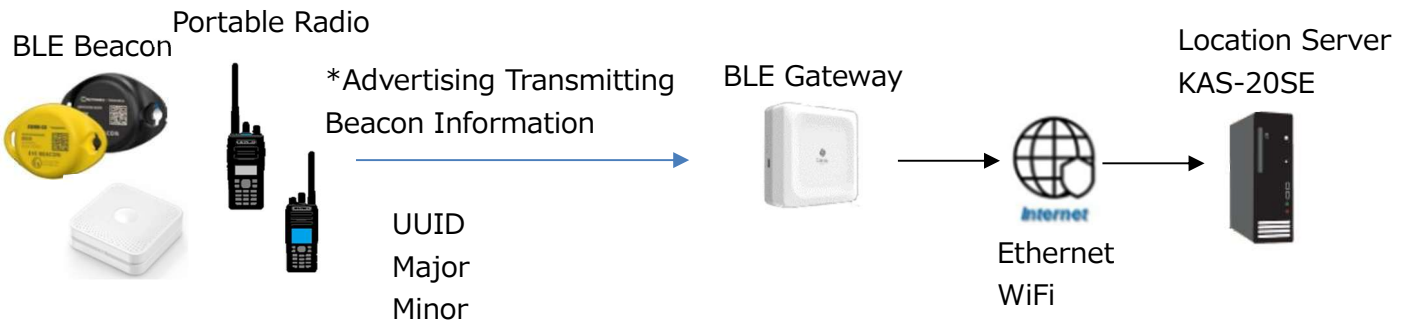
For specific instructions, please consult the vendor from whom the device was purchased.

For example, Minew provides an application (BeaconSET Plus) for scanning beacons, since UUID, Major, and Minor values can be retrieved using the BeaconSET Plus, you can use it to search for the target beacon by its MAC address and verify its UUID, Major, and Minor values.



1.1.4. About BLE Gateway

This device (BLE Gateway) receives indoor location data from radio, which detect signals from nearby BLE beacons. The gateway then transmits this data including the beacon's UUID, Major, and Minor values to the KAS-20SE (Location Server) via a LAN or Wi-Fi network.



* In beacon data transmission mode, the device periodically transmits beacon data at regular intervals.

1.1.5. BLE Beacon Identification Method by Portable Radios and KAS-20E

To identify BLE beacons, the portable radio refers to the UUID and stores registered beacon data in its internal memory. The radio does not accept beacons that are not registered.

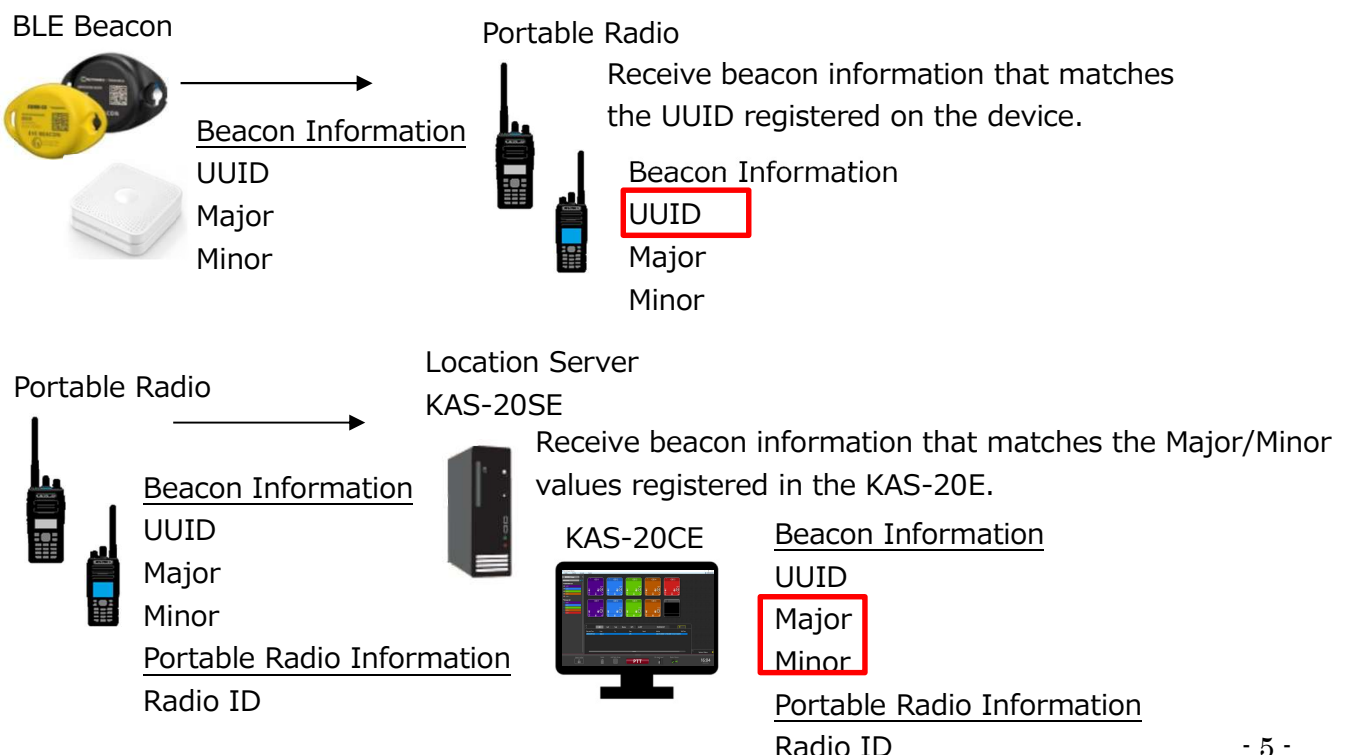
When saving, it stores the Major and Minor values received from the BLE beacon along with the UUID. Even if multiple BLE beacons share the same UUID, each is stored as separate data.

The KAS-20E identifies BLE beacons using the Major and Minor values.

It displays the received beacon information and radio terminal data on the map within the KAS-20E system.

Since the KAS-20E does not refer to the UUID, it cannot distinguish between beacons with identical Major and Minor values.

Therefore, each installed BLE beacon must be configured with unique Major and Minor values to avoid duplication.



1.1.6. How Indoor Location Works

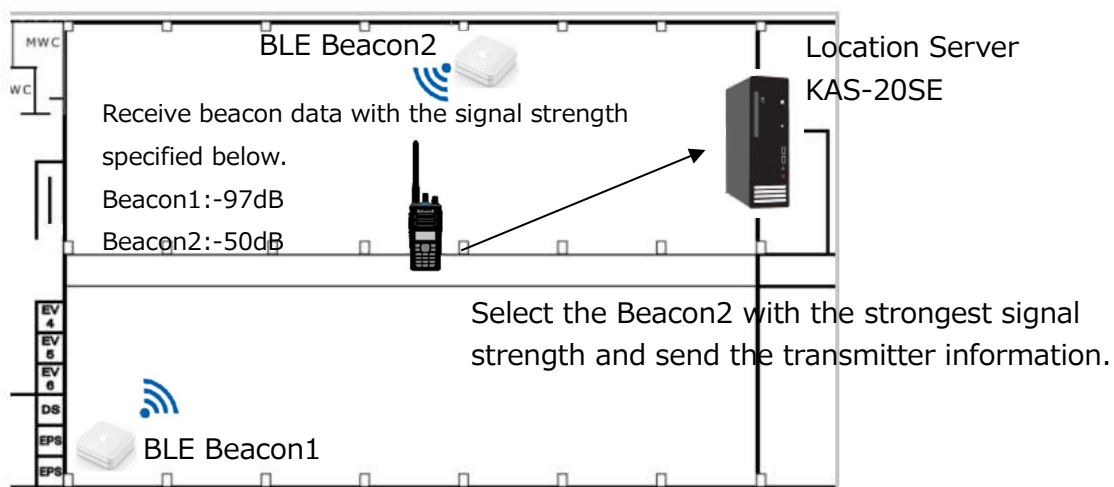
The radio has a BLE scan function that detects signals from BLE beacons at regular intervals.

