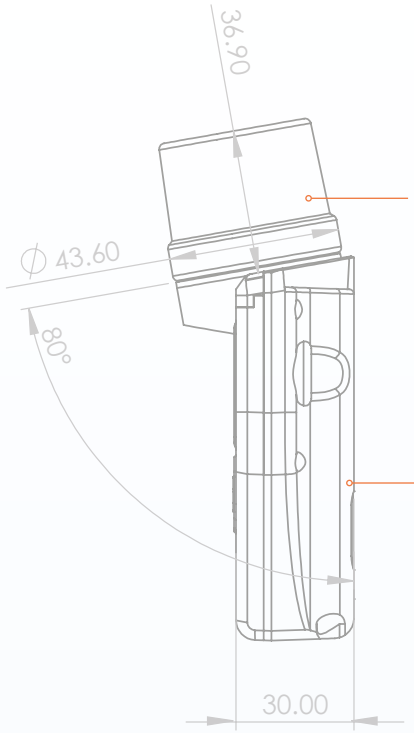
Lightbug

RH2

RTK Handset

Ultra-high accuracy alerting device

Physical Specifications



RTK Antenna

High gain helical L1/L2/L5 antenna is resilient to interference from nearby objects and people.

Angled 10° off vertical to further increase performance when worn or mounted.

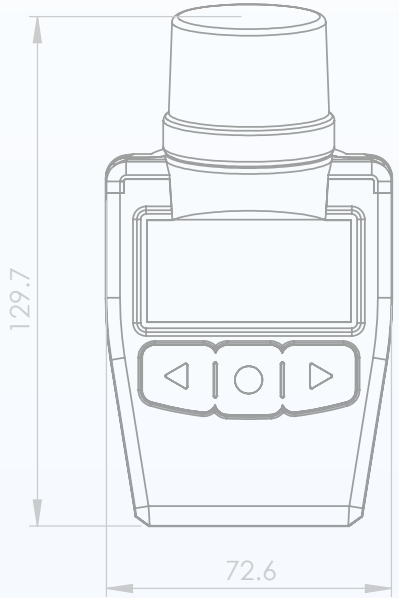
Robust **Enclosure**

IP67, Fire-proof, Shock Proof, UV-stable

Polycarbonate-ABS

95 x 72.6 x 30 mm without antenna

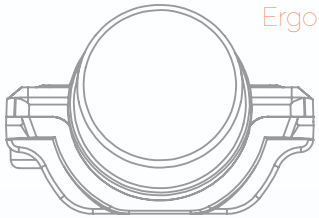
129.7 x 72.6 x 49.75 mm with antenna



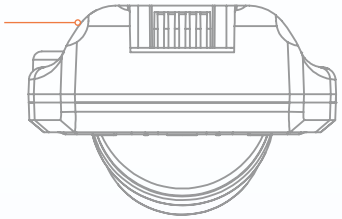
IP67 SMA Connector

Large Buttons

work with gloves

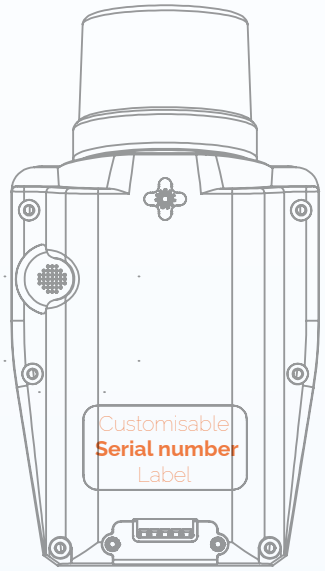


Ergonomic Grip



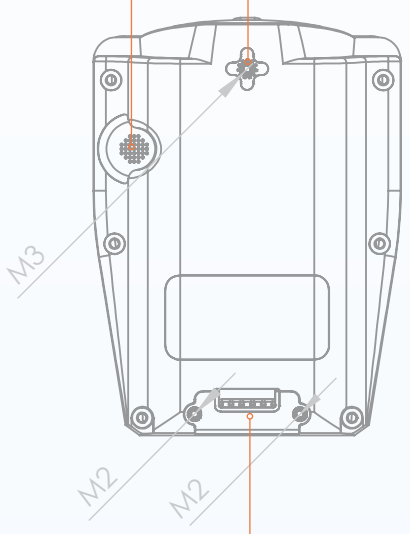
82dB **Siren**

Audible alert for personnel
IP67 Waterproof



KlickFast **Mount**

Wide range of attachments



Versatile **Connector**

Power + Data In/Out + Analogue input.
Suitable for docking & permanent wiring.

