# Advantech ROS2 Solutions for Next-Gen AMRs

### Arm-Based Edge Al Platforms $\times$ ROS2 Suite



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Enabling an Intelligent Planet

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## The Future of Mobile Robots: AMRs Outstrip AGVs

W e're on the cusp of a revolution in robotics and are witnessing a long-term transformation across all sectors. Apart from logistics and manufacturing, there are numerous emerging applications leveraging Autonomous Mobile Robots (AMRs) — including those found healthcare, disinfection, retail, construction, and agriculture scenarios. This growth is due to advancement in AI, Machine Vision, manipulation capabilities for automatic picking and placing, and robotic mechanics. Industries and organizations are realizing the role of automation in boosting productivity and growing revenue.

A LogisticsIQ<sup>™</sup> market research study indicates that the AGV (automated guided vehicle) and AMR Market will reach more than 18 billion by 2027 with a growth rate of around 24% and 43% for AGV and AMR respectively. Both AGVs and AMRs are going to cross the installed base of 2.4 million in 2027 and make the use of mobile robots the new normal in day-to-day operational activities.



In recent years, AMRs have evolved into flexible business solutions for warehouse automation. Numerous AI tools are used today in Warehouse 4.0 applications for process optimization. In such applications, they reinforce the global trend towards digital workflow across the entire supply chain.

As a result, the AMR market is booming. An analysis by Gartner<sup>2</sup> suggests that 25% of supply chain decisions will be made across "Intelligent Edge Ecosystems" by 2025. The data and decisions that originate at the edge – from operators, machines, sensors or devices – are becoming more dynamic and covering a larger network.

#### The Next-Gen AMRs — Autonomous Mobile Manipulator Robots

- Cobot and mobile robot hybrid concepts
- Modular wheeled base for diverse working environments
- Multiple machine visions integration for collaborative mobile robotics

#### **Trends on AMRs**

- On-device real-time monitoring and analytics
- Lightweight with longer operation time
- Combination of technical enhancements for specific needs
- Enables widespread deployment within specific applications
- Robot fleet expansion due to the collaboration of robots across facilities and the heterogeneous fleets of AMRs
- Data communication services required for intelligent edge ecosystems

## **Technology Requirements for Next-Gen AMRs**

The deployment of robots in dynamic and challenging environments is making the design of robots increasingly complex. This is especially apparent in scenarios where operating areas shared by robots and humans. As a result, robot systems have to overcome the high-tech demands created by sensing their surroundings, deciding their next action, and actuating their movement or manipulation to ensure safe and dependable human-robot interaction. To fulfill the trends and deliver the next generation of AMRs, numerous critical emerging technologies should be integrated to capitalize on this fast-evolving market opportunity or to differentiate solution offerings.



#### Perception

- 3D level sensor for highly complex environments
- Smart optical sensing with computer vision
- Wireless network positioning technology
- Sensor fusion creates a complete perceptual system
- Diverse I/O configurations for sensor consolidation



#### Reasoning

- Embedded AI achieves device-level processing at the edge
- Dedicated AI accelerators with low latency and scalability
- Low power consumption with high performance
- TensorFlow Lite framework for mobile and edge devices



#### Integration

- Robot Operating System (ROS): mainstream framework for robots
- ROS 2 with DDS for timely communication and interoperability
- Container-based software for dynamic planning
- 5G and Wi-Fi 6 for data transmission in low latency
- Fleet management system for efficient operations



#### Actuation

- MCU enables real-time motor control
- CANbus, Ethernet and EtherCAT for device connection and communication
- ROS 2-based component design
- Easy-to-install via modular design
- Low-profile solution fits into small installation spaces

#### TO SEE, TO SENSE, TO NAVIGATE

## Advantech ROS2 Solutions for Next-Gen AMRs — Arm-based Edge AI Platforms x ROS2 Suite

#### Low-Power, High-Performance Solutions with Propulsive Efficiency and Reduced Effort Requirements

Advantech unlocks new possibilities in the field of autonomous mobile robots by integrating ROS2 Suite into its Arm-based edge AI solutions. These power-efficient solutions comprise a wide spectrum of AI-native platforms in diverse form factors that engender flexibility and easy applicability for developing and expanding product lines. The ROS2 Suite is a coordinated and proven software package built on Advantech's AIM-Linux embedded software. It is designed to support Robot Operating System (ROS) environments. Likewise, the ROS2 Suite delivers the highest degree of integration for positioning, navigation, and motion execution to empower users during the robot automating process. As a hardware-software integrated solution, Advantech's Arm-based edge AI products with ROS2 Suite enable immediate development without wasted effort. A high level of integration is also provided to ensure efficiency. In sum, these solutions are robust, powerful, and unified – qualities that are vitally important to Advantech.

