Small transmitter, great potential – use of beacons in potentially explosive atmospheres

Beacons transmit small volumes of data with energy efficiency, can go many years without a battery change and trigger mobile apps for the most diverse applications. When combined with the enterprise mobility solutions from BARTEC, the cost-efficient radio transmitters offer considerable improvement in potentially explosive and non-hazardous areas. The spectrum ranges from increased safety, simplified and more transparent maintenance rounds using augmented reality navigation and automated data harvesting, through permanent data capture within the framework of IIoT concepts.

Those who visit a museum these days and who download the relevant app for this will increasingly interact with small radio transmitters. The so-called beacons are attached to the exhibits and transmit their ID regularly via Bluetooth. When visitors approach, their smartphone detects the ID signal and the app provides the corresponding multimedia content for the exhibit. The local reference not only turns museum visits into a completely new, interactive experience – the same is also true of shopping. The retail trade uses beacons to navigate shops, for discount schemes and loyalty card solutions. So what opportunities does the global beacon trend offer the process industry?

Substantial potential for the process industry

Beacons offer diverse opportunities for use in the process industry and other sectors with potentially explosive atmospheres: for example the mobile devices that receive a beacon signal in the field can be roughly localised (proximity) using the signal strength. Maintenance work in particular can be digitally supported or personnel safety improved using an app. Where there are several beacons in the proximity of the receiver, a more accurate localisation is possible by means of trilateration (measuring the distance to and between three beacons), for example for asset tracking.

In addition to transmitting the ID, sensor beacons can also be used to send measurement data to a smart device or a hub. This enables the condition-based monitoring or predictive maintenance of plant and processes in the context of the Industrial Internet of Things (IIoT). If beacons are connected to external sensors it is also possible to record and collect other measurement data. This is not least of great interest to the retrofitting of existing plant because it enables information to be obtained about parts of the plant that were previously not available. Moreover, it offers an alternative to expensive retrofitting with wired sensors, something that is not always possible for safety reasons.

Many versions of Bluetooth beacons are available, permitting diverse applications.
(Source: www.blukii.com)

» **A beacon transmits its ID, text information or measurement data to a smart device or a hub via Bluetooth LE.**

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Different beacon categories

Simple beacons transmit their ID at regular intervals, which can trigger an action following alignment with a back-end. Beacons with integrated sensors also transmit their live measurements which can be processed by mobile app or hub and forwarded to the back-end. Measurement data that can be captured include environmental data such as temperature, air humidity, air pressure and light, as well as acceleration (inclination), magnetic field, battery level and distance. To make the technology portable, wearables with integrated beacons are also available. In order to be able to operate beacons safely in potentially explosive atmospheres, BARTEC is working on a suitable solution with various suppliers of beacons.

Industry 4.0: Sensor beacons are suitable for cost-efficient data capture (Source: www.blukii.com)

» **Beacons are ideal for "brownfield" retrofitting, transmitting ID and measurement data up to 100 m away for up to 10 years without a battery change.**

Measurements at one-second intervals

The sensor values of the beacon can be read out very easily because, unlike an industrial sensor, no Bluetooth pairing is required. After the initial beacon ID, all sensor packages are sent at fixed intervals and can then be retrieved. With an advertising interval of 4 seconds, it is it possible, for example, to transmit the beacon ID (1st second), environmental data (2nd second), magnetism (3rd second) and acceleration (4th second), and thereby to monitor the temperature and vibration of a motor or pump and to service these based on their condition using analysis tools.

In contrast to an industrial sensor, beacons are not suitable for large data volumes, for saving data or for onboard evaluations, however the procurement costs are significantly lower.

What is a Bluetooth beacon?

A small radio transmitter or receiver based on Bluetooth Low Energy (BLE) or Bluetooth Smart technology is referred to as a beacon or Bluetooth beacon.In the simplest case, beacons transmit their ID which serves as a reference for other actions. Sensor beacons likewise transmit live measurement data.

