AAEON TECHNOLOGY INC.

AMR

DEPLOYMENT GUIDE

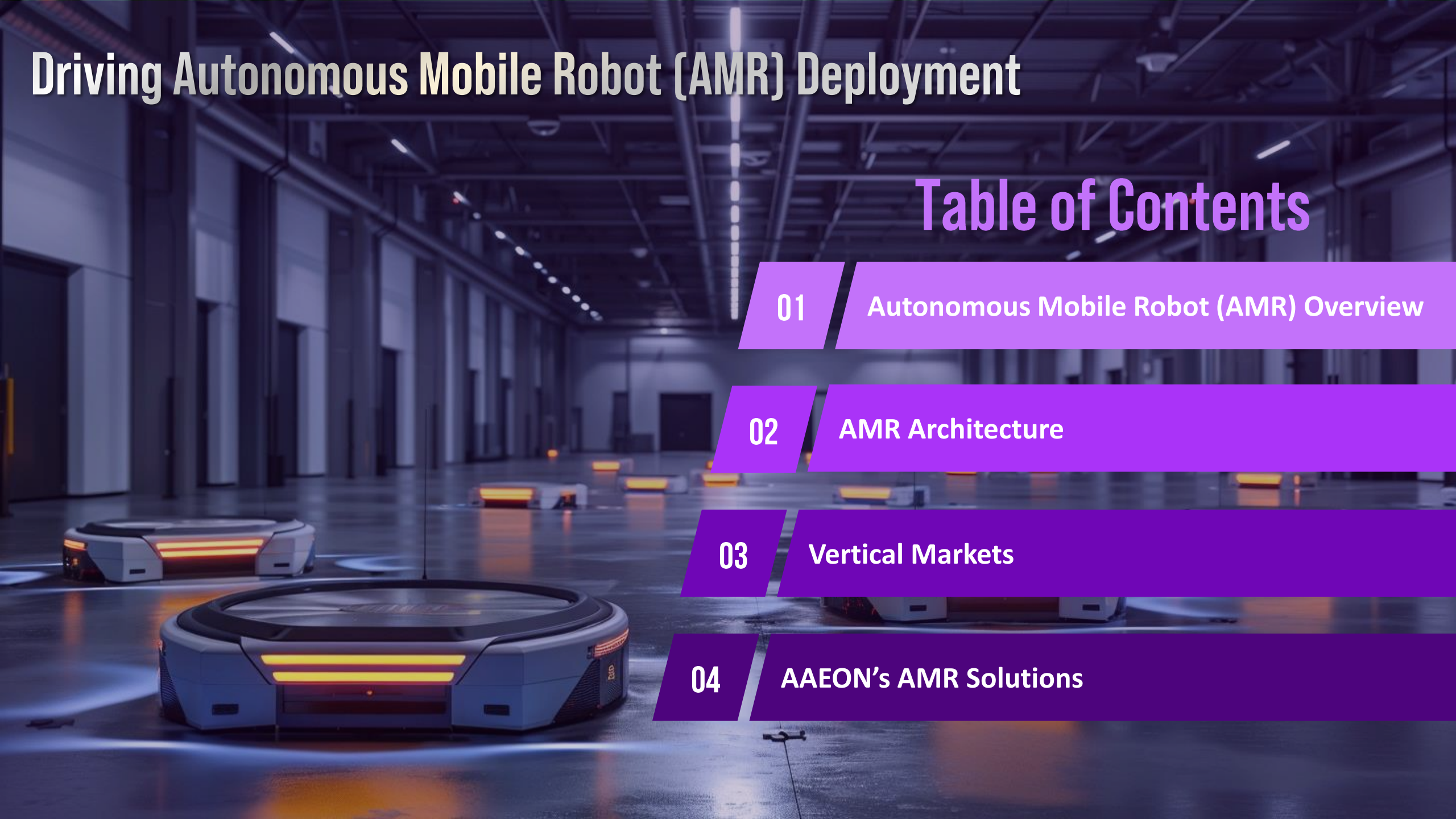
AAEON IOT

INTRODUCTION

AAEON Technology Inc. is a professional developer and manufacturer of IoT intelligent solutions, established in 1992. The company develops, manufactures, and markets IoT and AI edge computing solutions globally. Additionally, it provides embedded computer motherboards and systems, industrial LCD displays, rugged tablet PCs, industrial control systems, network security devices, and related accessories. AAEON offers comprehensive and professional hardware and software solutions for OEM/ODM clients and system integrators.

AAEON Technology Inc. has a dedicated team that provides customized services, assisting clients from the initial development concept through product creation, mass production, and after-sales service, delivering consistent professional consultation and service to tailor high-quality products to your needs. AAEON currently offers a wide range of AI edge computing products and system integration solutions for smart cities, smart retail, and smart manufacturing.

Driving Autonomous Mobile Robot (AMR) Deployment



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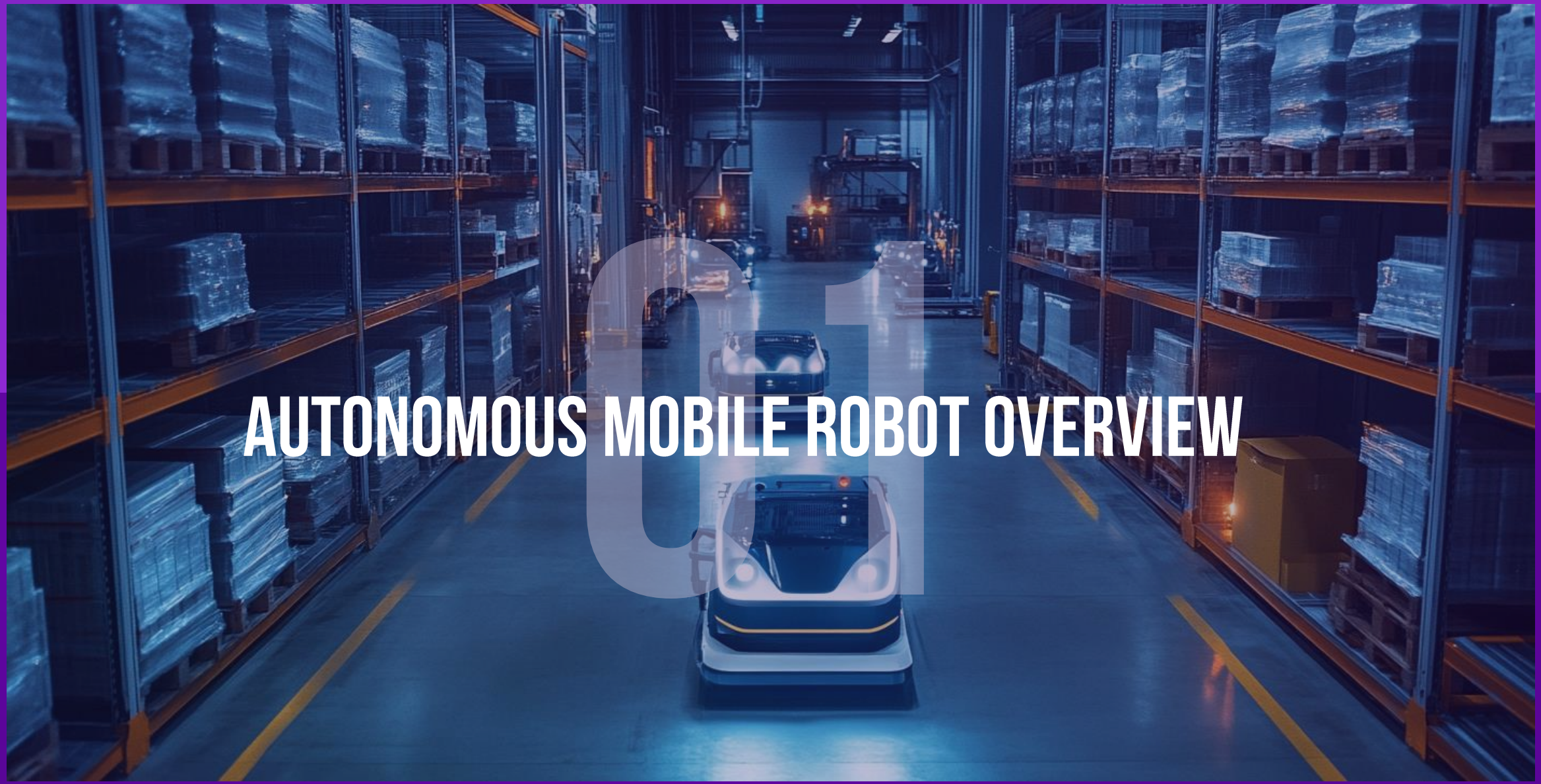

