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SPARROW ASSET TRACKER

User Guide

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Contents

1 Product Description

1.1 Overview

SPARROW device provides reliable asset tracking by utilizing periodic BLE scanning to collect data from nearby BLE peripherals to determine device location, or to act as a broadcasting BLE peripheral beacon.

SPARROW is connected via LoRaWAN, enabling seamless transmission and reception across various frequency bands: EU868, IN865, and US915.

This document provides comprehensive descriptions of SPARROW, along with detailed guidance on their hardware capabilities. For insights into the functional operation and software behavior of each variant, please consult the Technical Reference Manual (TRM) document.

Table 1-1 presents all SPARROW supported functions as well as enclosure and mounting options.

Table 1-1: Capabilities of SPARROW

Feature / Transducer	SPARROW	
		
Operating Environment	Indoor (IPX0)	
Battery	1XAA	
Reset Button	✓	
Activity LEDs	✓	
Battery Gauge	✓	Fuel gauge for the LTC batteries that can provide accurate results with ultra-low average power consumption.
BLE Rx/Tx	✓	Low-Energy Bluetooth scanning for indoor location tracking and reporting of nearby BLE equipped devices to function as a proximity sensor.
Function Button	✓	Pushed for triggering a data report which has configurable type (by default it triggers a BLE scan+report)
Accelerometer	✓	A high-sensitivity device that can measure any shock or movement events. Can be used as an on/off switch for the Tracker to report location data only when motion is detected.
MCU Temperature Sensing	✓	Sensor can report MCU temperature by pressing the function button. The button is not configured to do it by default.

1.2 Specifications

SPARROW specifications are listed in Table 1-2. The main sensing functions are described in the following subsections.

Table 1-2: SPARROW BLE Asset Tracker Specifications.

Parameter	Specification
Environmental Rating	IPX0
Enclosures and Mounting	Custom design by TEKTELIC
Operating Temperature	-40°C to 70°C
Storage Temperature for Optimal Battery Life	-5° to 45°C
Operating Relative Humidity	5% - 95% non-condensing
Storage Relative Humidity	5% - 95% non-condensing
Dimensions	65 mm x 24,5 mm x 26 mm
Weight	28.3 g enclosure + 17.5 g battery = 45.8 g total
Power Source	Battery-powered: 1x AA-cell LTC (3.6 V)
Network technology/Frequency band	LoRaWAN in the following Global ISM bands: EU868, IN865, and US915
Air Interface	LoRa, BLE
Maximum Tx Power	15 dBm (AS923, KR920, EU868) 22 dBm (AU915, IN865, US915)
Sensing Elements	BLE transceiver, Accelerometer, MCU temperature transducer, Battery Gauge
Bluetooth Compatibility	BLE based on Bluetooth 5.3
LoRa RF Sensitivity	Up to -137 dBm (SF12, 125 kHz BW)
BLE Sensitivity (0.1% BER)	125 kbps: -103 dBm 500 kbps: -98 dBm 2 Mbps: -91 dBm
Accelerometer Sensitivity	Sample rate: 1, 10, 25, 50, 100, 200, 400 Hz Measurement range: ±2, ±4, ±8, ±16 *g* Precision: 16, 32, 64, 192 m*g*
Function Button	User-configurable function
User Feedback	Buzzer and vibration motor
LEDs	Green: Joining the network and LoRa Rx Red: LoRa Tx
Battery Gauge Features	Remaining battery capacity and remaining battery lifetime
Battery Lifetime	5.5 years in Tracker mode 16 months in beacon mode

2 Installation

2.1 Included Product and Installation Material

The following items are shipped with each sensor:

- 1x sensor inside an enclosure with AA-cell LTC (3.6 V) battery installed.
- 1x corresponding sensor Quick Start Guide.

NOTE: to ensure safe installation and maintenance please read Safety Precautions.

2.2 Unpacking and Inspection

The following should be considered during the unpacking of a new sensor.

1. Inspect the shipping carton and report any significant damage to TEKTELIC.
2. Unpacking should be conducted in a clean and dry location.
3. Do not discard the shipping box or inserts as they will be required if a unit is returned for repair or re-configuration.

2.3 Commissioning

Each sensor has a set of commissioning information that must be entered into the network server for the sensor to be able to join the network and begin normal operation once activated. For instructions on how to do this please refer to the Network Server Quick Start Guide you get in the box with the device (also available online in the *Knowledge Base*).

2.4 Activation

The sensor is shipped in a secured enclosure with the battery preinstalled in a state of DEEP SLEEP.