Power is typically supplied by a battery, and less commonly by cable. Depending on the manufacturer, level of development and operational environment, the range may extend to 30 metres and the service life to up to 10 years.

In an IT environment, the term "beacon" is additionally used for status messages in a WLAN or for tracking pixels in messages and websites. The growing need for solutions to boost transparency and efficiency in connection with new IoT concepts over recent years has resulted in the increasing importance of beacons. Smartphones, tablets and tablet PCs running Android 4.3 and Windows 8.1 or higher can be received by beacons.

Industry 4.0: Sensor beacons transmit all measurement data packages at an adjustable advertising interval. (Source: www.blukii.com)

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Making good use of beacons

In the process industry, beacons offer their greatest improvement potential in conjunction with the standards-based BARTEC Agile tablet PC series, because this range can be used in all potentially explosive and non-hazardous areas and, thanks to Windows 10 IoT, supports all standard software solutions. Owing to the BLE standard, it is also possible to use beacons with smartphones and mobile computers, and a few interesting use cases are set out below:

1. Proximity applications for greater safety

Inside buildings, Ex certified mobile devices such as the BARTEC TC75 NI usually detect the BLE signal of the beacon at a distance of 10 to 15 metres, permitting localisation of the mobile device. Ranges of up to 100 metres are possible in interference-free environments. If the person carrying the device remains in an area for longer than usual, the mobile device can send a man-down message to the control centre. The use of armbands with beacons and push button is also conceivable for manual alerts.

> » **Beacons can increase the safety of persons in the field.**

2. Access control

With the help of localisation, it is also possible to dispatch warning messages when employees approach an area that they are not permitted to enter, or if their mobile device has not been certified or approved for the potentially explosive atmosphere in question (geo-fencing). In these cases an alarm is triggered, the individual and the control room are informed. Wearables with integrated beacons combined with Near Field Communication (NFC) are also suitable for locating people and for access monitoring.

Access control: When a mobile device detects the beacon signal, checks using WLAN in the back-end establish whether the mobile device or its wearer are permitted to be in the respective potentially explosive atmosphere.

3. Proximity and asset tracking

Proximity applications can greatly simplify maintenance deployments, rounds and avoid errors; a time stamp and localisation can be automatically detected, thereby increasing the security of data captured and reducing the ability to manipulate the data. Thanks to beacon localisation, the objects of plant to be inspected are visualised to users directly, where necessary by means of augmented reality. There is no longer any need to search for the pump to be inspected, for example, as it appears on the display immediately.

A further application scenario is asset tracking, for example to equip vehicles inexpensively with beacons and use these to detect them at certain checkpoints.

4. Digital support for inspection rounds

The documentation of rounds is significantly reduced by a combination of beacons, the BARTEC Agile X tablet PC and maintenance-supporting apps. In the simplest case, the app registers whether the maintenance worker is present in the inspection area for a certain amount of time. If he does not create an error message, the system automatically notes that "everything is OK". If there is an error, the employee creates an error message. The touchscreen can additionally be used to mark the place concerned in the plant plans (redlining), and to attach a photo or video. Digital checklists in conjunction with localisation ensure that at the end all stations have been run through and inspected. The Austrian system integrator Augmensys has already implemented applications such as these many times.

The UBIK® software solution also connects mobile data management to augmented reality in order to further optimise efficiency and security in the field.
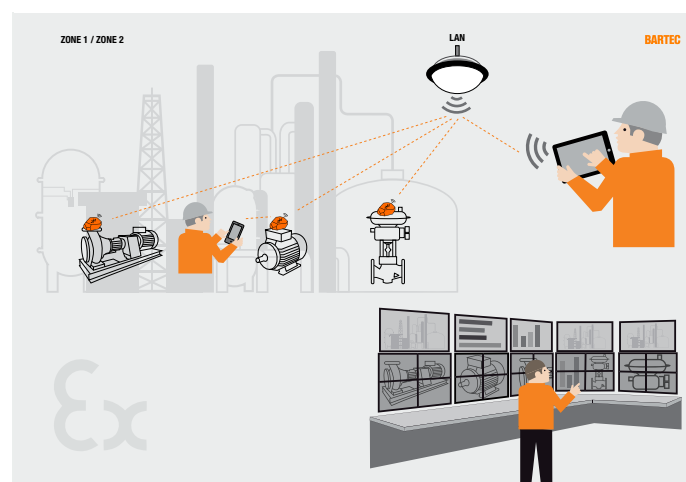
Sensor beacons with hub simplify maintenance rounds and provide data for condition monitoring and predictive maintenance. The current measurements are also visible independent of the location on the BARTEC Agile X tablet PC.

