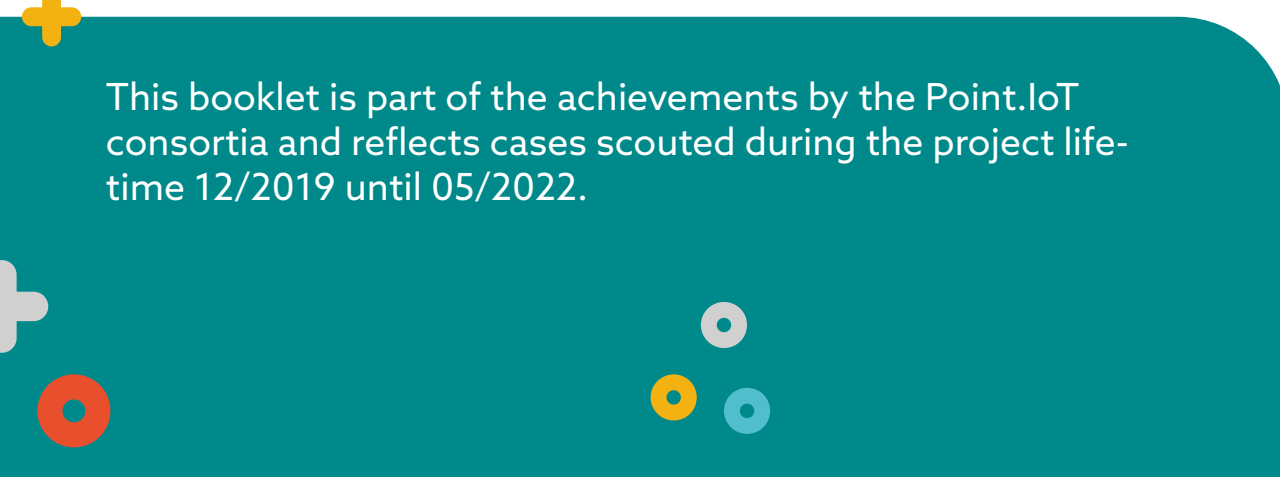


# Success Story Booklet

15 successful implementations of Global Navigation Satellite Systems (GNSS) and Internet of Things (IoT) in various industries.



This booklet is part of the achievements by the Point.iOT consortia and reflects cases scouted during the project lifetime 12/2019 until 05/2022.



**“IoT is a complicated, multi-tiered problem. Developers of all types - from Edge developers and Platform & WebService Developers, to Data Scientists and App Developers - are the engine to create the enterprise-wide IoT solutions that will power that kind of industry growth.”**

Kevin Holbrook, Senior Director of Partner Technology Strategy at ThingWorx.



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While the content of this booklet has been carefully checked, the consortium assumes no liability for the accuracy, completeness, or timeliness of the presented information.

On behalf of the Point.IoT project consortium, May 2022.

The coordinator  
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# Introduction

Dear Reader,

This booklet has been created in the context of the H2020 project Point.IoT fostered by the EU Agency for the Space Programme (EUSPA) formerly known as European Global Navigation Satellite System Agency (GSA), during the project lifetime 12/2019 and 05/2022. The pan-European project consortia aimed for demonstrating successful companies and start-ups across Europe merging the technical domains of Internet of things (IoT) and Global Navigation Systems (GNSS) with focus on Galileo in particular. The main target of the project was to support 20 start-ups with technical and business mentoring. Apart from the main task, the stories published are showing a variety of successful implementations in different scenarios, different industries and for different customer segments.

During the scouting process with a focus on European innovation the consortia identified more than **44** potential stories. Due to early development stage quite a lot of these showed a Technology Readiness Level (TRL) of **4** (Component and/or breadboard validation in lab environment) or even lower. To demonstrate a significant impact, the consortia agreed to publish stories with **TRL 6** at least. Nevertheless, the scouting clearly showed that there is a lot more to come. Especially start-ups are moving into the technological niche of IoT and GNSS, looking for new businesses and solutions in a smarter world.

The stories selected by the consortia demonstrate what is possible with the technology available today. Additionally, some stories highlight what will be

needed in the future or which implementation is already one step ahead. While we tried to spice up the stories with technical input such as components built in or frameworks used, discussions with the story owners clearly highlighted that their challenge lies less in technological feasibility. In most cases technology isn't a unique selling proposition, independent of whether it is linked to IoT or GNSS. The story owners very often told us, that the technology used is a kind of door opener for new and innovative solutions to improve processes, save costs or even lives.

**It must be clearly stated that none of the information published is private or part of any Non-Disclosure-Agreement. As a matter of fact, the level of (technical) depth is limited. If you want to know more about a specific development, please contact the corresponding business directly.**

We hereby thank you very much for the support and the contributions made by all story owners.

Sincerely yours,  
*The Point.IoT consortia partners*  
May, 2022

# The Point.IoT project partners

The consortium consisted of seven experienced companies and organisations which all brought a variety of in-depth knowledge and indispensable expertise to the project:



Overview of the Consortium


**Verhaert New Products & Services** is a product and service innovation specialist, developing various products and devices. Verhaert's services in innovation involve product design, business design, as well as system and hardware design such as IoT. Verhaert is also managing various start-up related activities ranging from large EU programme management to direct advice and support to individual start-ups and investors. Verhaert runs the Copernicus Incubation programme as well as ESA Space Solutions Belgium and coordinates the ESA Technology Broker Network. Verhaert brings a fresh perspective on innovation processes and management.

**SpaceTec Partners GmbH** is a management consultancy with an innovation advisory practice, known for its strategic advice to policy makers in the

space sector with a particular focus on innovation strategies & access-to-finance, Copernicus & Galileo market development and strategy engagements. They have an in-depth expertise of the space sector, an excellent understanding of the European GNSS programmes and long track record in coaching and business support of start-ups. SpaceTec Partners runs the Copernicus Accelerator and supports the MyGalileoApp competition and mentoring programme. Furthermore, it has designed the Luxembourg Space Innovation Strategy, and supported the conceptualisation of the ESA BIC Switzerland for ETH Zurich.

**cesah GmbH Centre for Satellite Navigation Hesse** acts as a central point of contact for all matters relating to the application of space technologies in non-space businesses, as well as vice versa – for transferring non-space technologies to the space industry. Since 2007, cesah has been entrusted by the European Space Agency (ESA) with the management of the ESA Business Incubation Centre Hesse and has thus been supporting the development of business ideas and start-up companies for 15 years. Since 2014, cesah has also been the ESA Technology Broker Germany together with EurA AG. The Centre is supported by ESA, the Region of Hesse, the City of Darmstadt, the Technical University of Darmstadt, the University of Applied Sciences Darmstadt, T-Systems International and Telespazio VEGA Deutschland.