To activate the device:

1. Remove the Battery pull tab.
2. Sensor activation will be displayed by LEDs turning on.
3. Once activated, the sensor will automatically begin the join process.

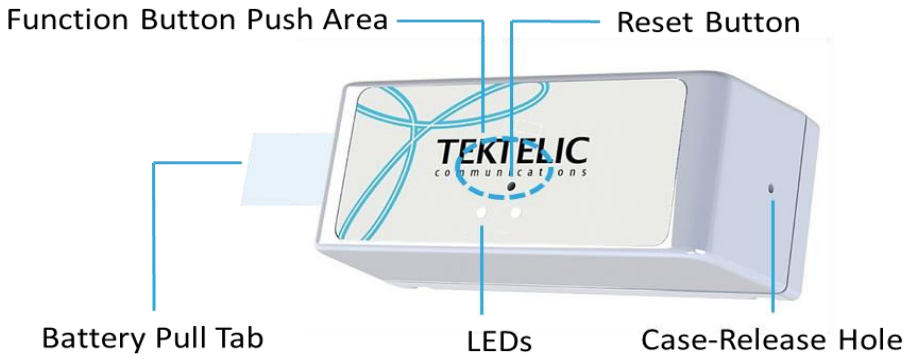


Figure 2-1: SPARROW Enclosure and External Interfacing

2.5 Default Configuration

Table 2-1 lists the default reporting behavior of the SPARROW. Reporting behavior can be changed from default through OTA DL commands (see how to do it in Basic Downlinks section).

Table 2-1: Default Reporting Periods

Reported Data	SPARROW
Battery Status	Every Day
BLE Report	Every Hour
Button Action	causes BLE scan + report
Accelerometer Report	Disabled
MCU Temperature Report	Disabled

2.6 Reconfiguration

SPARROW supports a full range of OTA configuration options. Specific technical details are available in the corresponding TRM documents. All configuration commands need to be sent OTA during the sensor's DL Rx windows.

2.7 Mounting

There is a mounting hole on each corner on the bottom side of the enclosure (see Figure 2-2).

Figure 2-2: The Mounting Hole Locations on the Bottom of the Tracker

These mounting holes can be used to fasten the enclosure to a solid surface, cable, etc. The mounting holes are slots so the device can be secured with ropes, zip ties, or hooks depending on the user's needs. If using cables or zip ties, they can be threaded through both slots on either side of the enclosure as shown in Figure 2-3. The recommended zip tie width is 3 mm. Mounting fasteners are not provided.

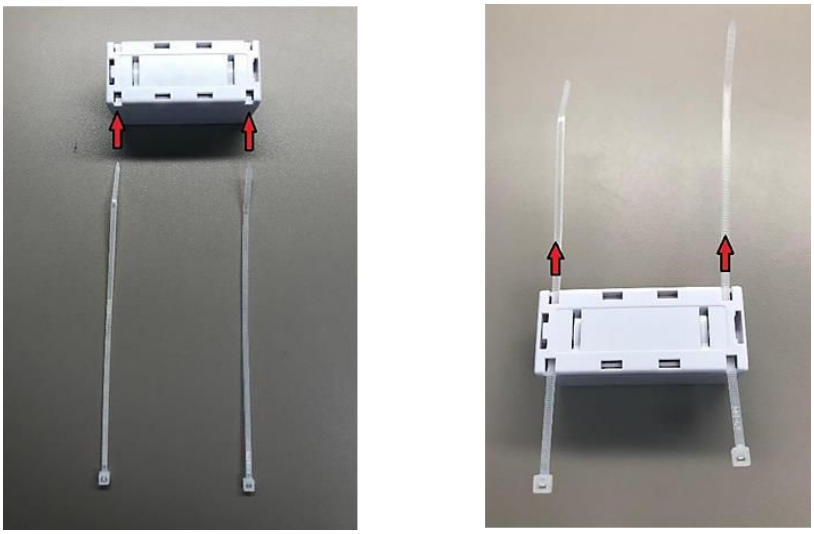


Figure 2-3: Threading Zip Ties Through the Mounting Holes to Fasten the Tracker

2.8 Battery Replacement

To replace the battery:

1. Insert the end of a paper clip or similarly thin object into the case-release hole on the right side of the Device (see Figure 2-4).