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About UBIK®

The industry-independent UBIK® augmented reality software from Augmensys provides users with the data they require at the right time in the right place. UBIK® efficiently consolidates data from various source systems (CAD, CAE, DMS, ERP, DCM, etc.), and by means of mobile terminals enables the intuitive, up-to-date, paperless and transparent access to the digital systems of the entire plant – for control bodies, maintenance staff, technicians and the operating company.

Mobile input opportunities for source and destination systems, feedback from photos and voice memos and measurement readings facilitate highly effective and efficient work in and with the industrial plant.

Thanks to the integrated augmented reality, where necessary UBIK® also navigates external staff and contractors efficiently and safely through complex plant.

Digitally supported plant inspection using the UBIK® software from Augmensys.

» **Beacons make maintenance easier, more efficient, more transparent and safe – for the operating company and for service staff.**

5. Automatic data collection

A further improvement step is the automation of the previously manual entries of objects and measurement data. The sensor data are immediately captured by the app on reaching the object and shown on the screen (where applicable by augmented reality). This automatic data collection enables personnel to assign, capture and save maintenance data immediately. If the thresholds stored in the control system are exceeded, e.g. temperature, vibration or power consumption of a pump, the app offers pre-filled messages. External sensor technology connected to the beacons permit the actual fluid statuses to be compared to those recorded automatically in the control system. Such scenarios can already be realised today using the UBIK® Augmensys software, the BARTEC Agile X tablet PC series and explosion-protected beacons.

6. Permanent or itinerant data capture

Beacons are suitable within an IoT concept as selective data sources which regularly deliver sensor data for condition monitoring and predictive maintenance via suitable hubs. Increased temperatures on motor housings or vibrations on pumps, for example, are indications that service life is coming to an end. Another example is where the power consumption is detected via external sensors by the beacon, so as to calculate the flow rate and transmit it wirelessly to the control system.

Last but not least, beacons are also possible as itinerant sensor technology, for example to establish suitable measurements for a production ramp-up. Beacons, hubs and mobile devices also come into consideration when making locations that have little digitalisation fit for Industry 4.0 by constantly collecting data and by replacing expensive wiring and back-end hardware.
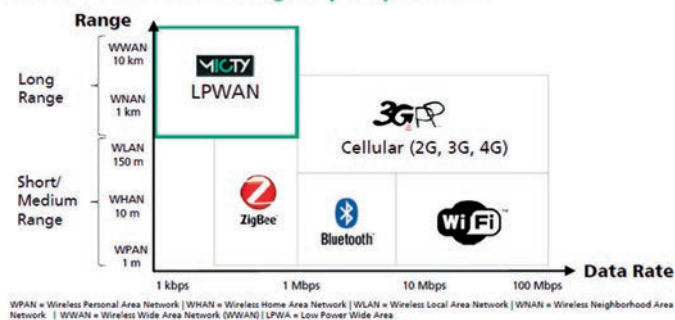
BARTEC
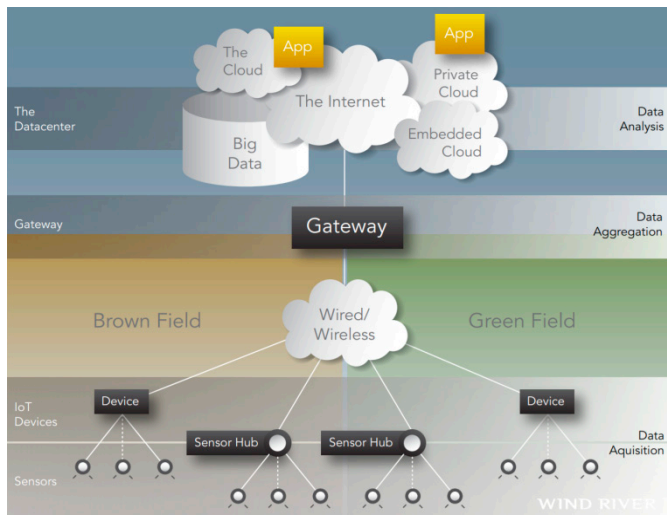
IIoT: Beacons at the bottom end of a greenfield and brownfield data supply chain.
© Wind River System - https://www.windriver.com