**Orange Business Belgium SA** is a global telecommunications provider. They provide fixed and mobile network infrastructure in over 200 countries and



territories. Next to this, Orange operates several service lines, including an end-to-end IoT business unit. With the Orange Data Journey programme, they deliver technology to collect, transport, store, analyse, protect and present IoT data. With its own France based R&D centre of approximately 3,000 people, they have a wealth of expertise in connectivity, data analytics and IoT. Orange supports start-ups and SMEs with their network of 14 start-up accelerators known as Orange Fab, present in 15 countries across four continents at end-2017.



**TechTour or Europe Unlimited (Belgium)**, is one of the largest investor-oriented communities in Europe connecting entrepreneurs, investors, and corporate partners from across the world. The firm provides event and on-line matching platforms between emerging innovative companies, investors and partners across Europe and its regions, sectors, and stages.

**Design & Data** is an award-winning cross-media agency specialised in science communication and outreach solutions for science domains in general and the space sector in particular. Our services are designed around our customers' needs. We help to increase the visibility towards various target audiences including stakeholders, investors, employees, media, and the general public.



**LOAD** is specialized in the research and development of new digital products. Based in Portugal and operating at an international scale, Load is composed of a multidisciplinary team, able to ideate, prototype, define, develop, and evolve digital products within several disciplines (IoT, AI, Web, Blockchain, Mobile, Big Data, Virtual and Augmented Reality), helping cus-

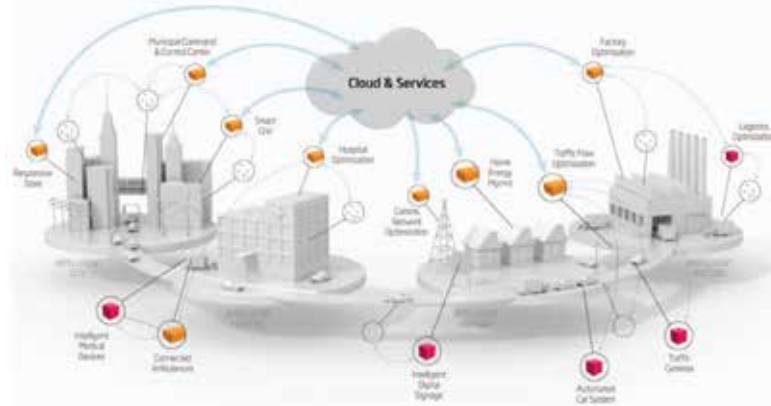
tomers in this innovation trajectory across different verticals. Subsequently, as part of digital product life-cycle, Load manages the process of technical knowledge transfer to their customers, orchestrating the eventual hiring, coaching & technical support, for a smooth transition of technical & industrial knowledge.



# About the Point.IoT project

IoT is the next stage of the internet's evolution. It merges physical and virtual worlds, creating smart environments. Today, a whole range of objects, devices, processes and „things“ are connected to the internet allowing people to interact with them from a distance at scale while gathering up useful data from them.

The uptake of IoT is growing rapidly and immense amounts of data are being generated every day. Ubiquitous connectivity and the omni-presence of mobile devices in our everyday life, are leading to evolving user needs and the emergence of new location-based applications. Technologies in the area of **LPWAN, 5G, drones, robotics, autonomous driving, smart cities**, etc. are boosting Internet of Things (IoT) developments. These evolutions require the use of accurate and secure positioning information provided by satellite constellations such as the European Union's Galileo – its increased availabili-



ty enables IoT devices to determine their position even in demanding urban environments.




The combination of GNSS & IoT is a natural development domain to be stimulated and for new applications to be scouted and developed. Specific application domains in IoT are particularly relevant to be augmented or supported with GNSS. The key challenges of mobile GNSS/IoT devices are connectivity and battery power.

**Connectivity:** IoT connectivity can be provided in several ways using regular 2G/3G/4G and even 5G data channels. On top of this there are technologies like LoRa, SigFox, LTE-M, NB-IOT, all with their own features and use cases. It is important to choose the correct technology stack to allow new products to connect everywhere with the appropriate features. This requires careful decision making on required bandwidth, latency, data packet size, power consumption, coverage, hardware dimensions, antenna development, radio placement, etc.

**Battery power:** Think about extreme low-power components and smart power management (like ultralow power chipsets), as well as energy harvesting using light, radio waves, movement, etc.


The Point.IoT project was born from this conviction that combining IoT and Galileo technologies can make a positive impact on industry innovation and result in breakthrough solutions. For two consecutive years, ten teams of





at least two ambitious entrepreneurs were selected to develop the next generation of IoT solutions. Point.IoT helped them turn their ideas into real-world solutions as teams engaged in a **3-month** virtual sprint, including tailor-made training, tasks, and advice from industry experts. One of the things that made Point.IoT special, was that the challenges posed to the participants consisted of real market needs that real companies were facing. Aside from the chance to win **€20.000**, participants therefore also gained access to industry partners who validated their solution throughout the programme.

The European Commission wants to unleash the potential of the IoT technology across the European Union and beyond by actively cooperating with industry, organisations and academic institutions. This is the starting point of the Point.IoT project.



# navyBelt, the belt that changed lives

## Can people learn to use an additional sense through training?

This question kicked off the amazing journey of feelSpace' navyBelt in 2005. Since then, several scientific studies, projects and founder activities have been initiated by the team of mostly female cognitive scientists. Today, the tactile navyBelt of feelSpace is a reliable and high-quality navigation device, tailored to meet the needs of blind and visually impaired people.

## A pioneering idea in a lunchbox

Prof. Peter König and a team of students started the project at the University of Osnabrück in **2005**. Driven by several questions, they researched the possibility of implementing an **artificial sensory organ**. Using the caps of lemonade bottles, hot glue and a lunchbox as a casing for the electronics, they soldered and tinkered their **first compass belt prototype**. Not very handy - but pioneering .

## From science to market by boosting the business

Scientific evidence clearly showed that compass belts were not only interesting research devices, but could tremendously simplify navigation problems faced by **1 million** blind and visually impaired people in Germany alone. Thus,

## Galileo enables secure navigation

For blind and impaired people, exact positioning and navigation information is important. The first versions of the tactile belt only used a compass to indicate magnetic north. Nowadays, GPS and Galileo are the door opener for high precision positioning - and for creating a lifesaving 6<sup>th</sup> sense!