01
AUTONOMOUS MOBILE ROBOT OVERVIEW

Autonomous Mobile Robot Overview

Autonomous Mobile Robots (AMRs) are robots that can perform tasks and independently navigate various environments by assessing and responding to their surroundings in real-time and without assistance from personnel. There are several key features that distinguish AMRs from similar technologies such as autonomous guided vehicles (AGVs), primarily with respect to the dynamic nature of how AMRs operate when compared to their pre-programmed counterparts.

01

AMRs deploy various mapping and localization models, such as Simultaneous location and mapping (SLAM) to interpret their surroundings.

02

AMRs utilize a combination of firmware and peripheral devices such as sensors, cameras, processing units, and actuators to move, analyze data, and execute tasks.

03

To identify objects, make decisions, and react to outside stimuli, AMRs rely on sophisticated AI algorithms deployed on the edge, as opposed to the cloud. This ensures minimal latency.

04

AMRs have been deployed across a range of industries, undertaking tasks that streamline the efficiency, safety, and productivity of business operations.

05

The global autonomous mobile robots market size accounted for USD 2.76 billion in 2022 and is projected to hit around USD 19.78 billion by 2032 with a registered CAGR of 22.3% during the forecast period 2023 to 2032.

Benefits of Adopting AMR Technology

A

Situational Adaptability

As opposed to AGVs, AMRs do not rely on pre-planned pathways, allowing for tasks and movements to be completed in the most efficient manner according to the scenario.

B

Legacy Compatibility

AMRs can operate independently, reducing the need for investment to integrate them into existing infrastructures. Meanwhile, AAEON's hardware includes common communication protocols that are compatible with legacy systems.

C

Increased Safety

AMR hardware can be ruggedized to ensure reliable operation in harsh environments, such as power plants, factories, and the outdoors. This, along with their small size, allow tasks such as quality inspection in tight spaces possible without human personnel.

D

Production Optimization

AMRs reduce personnel costs by enabling tasks to be delegated, while increasing the speed with which tasks can be completed. Higher accuracy and the elimination of human error also reduces product defect rates.

Challenges to AMR Deployment

Technical Complexity

Autonomous Mobile Robots (AMRs) need systems that can run advanced AI models and algorithms to perform effectively in complex environments. These systems must handle perception, decision-making, and action execution in real-time.

Accurate localization and mapping (SLAM) in complex, GPS-denied environments present significant challenges that must be overcome for AMRs to operate effectively.

Harsh Deployment Environments

Autonomous Mobile Robots (AMRs) often operate in environments with extreme temperature variations, like power stations, assembly lines, or outdoor settings, which significantly impact their design, operation, and maintenance.

Many industrial organizations adopt AMR technology to eliminate human risks in hazardous, confined spaces, making compact and lightweight designs essential.

Equipment Compatibility

Modifying existing machinery and infrastructure for AMR compatibility can be expensive, involving physical changes, software upgrades, and personnel training.

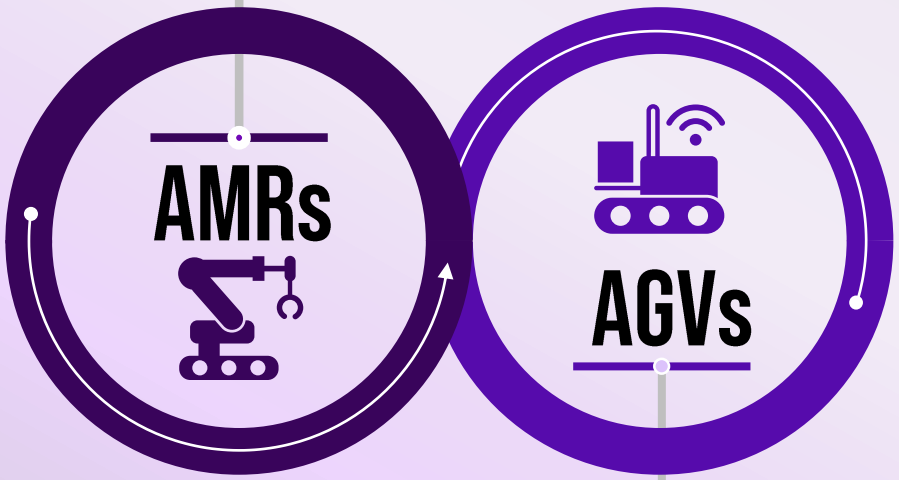
AMRs often need to interact with existing machinery like conveyor belts or loading docks. Design or dimension mismatches can hinder these interactions, requiring modifications to either the AMRs or the infrastructure.