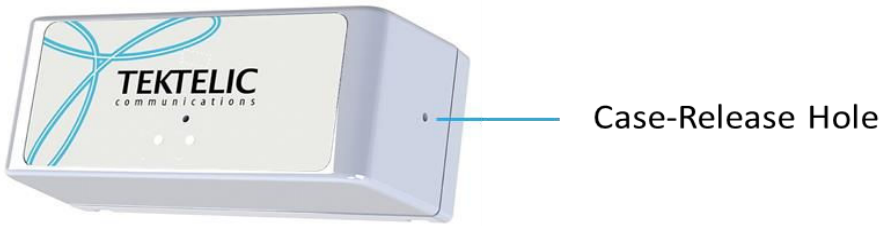


Figure 2-4: Removing the Battery Cover Screws

2. Push the paper clip straight in while simultaneously squeezing the middles of the sides of the enclosure. The top and bottom should unclip from each other and separate.
3. Remove the battery and replace with a new one as shown in Figure 2-5. Suggested replacement batteries are:
    - Saft SA LS14500
    - Tadiran SL-360/S

- Tadiran TL-4903/S
- Tadiran TL-5903/S
- Xeno Energy XL-060F STD

4. Replace the bottom enclosure piece by inserting the side with the long snap tab first, as shown in Figure 2-5. Push the other side of the bottom enclosure piece in until both the top and bottom fully snap together.

Figure 2-5: Proper Replacement Orientation of the Battery Cover

2.9 Reset Function

To physically reset SPARROW**:**

1. Push by a pin, such as a paper clip on a designated Reset Button as Figure 2-6.
2. Instant restart of the microprocessor will begin.
3. Once activated, the sensor will automatically begin the join process.

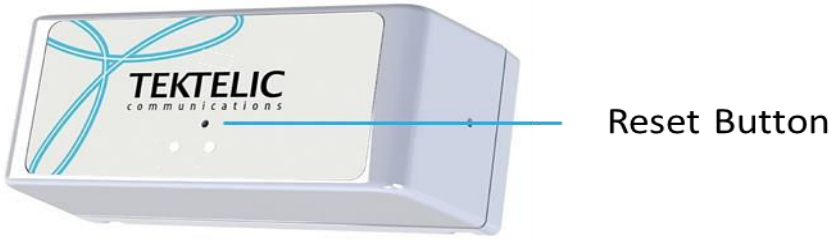


Figure 2-6: Reset Button

NOTE: Shutting down or resetting the device will cause all unsaved user configurations to be lost. Save the desired configuration to the device flash before powering off or resetting.

2.10 Function Button

There is an externally-accessible function button on the device as in Figure 2-7. The button should not be pushed hard. Pushing button will trigger the device to send BLE scan and report UL that will open receive windows to receive DL commands.

Figure 2-7: Function Button Push Area

The definition of when a push button event is registered is user configurable:

Table 2-2: Function Button Configuration

Configuration	Default Value	Possible Values
Button push time	1 second	1-15 seconds
Button push pattern	1 push	1-15 pushes, or press and hold
Uplink report type	BLE scan results (tracker mode) Battery report (beacon mode)	battery data, acceleration vector, MCU temperature, BLE scan results, or any combination of these

2.11 RF LED Behavior

The LEDs are normally off and the main patterns are summarized in Table 2-3. The detailed sequence and timings for each are described in the following subsections.

Table 2-3: Summary of LED Patterns

LED Pattern	Meaning
GREEN blinking rapidly and **RED** flashes	Join mode; attempting to join the network
Single **RED** flash	UL sent
3 quick **RED** flashes	Entering Deep Sleep
Single **GREEN** flash during normal operation	DL received

3 Sensing Functions

3.1 Bluetooth Low-Energy (BLE) Scanner

SPARROW is equipped with a BLE module that is embedded in the MCU. It serves as a BLE central device that periodically searches to discover nearby BLE peripherals. It can be used for positioning and also has a proximity sensor.

Each scan has a configurable scan duration and configurable duty cycle. Increasing either of these will increase the likelihood of detecting nearby BLE devices, but at the expense of decreased battery life. The scan period, duration, interval, and window are all configurable (see the TRM document for configuration details).

After each scan, up to *n* (configurable number) discovered BLE devices with the strongest RSSIs are reported over LoRaWAN. If no devices are found, an empty list is uplinked. If BLE device is observed more than once, the RSSI associated with the BLE device at the end of the scan duration is the average value over all observed RSSIs. Averaging is default behaviour and can be disabled.

The Tracker supports BLE of Bluetooth 5.3. The BLE scan is performed in the passive mode only, i.e. the Tracker listens for surrounding BLE devices, but does not transmit to them.

