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Space enabled solutions for the future of logistics

ASI projects

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ASI Satellite Navigation and logistics

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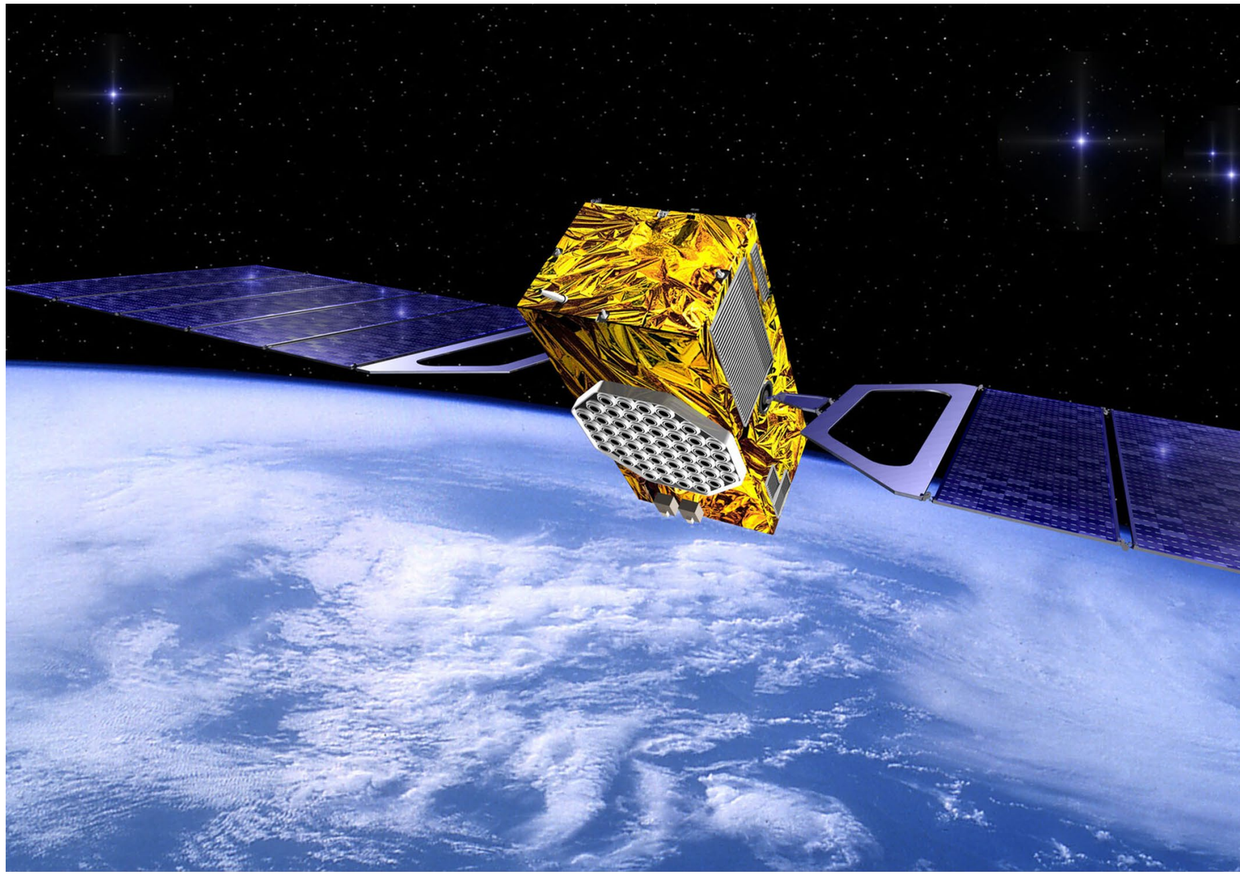
- One of the objectives of ASI programs in satellite navigation is the development of **innovative applications of satellite radio-localization** to be used by the citizen and the public administration boosting the economic and cultural development of the Country.
- In particular, ASI focuses on t**ransportation** in the maritime, road and railway sector, with a view to assist operators in **multimodal and automated transportation** with the support of satellite navigation.

- Moreover, ASI explores new possibilities of innovation for logistics services via dedicated R&D programs devoted **to IOT and industrial IOT (IIOT)** using indoor localization and GNSS/LPWAN technologies.

- Finally, solutions based on the **extended reality** (AR and VR) supported by GNSS are being explored to ease industrial maintenance operations.



