www.wittra.io

WiTTRA™

Overview and Deployment Guidelines

LoWPAN mesh & LoRa® LPWAN

Overview

- WiTTRA™ combines a Data Transport Network along with Positioning Infrastructure to allow you to Locate, Sense and Track your assets.
- In order to achieve a successful network deployment, it is important to understand both the capabilities of the WiTTRA™ technology as well as the intended use case.
- These guidelines give an overview of the hardware required and will help you deploy a robust, reliable and high-performance wireless network.

WiTTRA™ offers a range of wireless network technologies covering most conceivable use cases within IoT, our network solutions are based on open standards which help make systems and applications more functional and interoperable. The core elements within the WiTTRA™ network consist of the WiTTRA™ Unified Gateway, WiTTRA™ C{x}ameleon tag-our software-defined hardware solution for the creation of Positioning Beacons, Mesh Routers, WiTTRA Sense 360 and a range of additional clip-on sensors and accessories all described later in this guide. In addition, the WiTTRA™ network supports third-party LoRa devices connected directly through the WiTTRA™ Unified Gateway.

More information: http://www.wittra.io/

Devices

01

WiTTRA™ UNIFIED GATEWAY

The Unified Gateway is at the heart of any network deployment - combining a 6LoWPAN mesh network with either LoRa or mioty LPWAN (low power wide area network) radios to provide a high volume of on-site sensor and 3D positioning data, along with long-range connectivity options for wide area network coverage needed for mass IoT deployments.
The self-contained cloud gateway with either cabled ethernet, or cellular connectivity can be deployed to monitor assets through a cloud-based API. Fast to deploy and easy to use, the gateway delivers sensor and positioning data to the cloud service based on open and secured standards and protocols.

www.wittra.io/products/unified-gateway/

WiTTRA™ C{x}AMELEON TAG

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WiTTRA™ ‘Software Defined Hardware’ C{x}ameleon Tags extend hardware life and reduce waste. It is compact, rugged and IP67 sealed and certified. It Includes several integrated sensors, positioning functions and a modern radio/communication technology, delivering data to the cloud. You define the product identity and functionality within the WiTTRA™ Portal and the tag automatically connects to the low-power, IP-based network once registered within the user portal. The C{x}ameleon Tag can take the identity of the WiTTRA Sense 360, Mesh Router or Positioning Beacon through the use of our embedded software-defined radio.

https://www.wittra.io/products/wittra-cxameleon/

Identities and Functionality

Mesh Router:

The WiTTRA™ Mesh Router is a small, wireless “anchor point” that forms part of the mesh network on a local site. Mesh Routers work togeth- er to extend and scale the network coverage to suit any shape or size of site, indoors, outdoors, underground even in 3 dimensions upwards in a multi-level environment.

https://www.wittra.io/products/wittra-mesh-router/

Positioning Beacon:

Positioning Beacons offer the func- tionality of both ToF and RSSI. ToF (Time of Flight) positioning involves measuring the distance between a WiTTRA Sense 360 and several Positioning Beacons using accurate timing signals. RSSI (Relative Signal Strength Indicators) measures signal strength to work out positioning.

https://www.wittra.io/products/wittra-positioning-beacon/

WiTTRA Sense 360:

The WiTTRA Sense 360 is a small, wireless multi-function asset tracker with multiple built-in and click-on sensing capabilities. The device allows you to collect both positioning and sensor data.

https://www.wittra.io/products/wittra-WiTTRA Sense 360/

Third-Party Devices:

In addition to the WiTTRA™ WiTTRA Sense 360 the network accepts third-party LoRa devices, however, unlike the WiTTRA Sense 360 the third-party LoRa devices only transmit sensor data utilising a LPWAN star network across distances up to 20km line-of-site. The combination of devices offers long-range connectivity options for wide area network coverage needed for mass IoT deployment

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WiTTRA™ CLICK ON SENSOR

WiTTRA's expansive range of Click on Sensors further extends the functionality of the WiTTRA Sense 360 and is designed to future-proof your IoT deployment. The Click on Sensor extends your network in minutes by utilising WiTTRA™'s unique building block design whilst maintaining an IP67 rating. It comes in two versions; the short version is self-contained and is powered from the internal battery in the tag. The longer bodied version, is set up to take external power through the micro-USB connector.