Using this function, the radio receives beacon data transmitted by nearby BLE beacons.

After receiving the signals, it selects the single data point with the strongest signal strength from the most recent detections.

The radio then sends this selected beacon information (hereafter referred to as BLE data) to the KAS-20SE (Location Server), either at fixed intervals or at specified timing.

This enables the KAS-20SE to determine which BLE beacon the radio is currently closest to, effectively identifying the radio's location within the indoor environment.



1.1.7. Indoor Location System Diagram

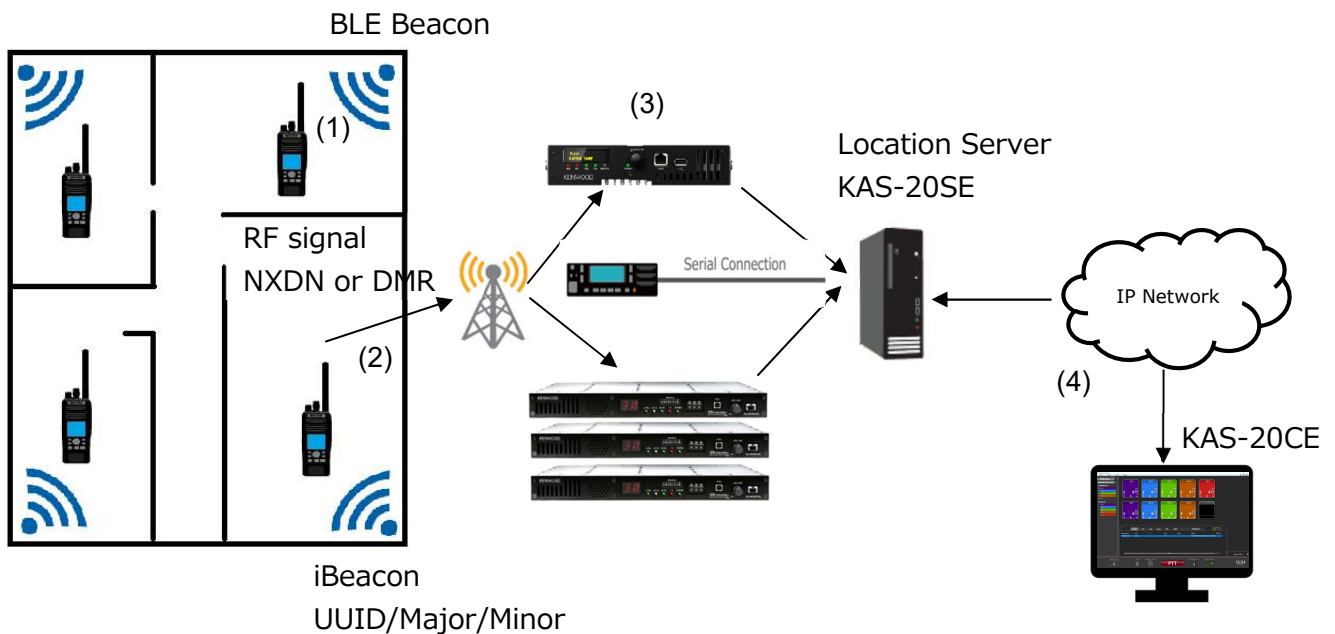
There are two communication methods for sending BLE data to the KAS-20SE (Location Server), as shown in the diagram below. The supported protocols for the KAS-20E are as follows:

<RF System Method>

- (1) The portable radio receives BLE beacon signals (iBeacon data) using its BLE scan function.
- (2) The BLE data is transmitted as an RF signal using either the NXDN or DMR air interface protocol, based on settings such as "Send Location Data" or "BLE Report Mode".
- (3) A repeater or base radio receives the iBeacon data from the portable radio. The repeater forwards the data to the KAS-20SE via IP, while the base radio does so via a serial connection.
- (4) The KAS-20SE (Location Server) processes the received iBeacon data and displays it on KAS-20CE.

This method is referred to as the RF System Method. BLE data is transmitted using the same configuration settings as those used for existing GPS location data.

Case #1 - BLE Beacon + Subscriber + Base Station (RF System)



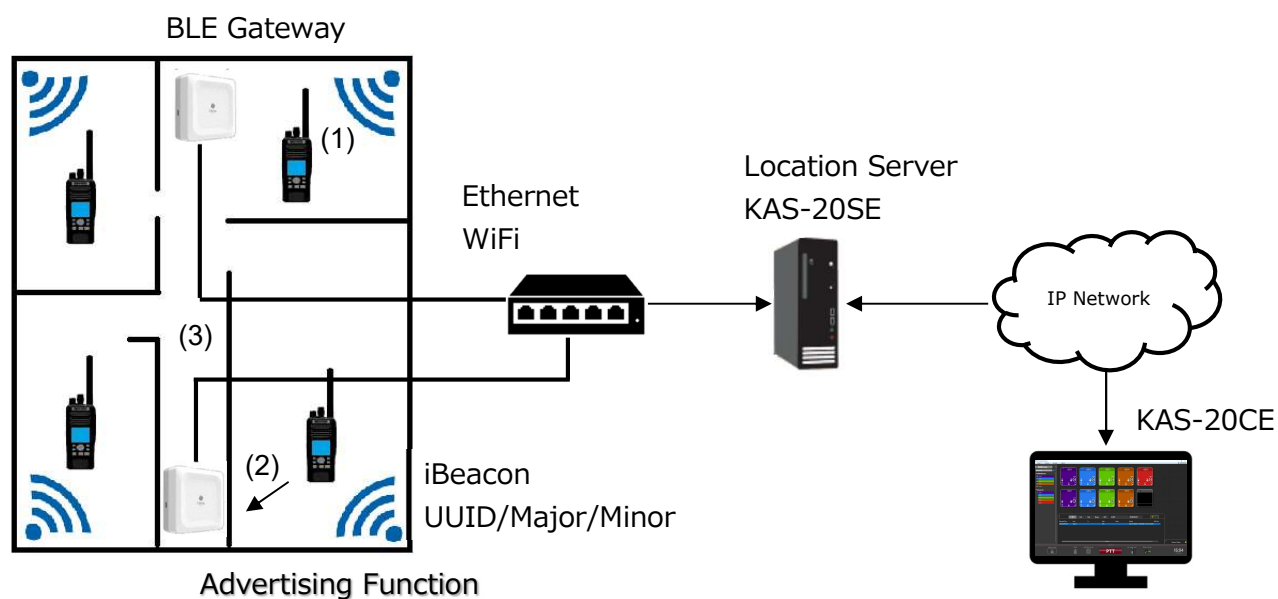
<Bluetooth System Method>

- (1) The portable radio receives BLE Beacon signals (iBeacon data) using its BLE Scan function.
- (2) The radio transmits the iBeacon data using Bluetooth's advertising feature.
- (3) The BLE Gateway receives the iBeacon data from the radio and forwards it to the KAS-20SE (Location Server) via IP network.