Corrosion resistant
Gold Plated Berylium Copper

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Technical Specifications

Full spec & certifications on our website

Integration Options & Interface

On Device ESP32-C6 Co-processor	**Control of device via APIs** Toit (micro-containers), Arduino, PlatformIO & Espressif IDF support. Automatic updates of main firmware independent of user code
External Wired	**I2C:** master or slave **USB:** Virtual Com Port
Cloud	**UDP, TCP, MQTT(s), HTTPS**
User Interface	3 Buttons, 2.13" display, Strobe, Haptics, Siren

Sensors

Accelerometer	**6D Accelerometer Gyroscope** (User CPU) **3D Accelerometer** (Main CPU)
Compass	**3D Magnetometer**
Pressure	**Barometric Pressure sensor** 13cm altitude resolution at sea level
Temperature	Non-calibrated internal sensor

Power

Battery	**6700mAh** 1S2P 3.6V Lithium Battery Over 50h continuous use. -10 to 60C operation. -40 to 60C Optional.
Charging	**4-14V DC** up to 3A, configurable Charging Dock and USB-C available.

Positioning

GNSS / RTK	**Up to 0.01m Accuracy** **L1/L5** AG3335A or ZEDF9P Chipset GPS, Galileo, BeiDou, GLONASS, QZSS
UWB	**Typical Accuracy 0.1m - 1m indoor** Compatible with most UWB TDoA or TWR systems, requires infrastructure
Bluetooth & Wi-Fi	**Typical Accuracy 2-20m indoor** Based on RSSI & triangulation

Connectivity

Cellular	**Global 4G (LTE CAT1)** **with 2G (GPRS/EDGE) fallback** **LTE-FDD:** B1/B2/B3/B4/B5/B7/B8/B12/B13/B18/B19/B20/B25/B26/B28/B66 **LTE-TDD:** B38/B39/B40/B41 **GSM:** 850/900/1800/1900 MHz
LoRa	**EU868 & US915 MHz support** LoRa P2P & LoraWAN capable
Bluetooth LE	**5.3** Host and/or peripheral
Wi-Fi	**6** 2.4GHz 802.11ax
UWB	**Channels 5 & 9** IEEE 802.15.4

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Performance Characteristics

10 Hz
Upload Rate
configurable 1-10

50 H
Battery life
1hz up + full RTK stream

3 yr
warranty
user serviceable

RH2 delivers **excellent performance in good, open sky conditions.** This can be demonstrated visually by walking the perimeter of playing fields and observing the recorded data on a satellite map.

A series of 3 fields in San Jose were selected for the test. In order to provide an accurate and objective comparison, the field boundaries were first surveyed using a third party receiver (Emlid Reach Rx). Each field corner postion was recorded and baseline reference traces recorded (red lines, bottom right)

The test RH2 was then worn on an armband (pictured bottom left) and set up with Swift Navigation's **Skylark Precise Positioning Service** to receive RTK corrections over cellular in real time, improving the accuracy of standard GNSS from 1-5m to **below 5cm**.

Results are shown on the right. Green arrows (100% of points) indicate RTK Fix type which is the best possible, with an estimated error less than 5cm. ZED-F9P and AG3335A chipsets

Accuracy

typically
1 - 10 cm
In Open Sky

Latency

device to cloud to application
< 100 ms
Good LTE coverage

SKYLARK™
Nx RTK

Marker Info

	typ. acc.
Autonomous	1-5m
RTK Float	0.2-1m
RTK Fix	<5cm

Stability in Challenging Conditions

Real world conditions are rarely "ideal". Tree cover, nearby buildings and structures all negatively impact GPS signal quality. Unfortunately trees and buildings are quite common in the real world...