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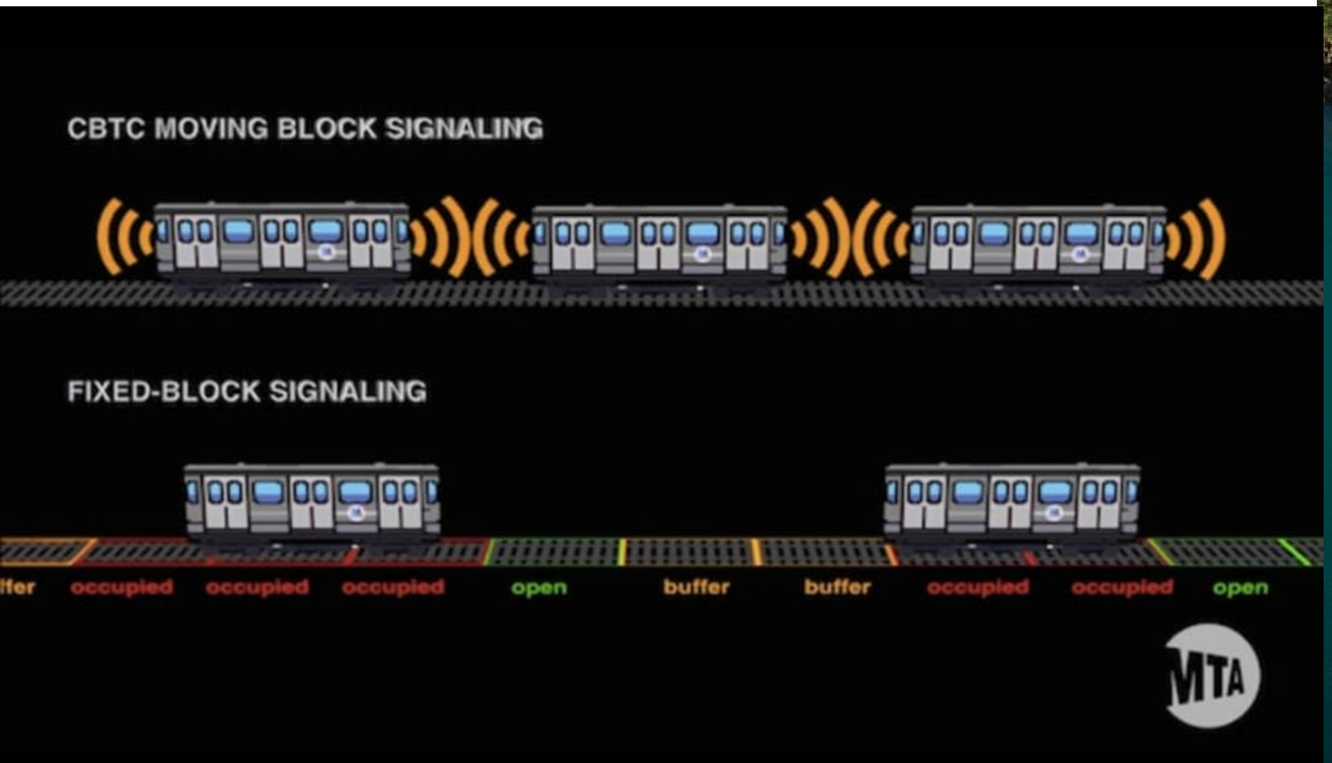
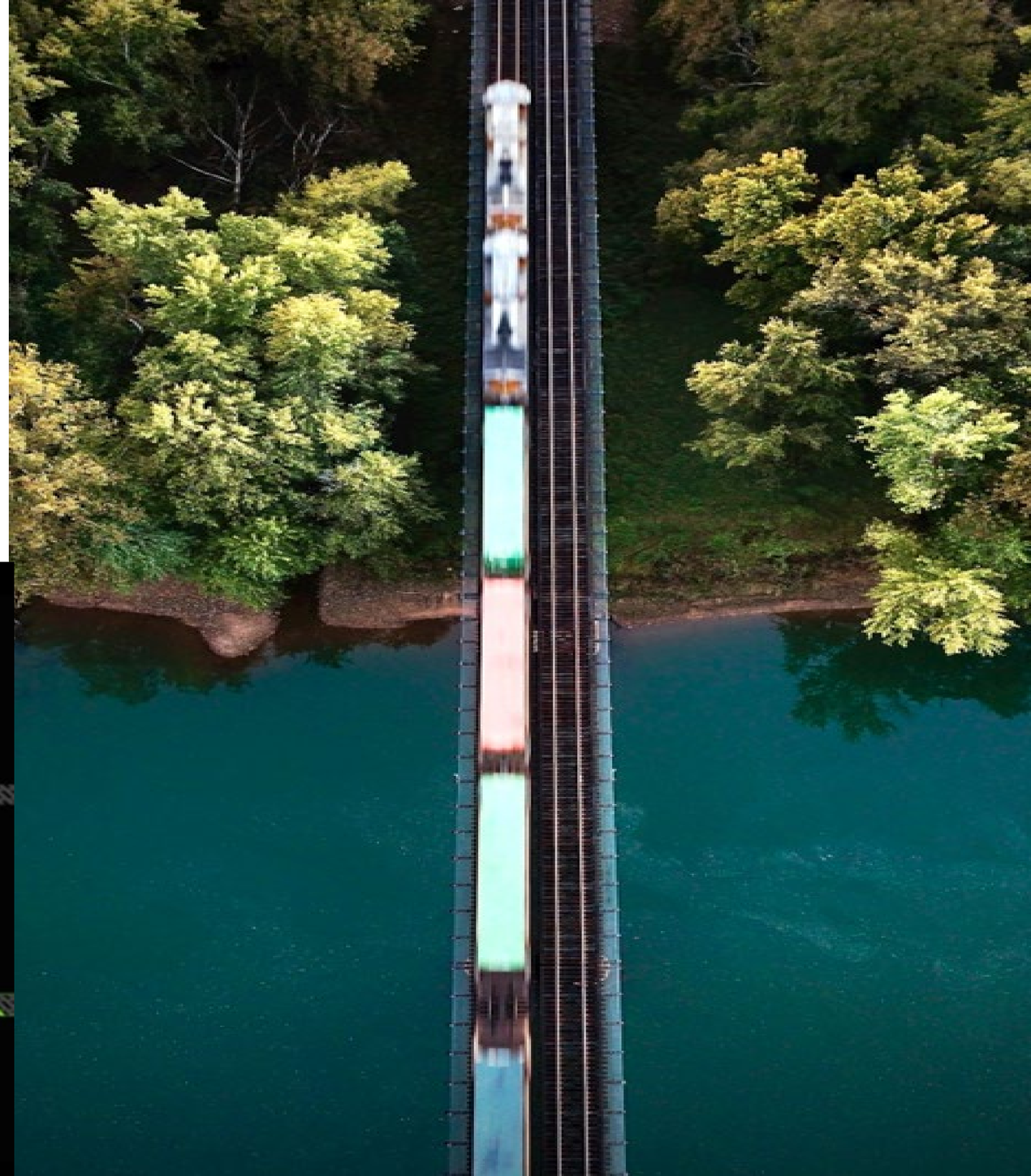
Automatic Train Protection