This method is referred to as the Bluetooth System Method.

*In beacon data transmission mode, beacon data is periodically transmitted at fixed intervals.

Case #2 - BLE Beacon + Subscriber + BLE Gateway (Bluetooth System)



<Supported Protocols by KAS-20E>

Protocols	Bluetooth System Method	RF System Method
NXDN Conventional	✓	✓
NXDN Site Roaming	✓	✓
NXDN Trunking	✓	✓
DMR Conventional	✓	✓
DMR Site Roaming	✓	✓
DMR-based Trunking (DMR Tier III Trunking)	✓	×
DMR-based Trunking (Trunking 2.5)	✓	×

1.1.8. Features of Indoor Location in KAS-20E

Since Indoor Location and GPS management can be used together, it is possible to manage locations using both systems. However, only one type of location data—either BLE data or GPS data—can be transmitted at a time.

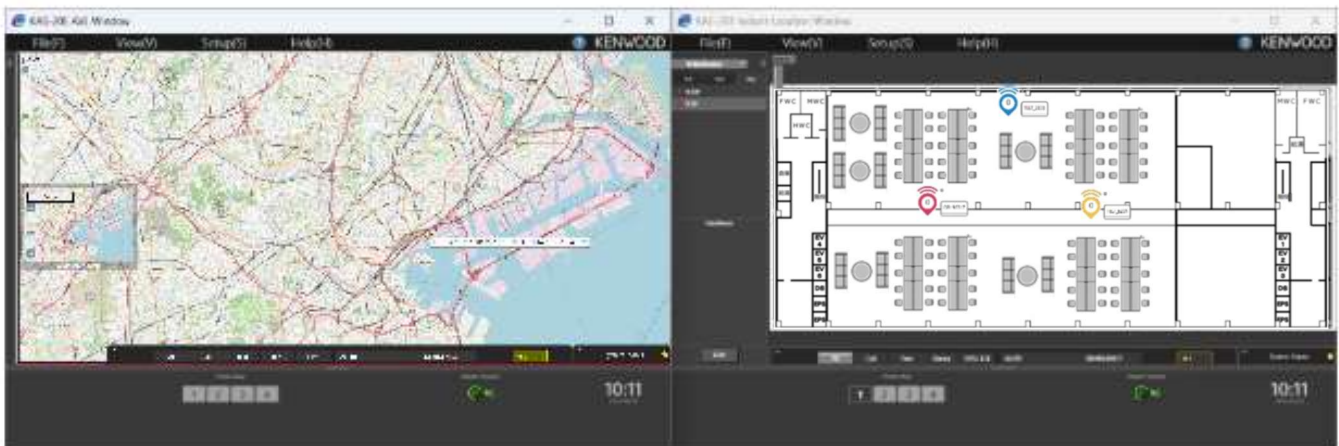
If both BLE data and GPS data are received, BLE data is prioritized, and GPS data is not transmitted.

If BLE data is not received but GPS data is available, GPS data is transmitted.

Therefore, BLE data is used for location tracking indoors, and high-precision GPS is used when moving outdoors, enabling seamless location management across environments.

Licenses already authenticated in the existing KAS-20 system can continue to be used after upgrading to KAS-20E. By upgrading the SQL Server and installing KAS-20E, you can use the enhanced version of KAS-20E that supports Indoor Location.

For details on how to upgrade from KAS-20 to KAS-20E, please refer to the Basic Operation Manual.



2. About BLE Beacon and BLE Gateway Devices

2.1. Verified BLE Beacon and BLE Gateway Devices

As of July 10, 2025, the BLE Beacons that have been tested and verified for proper operation are listed below.

Regarding BLE Gateways, proper operation has been confirmed only with the following Cassia Networks models: E1000 and ATX2000.

Please note that a dedicated web page will be provided later to manage and list the verified products.

	Vender Name	Product	Note
BLE Beacon	Minew	i3	BLE Beacon
		E2 Max	
		MBM01	
	Blueup	Forte+ BLE	
	TELTONIKA	BTSID1EXCB02 BTSID1	ATEX BLE Beacon ATEX Zone 1 certified: II 2G Ex ib IIC T6 Gb BLE Beacon
BLE Gateway	Cassia Networks	E1000	Standard BLE Gateway <u>*Operates on version 2.2.0.2503171357 or later.</u>
	Cassia Networks	ATX2000	BLE Gateway No internal test for ATX2000 which should work well because of ATX2000 has same interface as E1000. <u>*Operates on version 2.2.0.2503171357 or later.</u>

The devices used in this document are listed below.

- Minew i3
- TELTONIKA BTSID1
- Cassia Networks E100

3. Basic Configuration

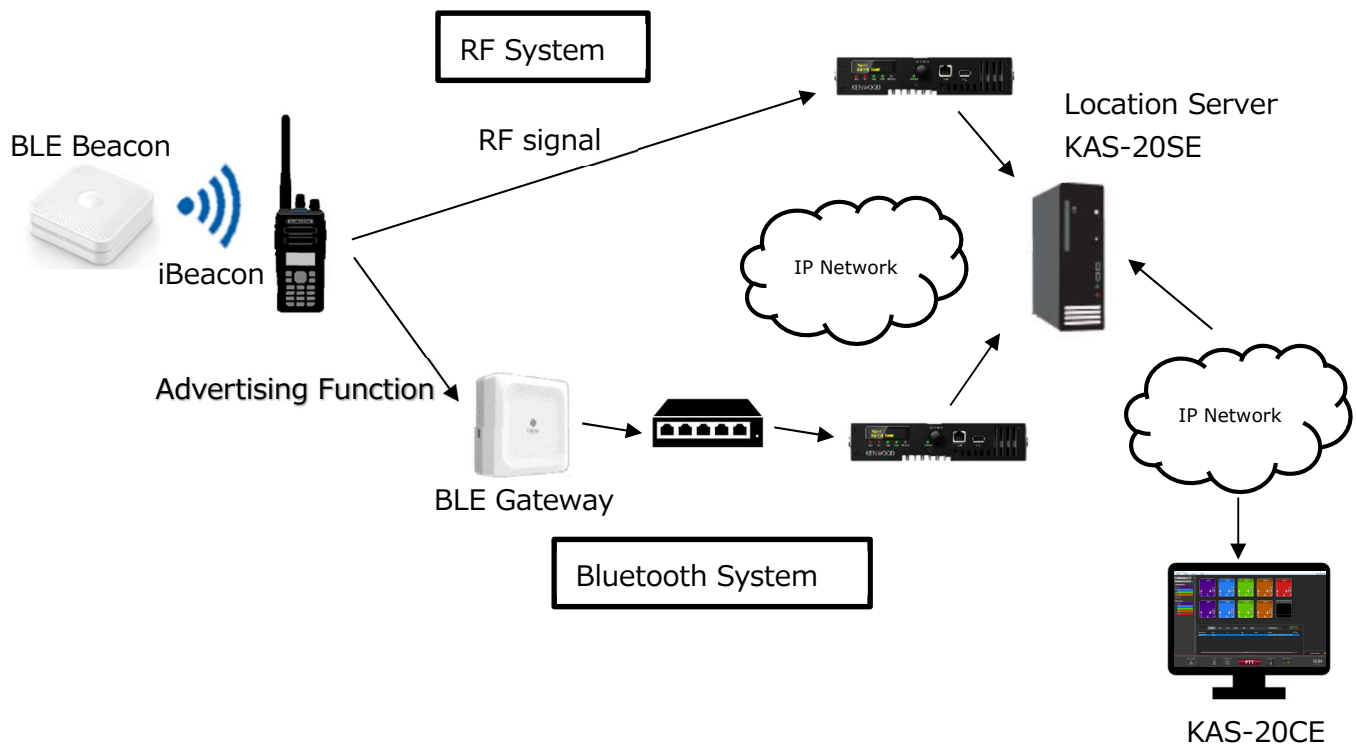
The following are the configuration steps required to enable Indoor Location in a DMR Conventional system. The verified system configuration is as described below. The setup process is explained in the following order:

- 1, KAS-20E configuration
- 2, Radio terminals and repeater settings
- 3, Initial setup of the BLE Gateway

Note: This document refers to Cassia Networks E1000. BLE Gateways are not required when using the RF System Method.

<List of equipment used>

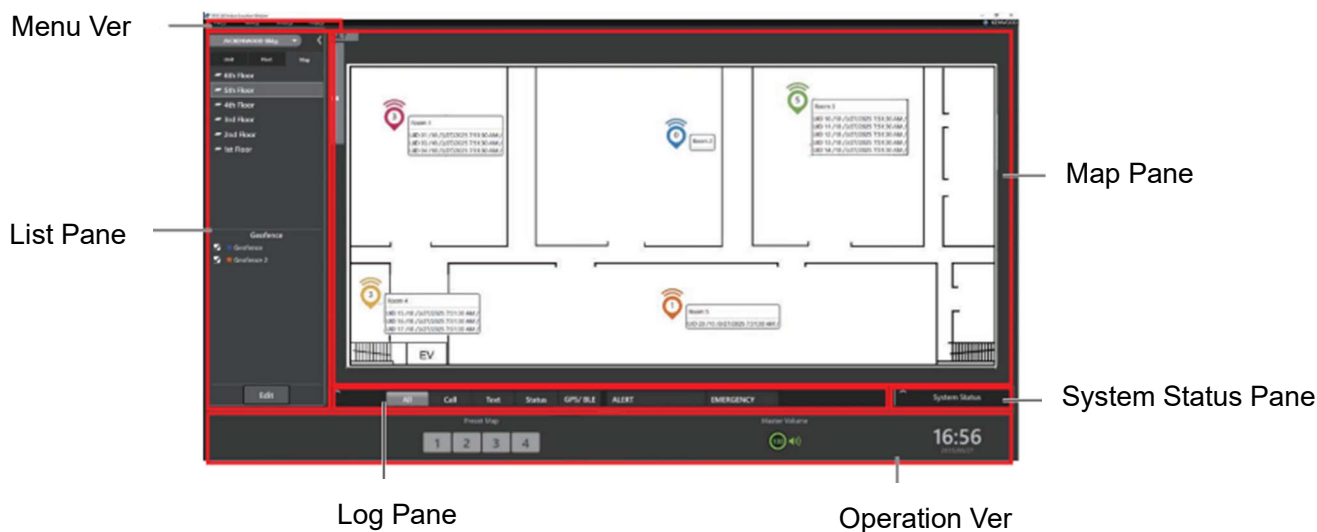
- BLE Beacon : Minew E2 Max
- BLE Gateway : Cassia Networks E1000
- NX-3220
- NXR-1700
- KAS-20SE/CE



3.1. KAS-20E Configuration Method (Indoor Location)

3.1.1. Indoor Location Window

The Indoor Location Window is structured as follows:

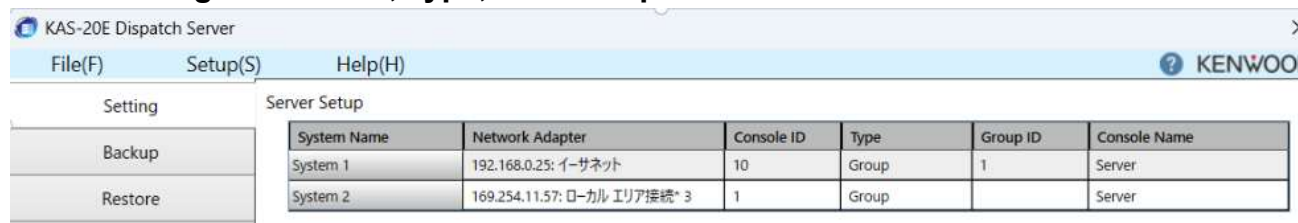


3.1.2. Indoor Location License KWD-20C-IL

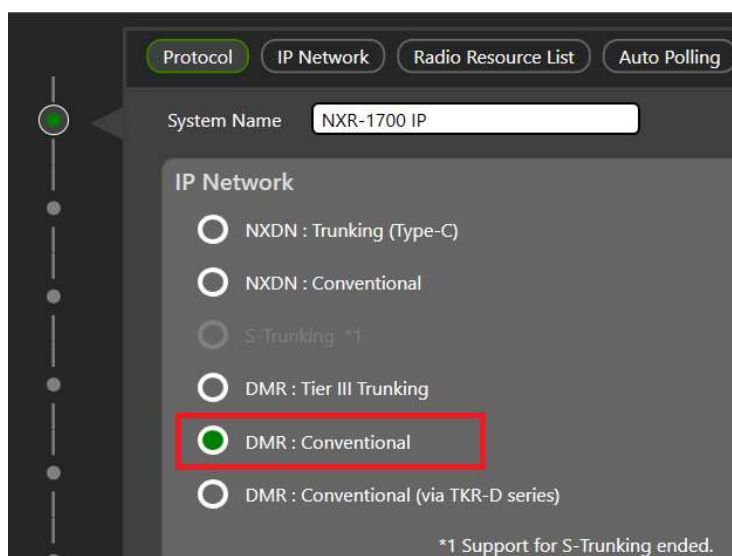
To use Indoor Location, authenticate the INDOOR LOCATION LICENSE (KWD-20C-IL) software option on the PC.