- https://www.wittra.io/products/wittra-click-on-sensors/

WiTTRA™ ACCESSORIES

A range of accessories are available to further enhance and support network deployment. Battery packs, mounting cradles, velcro straps, enclosures, power supplies, rechargeable batteries, USB cable and a reset plug.
A mounting plate for the gateway is available on request.

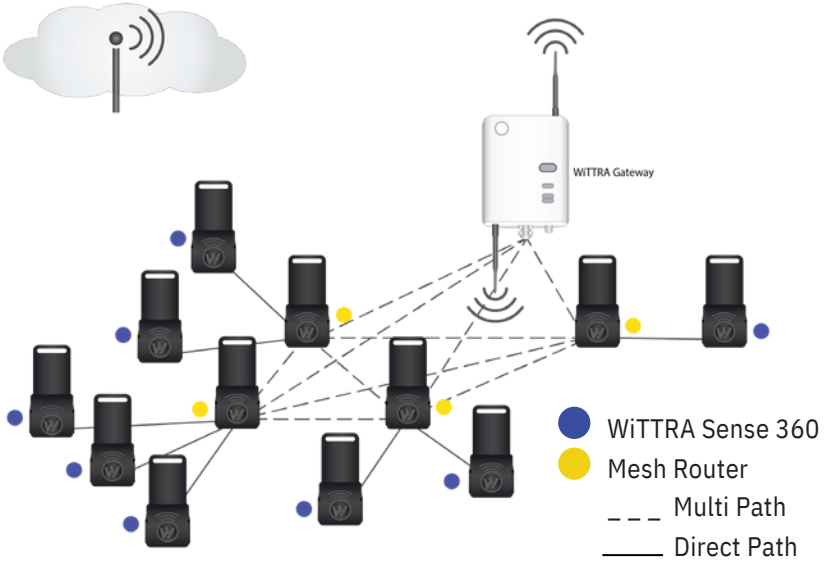
- https://www.wittra.io/products/wittra-accessories/

Network Overview

WiTTRA™ uses sub-GHz network technologies to reliably and securely deliver IoT data from sensor to cloud or to on-site computing platforms (or both) depending on preference. All three network types are scalable from small sites through to large, multi-site installations, driving mass IoT adoption.

WiTTRA™ only works with network solutions based on open standards, helping make systems and applications more functional and interoperable, reducing vendor lock-in and ensuring the long-term viability of the technology investment.

The WiTTRA™ network offers the only truly unified approach by enabling multiple topologies and protocols to run concurrently or independently in a single technology deployment.



Mesh (6LoWPAN)

Star (LPWAN)

Combined (6LoWPAN + LPWAN)