Boosting Train efficiency with GNSS

The GNSS solution will be a key factor in the boost of the efficiency of trains as rail automation grows. The adoption of GNSS-based ATP will increase the efficiency of rail services because through “hybrid” level 3 and virtual blocks

The high-precision localization GNSS function will be a key enabler for new advanced functions such as ATO and Virtual Coupling (railway platooning).

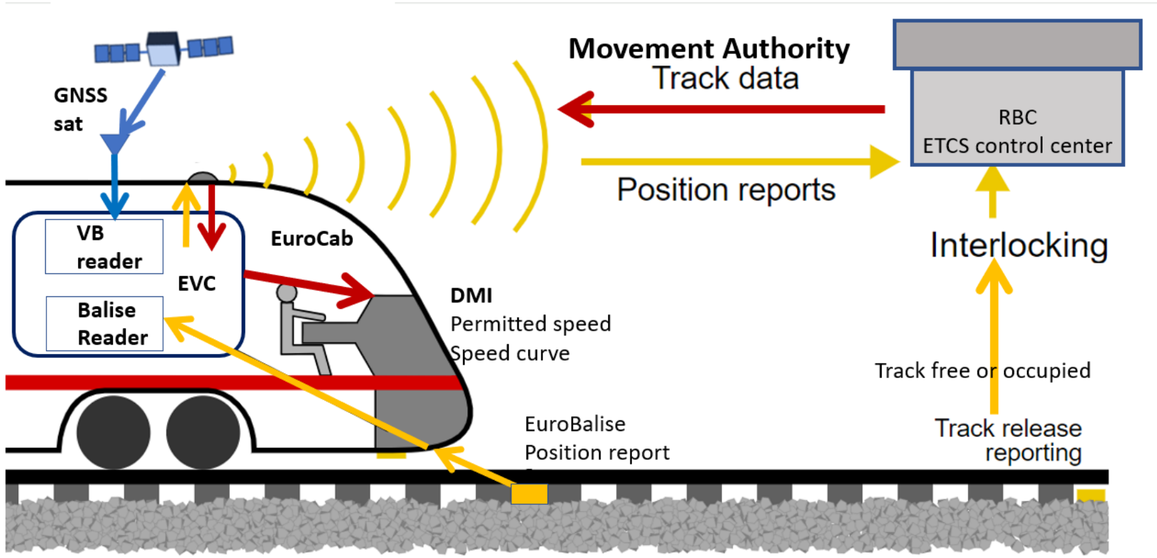




The project LOCBMF

ASI is finalizing a modern rail on-board locator (LOCBMF). The main features of the on-board localizer are the following:

- The MF/MC GNSS receiver will be hybridized (via Federated Filter or FGO, Factor Graph Optimization) with multisensor solution and **will be activated in an adaptive way according to the mission phase**;
- The system will use RAIM (Receiver Autonomous Integrity Monitoring) on board with FDE (Fault detection and Exclusion) and PL (Protection Level) calculation in a **3-tier integrity management** (SBAS-FDE, RAIM and local augmentation integrity);
- The localizer will be ready to be certified up to **SIL-4 (Safety Integrity Level).**