RH2 delivers **reliable sub-meter accuracy in most scenarios.**
To demonstrate, a second test was run by walking the perimeter of parking bays covered by solar panels (pictured below) to effectively block out half the sky (and satellite data). Again, **Skylark NX** was used to improve positioning accuracy to sub-meter levels, even under obstructed sky conditions, with **rapid reconvergence** after emerging from obstruction.

Using the same colour coding for arrows we can see the expected and noticeable drop in performance (pictured right).
54% of positions achieved RTK Fix (Green) and 40% RTK Float (Blue). The least accurate positions (in red) remained within 3m at all times.

In plain terms, sub meter accuracy was achieved 94% of the time.
ZED-F9P chipset only

Urban canyons and heavy tree cover tests yield comparable results.

Accuracy

typically

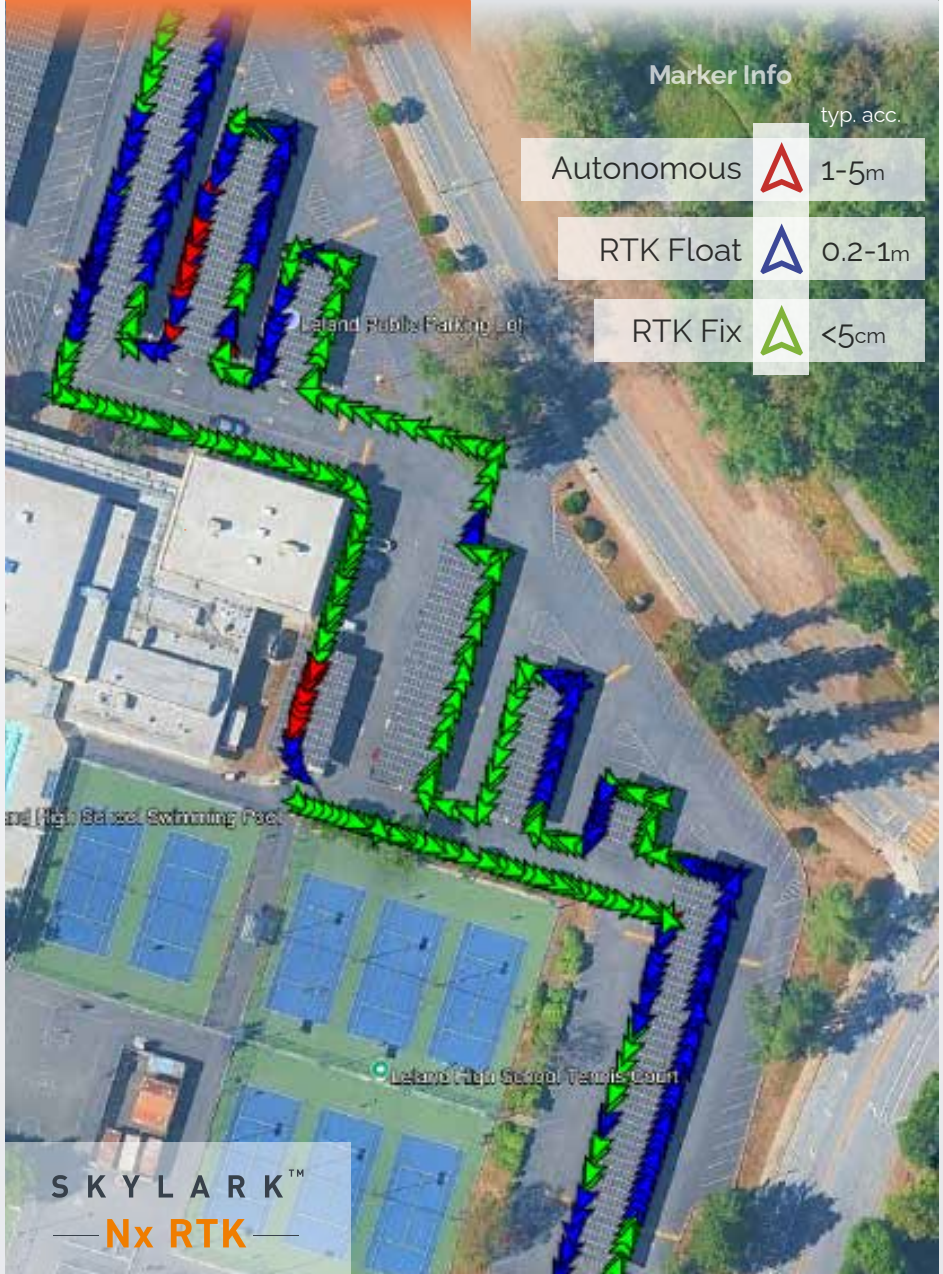
< 30cm

In partially obscured conditions

Recovery

< 1s

Time to re-obtain fix after blockage

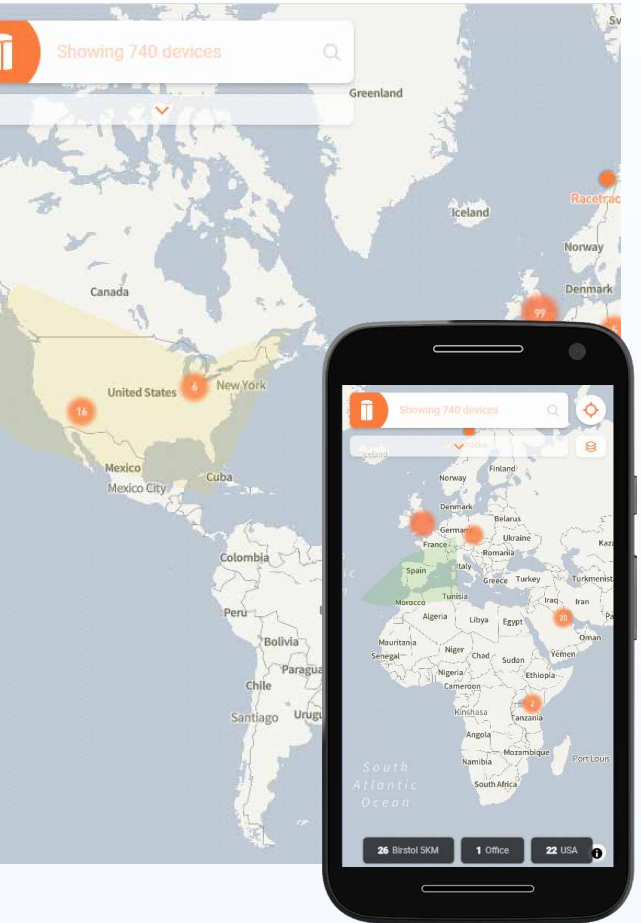


Software Overview

Every IoT project is different. Lightbug software solutions are designed to help you maximize value by offering all the building blocks you need to get started.

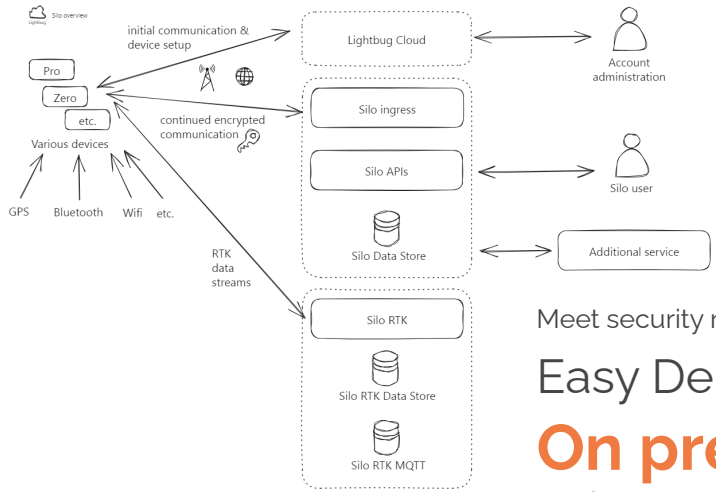
Run custom code on both the device and the cloud, with consistent APIs. **Integrate into existing systems with ease and confidence.**

All Lightbug SaaS features are optional and can be swapped out for bespoke alternatives as required, thanks to protocols that are open.