© feelSpace

the idea was born to take the tactile belt from scientific device to product. In **2015**, feelSpace successfully applied for EXIST and the ESA BIC Darmstadt programme, which provided valuable coaching, know-how and of course - funding.

## Finally, good vibes: Sensors and smartphone's GNSS

Not tailored to everyday usage by consumers, the scientific prototypes were heavy (up to **1,1 kg**), bulky (up to



© feelSpace

**4,5 cm thick**) and difficult to recharge. Several years later, the new models are **up to 50 % flatter, easier to recharge** and can be worn almost invisibly underneath clothing. A power bank prototype has been replaced by a small internal battery (**1400 mA/h**). Regarding GNSS, the team had to decide between an embedded navigation module (u-blox antenna module) or smartphone's GNSS capability. feelSpace decided to go for the non-integrated version, because GNSS receivers within smartphones are improving quickly and most visually impaired customers have one already. As a consequence, the cost of production decreased significantly. Additional benefits: internet access **via 3G and 4G network** and **automatically deployed updates**.

## Reliable connection required - time for Bluetooth

Since smartphones are carried in the user pockets or backpacks, the distance between smartphone and belt is **<10 m**, so **Bluetooth Low Energy** was the right choice for connectivity. The final product uses **16 vibration elements** and features **3 miniaturised motion sensors**. To transform the sensor information into tactile navigation instructions, feelSpace uses a **sensor fusion algorithm**. Even if the magnetic field is disturbed, i.e. in a lift or when crossing rails, the algorithm remains reliable, because it usually compensates for these distractions to the sensors.

Contact: [feelspace.de](http://feelspace.de)



PRESENTS

# At the frontier of the Green Revolution

## What does it actually mean to connect the un-connected and how should it work?

e.Ray works at the frontline of this change with several innovative products. They had to keep in mind the needs and limitations of their target group. Finally, they developed a solution that merges aspects of satellite communication, earth observation, IoT and turbine driven energy production in just one device.



## Drive the revolution

To start the revolution e.Ray had to begin at the very essential of an industrial world – energy. They decided to use

### Galileo ensures higher accuracy

e.Ray is desperately waiting for the hardware to become Galileo-compatible. "We want to reach a 1-2 cm level accuracy by using the Galileo High Accuracy Service, HAC", says CEO Sebastian Lemke. "With that we will strengthen the reliability of EMOR enormously."



the available green energy in rural areas, which are mainly flowing water and solar. It provides at a water velocity of around **2m/sec** an output up to **1,300 W**. On top of this basic layer they added several smart devices like environment sensors (**pH-value, temperature, water level, energy production**) and internet access via **SatCom** and **WiFi**. This basic setup can supply a whole community and easily be scaled with the demand of the community.



## At the heart of the revolution - EMOR

EMOR (energy and management of rivers) is the core solution by e.Ray. It is a swimming energy independent satellite-based measuring station that collects real-time river information and sends flood warnings to the rural population, if necessary. The key element is the water level sensor, which receives through GNSS signals the XYZ-coordinates of the floating power station. The **u-blox chip** with an **integrated RTK** module delivers an accuracy at a level of **10 cm**. The data is collected on an onboard memory and from there transferred via GSM Gateway with a frequency of **15 minutes** to the database. At the same time data of an ashore verification station enters the cloud solution and can be compared to the changing river level. An individual alert threshold then can send out warnings.

## Disruptive and more than tech

Before, life was affected by the goodwill of nature and abilities were limited. e.Ray's technology enabled pupils to go to school instead of collecting firewood as well as doing their homework after sun set. It enables craftsmen to use machines instead of hand tools only, which increased productivity and wealth. And finally, the monitoring system increased the overall safety for the community.

Contact: [e-ray.eu](mailto:e-ray.eu)



PRESENTS

# You'll never ride alone – a lifesaving companion

## Stephan Kaufmann knows what it means to fall with a motorcycle.

To have an accident and to be totally alone, somewhere in the outback. Stephan took part in the Rallye Paris-Dakar, drove **6,000 km** through desert, rocks and mud and fell several times. Once so hard he couldn't continue. What he also knows is the feeling of being rescued, of NOT riding alone, of being safe. A helicopter came and picked him up. Thanks to RideLink, a technical device that helps people to help you - based on IoT and GNSS signals.

## 30.000 accidents with motorcycles per year in Germany

**700** of these are deadly. **27 %** happen without the impact of third parties, only because of improper driving. These are too many, think Stephan and his team. They have the mission to increase passive safety of bikers. This includes actions after an accident: e-call, breakdown service and anti-theft solution. The dongle inside the device detects whether there was an accident and how serious it was, an e-call is set off. The persons from the emergency center get a notice and call the driver. If he or she answers - good, if not they send an ambulance. Via a button the breakdown service can be contacted manually.

## Galileo for precise positioning

As ridelink is a safety tool for motorcycle drivers reliable and high precision data is key. Therefore, Galileo's HAS is needed to allow best positioning when it is needed to save lives.



## Your riding buddy underneath the saddle

RideLink combines hard- and software. The device links your riding data via **Wi-Fi** to the corresponding app and via **LTE** to the backend of Stephan and his team. Thanks to the programming language **JSON** they can easily read the data arriving on their cloud server. Four antennas receive and forward information about the leaning angle of the bike, battery voltage, acceleration and GNSS data. For the



last-named a **Quectel sensor** with a **Cirocomm antenna** is being used - compatible with Galileo.

## It's hot and it's big

Inside a motorcycle high temperature occur and there is only little space. The first prototype was very big and needed a heat sink. They managed to minimize the product but then the antennas disturbed each other, which led to bad reception. Today, the device is bigger again (**10 x 10 x 2cm**) - but small enough to fit in a corner of the bike-, the temperature problem is regulated, all antennas have enough space and it calibrates itself. The internal battery lasts for **10 minutes**.

## The vision of active safety

Active security is RideLink's future project. They plan to develop a driving assistance trainer. For that they want to analyze EO and GNSS data as well as the driving style of a person. An AI algorithm shall be trained that supports the motorcyclist actively („Attention, you are driving towards a curve, please slow down.“). Therefore, they are trying to reduce the amount of data that is being transferred while riding at about **90 percent!**



TRACKTICS PRESENTS

# Track your football moves to become a pro

Tracktics is an affordable sports wearable tailored to the needs of football. It provides amateur footballers analytics on professional level. Players can improve their skills by tracking several performance sensor inputs and customized algorithms transform data into valuable analytics. Results are easily visualized on any mobile device.

