



HYBRID POSITIONING NETWORK TECHNOLOGY FROM WITTRA

MAKING THE IMPOSSIBLE POSSIBLE WITH ACCURATE
POSITIONING

WITTRA™



INTRODUCTION



Håkan Dackefjord was out on his routine run when he spotted a new bicycle leaning against a tree, passing the same bike every day for the next week, wondering if it had been stolen or misplaced. It was this thought that got Håkan thinking, where is my stuff and what is it doing?

Håkan began researching location technology and current solutions in the market and soon realized that the IoT technologies today were competing within two distinct positioning categories – indoor and outdoor. The indoor

market was filled with LPWAN solutions and outdoor consisted mainly of satellite and cellular technologies. Neither of which were suitable to track objects like bikes, tools or machines. Thinking about the bike he understood that a multitude of tracked objects within the IoT space would be moving, and specifically between indoor and outdoor spheres, and in complex environments such as cities or construction sites. A viable asset-tracking system would therefore need to work successfully within every type of environment. Unfortunately, no such tracking system existed.

In 2013, WITTRA® Sweden AB was founded, WITTRA technology has gained significant traction in the IoT industry and received several awards for its ground-breaking patent protected technology in location intelligence. This technology allows seamless tracking between indoor and outdoor spheres, no matter what the environment. In 2022 WITTRA rebranded to WITTRA Networks AB.

GETTING STARTED

LOCATION-BASED SERVICES

Location-based services (LBS) have become increasingly popular in recent years, and they require accurate positioning information to provide useful services to users. To achieve high positioning accuracy, various positioning technologies have been developed, including Received Signal Strength Indicator (RSSI), Time of Flight (ToF) and Ultra-Wideband (UWB) positioning technologies. In this context, we will explore the benefits of a hybrid positioning network that includes these technologies. A hybrid positioning network is a system that uses multiple positioning technologies to provide high-accuracy positioning information.

We will discuss the benefits of deploying this infrastructure where better position accuracy is needed. The following sections will detail the different positioning technologies, their working principles, and the advantages of each one.

HYBRID POSITIONING NETWORK

A hybrid positioning network is a sophisticated system designed to provide highly accurate and reliable positioning information by integrating multiple positioning technologies. The network employs a combination of positioning techniques, such as Received Signal Strength Indicator (RSSI), Time of Flight (ToF) and Ultra-Wideband (UWB) to achieve a high degree of precision in position estimation.

RSSI (RECEIVED SIGNAL STRENGTH INDICATOR)

A technique used to measure the strength of a signal received from a transmitter. It is commonly used in wireless communication systems to determine the quality of the signal being received by a receiver device.

In technical terms, RSSI is the power level of the received signal, measured in decibels (dBm). It is calculated by measuring the power level of the signal at the antenna of the receiver device and then comparing it to a known reference power level. The resulting value is expressed as a negative number, with higher negative values indicating weaker signal strength.

The RSSI value is affected by a number of factors, including the distance between the transmitter and the receiver, the frequency of the signal, and any obstacles or interference between the two. In general, the closer the transmitter is to the receiver, the stronger the RSSI value will be.

As for using RSSI as a positioning technology, it is possible to use RSSI measurements to estimate the location of a wireless device. This is known as RSSI-based positioning or radio positioning.

The basic idea behind RSSI-based positioning is to use the strength of the signal received from multiple access points to estimate the location of the receiver device.

The RSSI values are converted into distance estimates, and the intersection of these distance estimates is used to estimate the location of the receiver.

There are several techniques used to perform RSSI-based positioning, including trilateration and fingerprinting. Trilateration involves measuring the distance between the receiver device and three or more access points using RSSI values and then using geometry to determine the device's location. Fingerprinting involves creating a database of RSSI fingerprints at different known locations and using these fingerprints to match the RSSI values received by the device to estimate its location.

RSSI-based positioning has some limitations, such as being affected by signal attenuation due to obstacles and interference and being less accurate in indoor environments with many reflective surfaces. However, it can be a useful and cost-effective method for providing location-based services in many applications, such as asset tracking, indoor navigation, and location-based advertising.