02

AMR ARCHITECTURE

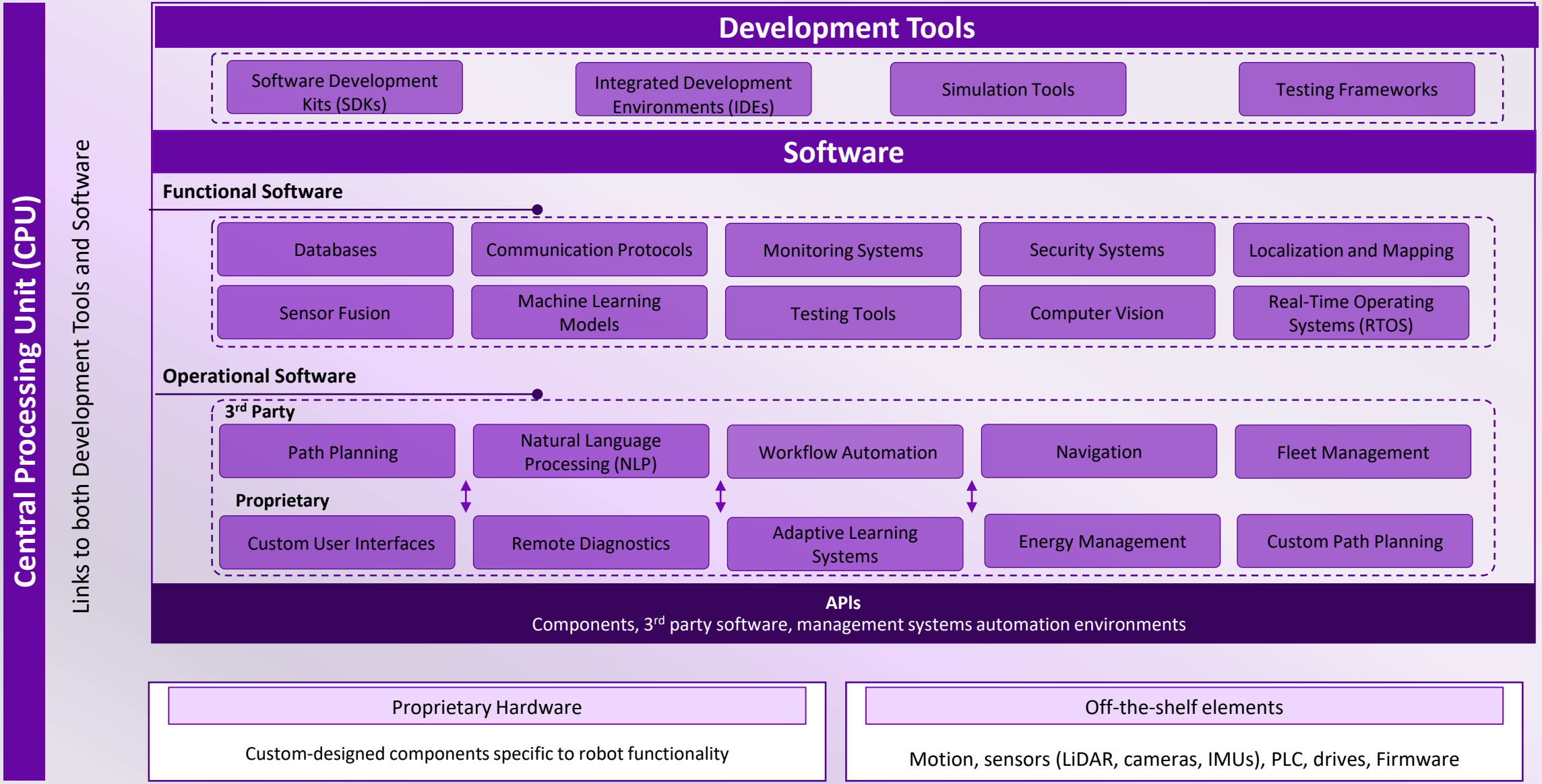
AMR vs AGV

- Don't require any navigational tracks
- Unrestricted in their movement around barriers
- Spend more time among people and are pretty safe
- Route expansion is quite simple
- Little or no requirement for depots



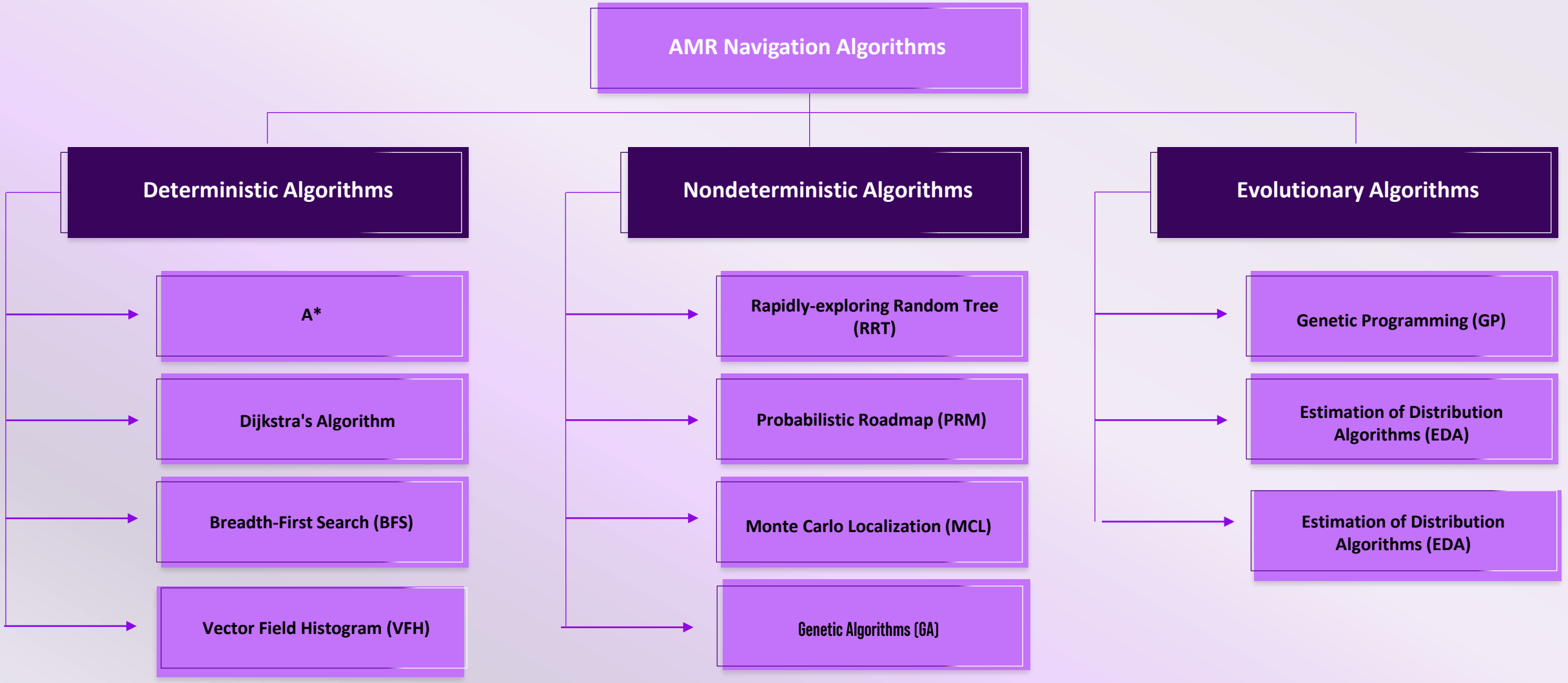
- For navigation, they require wired or designated trails
- When they come into touch with barriers, they come to a halt
- Due to safety concerns, they only travel in designated zones
- Due to infrastructural changes, path expansion is problematic
- Mobility is heavily reliant on depots

AMR Architecture



Proprietary Hardware	Off-the-shelf elements
Custom-designed components specific to robot functionality	Motion, sensors (LiDAR, cameras, IMUs), PLC, drives, Firmware

Functional Software



Operational Software

Incoming Build Feed

Components and systems involved in the assembly and testing of AMRs

Software system used for managing and monitoring fleets of robots

Fleetware

Central repository that stores real-time and historical data about each robot

Robot Status Database

Kitting Stations → Stations where parts and components are prepared and organized for assembly

Assemble Cells → Dedicated areas where robots are assembled from kits.