Get started quickly by leveraging

Pre-built **UIs** & **APIs**



Meet security requirements with

Easy Deploy **On premise** solutions

Maximize value with

Unified Cloud & **Firmware** APIs

MQTT & UDP integrations

+

Micro-**Containers**

for edge processing, alerting logic and custom menus

Enter Byte String

0x03, 0x21, 0x00, 0x0B, 0x00, 0x02, 0x00, 0x01, 0x02, 0x04, 0x06, 0x00, 0x00, 0x0(

3 33 0 11 0 2 0 1 2 4 6 0 0 0 8 86 153 147 0 0 0 0 0 1 0 1 4 0 0 0 0 143 195

Collapse details

Section	Element	Bytes	Type	Parsed
Meta	Protocol	3	uint8	3 ✅
Meta	Length	33 0	uint16	33 ✅
Meta	Type	11 0	uint16	11 (Open)
Header Meta	Header Field Count	2 0	uint16	2
Header Meta	Header Field Types	1 2	[]uint8	1 2
Header 1	Message ID(1) Length	4	uint8	4
Header 1	Message ID(1) Data	6 0 0 0	uintn	6
Header 2	Client ID(2) Length	8	uint8	8
Header 2	Client ID(2) Data	86 153 147 0 0 0 0 0	uintn	9673046
Payload Meta	Payload Field Count	1 0	uint16	1
Payload Meta	Payload Field Types	1	[]uint8	1
Payload 1	Payload 1 (1) Length	4	uint8	4
Payload 1	Payload 1 (1) Data	0 0 0 0	undefined	0 0 0 0
Meta	Checksum	143 195	uint16	50063 ✅

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Alerting Solutions

Loud **Siren**

Configurable tone, pitch & pattern

Powerful **Haptics**

Strong Vibration feedback with configurable patterns

Bespoke wired integration options

RGB Status Indicator

Designed for maximum flexibility, user feeback on the RH2 is fully customisable and can be controlled via both cloud APIs (over UDP or MQTT) and customer-specific code running on the co-processor (scripting, Arduino, C++ libraries available) for minimum latency and offline fallback.

Alert information and instructions can similary be displayed on screen, prompting desired user action