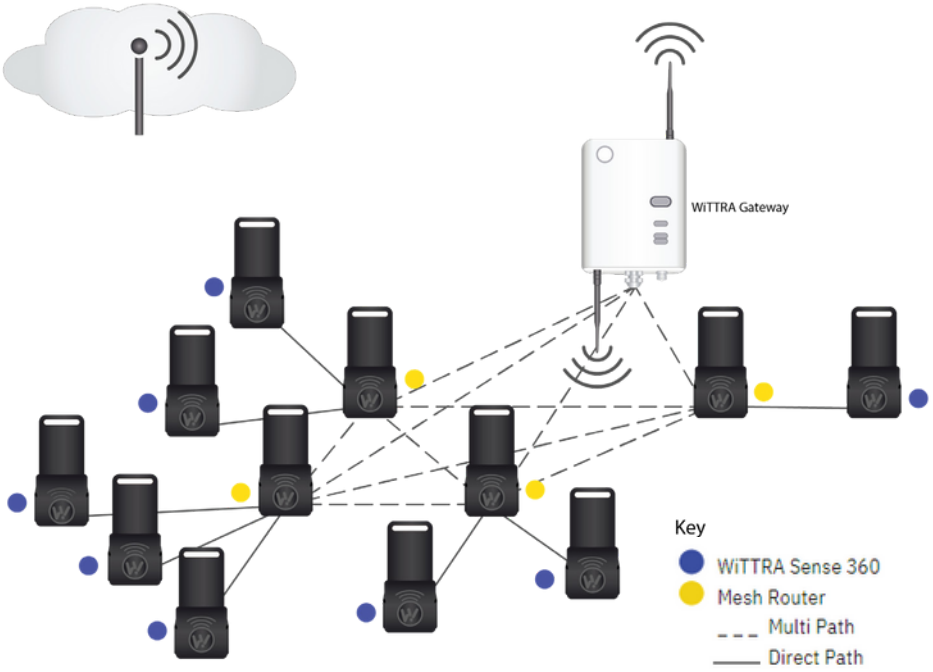
Mesh 6LoWPAN

The WiTTRA™ network is firstly a Data Transport Network. Mesh Routers relay sensor data and positioning data from the WiTTRA Sense 360 asset tags back to the Gateway. 6LoWPAN is a network protocol that brings IPv6 to low-power wireless networks. Defined by the IETF (Internet Engineering Task Force), it is an open standard protocol designed for efficient communication over a variety of wireless technologies, such as IEEE 802.15.4 mesh networks. This makes it an ideal choice for many IoT applications.

Being a Mesh topology, the network of installed Mesh Routers will self-form a single-hop or multi-hop network “backbone”. The in-built routing mechanism will automatically ensure optimal routing pathways through this backbone when transporting data from the sensor to the gateway.

The Mesh topology allows you to install a network on almost any site, regardless of size or shape or environment currently allowing up to 10K devices within a single network, deploying multi networks is easily achieved with devices being able to roam between.

Using a mesh topology also allows for redundancy in the network coverage to eliminate radio black spots, by providing more than one connection point to the network for wireless sensors. This is particularly important when those sensors are attached to moving assets. Being IPv6 packets, the data is simply transferred to the internet without any complex translation within the gateway – another advantage of using an IP-based network.



LoRa

LoRa is a spread spectrum, long-range, low-power device developed from chirp spread spectrum (CSS) technology. Launched by Semtech in 2015, and officially approved as a standard by the ITU (International Telecoms Union) in 2021, now LoRa and LoRaWan are regarded as the leading non-cellular low power wide area (LPWAN) network.

LoRa is suitable for transmitting secure low bandwidth data over long distances and can be operated across the ISM bands, 2.4GHz and the license-free spectrum. Ranges of over 10km can be achieved for uplink communication making it ideal for many low-power battery-operated IoT deployments.

Based upon a star network topology, gateways are connected to the server via standard IP connections while end devices connect to one or many gateways within a deployment and are bi-directional supporting over-the-air upgrades. The LoRa and LoRaWAN standard is interoperable which enables flexible IoT deployments at scale.

Star (LPWAN)

Unified Network

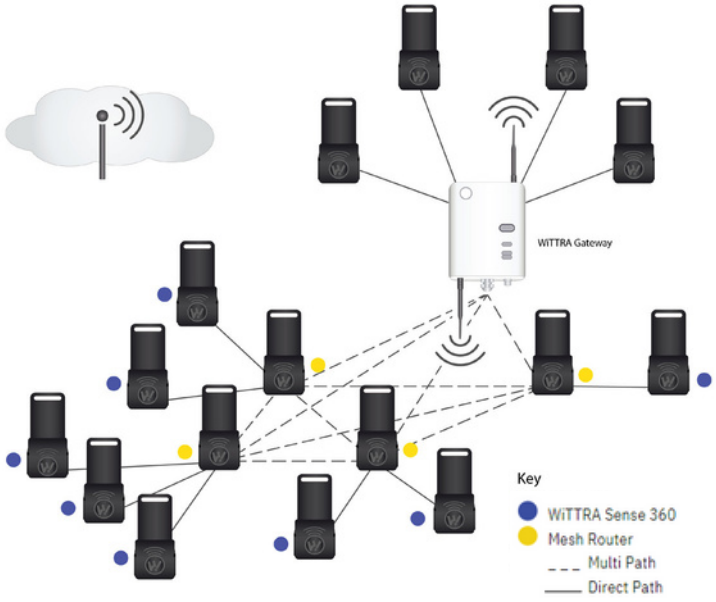
The combination of WiTTRA™'s 6LoWPAN IP-based mesh topology with LoRa LPWAN star topology (low power wide area network) in a single gateway provides a high volume of on-site sensor and 3D location data, along with long-range connectivity options for wide area network coverage needed for mass IoT deployments.