KWD-20C-IL: New License for KAS-20CE to be used Indoor Location Feature

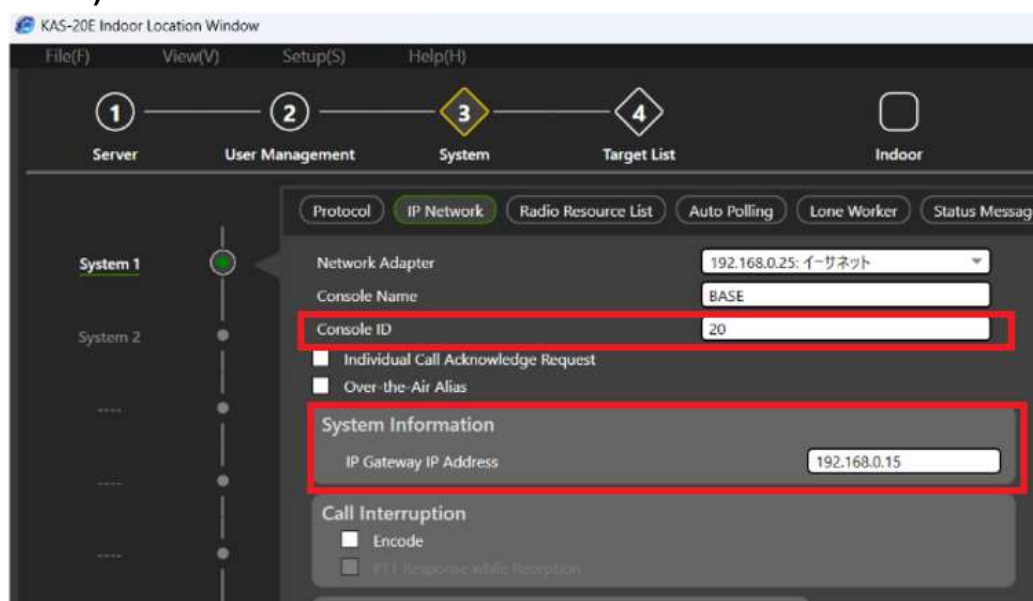
3.1.3. Setting Console ID, Type, and Group ID in KAS-20SE



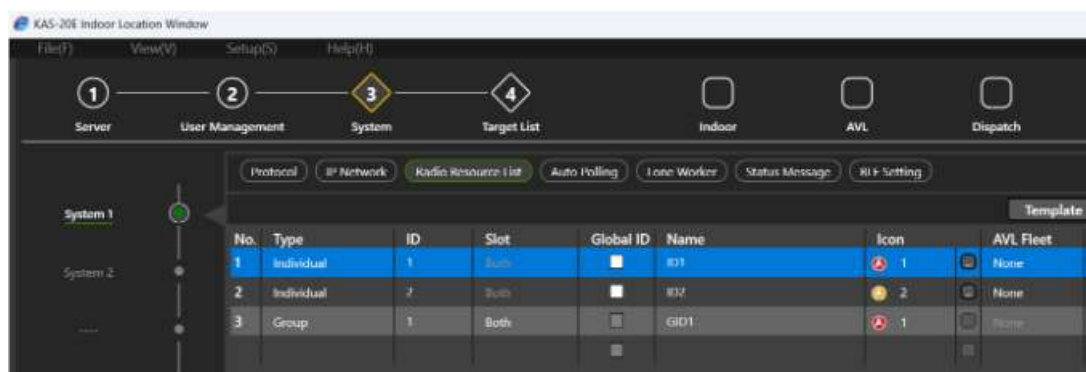
3.1.4. Selecting the Protocol in KAS-20CE (SetUp>Setting>System>Protocol)



3.1.5. Setting Console ID and IP Gateway IP Address (Setup>Setting>System>IP Network)



3.1.6. Registering Radios in the Radio Resource List (Setup>Setting>System>Radio Resource List)



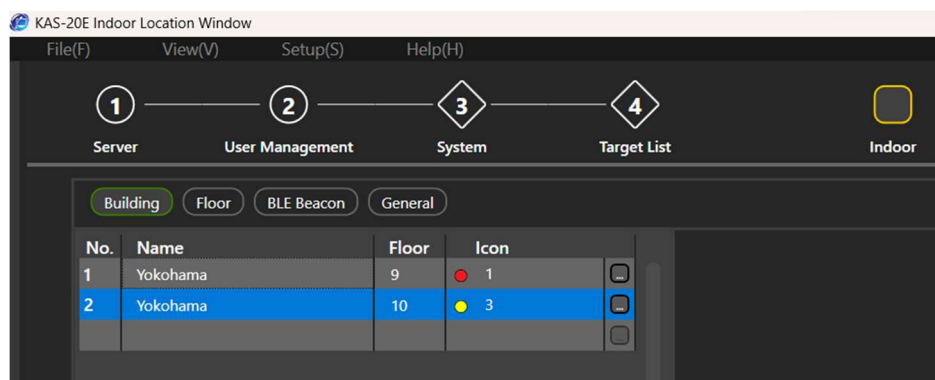
<MAP Setting>

3.1.7. Building Setting(Setup>Setting>Indoor>Building)

Configure Buildings. You can assign a name and an icon to each building.

When buildings are configured, their names and icons will be displayed on the AVL and Indoor Location screens.

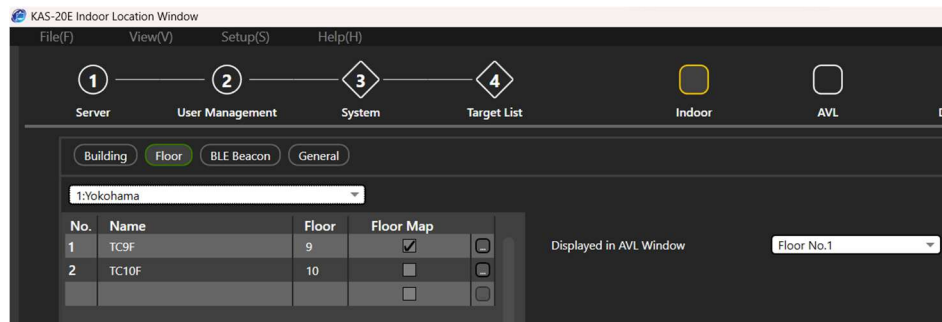
Up to a total of 20 floors can be registered across all buildings.



3.1.8. Floor Setting(Setup>Setting>Indoor>Floor)

Configure Floors. You can add floors to a building, assign names to each floor, and associate a floor map with them.

When floors are configured, their names and floor maps will be displayed on the Indoor Location screen.



3.1.9. Floor Map Options(Setup>Setting>Indoor>Floor>...)

Configure the Floor Map. The Floor Map configuration window is displayed when clicking the "..." button under Setting > Indoor > Floor > Floor Map.

You can add or delete floor maps. To set a point, select either Point 1 or Point 2, enter the latitude and longitude, and click on the image to place the point.

The maximum supported image size is 5120 pixels wide by 5120 pixels high, with a maximum file size of 5 MB.

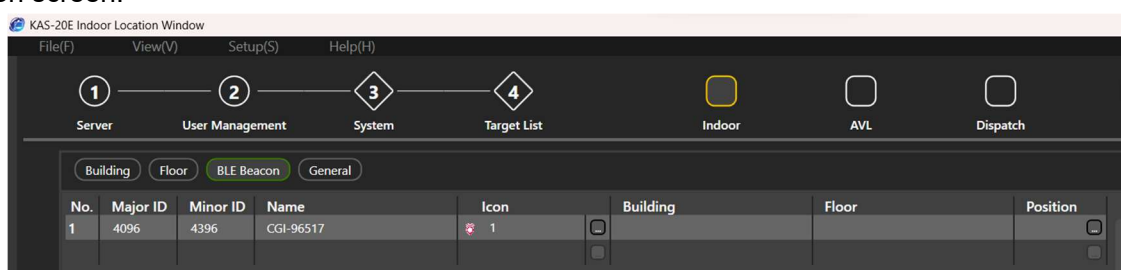


3.1.10. BLE Beacon(Setup>Setting>Indoor>BLE Beacon)

Configure BLE Beacons.