## Nothing alike on the market? Let's do it ourselves!

The idea came up when co-founder Ben was training for a half-marathon with the help of an app. He wanted to have something alike especially for football. There was just no appropriate solution, so he took the chance and got his business started together with football-loving and technically versed Patrick, the founding team was complete.

## Boosted with Space Support

Tracktics received valuable support from the ESA BIC in Darmstadt. In addition, they received about 120.000 € via the **European Pioneers Programme (H2020)**. Together with a strong value proposition, new connections into to the Israeli start-up scene and a business mentor onboard they raised more than **5.000.000 €** investment, until today.

## Galileo for best Quality

The tracker is designed for high accuracy positioning on football fields with sub-meter precision. This requires a multi-constellation GNSS solution, including Galileo for best quality.



## Customer feedback driven progress

The development of the final product took three main stages and many smaller iterations. First, they decided to develop hardware and software separately. Second, for hardware prototype development they chose to develop each sensor unit (**GNSS, Battery, IMU**) independently and merged all components afterwards. Third, the originally planned wearable as a captain's like armband didn't work,



because of too much secondary noise. 2<sup>nd</sup> approach was a cardboard box which slightly transformed into the final product design stored in a belt on the hips. A key element for development was the contact to highly qualified coaches who are now clients.

## Nothing works without AI

Tracktics had to face three main challenges: 1) Hardware issues – does it charge properly? 2) How to calibrate the sensors correctly? 3) How to ensure HQ data robustness? Significant progress was made from pure manually adjustments towards cloud-processed calibration, AI-driven technology and advanced mathematic tools such as the Kalman filter operation. Finally the needed to freeze the product design to concentrate on the device's internals.

## Invisible but full of sensors

The tracker is invisible and almost insensible as an ultralight weight device at **32 g**. The dimensions have been broad down to **85mm x 39mm x 9mm**. **9 sensors** are working on the tracker. **3 acceleration sensors** for improved movement tracking on small space, **3 magnetic field sensors** for optimized direction detection. **3 gyroscope sensors** that capture the spatial position of the tracker. The algorithms, especially developed for football, take all the sensor data into consideration and brings them together.

Contact: [tracktics.com](https://tracktics.com)

# DRONIQ PRESENTS

## A traffic management system for drones

Droniq is working on integrating UAS (Unmanned Aerial Systems) aka drones into the (controlled) airspace, reliable, secure and affordable. By making the drones "visible" for other aircrafts and airspace control, significant increase in operations safety can be achieved. Therefore, they developed a hook-on-device (HOD) called HOD4track which can be mounted to almost any UAS on the market.

### From research project to spin-off

Droniq was founded as a spin-off of the research project "connected drones" which was initiated by Deutsche Flugsicherung and Deutsche Telekom in **2016**. The project was awarded as best practice solution by the German mobility prize hosted by the Federal Ministry of Transport and Digital Infrastructure in 2018. The goal of the project was to demonstrate that drones can be safely integrated into the airspace by using existing technologies, like **LTE**, **GNSS** and **FLARM** to unleash their full economic potential. A drone safety solution is highly appreciated because millions of aircrafts are expected in the future.



© DRONIQ

### UAS Traffic management

To achieve the goals which have been set Droniq developed a drone traffic management system (**UTM**), an independent web platform for drone operators to perform below line of sight missions, like power grid inspections. To do so, the UTM calculates a real time airspace situation display. All operated drones signed into the system are visualized together with their flight routes. Alerts are trig-

gered for potential collisions and airspaces can be blocked on demand or when necessary. When the drone operator logs into the UTM the position is calculated continuously and independently from the UAS flight controller by the HOD. If necessary, received FLARM signals at **868 MHz** from surrounding air traffic are sent to the UTM, too. Additionally, the drone's position is sent via FLARM as well, to make it visible for other aircrafts nearby.

### Tracking with GNSS and LTE

The position of the HOD is tracked by a versatile **u-blox M8** GNSS module, which supports up to three GNSS systems including **GPS/Galileo** together with **BeiDou** or **GLONASS** at meter accuracy. These low-cost multi-constellation GNSS-receivers hit the price-range below **100 €** significantly and make them affordable for start-up projects. Operating at **5 V** and consuming **< 400 mA** the whole device weighs only **35g**, which is super energy efficient when mounted on drones. Even fully equipped with antennas and external battery weight is only **149g**. Allowing a 4-way antenna constellation on LTE, GNSS, FLARM and ADS-B signals can be processed simultaneously.

### Galileo PRS pilot project

Droniq is working on a pilot project together with the German Military (Wehrtechnische Dienststelle der Bundeswehr Manching), Fraunhofer IIS and Deutsche Flugsicherung to test **anti-spoofing** and **anti-jamming** GNSS applications for civil aviation. The **Galileo Public Regulated Service (PRS)** has been selected to provide this service for critical navigation. The consortium has built a demonstrator which is using Galileo PRS on the HOD, only. This generation of the device transmits the encrypted Galileo PRS signal to the UTM. The goal is to have a protected server environment within the infrastructure at Deutsche Flugsicherung which is decrypting the code. This would allow safe operations within the DFS Data Center together with the UTM.

Contact: [droniq.de](mailto:droniq.de)

### Galileo for best Security

The market is lacking a civil spam and spoof safe GNSS, so far. That's why Droniq integrates Galileo into their newest HOD, to use the secured Galileo Public Regulated Service (PRS). A high precision and secure navigation signal is of very high priority for aviation, as well as unmanned aerial systems.





# The future of power line maintenance

LESS has developed a suite of technologies for improving maintenance operations for power distribution. From sensor to data to decision ready information the future of maintenance is digital, highly automated and predictive.

## Decreasing costs and increasing efficiency

Maintaining a huge power distribution network spanning hundreds or thousands of kilometres is a sizeable challenge for daily operations. Maintenance staff need to react quickly, because loss of power supply can be critical for vulnerable infrastructure such as hospitals. On the other hand, too much fallow work force is a cost driver for the consumers.

## Breaking up a very conservative market

Even though the need for a solution is clear, it needs to be reliable and trustworthy in order to be accepted by clients. Despite the fact that other methods are less technologically advanced, they have been incorporated into operations over many years. Therefore, a shift to a new technology is also a risk for potential customers. LESS has overcome

## Galileo for dual frequency usage

The solution uses a dual frequency approach by combining Galileo's E1 and E5b open service bands for best ionospheric error cancellation. Thanks to the modulation by Binary Offset Carrier (BOC) GPS and Galileo, signals can be distinguished even on the same frequency.