EVC automatically checks the permitted speed and brakes the train if necessary

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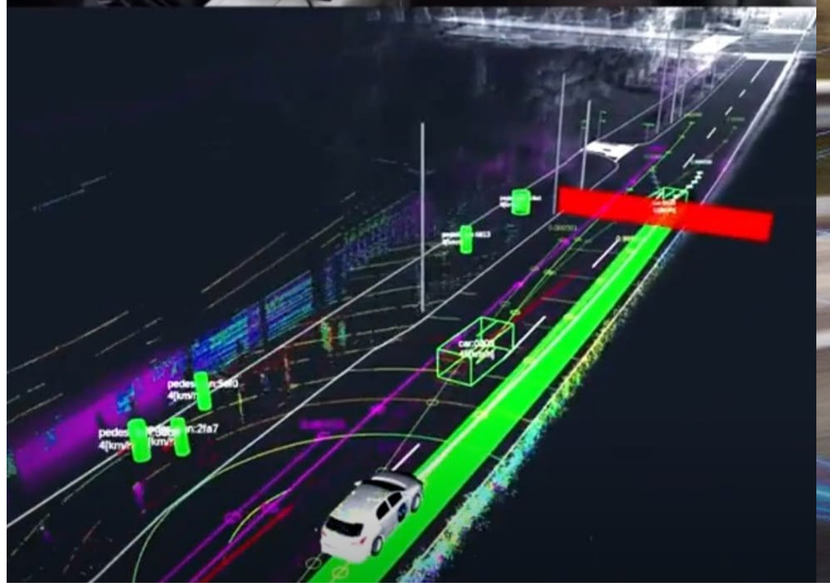
Connected and Autonomous vehicles (CAV)

Road automation

Research and industry have been focusing in recent years on the development of automated vehicles to achieve more efficient and safer driving.

The EC intends to accelerate the transition toward autonomous driving through an ambitious technology roadmap for the **development of shared Autonomous Driving System (ADS) components (software and hardware)**. [**European Commission, Industrial Action Plan for the European automotive sector 5.3.2025**]



The project LOCBS (Localizzatore di Bordo Stradale)

GNSS will play a central role in the location of autonomous vehicles and will serve as an absolute location source alongside high-definition maps.
For an autonomous vehicle application, 99.9% availability is expected in all conditions and locations: urban, rural, All Weather and All Visibility.
Accuracy shall change from street (or lane) level to in-lane accuracy. From initial estimates the required precision will be one decimeter, with a refresh rate of at least 200 Hz.

ASI intends to carry out an R&D project for the implementation of an advanced positioning system (LOCBS) for vehicles of type CAV/HAV (level 3 and above).

The activities covered by this call will be carried out along the two main directions of high accuracy and integrity, and with the aid of AI techniques applied to navigation.

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Multi-modal transportation

RAN project

ASI is leading a project for the realization of a first example of augmentation network in order to guarantee a modern and safe seamless transportation.

It will be the prototype of a national resilient infrastructure providing **a seamless real-time, high-availability, and integrity-assured navigation service** (PVT) that can be used by multimodal highly automated transport (road and rail, and in future maritime), improving the efficiency and ensuring better safety.

The positioning will be **continuous across domains thanks to the same GNSS corrections.**

RAN=Rete di Augmentation Nazionale

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Autonomous surface vehicles (ASV)

The automation of maritime transport

- USV/AUV (Unmanned Surface Vehicles/Autonomous Surface Vehicles) and MASS (Maritime Autonomous Surface Ship) are some of the most important developments in the maritime sector in the future.
- In particular, as in the field of road or UAV, **it is widely expected that maritime transport will become increasingly automated**, and therefore autonomous marine technology is already being developed and demonstrated in many countries around the world.
- Leaving aside the first military specific uses of USV, the studies dedicated to automation in the maritime field for civilian purposes now **cover more than two decades.**
- The first documented example is the MIT vehicle of **1996 called Artemis**, dedicated to automated bathymetry
- Automation **will enable more effective and competitive ship operations, while further reducing the environmental impact of ships, especially in ports**.

LOCBM project

ASI is promoting a project to realize a multi-sensor, high integrity and certifiable precision positioning system for maritime vessels **(LOCBM-Localizzatore di Bordo di tipo Marittimo)** suitable for the location of a level four of IMO classification, i.e. autonomous surface vehicle (ASV).