TOF (Time Of Flight)

A technique used for measuring the distance between a sensor and an object by measuring the time it takes for a signal to travel from the sensor to the object and back. This technology is used in a variety of applications, including positioning systems

In technical terms, ToF measures the time it takes for a signal, such as a light pulse or an ultrasonic wave, to travel from the sensor to the target object and back. The time-of-flight is proportional to the distance between the sensor and the object, and this distance can be calculated by measuring the time taken for the signal to travel back and forth.

ToF-based positioning systems typically use a combination of multiple sensors and algorithms to estimate the position of the object being tracked. The sensors are typically arranged in an array, and the signals emitted by each sensor are used to calculate the distance to the object being tracked.

The accuracy of ToF-based positioning systems depends on several factors, including the accuracy of the timing measurements, the accuracy of the sensor array, and the speed of the signal being used. To achieve high accuracy, ToF-based positioning systems typically use advanced algorithms, such as Kalman filters or particle filters, to estimate the position of the object being tracked.

ToF-based positioning systems have several advantages over other positioning technologies, such as GPS or RSSI-based systems. For example, ToF-based systems can be used in indoor environments where GPS signals are weak or unavailable. ToF-based systems can also provide higher accuracy and precision compared to RSSI-based systems.

ULTRA WIDEBAND (UWB)

A wireless technology that uses very low power, short-range radio signal to accurately measure distances between devices. UWB can be used for positioning systems, including indoor positioning and location tracking.

In technical terms, UWB works by transmitting short pulses of radio waves across a very wide frequency range. The duration of the pulse is very short, typically a few nanoseconds and the frequency range is very wide, spanning several gigahertz. When the pulse reaches a receiver, it is reflected back and the time-of-flight is measured. The distance between the transmitter and receiver can then be calculated based on the time-of-flight.

UWB-based positioning systems typically use multiple UWB transmitters and receivers to accurately determine the position of a device. The system can triangulate the position of the device by measuring the distance between the device and each of the UWB transmitters. The accuracy of UWB-based positioning systems can be very high, typically within a few centimetres.

UWB-based positioning systems have several advantages over other positioning technologies, such as GPS or RSSI-based systems. UWB signals are less affected by multipath interference, which occurs when signals bounce off obstacles and interfere with the original signal. UWB signals can also penetrate walls and other obstacles, making them well-suited for indoor positioning applications.

By combining these technologies, a hybrid positioning network can provide more accurate positioning information than any single positioning technology alone. For example, RSSI can be used to provide coarse positioning information, while UWB can be used to provide high-accuracy positioning information in a small area.

BENEFITS OF A HYBRID POSITIONING NETWORK

Traditional IoT solutions often require deploying multiple networks to meet different positioning requirements. This can be an expensive and time-consuming process, as it often involves the installation of multiple sensors and other infrastructure components. Additionally, this approach can result in increased complexity and maintenance costs.

However, WiTTTRA's unified gateway allows for a more flexible and cost-effective approach to IoT infrastructure deployment. With the ability to add zone-based positioning capabilities, the same network can be enhanced to meet different positioning requirements, minimizing the investment needed. For example, if high-accuracy positioning is required in a specific area, such as a shelf in a warehouse, a UWB click-on sensor can be added to the network to achieve decimetre-level accuracy. On the other hand, if less precise positioning is sufficient, such as locating a forklift in an open warehouse, a ToF solution can provide positioning within a few meters.

By deploying one network and enhancing it where needed, businesses can save time and money while also reducing the complexity and maintenance costs associated with managing multiple networks. Additionally, this approach can provide greater scalability, as businesses can easily add new sensors or other components to the network as needed to meet evolving requirements.

A hybrid positioning network has several benefits over a single-range positioning network. These benefits include:

- **Increased Positioning Accuracy:** As mentioned earlier, a hybrid positioning network can provide more accurate positioning information than any single positioning technology alone. This increased accuracy can benefit a variety of applications such as navigation, tracking, and logistics.
- **Improved Reliability:** A hybrid positioning network is less susceptible to interference and can provide better coverage in areas where single-range positioning technologies may not be effective.
- **Redundancy:** A hybrid positioning network provides redundancy in case one positioning technology fails or is unavailable. This redundancy can ensure that positioning information is still available even if one technology fails.
- **Flexibility:** A hybrid positioning network can be tailored to specific applications by choosing the most appropriate combination of positioning technologies.