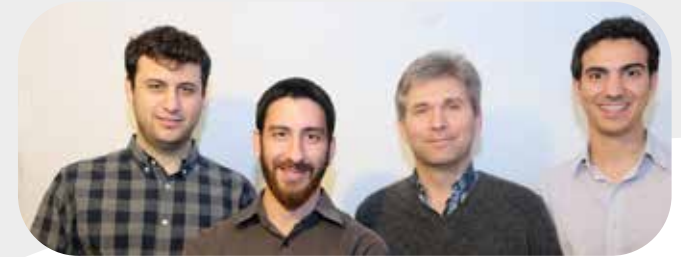


© LESS

this issue and convinced customers by demonstrating their technology in smooth operation in an **24/7 environment** and even under extreme conditions. Nevertheless, LESS had to face the fact that even the best solution will not succeed unless it gets the necessary certification. This step is absolutely crucial for the technology involved to get the final customer acceptance. But the process of getting a CE certification is time consuming and expensive.

## Turning the game

But even certified sensors will not turn the game by themselves. Replacing the alert system by another does not write new "gaming rules". This is done by introducing predictive maintenance. Using AI driven analysis, issues can be detected in a predefined tolerance range in which errors are getting more likely. This advantage makes maintenance much more plannable and downtime is reduced to an absolute minimum.



## Intelligence on the grid

Due to a low-cost approach LESS can provide a swarm of sensors, this enables LESS to build their own infrastructure for GNSS corrections. An integrated solar panel charges the device and it lasts one year without recharge. A metal case protects it against rough weather conditions. In addition to broadcasted weather station information sensors such as IMU, accelerometer as well as thermostat and hygrometer are part of the baseboard and fuel the predictive model. A precise GNSS receiver is used to handle the GNSS signals providing **1 cm accuracy**. An integrated antenna submits the signal via LoRaWAN network to the remote stations.

## Beyond grids

A key competence in the IoT sector is to adopt to customer needs quickly. LESS was able to modify one of its sensors, so it can be used for saving endangered turtles in Australia by measuring temperature and humidity in the soil. An alert was triggered when conditions get critical, and counteractions can start.

Contact: [lessindustries.com](http://lessindustries.com)

# CLAAS

PRESENTS

## Precision farming: lane by lane

Actually, CLAAS started to implement their first autopilot system for harvesters in **1977** already. Nevertheless, technology evolved significantly, as well as the needs to save resources like fertilizer or seeds, time, and money. Automated steering systems are state of the art technology towards fully autonomous machinery.

### Quick amortization

On average farmers save up to **5%** of their costs due to high precision steering on decimetre level (**± 30 cm**). It doesn't sound like much at first, but keep in mind that these are constant savings, hectare by hectare and year by year. Usually, investment in the technology is equalised after two years. Modularized services from GNSS positioning to **RTK-solutions (up to ± 3 cm accuracy)** can be offered, depending on the correction signal and/or service chosen.

### A multi-device system

Harvester and tractors are actually high-tech systems consisting of several devices, sensors and controllers. The basis is still the chassis and engine. In addition, a high precision GNSS antenna is mounted on the roof of the ma-

### Galileo for robustness

Galileo enables higher robustness of GNSS signals against shielding in multi-GNSS applications. In addition with license free EGNOS correction service lane-by-lane farming is possible out of the box. Moreover



Galileo signals can be improved by RTK mobile stations as well as services via cellular network.



© CLAAS

chine. Usually, it's connected with a screen-based terminal as well as a navigation controller. This controller hosts a **6-achs gyroscope** to help calculating the lanes precisely. The output are steering commands. They can either be implemented by an electronic wheel, if no proportional valve exists. If it exists commands control the valve directly. All this results in adjusting the proportional valve and is making accurate steering possible.



© CLAAS

### It all starts with GNSS

The basis for precision farming is the positioning, ideally on centimetre level. CLAAS's controller is capable of handling **GPS, GLONASS and Galileo**. For operation at least 5 satellites have to be available. More satellites ensure a higher robustness against shielding by trees, bushes or buildings. Dealing with centimetre accuracy also means that it matters which add-on device the machine is equipped with. Usually, jobs for pesticides are about **27 meters** wide or even bigger compared to ploughs which are much smaller. To enable automated lane-based steering, the controller needs to calculate the routes based on the terminal input and additional information, i.e. which add-on is being used on which machine, on which position the antenna is mounted and what is the task to be performed. And of course, we don't live on a flat earth, the terrain and curves are taken into calculation as well.

### A connected world

The position is crucial for application and harvest. During harvest, sensors such as infrared cameras can measure the yield. Combined with the position a map of yield can be created. An application map which is created on remote sensing data controls the quantity of seeds, fertiliser and pesticides spread on the field. Special control settings allow variable rate control or section control, to avoid double spread.

Contact: [claas.com](http://claas.com)



PRESENTS

# Your digital twin along the supply chain

Logistics is all about moving goods from A to B, isn't it? No, as the German start-up Packwise GmbH is about to prove. Hidden from consumers view, B2B businesses in various industries rely on standardized packaging systems, such as the Intermediate Bulk Container (IBC) to carry chemicals, groceries, cosmetics, or pharmaceuticals. These containers are reliable, flexible, re-useable or recyclable and circulated all over the world. But they aren't smart.

## Connecting containers

Packwise's customer base faces an increased need to lower costs along the supply chain. To do so their supply chain can be digitized. As a side effect their carbon footprint can be reduced, as well. Therefore, industry packaging stock needs to become smart. A digital twin is created by Packwise to make the involved logistics transparent.

## Hard- and software in a nutshell

The solution offered combines an easy to install sensor with a **Software as a service** (SaaS). Data is collected and transferred fully autonomously into the platform. Here extensive information about the goods is accessible. On top of that, the system analyzes the data to map the supply

## Galileo for higher accuracy

Packwise implemented Galileo to benefit from its higher accuracy, better indoor signal quality as well as its non-military operator.



© pack:wise



© pack:wise

determine the fill level. GNSS technology is used to allow a correct geolocation indoors and outdoors. An **IMU** is able to detect shocks or movements. And finally, temperature is tracked as well. All data is transferred via either **NB-IoT, LTE Cat M1, WiFi, GSM or BLE** to be present in the IoT data platform. For reliable operations the device is **IP 68** certified.