Machines → Machines involved in the assembly and testing processes.

End of line test → Final testing phase where assembled robots undergo rigorous tests to ensure they meet performance and quality standards

Crucial AMR Components

Perception

Input Devices:

Laser Scanners
- Distance Measurement Mapping

Stereo Vision Cameras
- Depth Perception
- 3D Modeling

Bump Sensors
- Collision Detection
- Physical Contact Feedback

Force-Torque Sensors
- Grasping and Manipulation
- Tactile Feedback

Spectrometers
- Material Identification
- Chemical Analysis

Additional Sensors
- Ultrasonic Sensors: Proximity Detection
- IMU: Orientation and Motion Tracking
- RGB Cameras: Visual Information

Decision

Decision Algorithms

Central Processing Unit (CPU): Core for processing and decision-making

Control Algorithms:
- Rule-Based: Simple "if-then" rules with fixed responses
- Behavior-Based: Combined behaviors with priority-based actions
- Machine Learning: Predictive analytics and adaptive responses

Action Execution

Actuators:
- Motors: Rotational movement and drive systems
- Servos: Precision movement and articulated joints
- Grippers: Object handling and manipulation

Feedback Loop:
- Monitoring and Adjustment: Real-time tracking and dynamic action adjustment

Safety Mechanisms

Autonomous Safety Systems:
- Real-Time Response: Immediate reaction to hazards
- Emergency Stop: Halts operations in critical situations

Actuation

Actuators

Core Component:

Motor:
- Converts energy into rotational or linear movement.

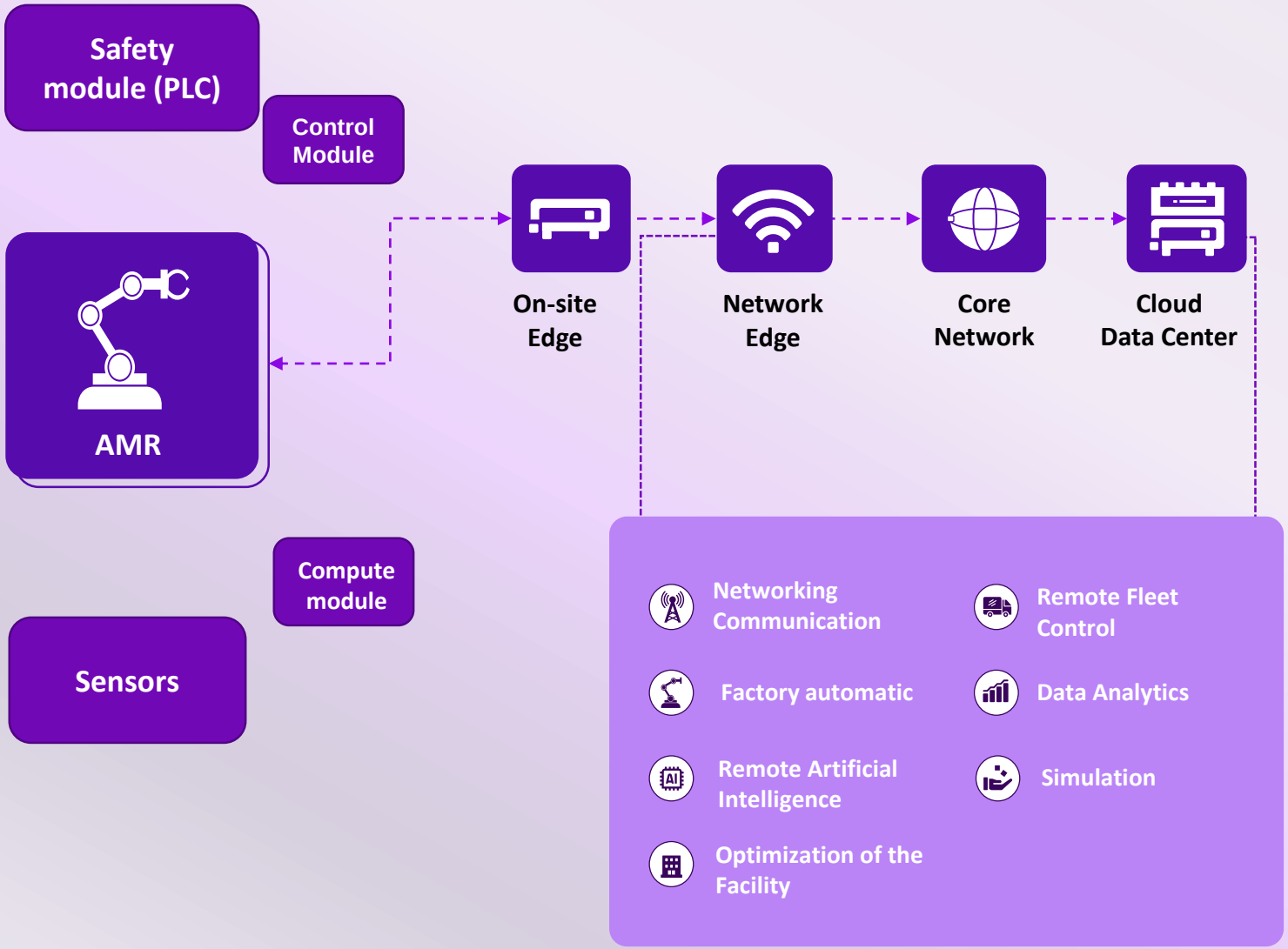
Types of Actuators:

Wheels:
- Enable movement and navigation.

Linear Actuators:
- Produce straight-line motion for tasks like lifting or pushing.

Hydraulic Rams:
- Deliver high force for heavy-duty applications.

AMR Component Synchronicity



Untethered from wiring power, AMRs comprehend and navigate their surroundings using a complex set of sensors, AI, ML, and computing for path planning.

Because AMRs are loaded with cameras and sensors, they will employ a navigation method called collision avoidance to slow, halt, or redirect their route around an unanticipated impediment, such as a dropped box or a crowd of people continuing with their mission

03 VERTICAL MARKETS

Smart Retail

Inventory Management
Conducts regular scans of inventory levels and shelf conditions, updating stock data in real-time

Order Fulfillment
Retrieves items from shelves and prepares them for customer orders, including online and in-store pickup.