» IIoT: Beacons permit cost-efficient retro-fitting that is focussed on maintenance, monitoring and optimisation.

Condition for use in potentially explosive atmospheres

For beacons and hubs to be used as standard solution they must be certified for potentially explosive atmospheres. BARTEC is working on special solutions in this area. The BARTEC Agile tablet PC series is already available from non-hazardous areas to Zone 1. BARTEC specifically has an innovative WLAN access point for Zone 1 (Wireless X) in the range for this.
What is more, BARTEC is working on Ex certified hubs and cradles which operate with long-range wireless protocols such as MIOTY or ZigBee. Such long-range protocols are of particular interest for expansive oil and gas installations and for petrochemicals and large chemicals plants. The beacons themselves can also transmit their signals across much greater distances to hubs or mobile devices using these long-range technologies.

Über Low-Power-Wide-Area Networks könnten Beacons und Hubs ihre Signale auch über lange Distanzen von bis hin zu 10 km aussenden. (Quelle: Fraunhofer IIS).

» Low power radio standards such as MIOTY expand the range of hubs and beacons to several km.

Security and vulnerability

An important question before introducing beacons and other IIoT infrastructure is security. Beacons are largely considered to be non-critical in this respect because in their simplest form they only transmit an ID, and this with limited range within the plant. There are mechanisms for enhanced security requirements that conceal IDs and measurements across a network of beacons by getting the IDs to rotate according to a specific algorithm. Conversely, beacons can also increase the security level as shown by the example of banks which use blukii® SmartKey beacons for two-factor identification.

» Beacons can usefully supplement existing processes and deliver data on plant statuses and maintenance urgency. They are not designed for classic process control.