RGB **Strobe**

Fully configurable high brightness RGB LED dome

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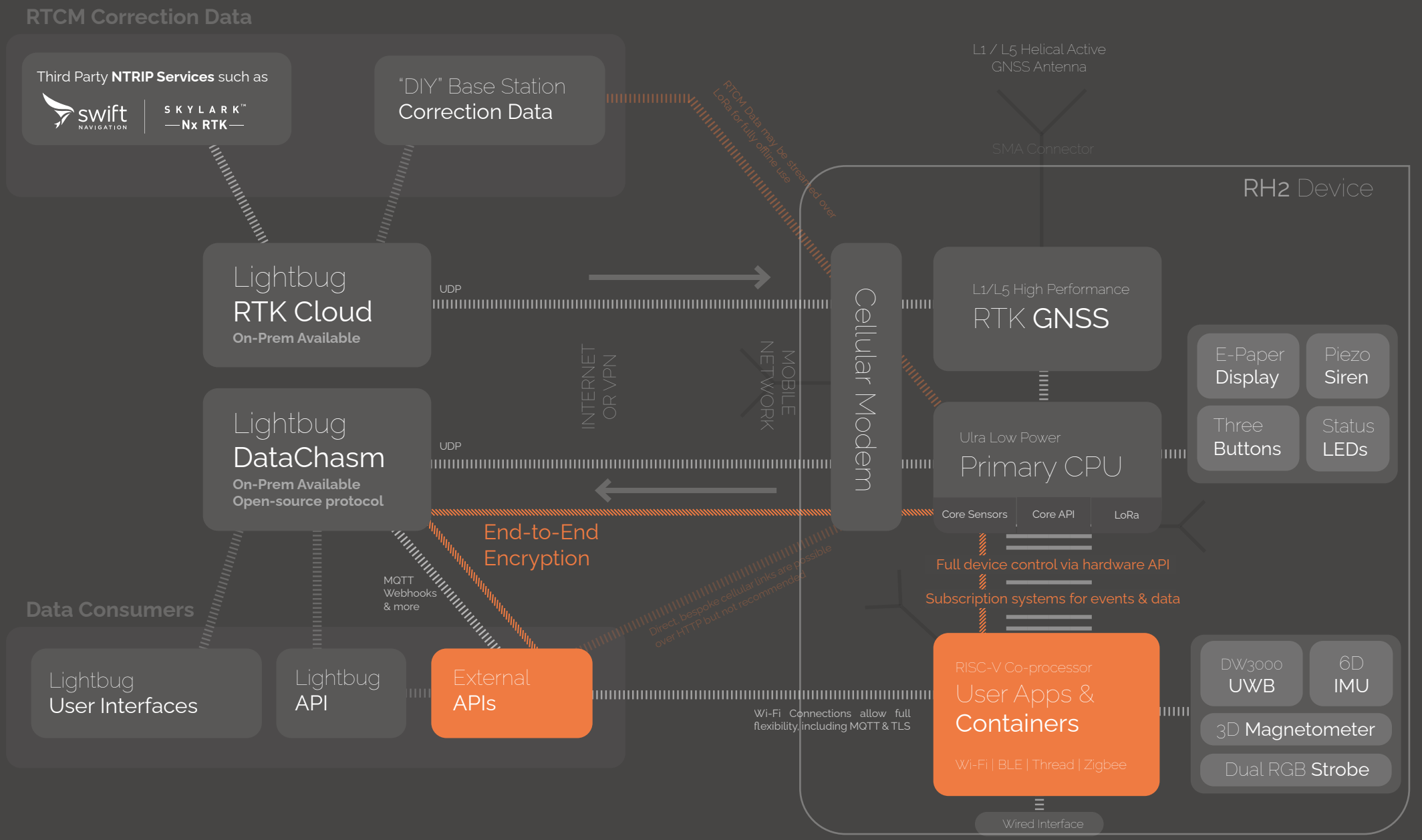
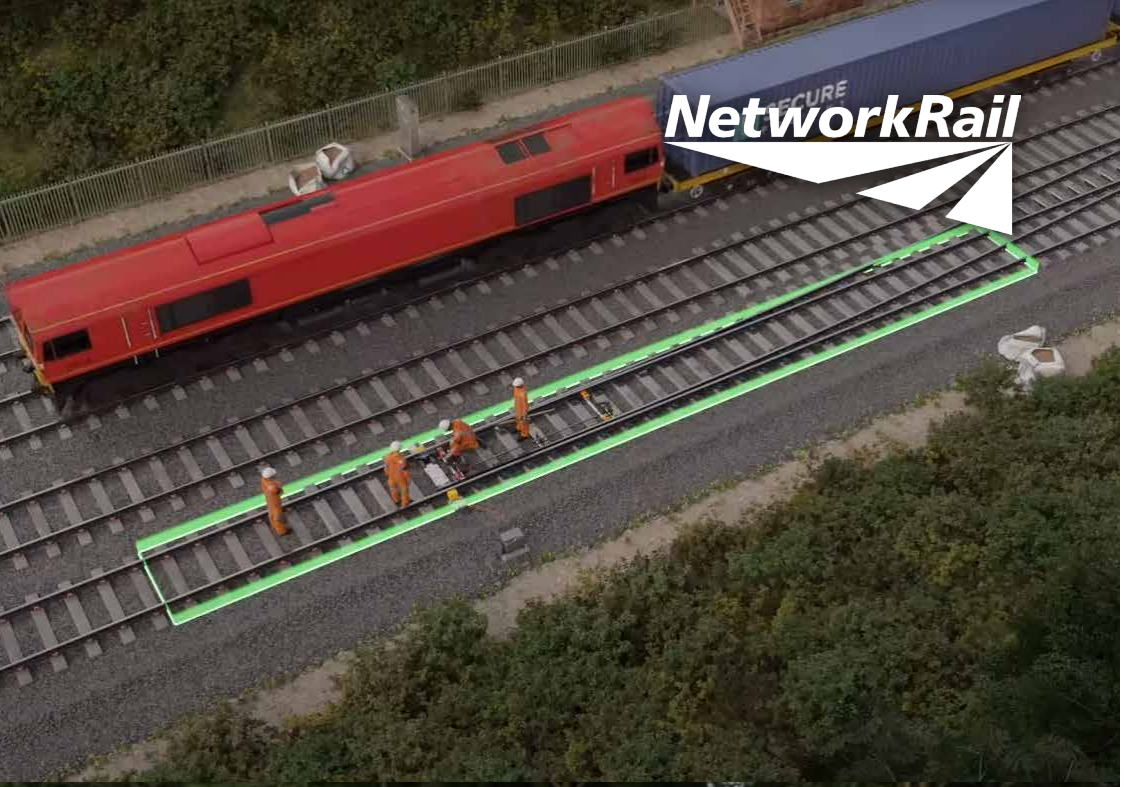
System Overview