Security and Surveillance
Monitors store areas for suspicious activity, assists in preventing theft, and supports security personnel

Shelf Management
Checks for out-of-stock items, pricing errors, or product placement issues, helping maintain store standards

Logistics Support
Moves bulk items or large quantities of merchandise between different areas of the store, such as from the receiving dock to storage

Smart Healthcare

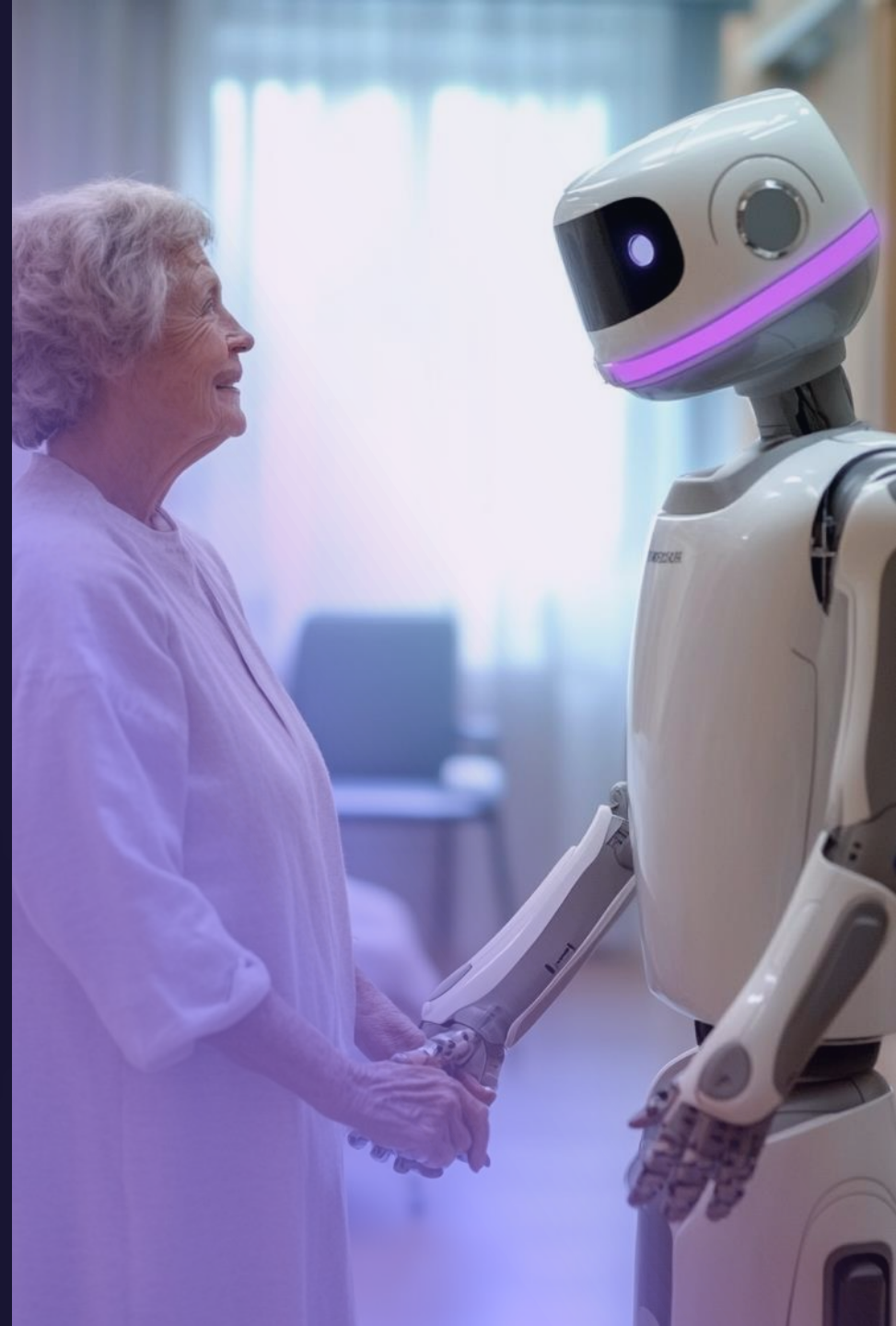
Medication Delivery
Delivers medications from pharmacy departments to patient rooms, reducing the workload on healthcare staff.

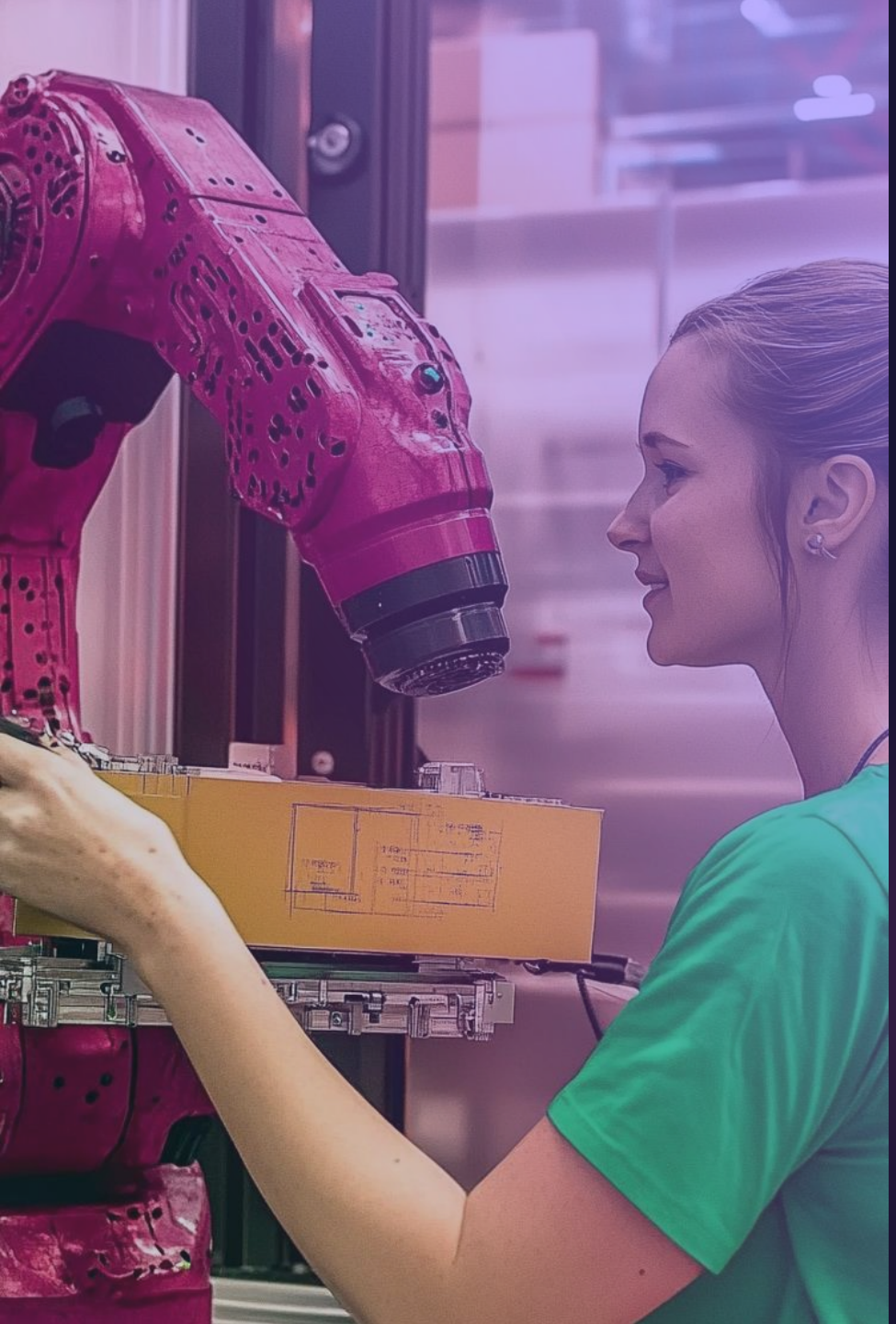
Fall Detection
Uses sensors to detect falls or other emergencies, alerting staff and initiating emergency protocols