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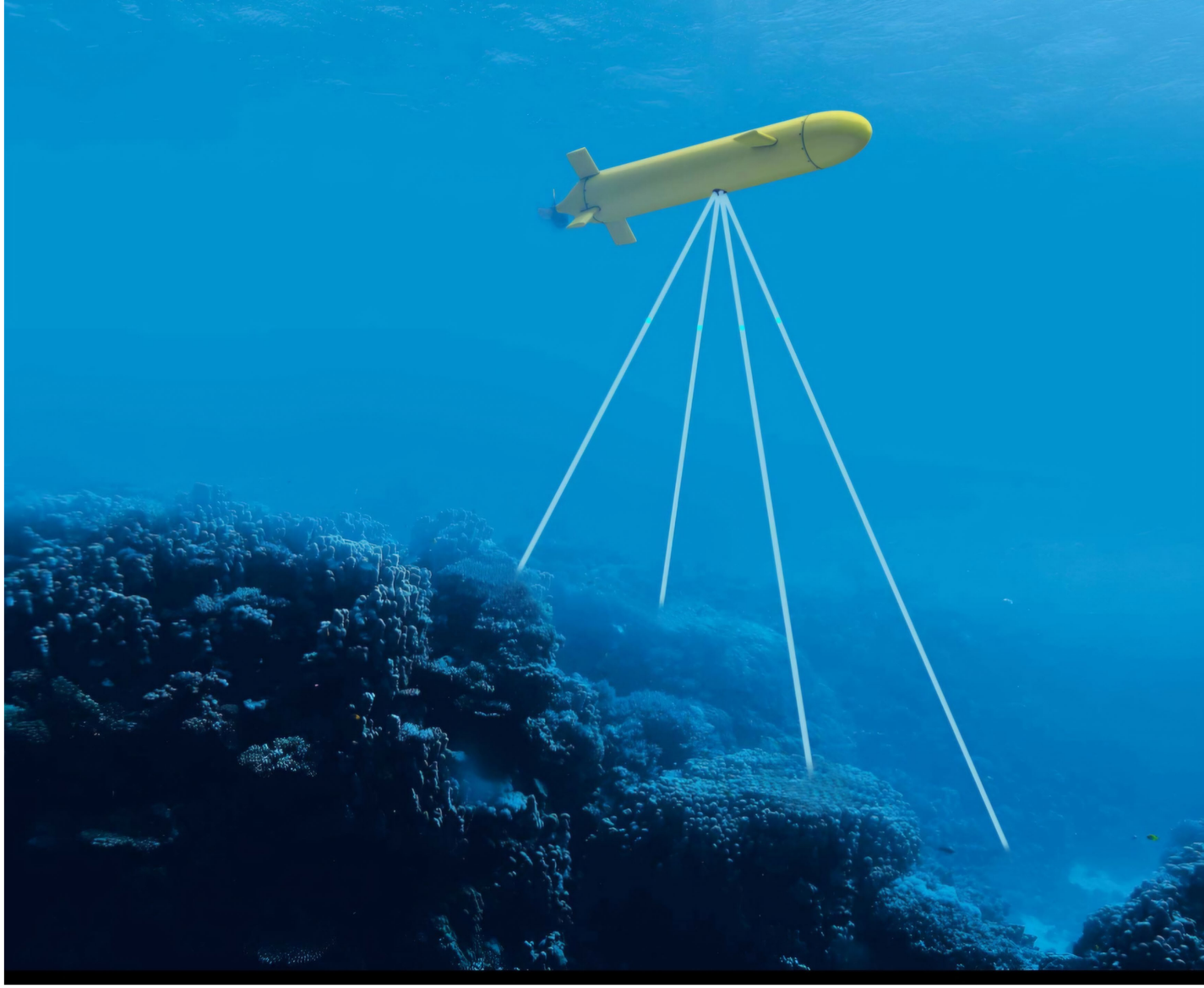
Autonomous underwater vehicles (AUV)

Underwater Navigation

ASI will develop **a cooperative UUV locator with ASV,** where short-range submarine operations are carried out with support ship.

The system will be used in a UUV typically dedicated to the **monitoring of seabed** (e.g. for the maintenance of submarine cables, debris and mines), **the inspection of port constructions**, **off-shore platforms, of underwater tunnels and hulls**, and for deep-water monitoring.

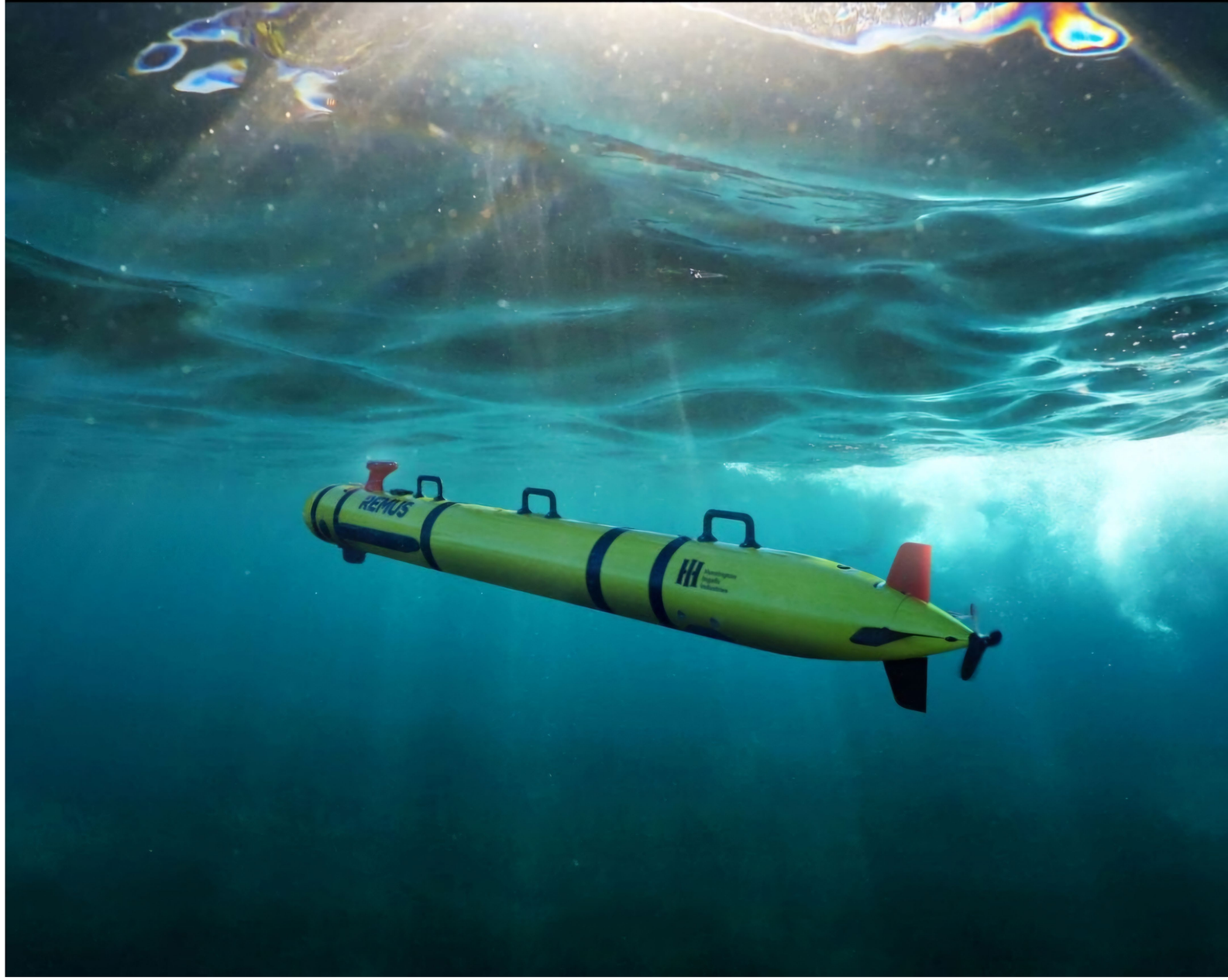
Such submarine operations do not require UUV to surface to update its position via GNSS or CNS and rely on the combined use of ASV and AUV.