Add BLE beacons to a floor and set their Major ID, Minor ID, name, and icon.

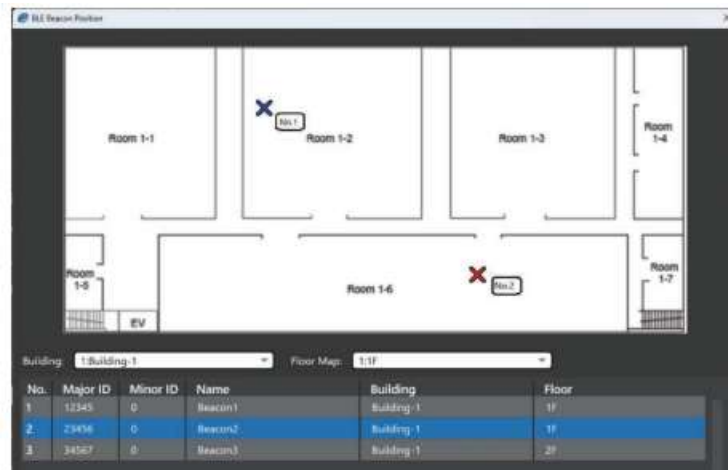
Once configured, the beacon's name, icon, and position will be displayed in logs and on the Indoor Location screen.



3.1.11. BLE Beacon Position(Setup>Setting>Indoor>BLE Beacon>Position...)

When you click the Position button, the BLE Beacon Position dialog box will appear.

In the BLE Beacon Position dialog box, you can select the beacon number to configure and then click on the floor image to set the point.



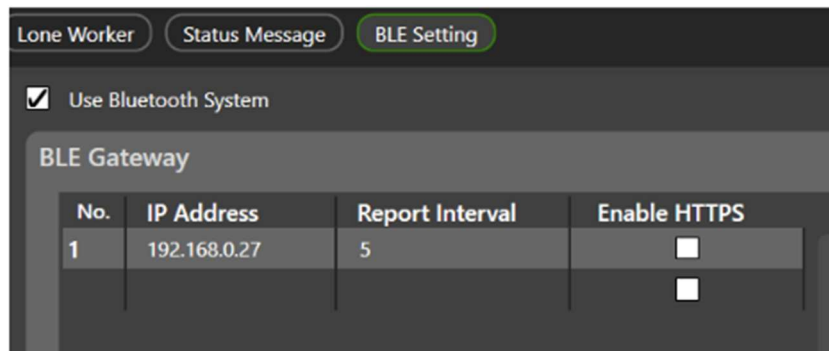
3.1.12. BLE Gateway (Bluetooth System only) (Setup>Setting>System>Radio Resource List)

When using the Bluetooth System, check the "Use Bluetooth System" option and enter the IP address configured in the BLE Gateway (see section 3.3.5 Wired (Basic Tab)).

Report Interval: Allows you to set the reporting interval from the BLE Gateway.

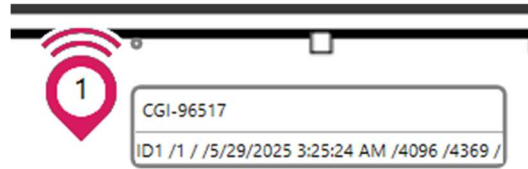
Enable HTTPS: Enables or disables HTTPS for the BLE Gateway.

*When secure communication via HTTPS is enabled on the BLE Gateway, activating this feature allows the KAS-20E to also communicate using HTTPS.

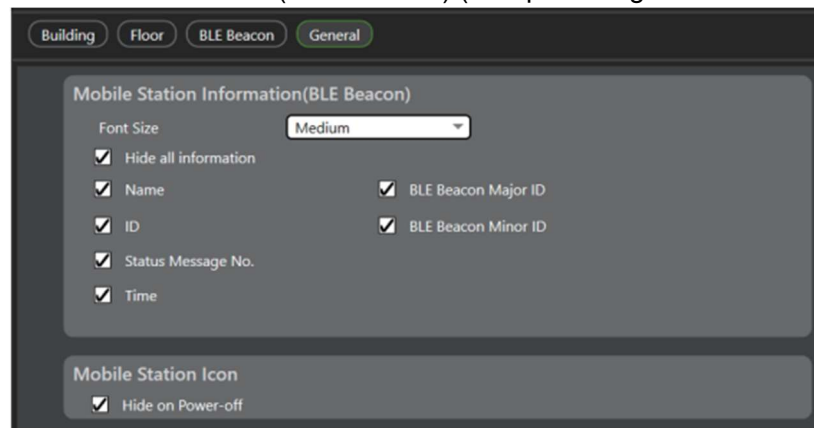


3.1.13. Displaying Mobile Station Information

Depending on the Mobile Station Information (BLE Beacon) settings in the Indoor Location Window, detailed information about the number of received IDs will be displayed near the BLE Beacon icon. This information can also be viewed in the Log pane (GPS/BLE Report must be checked in the Log Filter Settings).



<Mobile Station Information(BLE Beacon) (Setup>Setting>Indoor>General)>



<Log Filter Setting (Setup>Setting>Log)>



<Log Pane>

All Call Text Status GPS/ BLE ALERT EMERGENCY					
Date and Time	From	To	Type	Result	Activity
2025/06/10 9:03	ID1		BLE		4096 4369 -59 -68
2025/06/10 9:03	ID1		BLE		4096 4369 -59 -70
2025/06/10 9:03	ID1		BLE		4096 4369 -59 -68
2025/06/10 9:03	ID1		BLE		4096 4369 -59 -67
2025/06/10 9:03	ID1		BLE		4096 4369 -59 -58
2025/06/10 9:03	ID1		BLE		4096 4369 -59 -68

3.2. Radio/Repeater Configuration (Referring to NX-3000/NXR-1000)

3.2.1. Indoor Location License KWD-3020-IL (Radio)

To use Indoor Location, authenticate the INDOOR LOCATION LICENSE (KWD-3020-IL) radio option on the radio, and enable Indoor Location (KWD-3020-IL) using the FPU.

Product Information

Model Name: NX-3200 (Portable) K3/F3

Frequency: 136-174 MHz

Configuration Alias:

Configuration Tag:

Read Product Information

NXDN

- ☐ NXDN Conventional (KWD-3500CV)
- ☐ NXDN Conventional (KWD-3200CV)
- ☐ NXDN Type-C Trunking (KWD-3501TR)
- ☐ NXDN Type-C Trunking (KWD-3201TR)

DMR

- ☒ DMR Conventional (KWD-3500CV)
- ☐ DMR Conventional (KWD-3301CV)
- ☐ S-Trunking (KWD-3501TR) *1
- ☐ S-Trunking (KWD-3301CV) *1
- ☐ Trunking 2.5 (KWD-3501TR)
- ☐ DMR Tier III Trunking (KWD-3302TR)
- ☐ Fleet Dialing Plan

*1 Support for S-Trunking ended.