Disinfection Robots
Uses UV light or chemical sprays to disinfect surfaces and reduce the spread of infections in hospitals and nursing homes.

Fire and Safety Monitoring
Monitors for fire or other safety hazards, alerting staff and initiating evacuation procedures if necessary.

Waste Disposal
Handles the collection and disposal of medical waste, ensuring compliance with health and safety regulations.





Manufacturing

Production Line Automation
Handles repetitive tasks such as loading/unloading parts, increasing productivity and reducing labor costs.

Quality Control
Assists in the inspection and testing of products for quality assurance, including checking dimensions and performance.

Routine Maintenance
Assists in the scheduled maintenance of machinery and equipment, reducing downtime and extending equipment lifespan.

Adaptive Routing
Adjusts routes and tasks dynamically based on real-time production needs and conditions.

Cobots
Works alongside human operators in collaborative environments, providing support and enhancing productivity.

Construction & Heavy Industry

Site Inspection and Mapping
Utilizes LiDAR and other sensors to create accurate 3D maps of construction and mining sites for planning and monitoring.

Hazard Detection and Safety Monitoring
Equipped with sensors to detect hazardous conditions such as gas leaks, fires, or structural weaknesses

Environmental Monitoring
Continuously monitors environmental conditions to ensure compliance with regulations and minimize impact on surrounding areas.

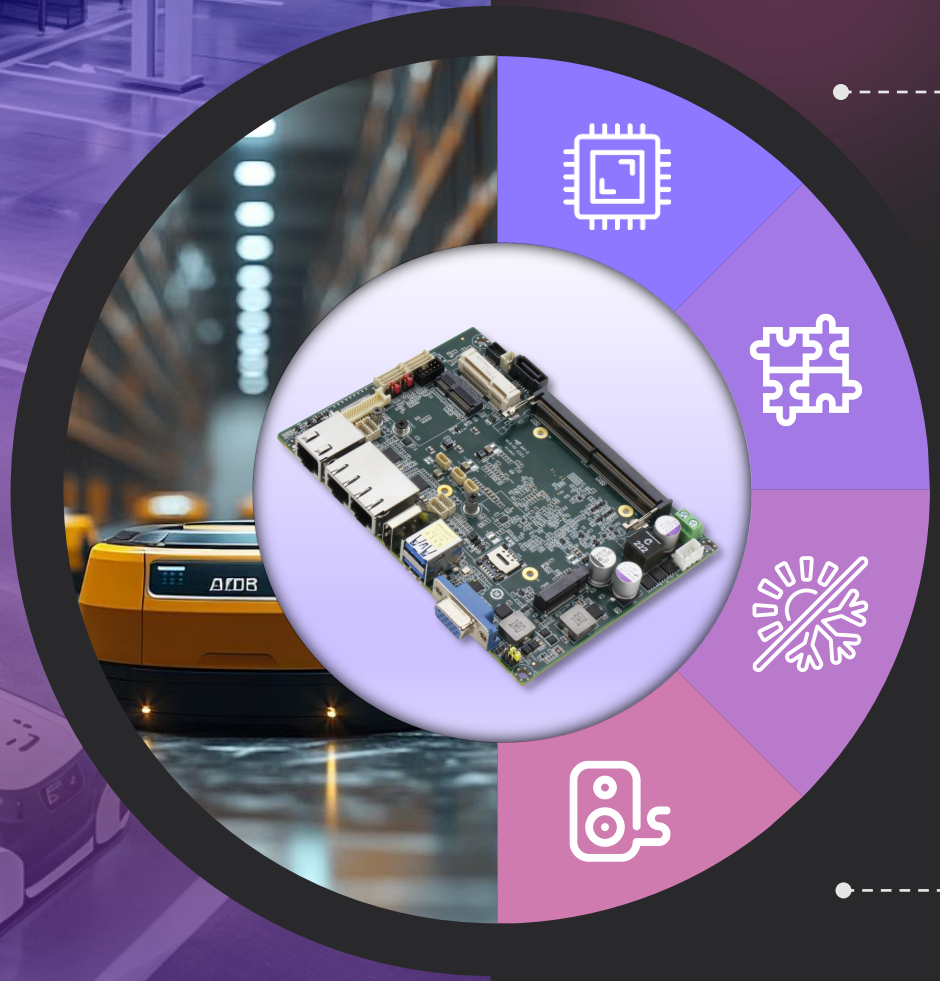
Predictive Maintenance
Uses data analytics to predict equipment failures and schedule maintenance before breakdowns occur, reducing downtime.

04

AAEON'S AMR SOLUTIONS

GENE-ADN6

OVERVIEW



CPU

The Intel® Core™ i3-N305, Intel Atom® x7425E, or Intel® Processor N-series platform offers the computational power needed for real-time data processing, complex algorithms, and decision-making tasks while maintaining power efficiency, extending battery life and reducing costs.

Compatibility

Multiple communication interfaces such as RS-232/422/485, GPIO, and SMBus allow for broad compatibility with legacy equipment.

Rugged Design

A -20°C to 70°C (-4°F to 158°F) temperature range and 9V to 36V power input tolerance allows the board to be deployed in harsher environmental conditions.