The WiTTRA™ WiTTRA Sense 360 device allows you to collect both positioning and sensor data when present within the mesh network environment. The third-party LoRa devices only transmit sensor data utilising a LPWAN star network across distances greater than 10km line-of-site. The combination of devices offers long-range connectivity options for wide area network coverage needed for mass IoT deployments.

Each technology implements various spectrum spreading processes to ensure reliable data delivery even in the presence of radio interference.

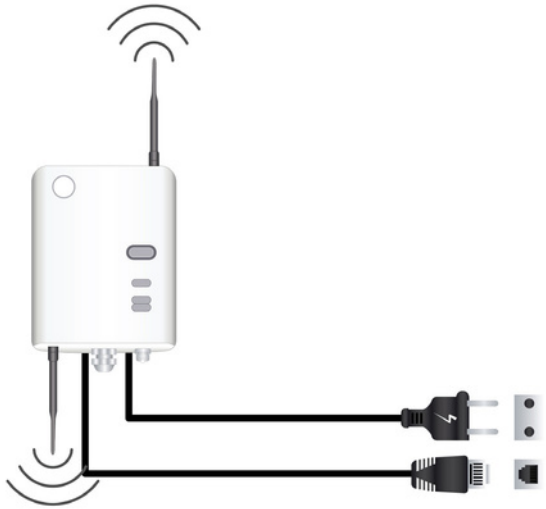
In addition to WiTTRA™'s own WiTTRA Sense 360 sensor tag, the WiTTRA™ solution allows for all third-party LoRa devices to join the WiTTRA™ infrastructure.

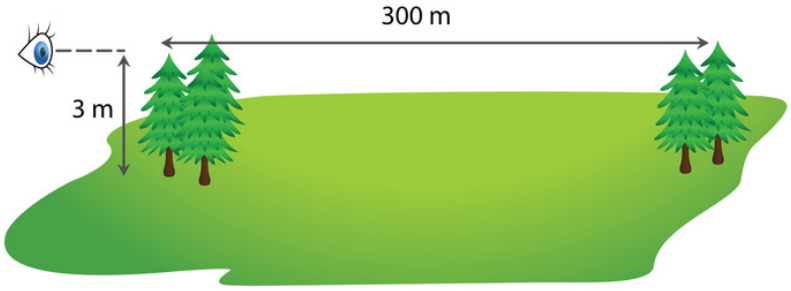
Combined (6LoWPAN + LPWAN)



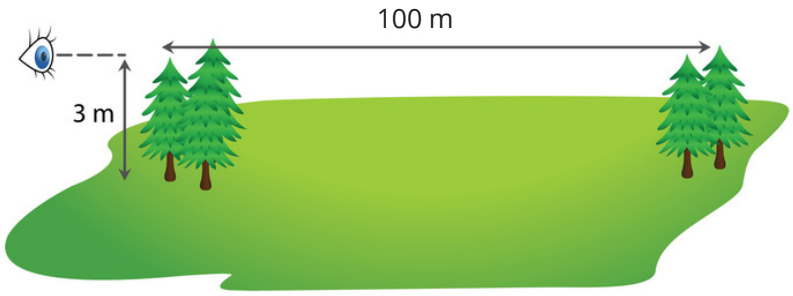
Infrastructure Deployment Mesh

The gateway can be connected to either cloud or on-premise computing resources (or both) via wired ethernet or cellular backhaul. It provides industrial-grade reliability both indoors and protected outdoors. The gateway accepts power from an AC mains outlet, is built to IP51 standards and is fully certified and ready for field deployment.





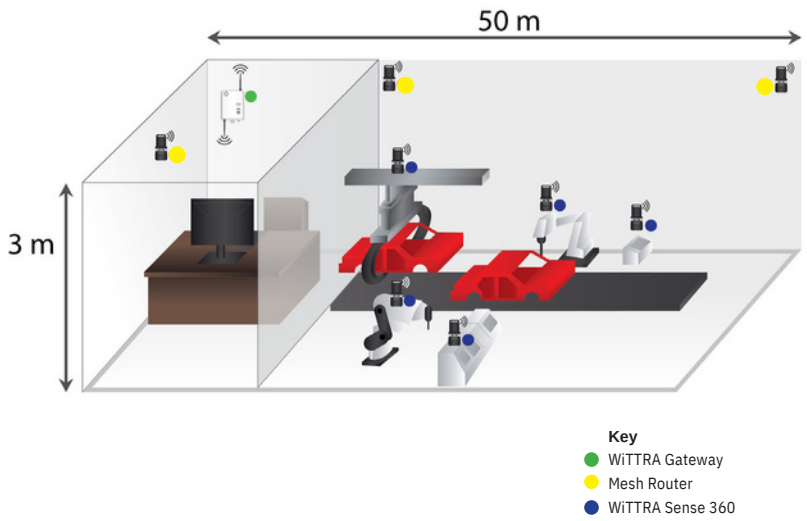
Mesh routers (MRs) can be deployed up to several hundred meter's apart outdoors, line of sight, when installed at least 3 meters above ground level) and achieve a reliable mesh formation.