NOTE: The BLE scan is exclusive to LoRa radio transmission. If any reporting becomes due at the same time of a BLE scan, the reporting will be done after the BLE scan is complete.

3.2 Accelerometer Transducer

SPARROW supports motion sensing through an integrated 3-axis accelerometer which can optionally be disabled. The main role of the accelerometer is to detect motion that can indicate a change of the sensor's status from stillness to mobility and back.

The accelerometer generates an acceleration alarm when a motion event is detected that may be reported OTA (user-configurable). An acceleration event report is based on exceeding a defined acceleration alarm threshold count in a defined alarm threshold period. These thresholds can be customized such that there will not be multiple reports for a single event. An alarm event can only be registered after a configurable grace period elapses since the last registered alarm event.

The accelerometer can also be polled periodically for its output acceleration vector for applications in which the sensor's orientation is of interest.

3.3 Temperature Transducer

SPARROW can measure and report the MCU temperature. This is a temperature measurement using a transducer located in the device microprocessor. It can only be reported periodically or if the function button is configured to do it (not configured by default).

4 Basic Downlinks

SPARROW uses a "tick" system for reporting data. Generally, the sensor will report most important data every tick. A tick can be measured in seconds.

There are two sets of settings that must be configured in conjunction - "Core reporting tick in seconds" and "Ticks per [data/report]".

"Core reporting tick in seconds" will determine the interval between ticks. For example, you may set it to 30 seconds or 180 seconds (3 minutes) for each tick.

"Ticks per [data/report]" determines how many ticks it will take before the sensor reports any data. For example, if you set "Ticks per Battery report" to 2, it will take 2 ticks before the sensor reports battery data.

To Change the Core Report To Every Minute

With ATLAS: check the box for Core report tick in seconds and Tick per Temperature report. Write the values shown in the Figure 5-1 and click send.