## Power management & encryption

Ultra-low power processors and a high-performance energy concept allow a configuration to last **up to 5 years** under normal circumstances, if sending intervals are set to 1 per day. The wireless data transfer is end-to-end encrypted for maximum data security. To integrate into existing ERP systems which are common in the logistics sector packwise offers an API solution.

## Smart logistics

As a result, Packwise achieves highly optimized logistic processes without significant additional workload at low costs. The optimization is reflected in less losses of containers, better fleet management and a higher response rate in case of accidents. On top of that geo-located asset tracking is an enabler for efficient usage of existing containers, shorter transits and finally time saving, due to shorter transport cycles.

Contact: [packwise.de](https://packwise.de)

chain processes for automatization. In case of unintended events various alerts can be triggered and concrete counteractions are provided for the operators.

## Plug & Play sensor

The IBCs are tracked by a couple of sensors in a single device. It can be attached without further maintenance within minutes by almost everybody. Radar is used to monitor and

# Toolkit for open education to foster creativity

Re-engineering education was more than a mission for a group of researchers of the Institute of Geoinformatics at the University of Münster. It was a promise. More than a decade ago, they created a tool set to enable people to learn more about technology by merging their experience and knowledge. From this, the German start-up re:edu was founded as a spin-off spin-off of the Institute for Geoinformatics. It isn't selling environmental gauges it is providing a solution called senseBox to satisfy our constant desire to understand the nature around us.

As open education isn't limited to students, re:edu had to focus on a **DIY approach**, breaking up the complexity of the technology at the same time. In addition to that, they had to ensure not to lose correct and reliable data within a given accuracy range. These goals have been met by removing unnecessary complexity. For example, the senseBox requires no soldering, everything can be stacked or plugged together. Classic line-by-line coding was replaced with a graphical programming interface called Blockly, which makes programming feel more like a puzzle rather than coding and allows more people to be addressed. As a side benefit, removing the complexity also minimized time-wasting errors or failures.

## Galileo for better signal quality

The usage of Galileo is one of the key aspects of having a reliable GNSS positioning event when signal shadowing is becoming an issue. Without accurate positioning, many upcoming challenges could not be tackled.



© re:edu

## Modules instead of confusion

Unlimited possibilities are great, but when it comes to education, one needs to focus. Because of that, re:edu decided to establish unique extension boards instead of an all-in-one board. For example, there is either **WiFi, Ethernet, LoRa** or **card storage** available. The same goes for the various sensors such as **temperature, air pressure, humidity, illuminance** and **UV-intensity, dust, cloudiness, loudness** or wind speed.

## Complementary documentation

We all love the internet, where information about almost everything can be found. By backing up their hardware packages with good and easy to understand learning material and workshops, the last accessibility gap can be closed. Materials such as flashcards allow an ad-hoc study progress. With open education in its heart, re:edu has a keen interest to qualify teachers, so they can integrate the technology in their classes.

## What is around you?

Environmental data has a geo-localization by nature. Since the beginning of constant weather recording, every temperature measured was tied to a specific position. While stationary devices can be positioned using the street number or map coordinates, the tracking of moving devices cannot be solved without the use of GNSS. By connecting a GNSS module based on the **u-blox CAM-M8Q** multi-GNSS module, a whole new range of applications becomes possible. This way, trajectories with environmental data can be visualized on the freely available online platform. This enables users to perform measurements on vehicles like cars or bikes.

## Open means open

Re:edu is very transparent about the involved components in their senseBox, knowing that the hardware itself isn't about their USP, so parts of the **Arduino** universe are used. An **ARM Cortex M0+** is providing the power to foster the applications without draining the battery or running out of memory. Interfaces use **I1C, UART** or digital I/Os and robust JST-plugs. Via the **XBee socket UART** and **SPI modules** can be attached. The senseBox ([www.sensebox.de/go](http://www.sensebox.de/go)) can be set up within a minute by connecting it to a computer via **USB cable**.

Contact: [reedu.de](http://reedu.de)



PRESENTS

# A digital beehive

Bees are one of the most important species for the entire domain of agriculture. Crops, supply chains and businesses are attached to healthy bee colonies. Nevertheless, due to heavy use of environmental pollutants and decreasing habitats with extensive cultivation bees are under constant threat. Furthermore, the centuries-old tradition of bee keeping is ready for disruption to secure the next generations of bees and beekeepers. Therefore, bee keeping needs to become smart.

The Italian start-up 3BEE S.R.L. is working on such a solution. The idea was triggered by the experiences of one of the founders who has been a part-time beekeeper since he was a child. Combining the tradition of bee keeping with smart technology within a valuable and sustainable business model is the foundation of their work. To optimize personnel deployment 3BEE installs sensors directly to the beehives. The bundle of IoT sensors is connected to a mobile app. Additionally, the data is made available on an online platform.

## Data based decisions

Beekeepers can check all their hives remotely. With a focus on parameters for the health status of each colony as well

## Galileo for best results

GNSS positioning via Galileo is key to correlate honey yield with the exact position of the beehive in the field. The sometimes very remote conditions allow no other alternative. Due to sub meter positioning precise local interference can be measured and recognized.



© 3Bee

as predictions about the honey produced, beekeepers can decide when and where on-site intervention is needed. Software and hardware by 3BEE are tailored to a non-tech-driven target group. Consequently, UX/UI are easy to understand, and sensors can be installed with just a few simple steps.



© 3Bee

## Field data collectors

To gain all this information 3BEE collects data about **weight, temperature, humidity, sound spectrum** and **position** of each hive. The data is transferred **via cellular network** to the 3BEE cloud infrastructure. AI algorithms process the data to prompt easy to understand information on an interface. The technology involved works **24/7**, which is a key argument for the clients.

## Optimized hive positioning

Unfortunately, not every bee can be tracked on an individual level. Nevertheless, the positioning of beehives and the knowledge about bees' behaviour and instinct allows beekeepers to optimize honey yield. Every consequence of changing the position of the hive is tracked thus enabling the user to find the best position based on experience and data.

## IoT as a door opener

Getting more and more predictable results opens another door for beekeepers. If concrete impacts on the colony can be measured and tracked insurance becomes a key.

Contact: [3bee.com](http://3bee.com)



## On track to autonomous agriculture 4.0

Earth Automations is an Italian company that believes technological innovation can bring a new way of operating in the world of agriculture. A team of three young entrepreneurs got together in 2014, and the passion and interest they had for agriculture drove them to combine their engineering talents to develop a robot that could work the fields in an automated way. The team was also one of the highlights of the second year of Point IoT, confidently making it into the finals.