Positioning Beacons (PBs) should be placed no more than 100m apart and elevated 3m outdoors. Additionally. Each positioning beacon needs to connect to a Mesh Router and should be no more than 200M away if the site deployment is using ToF (time of flight).

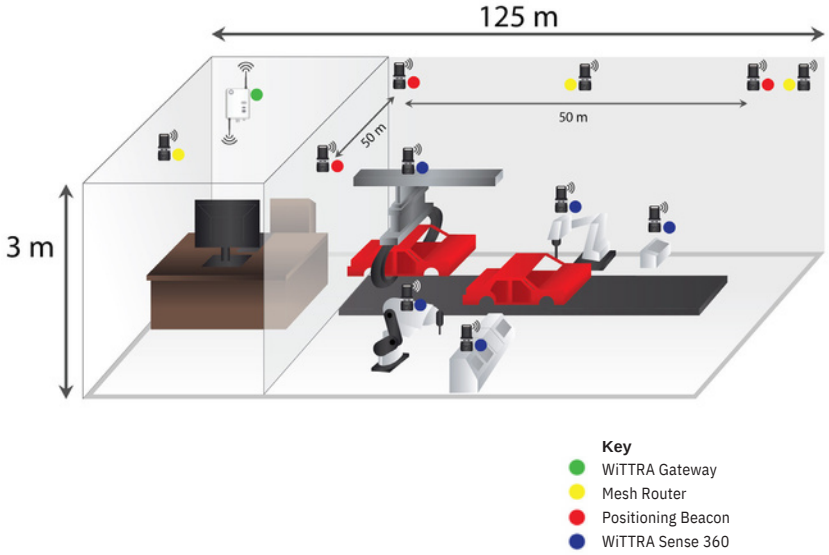
RSSI Indoor deployment

Indoor deployment distance is lower, due to signal obstruction caused by walls, furniture etc. In a typical indoor environment, deployment should be around 50M which is still a 10x improvement of standard beaconing solutions.



Time of Flight Indoor Deployment

When ‘more accurate’ positioning of the WiTTRA Sense 360 device is required Positioning Beacons (PBs) need to be installed, Indoor deployment distance is lower and Positioning Beacons should be placed no more than 50m apart to maintain good positioning accuracy and within 100M of a Mesh Router (MR).



Positioning Infrastructure

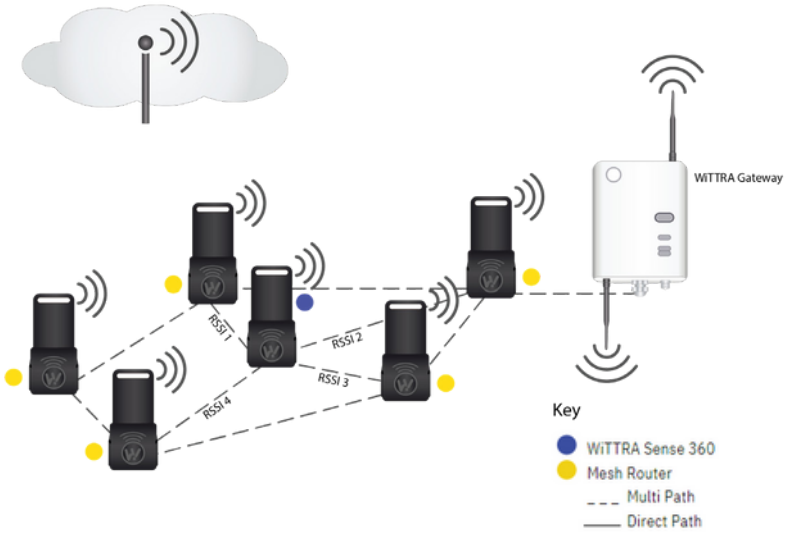
In addition to collating sensor data, the WiTTRA™ network functions as a Positioning infrastructure, meaning it can position the WiTTRA Sense 360 devices using signals transmitted within the network through RSSI (Received Signal Strength) and ToF (Time of Flight). Environment dependent you can expect to achieve accuracy of +/-5m 85% of the time. There are two separate considerations when installing the network: Firstly, placing the Mesh Routers (MRs) in optimal locations to enable routing of the data from the WiTTRA Sense 360 device to the Gateway; and secondly, if the deployment is also using Time of Flight positioning to ensure that the Positioning Beacons (PBs) are also placed in optimal locations. Note the Positioning Beacons route their data via a Mesh Router and are not part of the network backbone, they are dedicated purely to signals related only to positioning.