Lightbug enables you to focus on **business logic.**

We take care of *all* the rest, without eliminating flexibility.





Case Study

Railway Safety Tracker

Workers can be unaware of dangers on site and require supervision resource, which is still vulnerable to human error. Automating safety reduces near misses and increases productivity significantly.

Lightbug, in partnership with Onwave, provides geofencing safety solutions to Network Rail, Highways England and a range of other companies in the Infrastructure sector.

Our products have achieved Product Acceptance with Network rail, meeting the 300mm accuracy requirement in all scenarios, Through integration with safety ecosystems, our devices are ensuring workers stay safe on site, enabling machines to work safely in proximity of people.

Pictured right:
RH1 (released 2021)
Now superseded by RH2

Case Study - Customised RTK

High Accuracy Event Tracker

PGA Tour were launching an App and website for spectators to follow all tournaments from home, without the usual high budget crews. They needed trackers to identify where players were taking shots from in order to make the immersive 3D app functional

They required high accuracy devices that were small enough to be comfortably worn on a belt. Through selective compromise, Lightbug delivered a tracking unit that could reliably achieve sub meter accuracy on the green, last 18h on a single charge and quickly be distributed at events.

Devices integrated directly into PGA Tour's AWS stack, ensuring high availability and technical independence at events.

On site support key to success

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FAQ

Can we use only part of your solution?
Yes, our solutions are adaptable. You can use our APIs, hardware, or software independently to fit your specific requirements. On device micro-containers ensure total flexibility.

Can I use my own SIM Card and Backend servers?
Yes - our technology is designed to work with and not against you. We aim to charge fairly without tying you down to a long running subscription that you can never cancel. You should find our connectivity and cloud offerings are quite competitive nonetheless.

Do you offer white-label options?
Yes, we provide white-label & custom, hardware that fit your needs and brand, typically < 12mo for full scale deployment.

Can I supply my own RTK correction data?
Yes. We've partnered with Swift to ensure reliable, hassle-free performance (turn on and go) but can support correction data in RTCM MSM format from any NTRIP source.

Do you offer testing before full deployment?
Yes, we provide low-commitment testing to validate the solution before scaling.

Do your solutions come with warranties?
Our devices include 3-year warranty as standard, and we provide ongoing support to ensure long-term reliability.

Capabilities

We are experts in our field and welcome the opportunity to create bespoke products & solutions. Below is a summary of our core competencies.

Hardware Design, Manufacture & Delivery
Electronic & mechanical design
In house production facilities
Compact, low power, waterproof devices
Certified for international use.

Connectivity
Cellular (2,3,4,5G, LPWAN), Global
LoRa
BLE & Wi-Fi
UWB
+ Sat Comms, Sigfox/ISM, RFID/NFC

Positioning
GNSS (Multi-constellation, multi-band) + RTK (opt.)
UWB, BLE & other signal based trilateration

Sensing & Feedback
E-Ink & OLEDs
Audio & haptic feedback
Wide range of sensors

Software & Cloud
Firmware, cloud & Cross-platform UI development
Scalable, secure cloud apps & APIs with MQTT & streams

Lightbug

swift NAVIGATION

Website

Documentation

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Whether you need expert advice, tailored solutions, or just a quick chat about your project, reach out - we'd love to help!