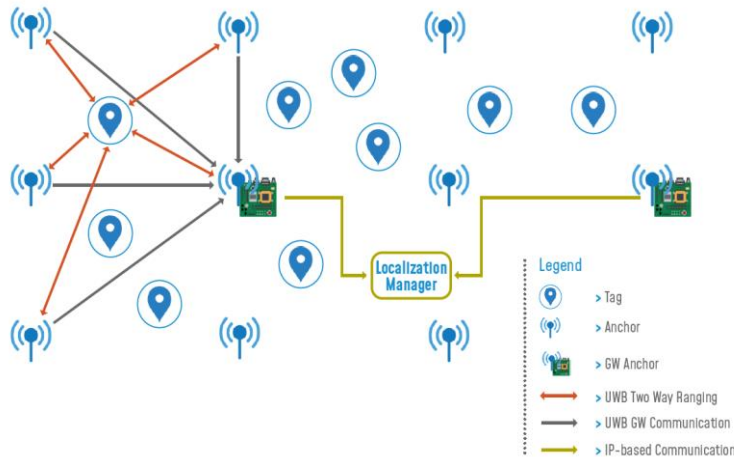


# Artemis

Ultra-Wideband Solution Enabling  
Large-Scale Indoor Localisation



## SOLUTION



Large-scale Ultra-Wideband localisation system localises a large number of tags in areas of any size to enable Industry 4.0 applications. The system is based on the Ultra-Wideband (UWB) technology supported by a common Time-Division Multiple Access (TDMA) protocol opportunely propagated across all UWB devices. Moreover, the resulting scalable localisation system performs ranging measurements employing a method called Two-Way Ranging (TWR).

The Artemis solution is composed of the following components:

- > Tags nodes (attached to mobile items to be tracked) (hw + sw)
- > Anchors nodes (to be deployed in known positions) (hw + sw)
- > GW Anchors with UWB and IP connectivity (Wi-Fi or Ethernet) (hw + sw)
- > Localisation Manager executing a localisation algorithm based on the Extended Kalman Filter (EKF)
- > Web-based GUI (Graphic User Interface)

Since the ranging measurements are based on the TWR method, anchor nodes do not need to be time synchronized, thus, this simplifies the deployment of the fixed infrastructure.

The Artemis solution has been tested in a real industrial environment reaching a **Technology Readiness Level (TRL) 7**.

It has been conceived for an **Industry 4.0** use case but it can be adapted to **other application domains**.

The tag can be attached to mobile objects with an energy source enough to also provide power to the tag (e.g., forklift, AMR - Automatic Mobile Robot), but the system is also suitable for locating people.

## TEAM

Reference persons:

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Team:

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Connected Systems & Cybersecurity  
Research Domain

*Broad experience in designing and developing novel localisation algorithms based on Kalman Filters and Bayesian methods that process ToA and AoA range measurements.*

## KEYWORDS

- > UWB
- > Wireless
- > RTLS
- > Indoor Localisation
- > Large-scale

## OPPORTUNITIES

- > Artemis solution is especially suitable for companies / organisations that need to localise mobile objects in **large environments and with high accuracy** (e.g. for robotics applications).
- > Companies already developing **indoor localisation systems** can consider Artemis to improve their offering or facilitate collaboration in R&D activities.
- > Collaboration with other companies developing **UWB solutions capable of localising tags only on small scale environments** can be fruitful to enhance their solutions.

## VALUE PROPOSITION

### Scalable

- > Localisation capacity: 150 localisations per second in a small area.
- > Configurable localisation frequency up to 10 Hz (per single tag).
- > Large coverage area: indoor areas of any size.

### Accurate

- > High level localisation precision (10-20 cm)

### Customisable

- > Proprietary source code (firmware and software) can be tailored to meet specific requirements (e.g. number of ranging anchors for each localisation, frame duration of the TDMA protocol).

### Made in Italy

- > Developed by an Italian research team with long and proven experience in the field.

## TECHNOLOGIES FOR INDOOR LOCALISATION

Real-Time Locating Systems (RTLS) use sensors and radio technologies to locate objects and/or people in indoor environments. RTLS have been attracting scientific and enterprise interest because there is a big market opportunity for applying these technologies.

The main radio technologies used for indoor localisation are [Bluetooth Low Energy \(BLE\)](#), [Wi-Fi](#) and [UWB](#). While BLE and Wi-Fi already benefit from a very broad market adoption and scalability opportunities, they lack in positioning accuracy and provide relatively low level of security if compared to UWB.

UWB, in fact, operates in higher frequency bands and uses a wider bandwidth (500 megahertz or more) than Bluetooth. Thus, UWB positioning solutions are [more accurate](#). It also provides a [higher level of security](#) leveraging the ranging measurement capability. Moreover, if compared with other indoor localisation technologies, UWB is particularly suitable for [localisation in large areas](#).

### Advantages of UWB

- > **Secure:** protection from relay station attacks
- > **Co-existent:** operates in bands different from BLE / Wi-Fi
- > **Reliable:** immune to multipath interference and fading
- > **Accurate:** centimetre resolution in dense multipath environments
- > **Low energy:** uses ultra-short air-time pulses
- > **Large-scale:** allows higher power indoors for precise location in large spaces.

## MARKET

### > Trends

BLE and Wi-Fi already benefit from a very broad market adoption. UWB is newer, has a smaller market size, however, it has higher Compound Annual Growth Rate (CAGR).

It is reasonable to think that the [increasing adoption of UWB by smartphones will boost its growth](#).

While Wi-Fi and BLE are currently available for almost all smartphones, UWB is adopted only by some models of the mayor players (in 2021, UWB was installed in over 300 million smartphones, approximately 20%). However, forecasts estimate that in the next 5-10 years, UWB will gradually be adopted across all smartphones, representing a market potential of 1.5 billion UWB-enabled devices per year (source: FIRA Consortium, 2022).

### > Companies

A synthesis of the most relevant players in indoor localisation market is provided by the Gartner Indoor Localisation Magic Quadrant (source: Gartner). It identifies the most relevant companies operating in the indoor localisation market and classifies them according to their completeness of vision and ability of execution. It considers a wide spectrum of technologies and use cases. Within this framework only [the most visionary companies use UWB](#) for indoor localisation: this reveals, again, [great opportunities for this technology in the next future](#).

Despite differences between the companies offering UWB solutions for indoor localisation in terms of use cases, sectors addressed, main customers and technologies used, their offering is quite similar. Moreover, in many cases they use a "partnerships program" to enhance collaboration between organizations for the development of UWB modules.

### > Applications

The main applications of UWB for indoor localisation are in the following sectors:

[Manufacturing](#) and [Logistics](#).

In addition, also the [Health](#) sector and all the sectors in which the management of things, vehicles or persons in large spaces is needed offer opportunities:

[Transportation](#)                      [Precision Agriculture](#)                      [Robotics](#)  
[Construction, Mines](#)                      [Entertainment, Culture](#)

	Value (in 2022)	Projection (2030)	CAGR (2022-2030)
Indoor localisation (Global)	USD 8.8 billion	USD 44 billion	22.4%
<b>Technologies for indoor localization market</b>			
Bluetooth Low Energy (Global)	USD 8.6 billion	USD 23.3 billion	13.3%
Indoor wireless coverage & objects localisation (Europe)	USD 3.3 billion	USD 8.1 billion	12.11%
Ultra-Wideband (Global)	USD 1.6 billion	USD 6.6 billion	19.6%

*Source: elaboration from markets and markets, growth market reports*

### Standards

Artemis UWB chip is compliant with the standard IEEE 802.15.4-2011