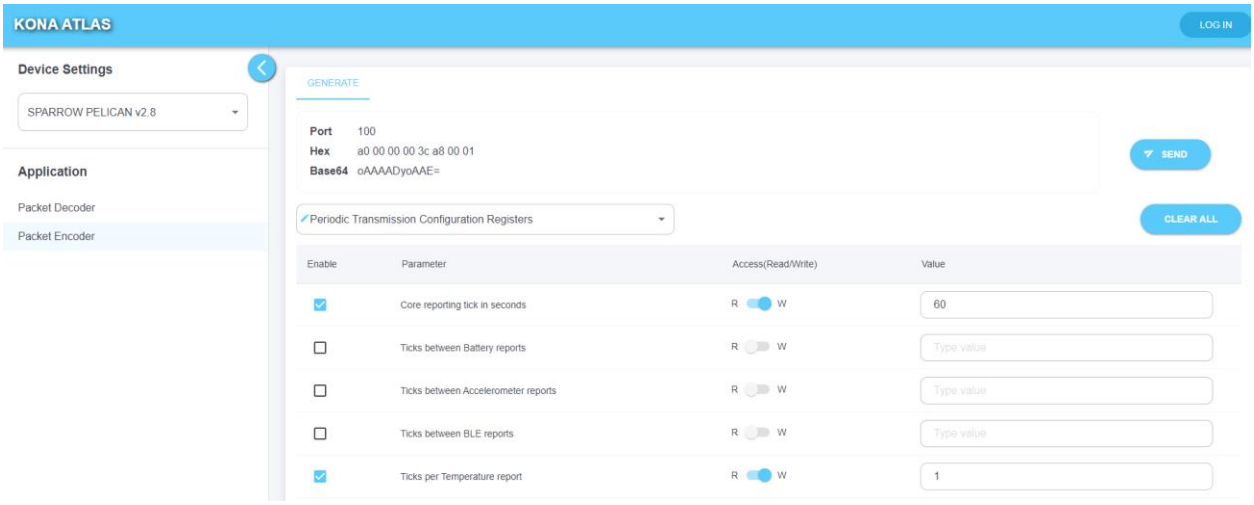


Figure 5-1: ATLAS

Examples Of Uplinks

0x 00 67 00 EB

Channel ID = 0x 00, Type ID = 0x 67 → MCU temperature data report

0x 00 EB = 235 × 0.1°C = 23.5°C

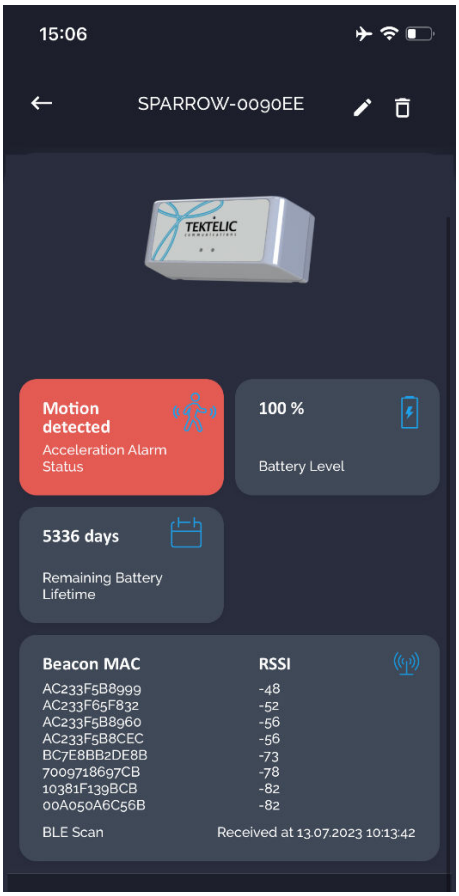
0x 0A 64 7F DA 00 00 01 C9

Header = 0x 0A → basic BLE data report

0x 64 7F DA 00 00 01 = BDADDR = 64:7F:DA:00:00:01

0x C9 = RSSI = -55 × 1 dBm = -55 dBm

View from Leapx



5 Device Configuration with ATLAS

To perform more configuration and read the data of the SPARROW device you can use TEKTELIC's complementary service ATLAS.

There are two ways to access ATLAS:

1) using in Offline mode

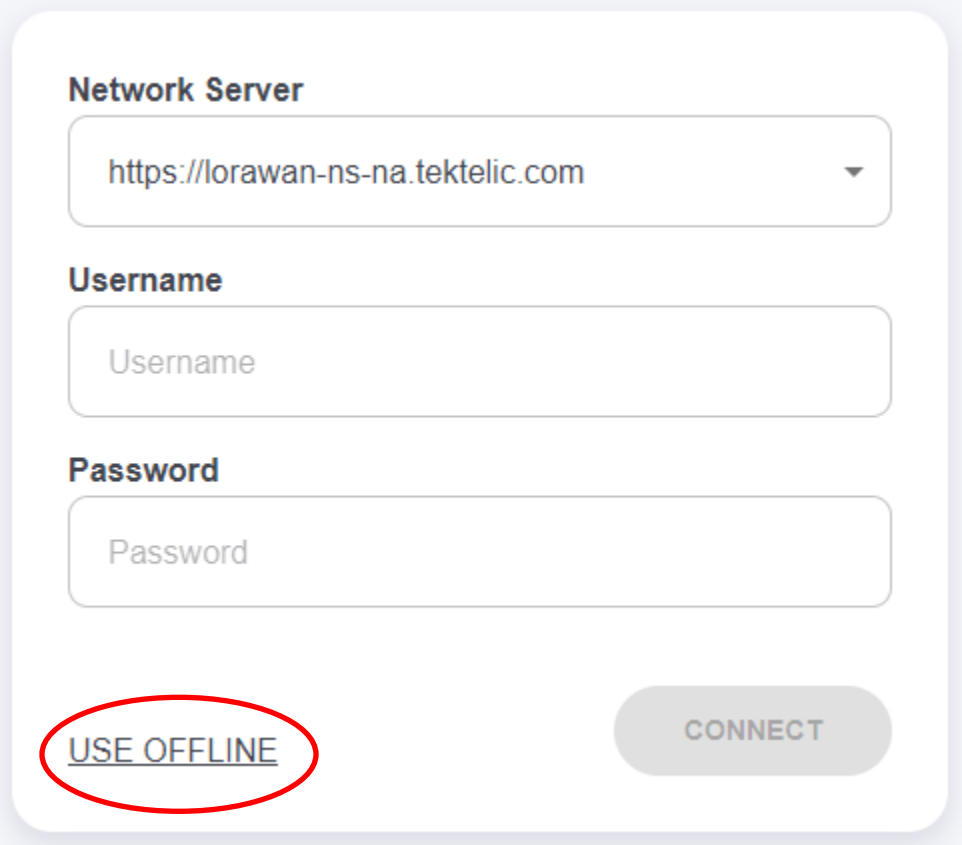


Figure 5-2: Login as offline mode

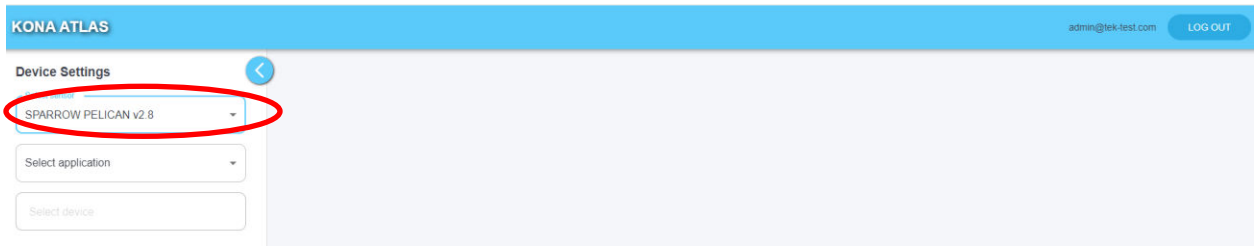


Figure 5-3: Select SPARROW decoder

2) with your TEKTELIC Network Server Credentials

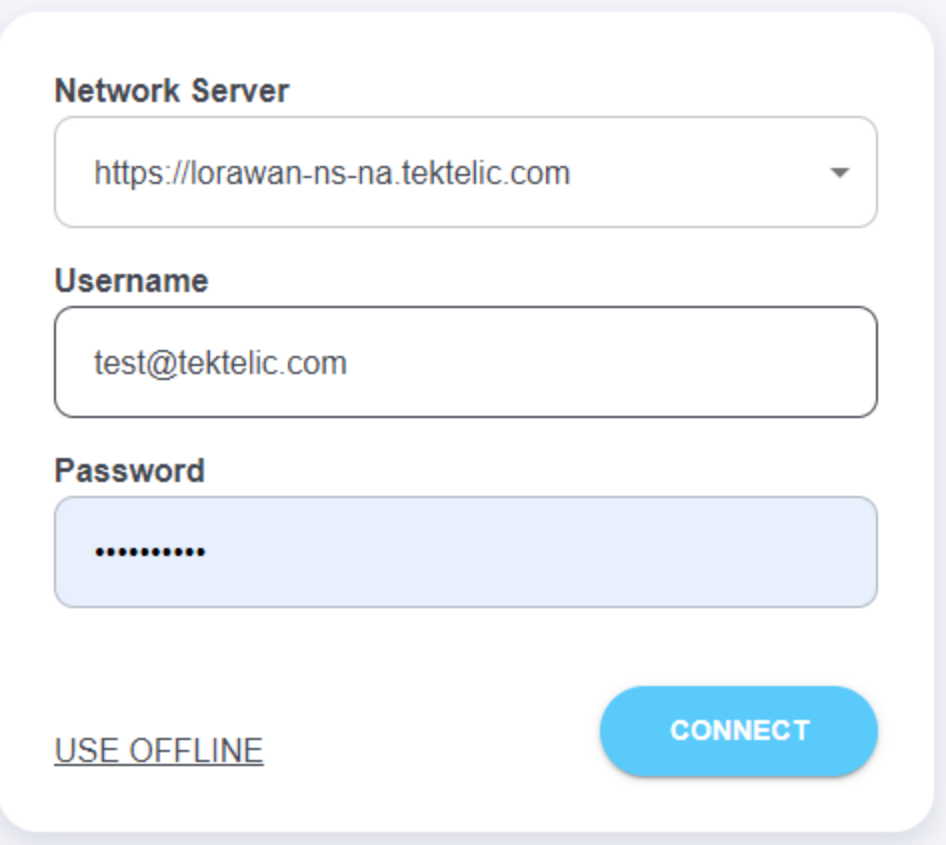


Figure 5-4: Login with Network server credentials

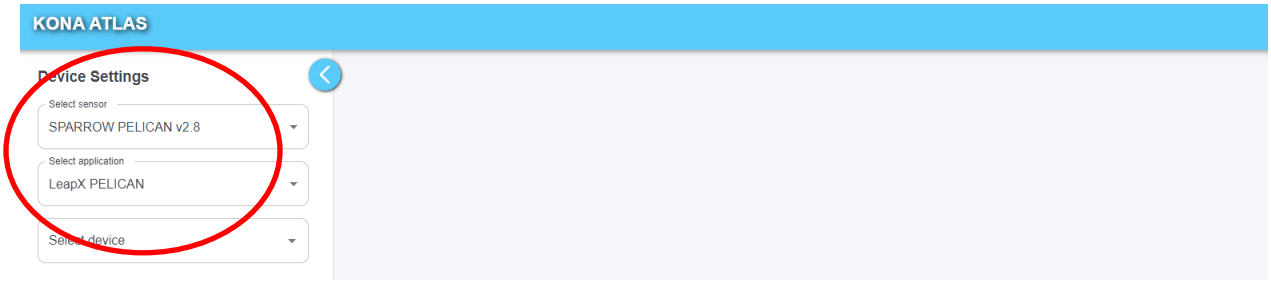


Figure 5-5: Select SPARROW Decoder, application and the device

For more information follow this link https://knowledgehub.tektelic.com/kona-atlas