Positioning Technology Options:

There are two distinct methods used for positioning WiTTRA Sense 360 tags within the network:

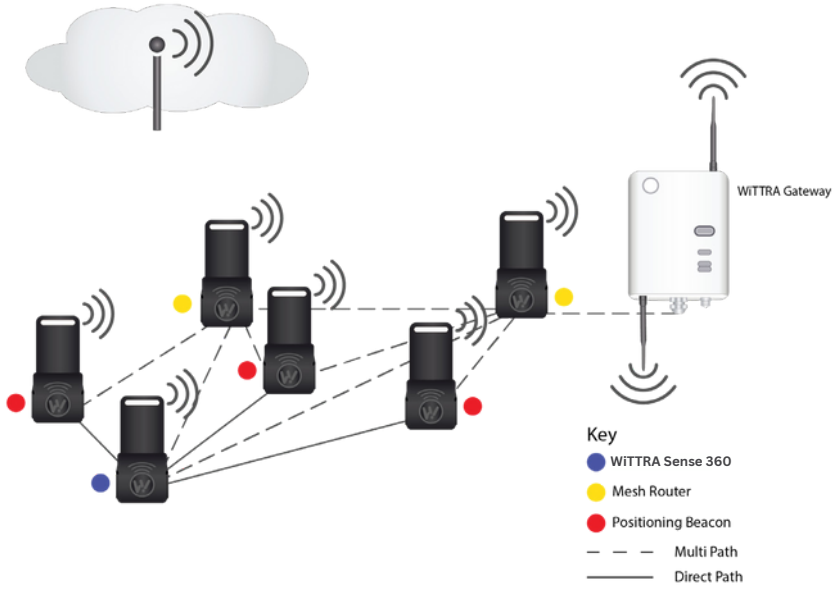
01 RSSI (Received Signal Strength) Positioning:

Received signal strength indicator (RSSI) is a measurement of the power present in a received radio signal. RSSI is used by most indoor positioning systems because it is easy to implement. If the distance between the tag and measuring infrastructure is too long, you will need additional devices to improve the accuracy of your deployment.



02 ToF (Time of Flight) Positioning:

Time of Flight positioning involves measuring the distance between a WiTTRA Sense 360 and several Positioning Beacons using accurate timing signals. The advantage is consistent accuracy over much larger distances. As an example, the WiTTRA™ network has shown an accuracy of plus/ minus a few metres at a distance of 100 metres from the network infrastructure. Positioning signals need to be sent into the mesh network and require a radio link to at least one Mesh Router.