Security

- ☐ AES/DES Advanced Encryption (KWD-3503AE)
- ☐ DES Encryption (KWD-3505DE)
- ☐ Enhanced Encryption (KWD-3502EE)

Features

- ☐ 1000 Channel(KWD-3000CH)
- ☒ Bluetooth Data (KWD-3002BT)
- ☐ Remote Control (KWD-3504RC)
- ☐ Front Panel Program (KWD-3001FP)
- ☐ OTAP
- ☒ Indoor Location (KWD-3020-IL)

Selected Model Image

OK Cancel

3.2.2. Built-in Device Activation (Radio Configuration>Global Options>Basics>GPS/Bluetooth)

To use Bluetooth features such as Indoor Location, you must enable Built-in Device Activation in the FPU.

Basics

General Audio/Indicator Display/Language Stack/Recording GPS/Bluetooth OST Task Request

☒ Built-in Device Activation

Preset Activation

- ☐ GPS
- ☒ Bluetooth

GPS

GPS Position Display

- ☒ Latitude and Longitude
- Format: ddd mm.mmm
- ☐ Altitude
- Unit: Meter

GPS Data

- ☐ GPS Data Storage
- Interval [s]: 60

Bluetooth

- ☒ Bluetooth Discoverable
- Define Bluetooth Device
- Address: 00.00.00.00.00.00
- Fixed PIN: 0000
- Bluetooth Headset Connection Type: Headset 1
- ☐ BLE Scan Preset

3.2.3. Beacon List (Radio Configuration>Global Options>Indoor Location>General)

Among the beacon data received by the radio, only data with UUIDs registered in the Beacon List will be used.

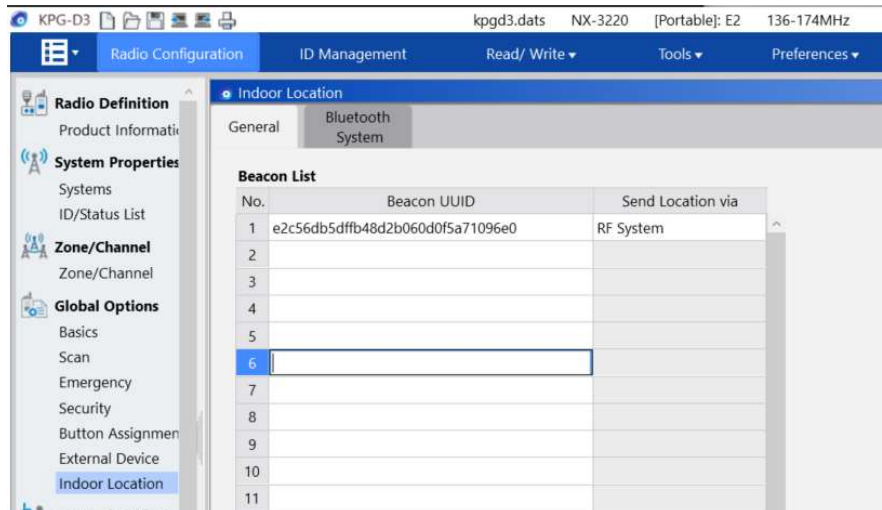
For each beacon, you can choose the communication method: RF System or Bluetooth System.

RF System: Sends BLE data via RF.

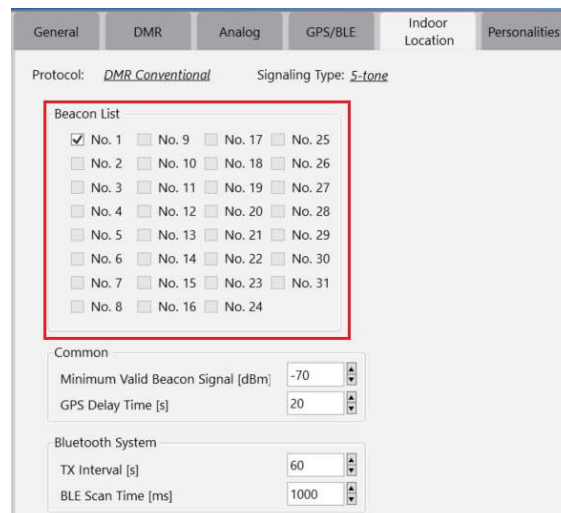
Bluetooth System: Sends BLE data via Bluetooth.

Enter the beacon's UUID into the Beacon UUID field in the Beacon List.

(Radio Configuration>Global Options>Indoor Location>General)



Then, go to the System Settings screen and check the box for the beacon you want to use in the Beacon List. (Radio Configuration > System Properties > Systems > Indoor Location > Beacon List).



3.2.4. Base Station ID (RF System only) (Radio Configuration > System Properties > Systems > GPS/BLE>Base Station)

The Base Station ID is a dedicated destination ID for BLE data.

It is configured for radio in the Indoor Location system and is used with the RF System method.

The setting value is shared with the GPS Base ID, and both operate using the same configuration.

3.2.5. BLE Report Mode (RF System only) (Radio Configuration>System Properties>Systems>GPS/BLE>GPS/BLE Report Mode)

BLE Report Mode is a function that allows you to configure whether BLE data is sent automatically or only after a request is received.

It is configured for mobile stations in the Indoor Location system and operates using the RF System method.

The setting value is shared with GPS Report Mode, and both operate using the same configuration.

•Poll

When a BLE data request is received via Air, the radio will automatically transmit BLE data the number of times specified in the Number of Times setting.

The Number of Times setting for GPS and BLE operates using the same configuration.

- Auto

The radio transmits BLE data at intervals specified by the BLE Report Interval Time setting.

This is useful for regularly sending location data to enable time-based vehicle tracking and monitoring.

General DMR Analog GPS/BLE Indoor Location Personalities

Protocol: *DMR Conventional* Signaling Type: *5-tone*

Base Station

ID Type: Group ID

ID: 1

GPS/BLE Report Mode: Auto

Poll

Number of Times: 1

☐ Respond to Polling ID

Auto

GPS/BLE Report Interval Time [s]: 180

☐ GPS Distance Change

GPS/BLE Combination

☐ Status

Combination Status Range: 0 - 1023

☐ Emergency

3.2.6. Send the Location Data (RF System only)

Send the Location Data is a function that allows the user to manually transmit the radio's location information by pressing a button.

Either BLE data or GPS data is sent, with BLE data being prioritized when a valid beacon signal is received.

This function is configured for mobile stations in the Indoor Location system and operates using the RF System method.

3.2.7. Bluetooth System (Bluetooth System only) (Radio Configuration > System Properties > Systems > Indoor Location>Bluetooth System)

TX Interval [S]: When operating in Bluetooth System mode, if the same beacon data as previously transmitted is continuously received and is eligible for transmission, the radio will retransmit the same beacon data after the TX Interval time has elapsed.

For different beacons, the data is transmitted periodically using the advertising function.

BLE Scan Time: This function sets the duration of BLE scanning while operating in Bluetooth System mode.

BLE Scan Time is configured for mobile stations in the Indoor Location system and determines how long the radio performs BLE scanning.

After the scan ends, the radio checks the beacon data stored in internal memory. If any beacon data meets the advertising transmission conditions, the radio switches to advertising mode. If not, BLE scanning continues.

The screenshot displays the 'Indoor Location' configuration window. At the top, there are tabs for 'General', 'DMR', 'Analog', 'GPS/BLE', and 'Indoor Location'. The 'Indoor Location' tab is selected. Below the tabs, the 'Protocol' is set to 'DMR Conventional' and the 'Signaling Type' is '5-tone'. A 'Beacon List' section contains a grid of checkboxes for beacons numbered 1 through 31, with 'No. 1' checked. Below this, the 'Common' section includes 'Minimum Valid Beacon Signal [dBm]' set to -70 and 'GPS Delay Time [s]' set to 20. The 'Bluetooth System' section, highlighted with a red rectangle, contains 'TX Interval [s]' set to 10 and 'BLE Scan Time [ms]' set to 500.