The project UUV-NAV

The **UUV-NAV project is innovative because it shall deliver a robust locator capable of operating in the challenging marine/oceanic environment** based on the following characteristics:

- the multi-sensor fusion
- the estimation of ocean or sea currents in case of DVL water tracking
- Gyroscope drift compensation
- the use of an external speed measurement derived from the vehicle kinematic model
- the use of non-linear adaptive filters to mitigate the effects of the complex underwater environment



Reference

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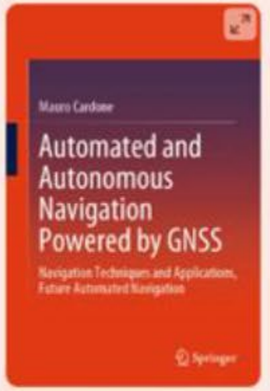

Automated and Autonomous Navigation Powered by GNSS

Navigation Techniques and Applications, Future Automated Navigation

Book | © 2025

Overview

Authors: Mauro Cardone

- Provides a comprehensive review of the navigation methods applied to transportation means
- Proposes technical solutions to address automated and autonomous navigation
- Supplies a full updated list of references for further studies on navigation topics

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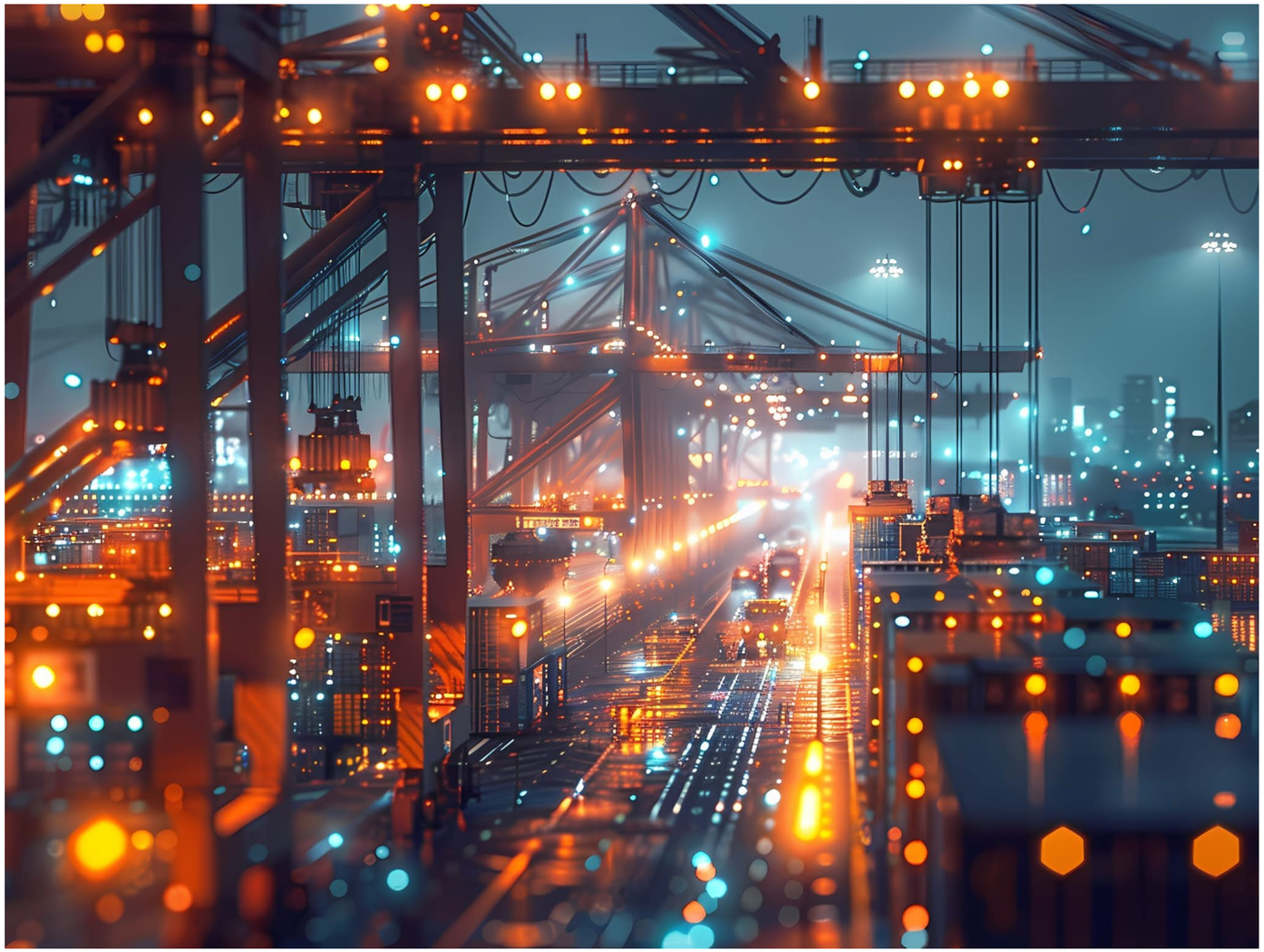
Internet of Things