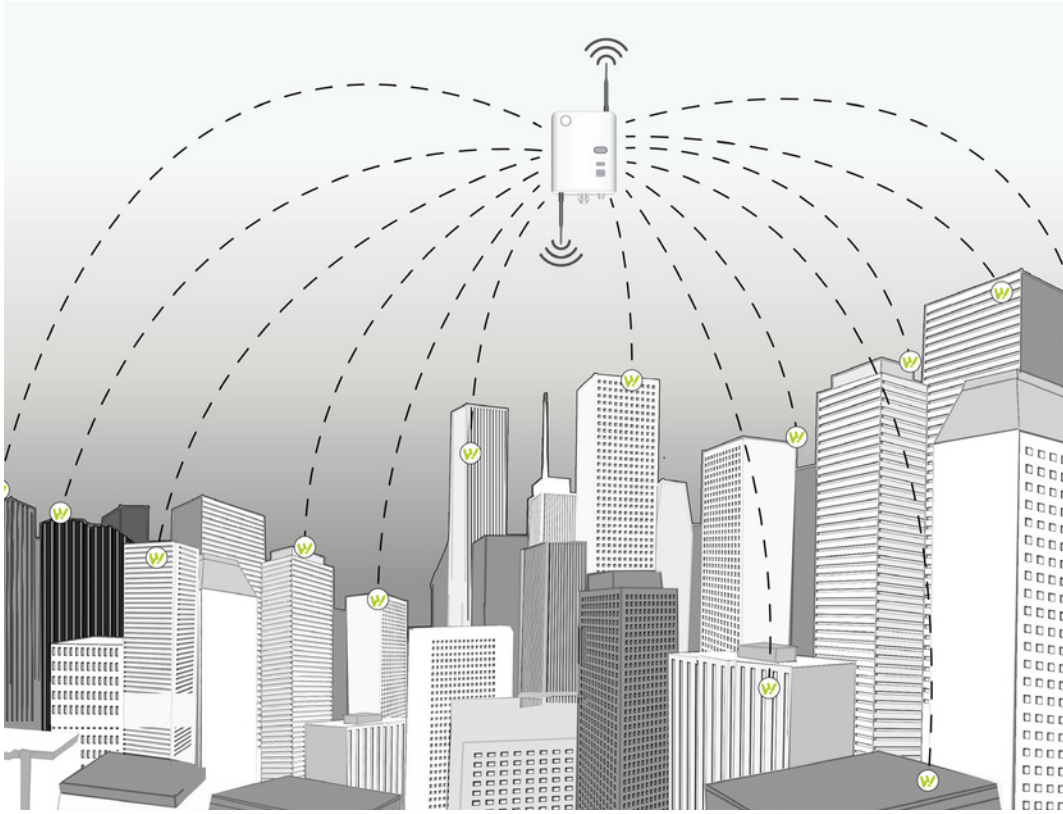
Infrastructure Deployment LoRa LPWAN Only

As an LPWAN star topology, LoRa-only networks are fast to install achieving long-range up to 20 km line of sight with Sub-1 GHz communication through a robust network.

A single gateway can cover vast areas the better the line of site the longer the range achieved. In general, locating the gateway as high as possible will improve the range. Positioning outside is better than inside due to structural attenuation. Note that the Gateway is IP51 rated so when placed outside some form of shelter should be provided.

Note: To deploy a combined mesh and LPWAN solution you will need to follow the 'Infrastructure Deployment Mesh' guidelines; by doing this you will achieve a range of circa 4sq km within the mesh multi-hop and greater than 10km outside of the mesh environment.

