



## Dynamic coverage Extension and Distributed Intelligence for human Centric Applications with assured security, privacy, and Trust: from 5G to 6G

### Smart Warehousing

#### Need for 5G/6G

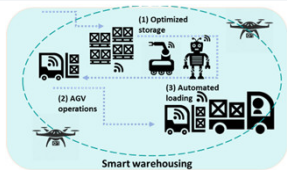
- **Low latency and high reliability** for timely delivery of data and interactions with robots
- **High throughput** for video streaming for remote surveillance
- **High location accuracy** to guarantee correct positioning of robots and assets

Global warehousing market size is estimated to reach US\$ 533.4 Billion in 2024

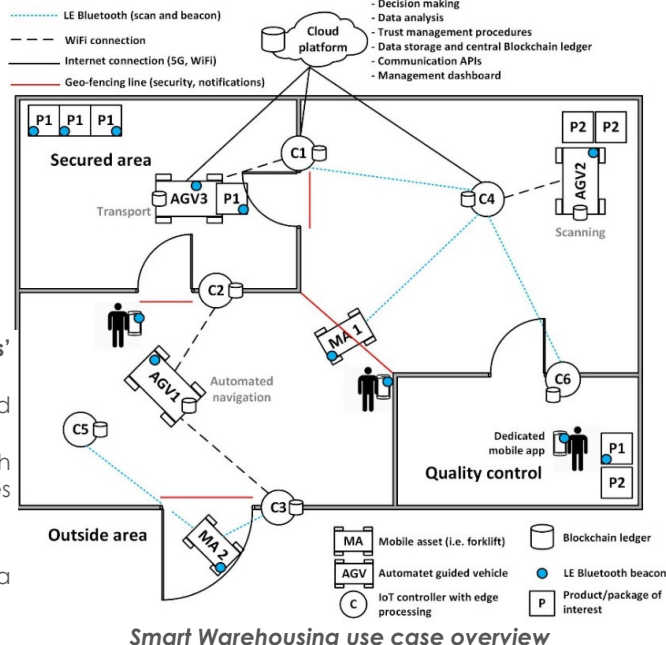
The market growth is expected to accelerate at about 7% CAGR

Smart warehousing and logistics are key for the proper preservation of goods

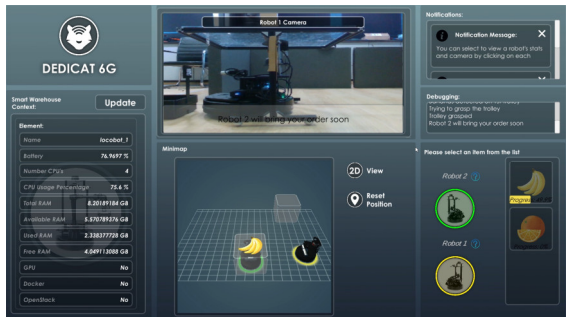
Availability of data as well as functionalities such as AR and remote-controlled operations can reduce operational delays and wastes



- **Enhance warehouse automation** towards significant increase of operations' efficiency (elimination of time wastes, decrease of product damages)
- **Enhance safety and security of goods and personnel** with indoor positioning and asset tracking
- **Increase efficiency in use of resources** (AVs, humans, other equipment) through predictive analytics by distributed AI and data analytics functionalities combined with cloud, edge, and fog computing capabilities.
- **Assisting training and maintenance through 3D augmented reality**
- **Enable remote monitoring** of processes as well and remote handling by a human operator in case of equipment failure through multiple UHD streams
- **Identification and tracking of goods throughout value chains**



## Technical approach



#### Warehouse manager dashboard

The warehouse manager can:

- configure daily tasks for the fleet of AGVs including product quality monitoring parameters, interaction rules with warehouse personnel and product offloading/loading schedule;
- view the overall status of AGVs and processes of the warehouse
- direct personnel or AGVs towards an area of interest or an asset.



Automated Guided Vehicle (AGV) : LoCoBot



Kobuki Base



Intel NUC NUC8i3BEH Mini PC



Intel® RealSense™ Depth Camera D435



RPLIDAR A2M8 360° Laser Range Scanner

AGV hardware components

#### Warehouse worker app

the employee can

- receive a list of daily tasks as specified by the warehouse manager
- direct AGVs towards a product or an area of interest if he/she is authorized to do so.
- View digital information on real world objects through the **Augmented Reality application** e.g., interact with the 3D model of an AGV or even watch a video explaining how the robotic arm works.

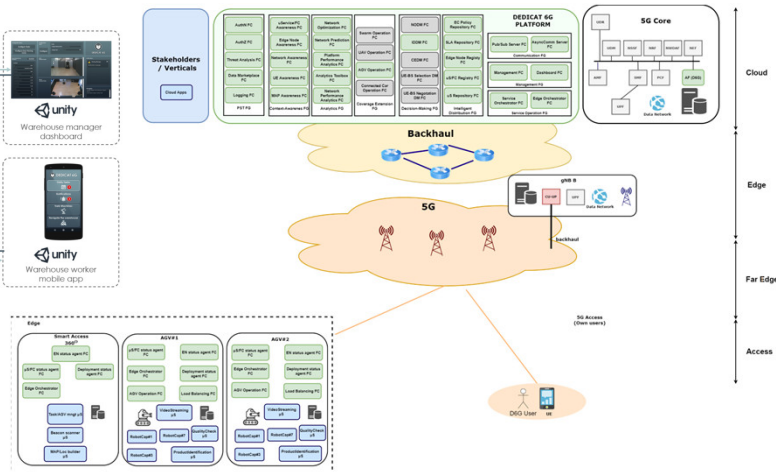
The Smart Warehousing pilot will take place in Diakinisis, Greece



#### Preliminary KPIs

KPI ID	Description	Target value
UC1_KPI1	Decreased latency (incl. mean delay and delay jitter) via intelligence distribution mechanisms by up to a factor of 10 in congested and faulty situations in order to improve quality of experience.	End-to-end: 200ms UpLink (UL) / Downlink (DL) network delay: 10ms
UC1_KPI2	Decreased energy consumption (incl. communication and computation) via intelligence distribution mechanisms by at least a factor of 10 in order to increase the operation lifetime of a mobile station or server.	<10 Mbit/J
UC1_KPI3	Advanced warehouse automation towards significant increase of operations' efficiency (elimination of time wastes, decrease of product damages) and safety, in a complex warehousing environment. Reduction of time required to complete quality assurance	15% reduction
UC1_KPI4	Enhancing safety in warehouses, as automation will reduce the collision risk by timely warning and/or anticipating in case of dangerous situations. An incident reduction is envisioned when a high level of automation is deployed.	>=10%

#### High level view of interactions between Human-centric applications and AGVs



DEDICAT 6G architecture deployment view for Smart Warehousing