Good reasons for an investment

The strongest arguments in favour of using beacons is their high level of efficiency. On the one hand this is due to the low procurement costs and long service life (depending on the battery used, the possibility of replacing it and the transmission interval), and on the other hand because of the Bluetooth LE standard supported by all up-to-date mobile devices.
Mobile infrastructure can be designed extremely economically in combination with the BARTEC Agile tablet PC series. Since the series is available throughout for Zone 1, Zone 2 and non-hazardous areas, the user can select one level lower as the protection level. For example, a Zone 2 device is sufficient when receiving data from a beacon in Zone 1, and a Non Ex device for data from beacons in Zone 2.
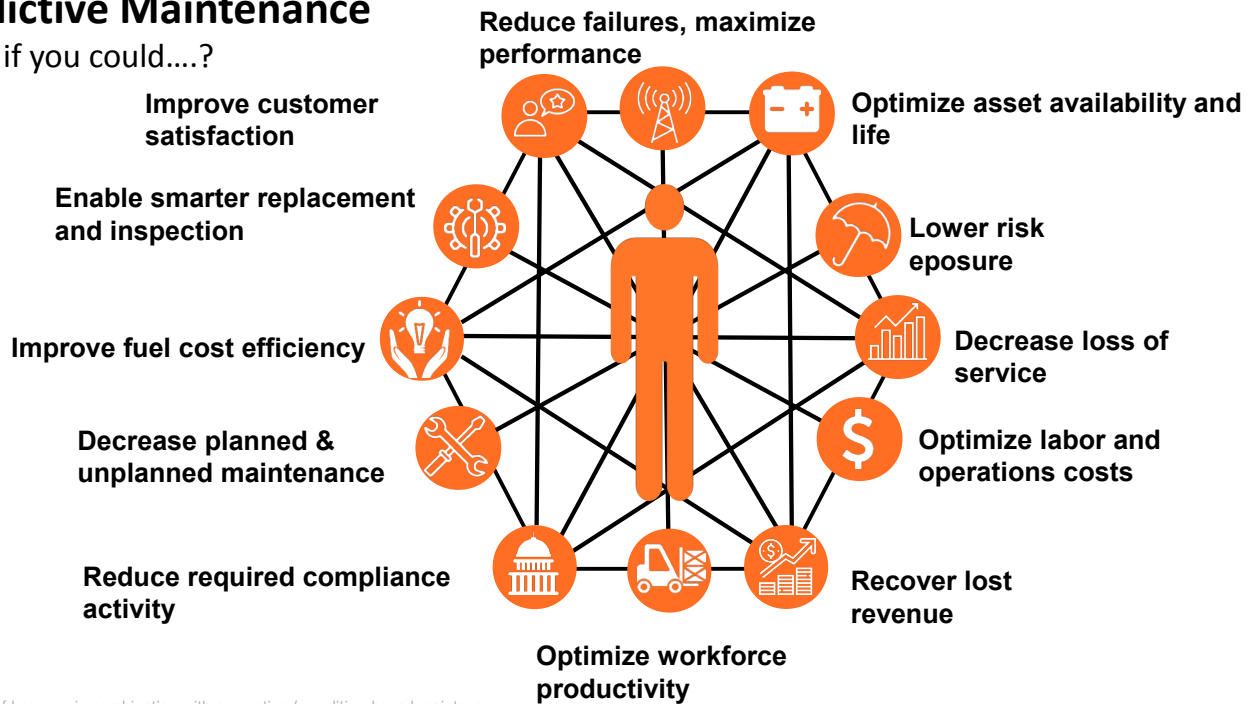The number of hubs can be reduced by the combination with long-range transmission technology. In view of the diverse efficiency gains, it may further be assumed that the payback will be quite fast. Added to this is the potential for boosting security and safety, for example with alert messages in the case of unauthorised access or to locate people who have had accidents.

»The investment risk is low, the range of applications enormous. The technology for the field of application – for certain!

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Predictive Maintenance

What if you could....?

Improve customer satisfaction

Enable smarter replacement and inspection

Improve fuel cost efficiency

Decrease planned & unplanned maintenance

Reduce required compliance activity

Reduce failures, maximize performance

Optimize asset availability and life

Lower risk eposure

Decrease loss of service

Optimize labor and operations costs

Recover lost revenue

Optimize workforce productivity

Benefits of beacons in combination with preventive / condition-based maintenance.
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Conclusion and outlook

Ex certified beacons, hubs and BARTEC enterprise mobility solutions can make a major contribution to the continuous increase in security, process quality and plant availability. The low procurement costs, durability and consistent use of standards such as BLE and Windows 10 IoT speak in favour of a fast payback. On the basis of this, companies can start initial pilot projects quickly in brownfield areas, and then gradually develop further use cases. With innovative partners such as Augmensys, blukii® and the Fraunhofer IIS, BARTEC is developing a solid foundation for IIoT applications in potentially explosive atmospheres.

» **With beacons and enterprise mobility solutions from BARTEC, IIoT pilot projects can be set up quickly and and easily expanded.**

Potential benefits of beacons

- Lower investment costs for beacons, sensors and mobile devices
- Low maintenance costs (service life)
- Easy data capture in potentially explosive atmospheres
- Greater security in the field (access control, man-down messages etc.)
- Easier interaction on rounds and automatic data collection during rounds
- Possibilities for navigation in the field
- Cost-efficient asset tracking
- IIoT-enabler: cost-efficient data collection for condition monitoring and predictive maintenance
- Development for outdoor use through long-range standards such as MIOTY

BARTEC AGILE X tablet PC series

BARTEC