Industrial IOT

With reference to IIOT, according to **3GPP TR 22.804,** it is possible to distinguish different application areas for IIOT, such as factory automation, process automation, man-machine interfaces, logistics, monitoring and storage.

In the context of **Industry 4.0,** accurate indoor positioning can be used **to locate and track assets, guide robots, for navigation, real-time monitoring, management of location-based events and the collection of georeferenced positioning data.**



Industrial IOT project

ASI promotes the IND-NAV (IIOT) project **to develop indoor navigation technologies for industrial indoor applications**.

The objective of the project is to implement an internal positioning system (IPS) that integrates alternative location techniques to GNSS and ensures availability and accuracy appropriate to the internal factory environment

The IPS system will have seamless indoor-outdoor capabilities, ensuring continous positioning between exterior and interior.

R&D IOT project

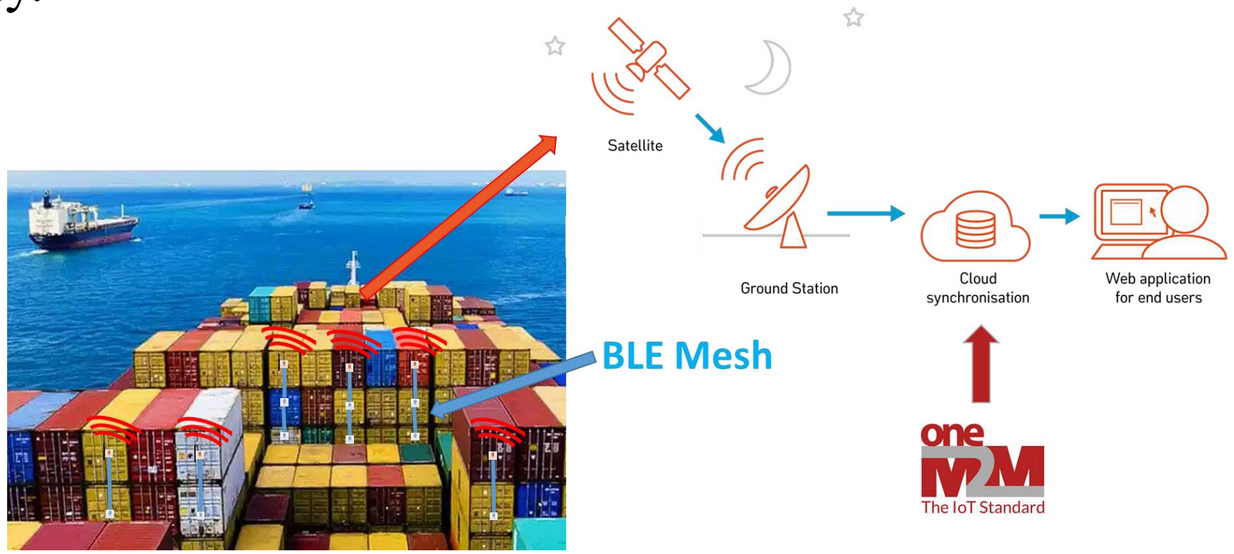
ASI promotes the Sat5GCon project **to develop a low-cost system for tracking and monitoring ISO containers using LEO satellites, NB-IoT 5G networks, and Bluetooth Low Energy mesh technologies.**

Key Features:

- Interoperability: Uses standard M2M communication technologies to avoid technological lock-in and ensure global supply-chain compatibility.