### Envisioning a new agricultural future

During their development, the team was led by a few guiding principles that crystallized into the current solution. First of all, their robot was supposed to be as autonomous as possible. Reducing the burden of physically operating machinery when working the land is one of the major advantages of this solution. Also, the robot itself is a great asset to collect information on the field itself, offering a chance for agricultural companies to understand and analyse any relevant data. The robot is also not a standalone product, there is a need to offer powerful integration in an ecosystem of tools and services surrounding the robot. For instance, the ability to manually take over remote operations of the robot when desired. Lastly, the overall solution

### Galileo for optimized p2p navigation

GNSS positioning via Galileo is used to have a precise point-to-point navigation on predefined paths. Galileo is key to verify the measured position with the pre-calculated trajectories.



© Earth Automations

needs to be made as simple as possible for the end-user. A complex autonomous robot that is easily maintained and operated.

### Enter: The Dood

The Dood is the innovative autonomous crawler tractor robot that took shape after years of development. It is capable of cultivating the land autonomously or with a wi-



© Earth Automations

reless ruggedized tablet touch screen. It is equipped with a three-point hitch and PTO (Power Take Off) generator. The potential failure points and maintenance of PTO generators are very minimal and used in many tractors. On top of that it is also powered by a hydraulic system with a **stage V diesel engine**. This means the Dood is extremely reliable and is designed to have minimal chances of breaking down. The shape of the „Dood“ is designed specifically for orchards and vineyards: low height (**1.5 meters**) and able to pass under the canopy of trees, even with its weight of around **3 tons**.

### On the Farm: Guided by Galileo

The robot itself is connected to a **GSM/GPRS module** and uses its data connection to automatically update its software. It can also detect faulty components through its on-board AI. Furthermore, it incorporates a standard sensor control system with Galileo data being fed into a „Cloud Drive Path Memory“. In areas where the positioning signal could be impaired the team is currently also developing a local IoT beacon network that could augment the precision of the robot's movements.

Contact: [www.earthautomations.com](http://www.earthautomations.com)



vision  
anchor

PRESENTS

# An anchor you can trust in

After ages of the same simple concept VisionAnchor is willing to re-invent the way ships anchor by adding a visual security layer combined with GNSS technology. This will help to avoid one of the **10** most common reasons for crucial boat accidents. The likelihood of expensive damages, heavy injuries or even death can be reduced significantly. On top of that diving to check the anchor can be avoided.

## Re-invent the anchor

Classic anchors all follow the same principle. The actual anchor acts as a hook and locks to the sea ground. This part is tied to an anchor cable or chain and connected to the boat. Ideally, this already solves the problem of a ship moving. However, in reality it is quite a common problem that an anchor is not locked well. To resolve this issue, VisionAnchor decided to connect a second cable to the anchor which establishes a straight up connection to a buoy centered above the anchor. A few meters above the hook an underwater camera provides visual insights of sea ground conditions.

## Sealed technology

The actual brain of the solution – the buoy is at sea surface.

## Galileo for safety

The civilian positioning signal of Galileo will guarantee high position accuracy anywhere, anytime. In combination with other GNSS signals this ensures a good position signal even at non ideal spots, like next to cliffs or steep faces.



© VisionAnchor

The **FULLHD** video footage is sent from the camera which sits above the anchor via cable to the buoy. The buoy itself hosts additional sensors, such as a GNSS receiver which uses all bands of GNSS for accuracy less than **1m**. By adding an additional **gyro/roll** component they are able to track the anchor even if GNSS signal is lost. The user can select the **geofencing** (radius of allowed buoy movement) from 2m to **20m** depending on the situation in which they're anchored.



© VisionAnchor

Together with other sensors and the camera module it acts as a transmitter for visual information and the position signal. Data transfer is achieved wirelessly via WiFi and inspection information can be accessed via a smartphone app. If the captain decides to leave the boat, they can still access the information via **LTE/5G** network. The buoy can be attached to any anchor on the market.

## Alert triggers

Depending on the user settings alerts can be triggered via the app for example if the boat moves due to a non-locked anchor. Even if the phone loses connection to the buoy there is a backup alarm physically inside the buoy. While visual cross-checking would be almost impossible at night, the camera includes an infrared camera to allow night view. If the visual inspection confirms the moving, the anchor can be re-dropped.

## Future

Anchoring safely for captains VisionAnchor's main concern, but safe anchoring for the environment is also something that they care about. If captains see where they anchor they can also help preserve the protected seabed vegetation like Poseidonia and the coral reefs.

Contact: [visionanchor.net](http://visionanchor.net)



**Lympik** PRESENTS

## Winter's (be)coming – digital

Lympik developed a motion tracker for winter sports professionals called OCULUS. The IoT tracker as well as the connected cloud platform focus on the digitalization of training units. In depth data analysis and training protocols unleash a new dimension of insights and will help to take winter sports professionals to the next level.

### Redress limited insights

Nowadays professional training in skiing is limited to the trainer's line of sight and some basic measured statistics, like the section time or final time. Keeping in mind the rather large total track distance of about **3.000 meters** and significant altitude drops of up to **1.000 meters**, it is key to find the best racing line. Depending on the discipline, like downhill or super G, improvements are measured in a range of milliseconds which make the difference between a new record or just a good time. In racing, time is usually gained or lost at the gates. Therefore, precise measuring is needed. This is done by Lympik's solution, because in addition to track time OCULUS calculates the time at each gate. Considering that there are more than 60 gates in a giant slalom, it is obvious what can be achieved using this data. A second generation

### Need of Galileo HAS

To push the concept forward Lympik is willing to implement the Galileo High Accuracy service to allow centimetre-level precision. With this accuracy it will be possible to perform exact line comparisons which are currently



only possible with a highly complex and expensive GNSS-RTK solution. The Galileo HAS will be a game-changer for our system.



© Lympik

by some **online processing** the training results are visualized in a web application which can be accessed by standard smartphones or tablets.

### High precision timestamps

To achieve these training benefits, it is necessary to have technology with maximal accuracy. Therefore, Lympik is using UTC timestamps with an accuracy down to **nano-seconds** which are part of the Galileo signal. A single frequency **GNSS** receiver with an update rate of **25 Hz** of uBlox current line-up is used for the tracker.