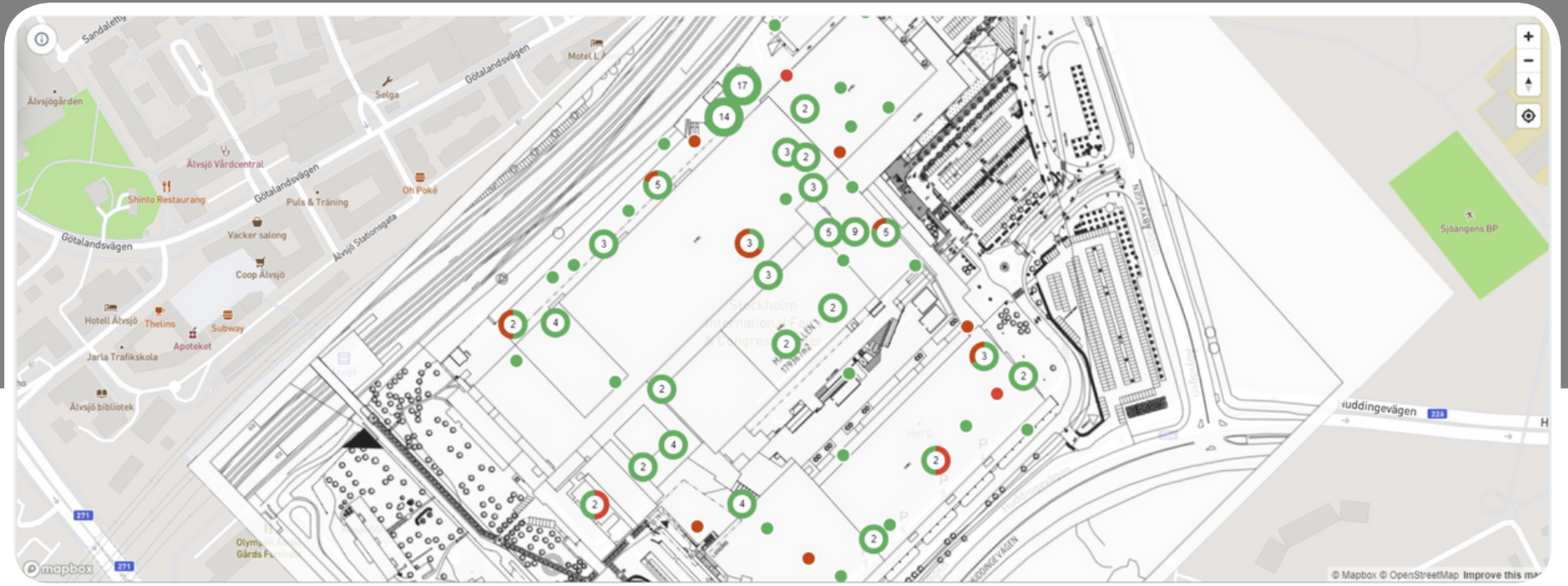
The WiTTRA Sense 360 allows you to collect both positioning and sensor data when present within the WiTTRA™ mesh network environment. Third-party sensor tags can connect seamlessly to the WiTTRA™ Unified Gateway using star topology however, they will not transmit positioning data.



WiTTRA™ WiPE (WiTTRA Intelligent Positioning Engine):

WiPE is an intelligent “Positioning Engine” application that runs on the Gateway. WiPE takes all the RSSI and ToF timing data and combines it to produce a unique Latitude / Longitude coordinate (plus floor level positioning) for each WiTTRA Sense 360 tag, each time a position update is requested by the WiTTRA Sense 360 device. There are advantages in combining both RSSI and ToF data together for improved accuracy and consistency.

This coordinate is then transported to the specified data End Point (either the WiTTRA™ portal or a third-party computing resource) where it can be displayed on a map GUI.



Site Deployment:

Plan ahead! This is a golden rule to make the site deployment a smooth process. Get hold of a floor plan or site map (Google Maps can be a good start) and look for appropriate installation locations for the infrastructure. Bear in mind you will need to go to the site and confirm there is mains power available for the chosen locations (unless you plan to run the infrastructure devices on battery power alone, which will then eventually require battery replacement/charging).

Install the Mesh Routers (MRs) and Positioning Beacons (PBs) in “clear air”, meaning as far as possible from large metal objects and surfaces (e.g., metal poles, metal beams, sheet metal etc.). If it is impossible to avoid these types of objects, the WiTTRA™ device will still function but the effective communication distance might be reduced in some directions.

General Rules for Mesh Routers:

Outdoors: Mesh Routers (MRs) can be placed several hundred meters apart provided they are elevated at least 3 metres above ground level. This allows the antennas to operate efficiently and achieve reliable data links for the mesh.

Indoors: Mesh Routers (MRs) can be placed 30m - 100m apart depending on how many obstructions lie between the devices. The quality of the radio links can be seen in the WiTTRA™ portal so it is easy to check this during installation.

General Rules for Positioning Beacons

Outdoors: Positioning Beacons (PBs) should be placed not more than 100m apart for good positioning accuracy, as well as being elevated at least 3 metres above ground level. If there are obstructions (trees, buildings) between the PBs then you might need to reduce this distance. In addition, there should not be more than 100m - 200m between each PB and the nearest MR (the positioning signals from the PBs need to be sent into the mesh network, so every PB needs a good quality radio link to at least one MR).

Indoors: Positioning Beacons (PBs) should be placed no more than 50m apart to maintain good positioning accuracy. For a heavily obstructed environment (a lot of walls or other physical obstacles) this distance might need to be reduced. The WiTTRA™ portal can be used to assess radio link quality.

Third-party sensor tags can connect seamlessly to the WiTTRA™ Unified Gateway using star topology and unlike the MiotySense360 will not transmit positioning data.

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Version 1