Audio Interface

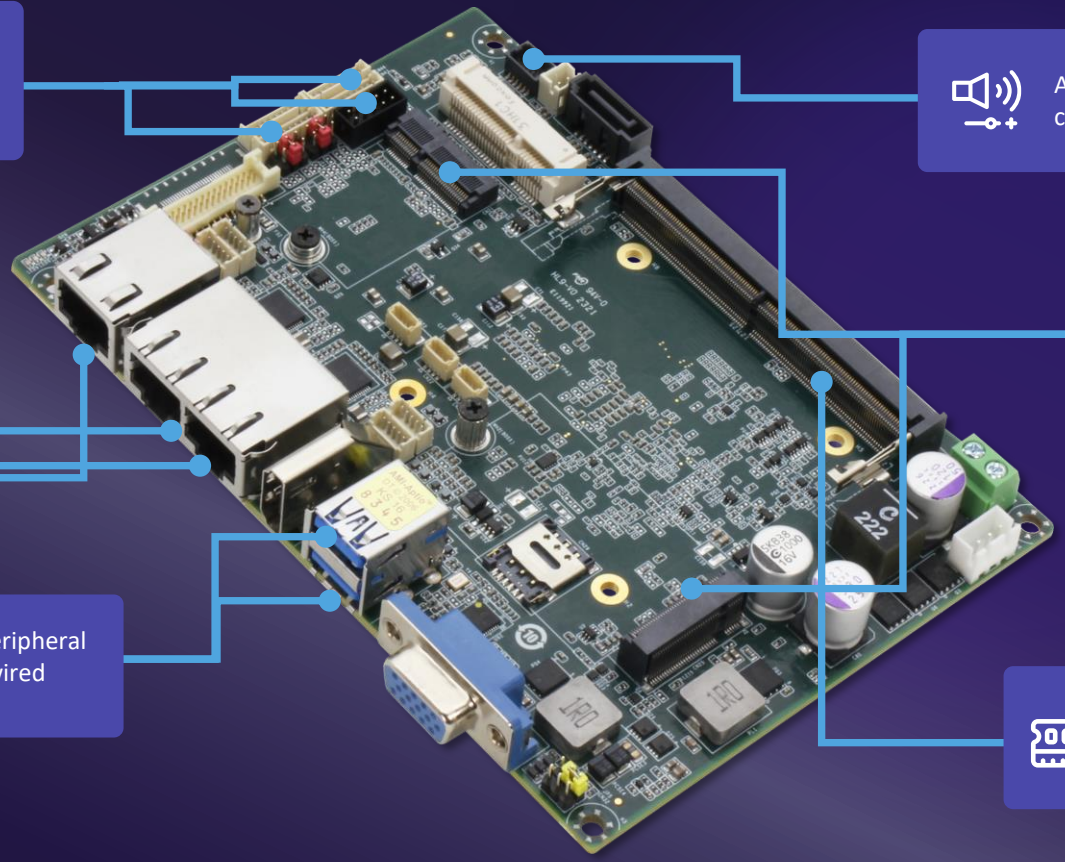
The board's Line-In/Line-Out/Mic interface makes it particularly suited to retail usage, where it can provide a more interactive customer experience

AMR Service Robot

AMRs can deliver food, beverages, and amenities directly to guest rooms, avoiding obstacles and identifying the correct room using LiDAR and motor controllers, without predetermined path planning.

AMRs in manufacturing enhance work processes by improving efficiency and production, automating material handling, goods transportation, and supporting assembly line tasks.

Why the GENE-ADN6?



RS-232/422/485 and GPIO for LiDAR sensors, motor controllers, and actuator integration

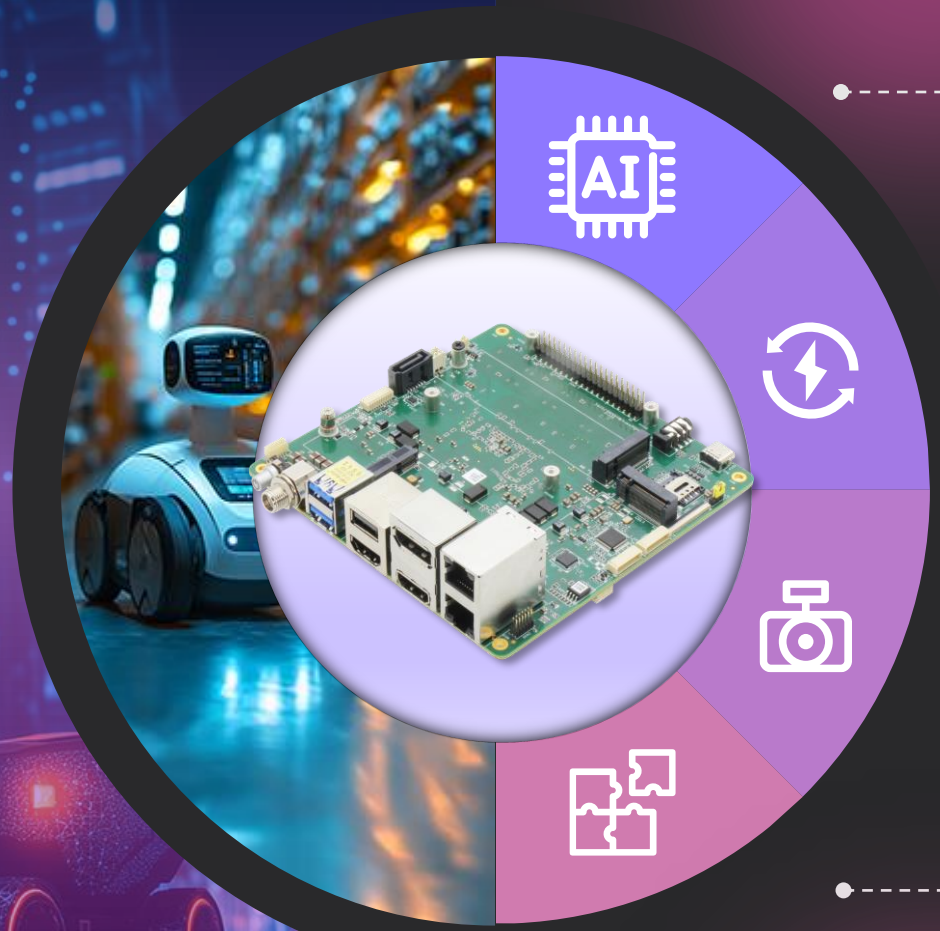
Audio Header for interactive customer experience

M.2 slots for Wi-Fi and 4G/5G module support

2.5GbE & USB 3.2 for peripheral cameras, sensors, and wired intranet connectivity

DDR5 for high-bandwidth system memory

UP Xtreme i14
OVERVIEW



AI-Integrated SoC

The Intel® Core™ Ultra platform offers an integrated CPU, GPU, and NPU for up to 32 TOPS of inference performance. The addition of Intel® Arc™ graphics enhances the real-time video processing capacity of the board for higher resolution image acquisition for real-time edge processing.

Power Efficiency

The UP Xtreme i14 has an extremely high performance to power consumption ratio, along with its wide 9V-36V power input allowing flexibility for integration with various battery configurations.

MIPI Camera Support

Due to its high resolution, frame rates, and bandwidth, MIPI camera support allows for more detailed image data to be obtained, leading to more accurate output. The interface is also low in both power consumption and latency, providing benefits in both practicality and performance.