### LTE on the roadmap

To allow live data transfer without a required WiFi hotspot the next generation will include an **LTE-modem**. This would allow the trainer to have live data during the race and data to be available without significant interruptions during the short clocked races.

### Multi-sensor approach

The tracker has an on-board **gyroscope**, **accelerometer**, a **magnetometer** as part of a **9-DOF IMU** sensor, as well as a **barometric sensor** for improved altitude measurement. Multi-sensor fusion algorithms are used within the cloud platform to calculate best results. Together with the **GNSS** receiver they form the functional hardware part of the solution.

Contact: [lympik.com](http://lympik.com)



© Lympik

of the device will also evaluate the reason for time lost in addition to the amount of time. On top of that a digital coach will provide feedback on how to improve.

### Wireless data transfer

The current sports tracker is **WiFi** ready. Each start and finish are detected by the motion controller and the data is automatically transferred to the cloud platform. Followed

**IT'S MY BIKE**  
TRACK AND PROTECT



PRESENTS

# Hands off! It's my bike

The IoT Venture GmbH is about to close the door on a nightmare for e-bike owners. Bike robbery is still a huge thing, for example more than 300.000 bikes per year are stolen in Germany, only. At least for e-bikes a new solution is on the horizon, 4 out of 5 bikes can be found with the solution of "IT'S MY BIKE". If this is not possible, an additional insurance programme provides a loss and damage waiver.

## Built-in IoT tracker

New e-bikes of IoT Ventures cooperation partners have built-in tracking solutions. Those which haven't can have the tracker installed by local partner retail specialists. It is not part of the strategy to offer a DIY method, because the tracker has to be installed safely and correctly into the motor compartment of modern e-bikes – a job for bike professionals. Good news, bikes with tracking devices get better insurance conditions, because it lowers the risk of total loss for the insurances.

## Smart connectivity

The tracker has several features on-board. The **L76-L multi-band GNSS** module from Quectel receives the current

## Galileo and NB-IoT positioning

To have full flexibility and best signal coverage, it is planned to use the merged position of GNSS and NB-IoT in future versions of IT'S MY BIKE. This would allow an optimized location service, when GNSS



constellations have troubles in providing strong signals, like in urban canyons while GNSS is strong in very remote areas.



© IoT Venture GmbH

position. The device is connected via **Narrowband IoT (NB-IoT)** standard, which is available worldwide as a sub-band of the **4G network**. It operates at **200 kHz** and can downlink with up to **127 kbit/s** and uplink with up to **159 kbit/s**. Additional benefits of **NB-IoT** are: high signal penetration into structures like buildings, garages, or transporters. Furthermore, there is only low battery consumption, which is key for a sensor that weighs **45g**, only.



© IoT Venture GmbH

## Robustness and battery management

The placement of the sensor is not easy to access and removing it takes time, so it is very unlikely to be displaced at the site of crime. The sensor is only activated, if movement is recognized. If the bike is permanently moved a position is sent once per minute for up to **8 hours** of live tracking. Staying operational for up to **5 months** on stand-by and between a temperature range of **-20 to 60° C** increases the likelihood of receiving good positioning data after a theft.

## Full-service approach

If a theft is recognized the user has several options. Assuming the bike has been locked on the corresponding App the user can search for the bike himself or report a theft via App. With basic information, like photos of the bike, the police get informed by "IT'S MY BIKE" staff, who also provide the last known position. Thanks to the NB-IoT network the service works across frontiers and takes into account that stolen bikes are often quickly shipped beyond the borders. Bikes are quite often stolen by professional operating gangs, which leads to the nice side effect that if a tracked bike is located other non-tracked bikes can be returned to their owners as well.

Contact: [itsmybike.com](https://itsmybike.com)



## Into the wild and free without fear of getting lost

Big adventures challenge us. We can learn to go further, test our limits, and push ourselves to the next level, especially when it comes to extreme sports. It's a thin red line between pumping adrenaline and scary situations. LifeLine srl. brings together both the desire for adventure and the need for safety. Whether it's hiking in the Alps, canyoning in France or running in very remote areas, people are often faced with a lack of broadband internet access or even cellular connectivity. The wrist-wearable O-BOY solves the problem on connectivity when it is needed most.

### No smartphone required

Other than competitors' solutions LifeLine does not require the user to carry a smartphone with them to connect a smart watch to it. Their target-group of outdoor and sports enthusiasts don't want their leisure time to be disturbed by any notifications. Apart from showing the time, their wearable focuses on three specific services: GETME, to share the wearer's position, RESCUEME to send an emergency signal and TRACKME, to live-track the user's position. The complete solution consists of the wearable, a mobile app, and an online platform.



© LifeLine srl.

Extreme sports often go hand in hand with extreme (weather) conditions. O-BOY is light-weight (**40g**) and **IP68** certified to be dustproof, waterproof and shockproof. The size of **50 mm diameter** is comparable to well-known smart-watches. In addition to that it can be used in a temperature span of: **-20 to 50° C**.

### 2 satellite networks

While the positioning of the device is handled via GNSS, the communication backlink is established via satellite communication. The dual usage is achieved due to an omnidirectional satellite antenna. O-BOY is not only a wearable or a personal beacon locator, it is both. The communication Backlink is achieved via a service from the private operator **Globalstar**, who operates a constellation of **48 satellites** with almost global coverage (apart from the poles). Compared to others Globalstar can achieve data transfer rates of **9.600 Baud**.

### Low-energy consumption

Unlike most smart-watches, one battery charge lasts for up to **20 days on standby** without recharge and **48 messages** or track points can be sent. Additional energy efficiency is achieved through the use of the simplex-mode satellite communication. The downside of this is that users don't receive a confirmation that the data has been received. Charging the lithium battery is done wirelessly via **Qi chargers**, full charge being achieved within **64 minutes**.

### Easy setup

The wearable has no user interface, the setup is achieved via the smartphone App and Bluetooth Low Energy. After the initial transfer of the settings to the device, the App is no longer needed and the smartphone can be left at home if the user wishes to do so. There are several customization options to choose from, targeting the settings for the most likely scenario. Once set and charged the device is ready to go. If the wearable is triggered the corresponding message is sent within seconds, for example as an **SMS** to a pre-defined contact including live coordinates.

The precision of Galileo is of the utmost importance when 1 meter can make the difference. The multi-constellation chip and omni-directional antenna is key. The Galileo Search & Rescue (SAR) service means that one can accurately send their location via the



O-BOY, supported by a private EOCC (Emergency Operations Coordination Center), in addition to Globalstar SatCom connectivity.







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