6 Data converters

Please follow this link: https://github.com/TektelicCommunications/data-converters/tree/master for the data converters that are to be used on TEKTELIC & other Network Server for TEKTELIC Sensors. These data converters can be used as a reference for nother platforms.

TEKTELIC's data converters conform to the LoRa Alliance Payload Codec Specification and can be used with any 3rd party Network Server / Application Server that supports this specification.

https://resources.lora-alliance.org/technical-specifications/ts013-1-0-0-payload-codec-api

7 Locus

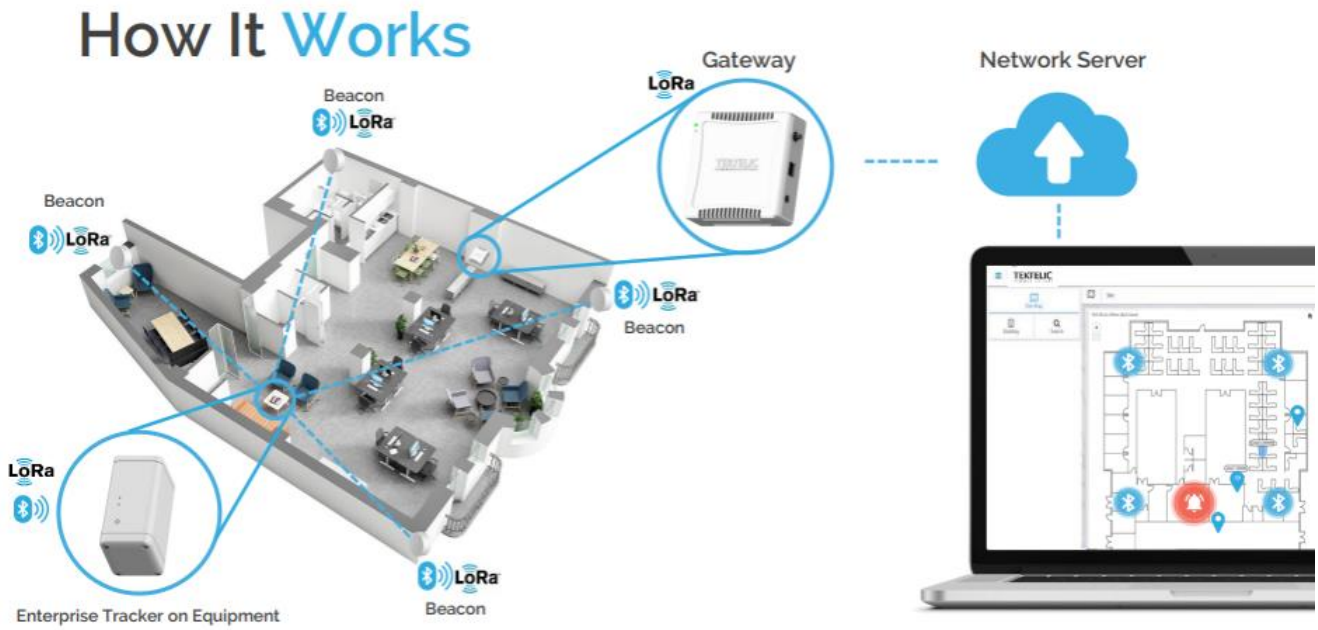
Locus is an application to track and monitor all assets in your network, including indoor, outdoor, and hazardous location asset tracking. Assets can be tracked across entire campuses, multiple buildings, and floors. For more detail about Locus please visit [Locus Application Documentation]

Application capabilities:

- Self managed floor plan/map loading
- User management – permission levels
- Geofencing & alerts
- API to customer database integration
- Support of multiple campuses, buildings & floors
- Device management/battery status
- Integrated to enterprise SAP

7.1 Operation principle

Asset tag localization uses RSSI multilateration. The location is determined by the signal strength reported by the BLE beacon in relation to the asset tag, providing precise location accuracy (2-5m).