Raspberry Pi-Compatible 40-pin Header

The board provides a versatile set of peripheral connections all in one 40-pin header, including GPIO, UART, I2C, SPI, and time synchronization pins, making it incredibly versatile for AMR development.

AMR Security Patrol Robot

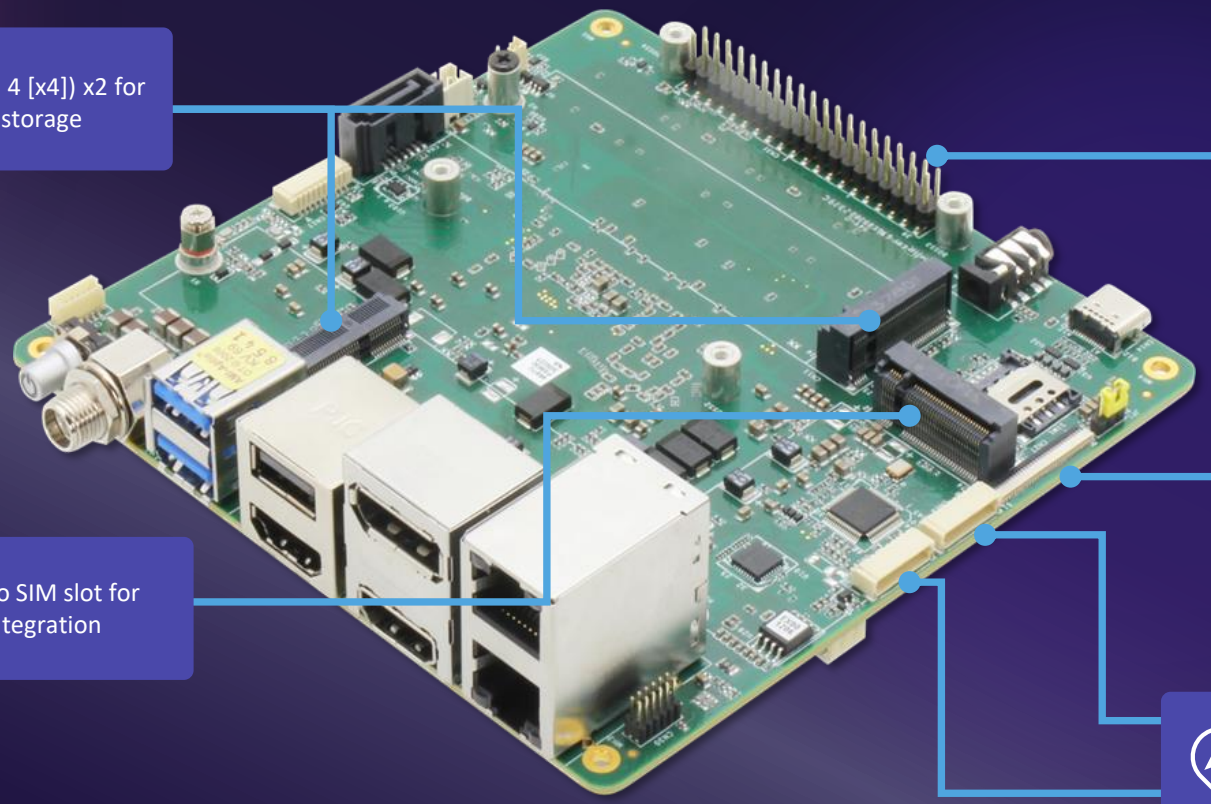
Airports

Government Buildings

Retail Stores

Security Patrol AMRs enhance safety and security in retail stores, government buildings, and airports. These robots autonomously patrol premises, monitor for unusual activities, and provide real-time alerts to security personnel.

Why the UP Xtreme i14?



M.2 M-Key (PCIe Gen 4 [x4]) x2 for AI modules or NVMe storage

40-pin header (sensor, motor control, serial comm, time sync)

MIPI-CSI Connector for high-definition, real-time video capture

M.2 B-Key w/ Nano SIM slot for wireless module integration

10-pin UART wafers for sensors, actuators, GPS, or other hardware

BOXER-8645AI
OVERVIEW

NVIDIA® Jetson AGX Orin™

275 TOPS of AI performance alongside the 2048-core NVIDIA Ampere architecture GPU with 64 Tensor Cores for world-leading inferencing on the edge.

Communication

Equipped with a range of serial communication ports, including DB-9 connectors for CANBus and RS-232/485 interfaces. This versatility in serial communication supports integration with a broad array of sensors and devices.

GMSL2 Camera Support

Real-time video streaming from multiple high-definition cameras over longer distances without signal degradation. which is essential for monitoring and navigation in dynamic environments.

Environmental Durability

Wide 9V to 36V power input range with ignition delay on/off function, MIL-STD-810G shock and vibration tolerance, and a wide -25°C to 65°C temperature range allows operation in harsh settings.

AMR Multipurpose Outdoor Autonomous Vehicle

Construction Sites

Search & Rescue

Mining

Multipurpose outdoor AMRs can be deployed in harsher environments for the purposes of construction site surveying, materials handling, and emergency response efforts where it is unsafe for human personnel.

Why the BOXER-8645AI?

Isolated CANBus for control, shielding against interference and voltage spikes

10G LAN for real-time tasks: object detection, pattern recognition, predictive maintenance

Support for 8 GMSL2 cameras, for long distance visual coverage and high-speed data transmission

COM 1 for serial communication with legacy devices, sensors, and equipment.

DIO for digital sensor and actuator integration, status monitoring, and custom control instructions

COM 2 for serial comm with legacy devices, sensors, and equipment.

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DRIVE AMR DEPLOYMENT WITH AAEON

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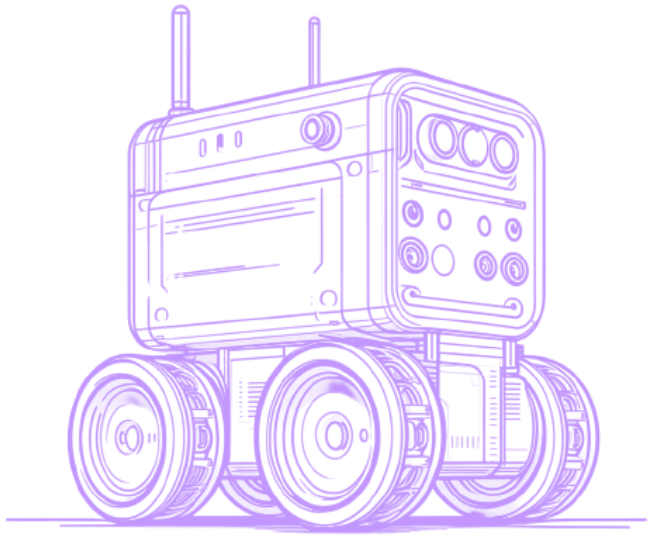

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