WITTRA UNIFIED GATEWAY VS PURE UWB

In a pure UWB installation, the focus is solely on achieving high-precision location accuracy using UWB technology. This typically involves deploying a dense network of UWB nodes, which can be costly and time-consuming. The network must be optimized to provide the desired level of accuracy and reliability. While UWB technology can provide centimetre-level accuracy, it can be susceptible to interference and multipath errors, which can degrade accuracy in certain environments.



On the other hand, a WiTTTRA unified gateway installation with UWB capabilities provides the flexibility to deploy a single network infrastructure that can support a variety of positioning technologies, including UWB. This approach can help minimize investment costs by allowing you to enhance the network only where you need it. Additionally, the use of multiple positioning technologies can provide redundancy and fault tolerance, improving overall system reliability.

Furthermore, WiTTTRA's solution is designed to work in harsh industrial environments where traditional UWB solutions may struggle due to interference or signal blockage. By combining different positioning technologies and optimizing them for specific environments, WiTTTRA's solution can provide accurate location information in a wide range of settings.

Overall, a pure UWB installation may be best suited for applications that require the highest level of location accuracy, but a WiTTTRA unified gateway installation with UWB capabilities can provide a flexible and cost-effective solution for a variety of industrial and commercial applications.

DEPLOYMENT OF HYBRID POSITIONING NETWORKS

The deployment of a hybrid positioning network can provide significant benefits in areas where better positioning accuracy is needed. Some examples of such areas include:

- **Indoor Environments:** Indoor environments can be challenging for positioning technologies due to the presence of walls and other obstacles. A hybrid positioning network can provide better accuracy and coverage in indoor environments.
- **Logistics and Warehousing:** Logistics and warehousing operations require accurate tracking of goods and personnel. A hybrid positioning network can provide accurate location information, reducing the time and effort required for inventory management.
- **Healthcare:** In healthcare settings, accurate tracking of medical equipment and personnel is critical for patient safety. A hybrid positioning network can provide accurate location information, ensuring that equipment and personnel are always in the right place at the right time.
- **Transportation:** Transportation applications such as autonomous vehicles require highly accurate positioning information. A hybrid positioning network can provide the required accuracy and reliability for these applications.

CONCLUSION

The benefits of a hybrid positioning network that includes RSSI, ToF and UWB are numerous. By using multiple technologies, a high-accuracy positioning network can be established, which is essential for various location-based services. The use of RSSI-based positioning is cost-effective and can be used in various applications, such as asset tracking, indoor navigation, and location-based advertising. ToF-based positioning can provide higher accuracy and precision compared to other technologies and can be used in indoor environments where GPS signals are weak or unavailable. UWB positioning is highly accurate. A hybrid positioning network that includes these technologies can provide high-accuracy positioning information for a wide range of applications, making it an important infrastructure to deploy in situations where better position accuracy is needed.

WiTTTRA offers numerous benefits as an infrastructure deployment that covers all positioning technologies. One of the most significant benefits is the ability to choose the level of position accuracy by zone, which allows for greater precision when needed. Additionally, the system's easy installation process and lower cost make it an attractive option for businesses and organizations looking to implement a positioning solution. WiTTTRA's technology also has low disturbance, making it ideal for use in environments where minimal disruption is necessary. Overall, WiTTTRA's comprehensive positioning technology offers a range of benefits that make it a highly effective and efficient solution for a wide range of applications.

About WITTRA

In 2013, WITTRA® Networks AB was founded as a consequence of the team's tireless research, insight, and ongoing development. Since that time, WITTRA® technology has gained significant traction in the IoT industry and received several prestigious awards for its ground-breaking technology in location intelligence. This technology is currently protected by 51 patents, making it possible to seamlessly track assets between the indoor and outdoor spheres, no matter what the environment. The next step has been to utilize emerging standards to create products with the right market fit. As a result, WITTRA® has launched its first applications into the market, providing a simple, practical solution for keeping track of your things.



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