8 Compliance Statements and Safety Precautions

8.1 Compliance Statements

Federal Communications Commission:

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

To comply with FCC exposure limits for general population / uncontrolled exposure, this device should be installed at a distance of 20 cm from all persons and must not be co-located or operating in conjunction with any other transmitter.

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

Innovation, Science and Economic Development Canada (Industry Canada):

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s) [8]. Operation is subject to the following two conditions:

i. This device may not cause interference, and

ii. This device must accept any interference, including interference that may cause undesired operation of the device.

This device should be installed and operated with minimum distance 0.2 m from human body.

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

(1) L'appareil ne doit pas produire de brouillage.

(2) L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Cet appareil doit être installé et utilise à une distance minimale de 0.2 m du corps humain.

California Proposition 65:

⚠ **WARNING:** This product can expose you to chemicals including lead, nickel, and carbon black, which are known to the State of California to cause cancer, birth defects or other reproductive harm. For more information, go to www.P65Warnings.ca.gov.

8.2 Safety Precautions

The following safety precautions should be observed for all sensor variants:

- All installation practices must be in accordance with the local and national electrical codes.
- Replace only with approved batteries (see section 2.8).
- The following sensor variants are intended for indoor use only: T0006779, T0007380.
- The sensor contains a single LTC AA-cell battery. When used correctly, lithium batteries provide a safe and dependable source of power. However, if they are misused or abused, leakage, venting, explosion, and/or fire can occur. The following are recommended safety precautions for battery usage.
  - **Keep batteries out of the reach of children.**
  - **Do not allow children to replace batteries without adult supervision.**
  - **Do not insert batteries in reverse.**
  - **Do not short-circuit batteries.**
  - **Do not charge batteries.**
  - **Do not force discharge batteries.**
  - **Do not mix batteries.**
  - **Do not leave discharged batteries in equipment.**
  - **Do not overheat batteries.**
  - **Do not weld or solder directly to batteries.**
  - **Do not open batteries.**
  - **Do not deform batteries.**
  - **Do not dispose of batteries in fire.**
  - **Do not expose contents to water.**
  - **Do not encapsulate and/or modify batteries.**
  - **Store unused batteries in their original packaging away from metal objects.**
  - **Do not mix or jumble batteries**

List of Acronyms

BER ..... Bit Error Rate
BLE..... Bluetooth Low-Energy
CNR..... Cahiers des charges sur les Normes Radioélectriques (RSS)
DL ..... DownLink
EOS ..... End Of Service
EU ..... European Union
FCC..... Federal Communications Commission
FW ..... FirmWare
HW ..... HardWare
IoT ..... Internet of Things
IP ..... Ingress Protection
ISM ..... Industrial, Scientific, and Medical
LED ..... Light-Emitting Diode
LoRa ..... Long-Range
LoRaWAN..... Long-Range Wide-Area Network
LoS..... Line-of-Sight
LTC..... Lithium-Thionyl Chloride
MCU ..... MicroController Unit
NA ..... North America
NS ..... Network Server
OTA ..... Over The Air
PCB ..... Printed Circuit Board
PCBA..... Printed Circuit Board Assembly
Rev ..... Revision
RF ..... RadioFrequency
RSS..... Radio Standards Specifications (CNR)
RSSI ..... Received Signal Strength Indicator
Rx ..... Receive, receiver, etc.
SW..... SoftWare
TRM..... Technical Reference Manual
Tx..... Transmit, Transmitter, etc.
UG ..... User Guide
UL ..... UpLink
US ..... United States
v..... Version

Document Revision

Revision	Issue Date	Editor	Comments
0.1	March 3, 2020	Carter Mudryk	• Initial draft based on Industrial • Tracker T0006279_UG v1.2 and • Home Sensor T0006338_UG v1.4. • Additional information taken from • BLE Tracker T0005946_TRM v0.4.
0.2	March 11, 2020	Carter Mudryk	• Minor corrections based on feedback. • Confirmed operational temperature range and battery life. • Corrected temperature transducer from battery gauge to MCU thermometer.
1.0	March 11, 2020	Carter Mudryk	• Confirmed upper operating temperature at 45°C.
1.1	April 6, 2020	Conor Karperien	• Updates to compliance statement and IP change.
1.2	June 4, 2020	Carter Mudryk	• Updated default configuration info based on T0005946_TRM v0.10. • Changed function button and reset button info to reflect accurate button locations.
2	August 6, 2024	Marharyta Yuzefovych	• User friendly format