3.2.8. BLE Scan

BLE Scan is a function that allows the radio to scan signals from beacon transmitters.

During BLE scanning, if the radio receives a beacon signal with a UUID registered in the Beacon List and a signal strength greater than the Minimum Valid Beacon Signal setting, the beacon data is stored in the radio's internal memory.



<Radio Configuration>System Properties>Systems>GPS/BLE>GPS/BLE Report Mode>

 A screenshot of a software configuration window. At the top are tabs: General, DMR, Analog, GPS/BLE (selected), Indoor Location, and Personalities. Below the tabs, it says 'Protocol: DMR Conventional' and 'Signaling Type: 5-tone'. A 'Beacon List' section contains a grid of checkboxes for 31 beacon numbers (No. 1 to No. 31). Checkboxes for No. 1 and No. 2 are checked. Below this is a 'Common' section with two fields: 'Minimum Valid Beacon Signal [dBm]' set to -70 and 'GPS Delay Time [s]' set to 20. The -70 field is highlighted with a red rectangle.

3.2.9. BLE Beacon Display

BLE Beacon Display can be assigned to a key on the radio device and is a function that displays information from received beacons on the radio's LCD screen while the Indoor Location feature is active.



UUID: The list number of the UUID configured in the Beacon List

R: RSSI value (dBm) indicating the signal strength when the beacon data was received

M: Measured Power value (dBm) contained in the beacon data

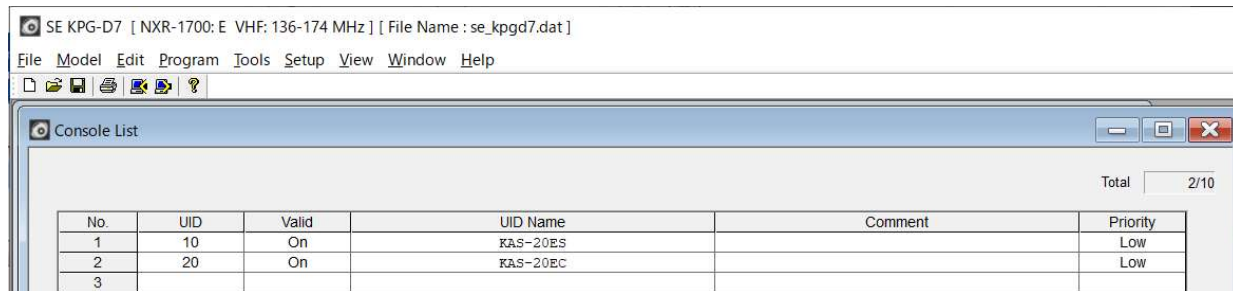
Major: Major value contained in the beacon data

Minor: Minor value contained in the beacon data

<NXR-1000 (DMR)>

3.2.10. Console List (Repeater)

Register the ID for KAS-20SE/CE.



3.3. Device Initial Setup Procedure

This section explains how to perform the initial setup of the BLE Gateway.

3.3.1. Power On the E1000

Turn on the E1000/X1000/X2000 device, then press and hold the RESET button for approximately 5 seconds. Please refer to the image below for the location of the RESET button.



3.3.2. Connect to the SSID

Since the Cassia Router supports Wi-Fi hotspot functionality, approximately one minute after pressing the RESET button, the SSID 'cassia-xxxxxx' (where 'xxxxxx' represents the last six characters of the router's MAC address) will appear in your PC's list of available wireless networks.

By connecting to this SSID, you will be able to configure the router settings.

(a) SSID: cassia-xxxxxx (where 'xxxxxx' is the last six characters of the router's MAC address)

(b) Password: cassia-xxxxxx (same as above)

3.3.3. Connect to the Device from the PC

After completing the above connection, launch a web browser on your PC (Google Chrome is recommended) and access the IP address 192.168.40.1 to set the password. ('xxxxx' can be any value of your choice.)

Old password: admin

New password: xxxxx

Confirm password: xxxxx

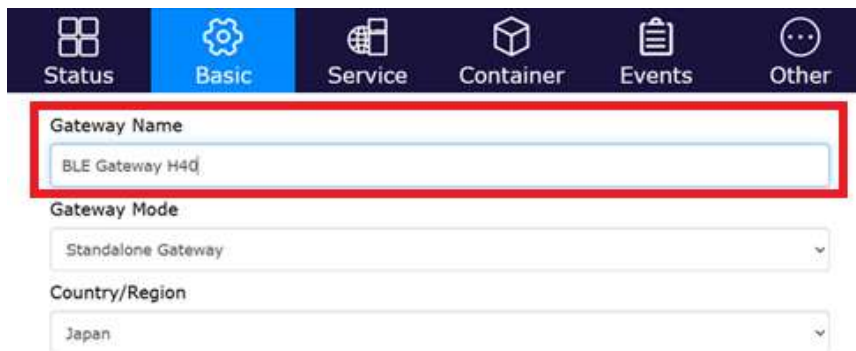
After completing the above settings, please proceed to log in.

The default username is 'admin'.

<Router Network Configuration>

3.3.4. Gateway Name

Set the Gateway Name (customizable).



The screenshot shows the 'Basic' configuration tab. At the top, there is a navigation bar with icons for Status, Basic (selected), Service, Container, Events, and Other. Below the navigation bar, the 'Gateway Name' field is highlighted with a red rectangular box and contains the text 'BLE Gateway H4d'. Below this field, the 'Gateway Mode' dropdown menu is set to 'Standalone Gateway'. At the bottom, the 'Country/Region' dropdown menu is set to 'Japan'.

3.3.5. Gateway Mode(Basic Tab)

If you are using the router as a standalone device, please select 'Standalone Gateway'.

Note that changing this setting will trigger a reboot.



This screenshot is similar to the previous one, showing the 'Basic' configuration tab. The 'Gateway Name' field still contains 'BLE Gateway H4d'. In this image, the 'Gateway Mode' dropdown menu is highlighted with a red rectangular box and is set to 'Standalone Gateway'. The 'Country/Region' dropdown menu remains set to 'Japan'.

3.3.6. Wired(Basic Tab)

Example: Router IP Address: 192.168.0.27 / Netmask: 255.255.255.0 / Gateway: 192.168.0.1 / DNS: 192.168.0.1

You can specify the wired IP address of the router.

For IP allocation, you can choose either DHCP or Static.

If selecting Static, enter the values for each field manually.



Wired

IP Allocation

Static

IP

192.168.0.27

Netmask

255.255.255.0

Gateway

192.168.0.1

DNS1

192.168.0.1

DNS2

3.3.7. Click 'Apply' to save the settings.

After completing the above settings, click the 'Apply' button to save the changes.

3.3.8. Confirming BLE Gateway Functionality

Replace the IP address below with the IP address assigned to the BLE Gateway, and verify whether data is being received.

http://192.168.0.27/gap/nodes?event=1&report_interval=10000

4. Revision History

Version	Date of issue	Note
1.00	27.Oct.2025	First edition