Components:

- DTMC Device: Battery-powered tracking and monitoring device placed on the container.
- Service Platform: oneM2M-compliant platform for data collection and access by logistics operators.



The MBS project: a dedicated metropolitan beacon navigation system

- Considering the difficulty of positioning in the urban environment, a supporting infrastructure is needed that strengthens the reception of the GNSS service through the implementation of a **Metropolitan Beacon System (MBS) totally transparent to the user in overlap with the satellite GNSS**, so as to ensure optimal reception thanks to increased power compared to the satellite signal.
- ASI intends to create a first example in Italy of such a system to be deployed in the urban environment for demonstration purposes and in compliance with 3GPP and OMA standards of mobile telephony. (3GPP, 3rd Generation Partnership Project)
- This system is the ideal candidate to assist port operations with high accuracy of positioning

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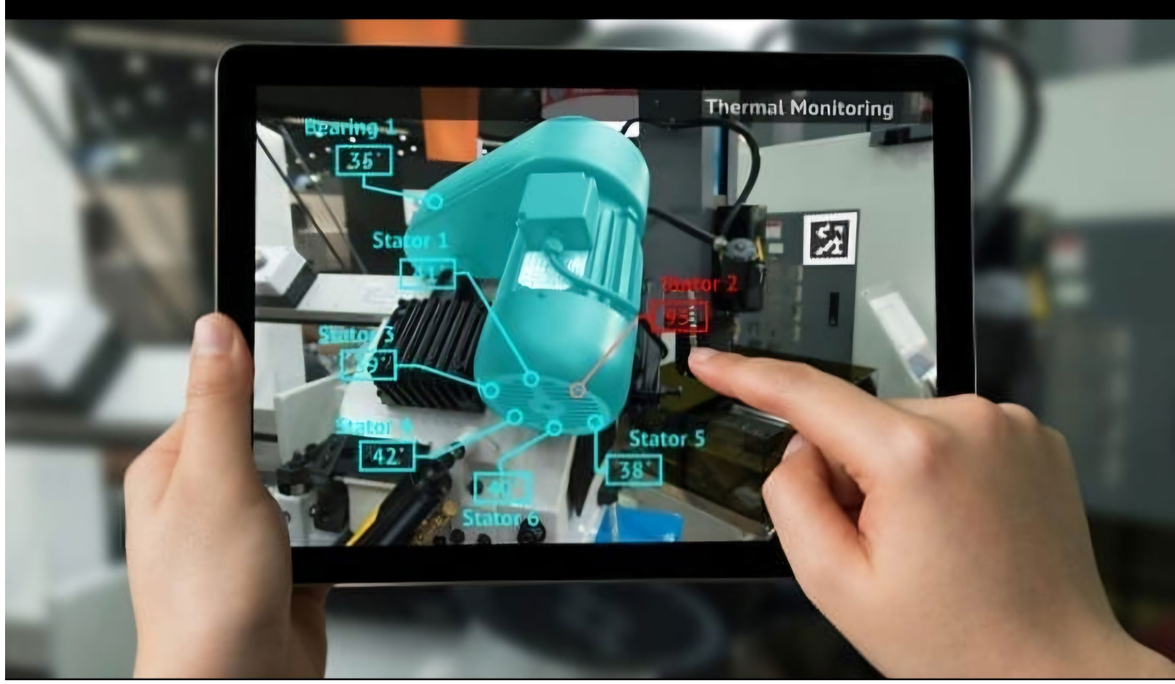
Extended reality

Industrial AR and maintenance

One must consider that the costs associated with **maintenance and repair expenses** are estimated to be between **15% and 70% o**f total production costs.
In addition, in sectors such as aeronautics, maintenance and repair activities can increase up to **80%** of the total cost of the product during its life cycle.
The use of industrial IOT, AR and ML can mitigate those costs



An **inspection to the industrial site** will be carried out for **preventive maintenance** in an immersive environment.
Each device will be connected via **IOT to a server that will provide its location and status**. **The AR system will be able to retrieve position status information from the server.**
If the condition of the apparatus is out of normal parameters, **corrective maintenance** shall be carried out according to the diagnosis received from the operating center and using the exploded diagrams and other useful information related to the machinery under examination.

Navigation in the extended reality (XR-GNSS)

ASI is issuing a call for tender addressing the **XR-GNSS project** which requests the realization of a ubiquitous XR tracking system for indoor **(VR, Virtual Reality**) and outdoor **(AR, Augmented Reality)** which merges the SLAM visual positioning system with the GNSS and inertial one for outdoor environments.

In the case of indoor VR, we will also use trusted points or pre-recorded HD maps to recalibrate navigation in dead reckoning without the need for external beacons.

The system is totally self-consistent (inside-out headset) without the need for external aids but uses only on-board sensors.

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THANK YOU FOR THE ATTENTION

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