## **Solution Stack**



## **Success Factors When Using Advantech ROS2 Solutions**



#### Ready for Development

#### **One-Click Installation**

- ROS 2 compatible environment with development software tools and libraries
- AIM-Linux Software Services: Linux, Jetson Linux, Ubuntu and Debian OS support with verified peripheral drivers



#### Designed for Application Integration

#### **Robot-Oriented APIs & SDKs**

- Integrated AI accelerator SDKs from silicon vendors
- ROS-compatible add-ons & SDKs in docker containers
- Unified SUSI APIs and SUSI-AI for hardware control



#### Easy to Expand

#### **Cross-Platform Solutions**

- Arm-based wide spectrum supports: MediaTek, NVIDIA, NXP, and Rockchip
- Design-in services for system integration
- Unified software design for easy migration

   from X86 to Arm or among various
   Arm-based platforms



 Robotic-oriented peripheral selection and review

#### **Requirement Review & Design**

- ROS environment ready BSP
- Software integration
- Robotic-oriented peripheral driver integration

## 03 System Validation • DQA test • RF test

Stress test utilities

## 04

#### **Production & Deployment**

- Customized image preload and confirmation
- Defined production test
- Long-term BSP maintenance

## **Streamlined Robotic-Focused Service Flow**

#### Strengthen the entire product development — from concept through production phases

Robot development requires mechatronics technologies to systematize processes while organizing and simplifying designs. Advantech offers a robotic-focused service flow that helps with robotic development at different stages. In the early development stage, Advantech experts can suggest a suitable platform according to the target task and scope of the robot application, help saving time when surveying different platforms from scratch. During the design stage, we offer a ROS environment-ready board support package (BSP) and verified peripherals with driver integration. We also reduce the effort required when building a software development environment. At the validation stage, our test utilities help improve robot functionality and reliability testing. During the production stage, Advantech helps pre-load images to the board and saves time when installing production software manually after receiving a board. During production testing, we accept additional test items or fixture requests for testing unique robot features. This service flow is oriented around robot development. It is aimed at saving time and resources, and reducing robotic application time to market.

## **Explore New Possibilities for AMRs with Arm-Base Edge AI Platforms**

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#### **Energy-Efficiency and Maximized Functional Performance with Intelligence**

Robotic applications are trending towards lightweight designs for better space management. Likewise, solutions with lower power consumption and more efficient thermal design, AI capabilities, and other technologies are producing more valuable and versatile robots capable of handling more complex tasks.

Itial control for robotic applications

MCU

Low-power for real-time control

Video Processor Unit (VPU) A multi-standard video codec (encoder/decoder) capable of simultaneously handling multiple

streams by time multiplexing

Arm-based Edge AI Solutions are important in such applications due to the advantages they provide. This includes heterogeneous architecture, which enables any accelerator to operate at the same processing level as the system's CPU, meaning that each of the processing unit can take over control of its focused feature. For example, an AI accelerator can execute machine learning algorithms and send the results to the MCU for real-time control of the movement component. This architecture allows the offloading of the host CPU's tasks and balances the performance and the power of the whole system. AI Accelerator

A specialized processor (NPULAPU) for fast Al inferencing

GPU

Accelerate graphics rendering or process pieces of data paralleling for machine learning

Image Signal Processor (ISP) A specialized digital signal processor (DSP) used for

A specialized orginal signal processor (porr) used for camera image pre-processing to optimize the image quality

Advantech Arm-based edge Al platforms powered by:

Rockchio

## **Comprehensive Platforms for Building AMRs**

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Robots equipped with more than 4 x cameras utilize huge amounts of visual data in SLAM and manipulation applications.

#### For high-performance AI needs:

#### **EPC-R7300**

- NVIDIA Orin Nano and Orin NX
- Edge Al Box
- 20 ~ 100 TOPS
- 7 ~ 25W

Robots equipped with less than 4 x cameras utilize 2D/3D LiDAR-aided visual SLAM and perception technologies for motion planning.

## For mainstream Al needs: **BSB-3810** • MediaTek Genio 1200 • 4.8 TOPS • 2.5" Pico-ITX • 10W

Robots equipped with less than 2 x cameras utilize camera-assisted LiDAR SLAM system for collision checking.

1 1 4 0 0 0 0 0 0 0 0 0 0 0 0

#### For entry-level Al needs:

### RSB-4810

RESERVE

• Rockchip 3568 • 1 TOPS • 3.5" SBC • 10W

#### **Wireless Communication**

## **Sensor Fusion Enables Safe and Precise AMR Navigation**

Autonomous mobile robots need to be capable of working independently in diverse environments. Illustratively, AMRs are integrated as inventory management solutions in stores, as robotic vacuum cleaners in commercial areas, or as material handling vehicles in warehouses. AMRs must receive accurate information from sensors to detect both mobile and/or stationary objects, personnel, or other AMRs. Each sensor provides data unique to its characteristics. Sensor fusion technology enables real-time information to be derived to enable robots to move safely in unfamiliar environments. Sensor fusion helps overcome the challenges robots encounter when path planning and navigating while ensuring safe operation and the avoidance of collision.

#### Safer Human Presence Detection

LiDAR, RADAR, Camera

#### Mapping and Localization

Stereo Camera, LiDAR, Ultrasonic, RADAR, UWB, GNSS, 5G, Wi-Fi

#### **Collision Avoidance**

Stereo Camera, LiDAR, Ultrasonic, RADAR

Ultrasonic

Medium-Range RADAR

Camera

LIDAR

Long-Range RADAR

## **UIO40-Express Spans the Required Signal Chain for AMRs**

#### Expandability and flexibility for sensor fusion

Advantech provides the UIO40-Express to fulfill the diverse I/O interface requirements of sensor fusion. UIO40-Express leverages frequently used industrial I/O interfaces (such as CANBus, GPIO, I2C, and USB). Likewise, it features a modular, plug-and-play design to increase the speed of application development. Having these I/O drivers pre-integrated in a unified board support package (BSP) helps accelerate application development, and enables developers to configure the I/O needed for sensor connections quickly.

- A GPIO for ultrasonic
- B RS-485 for E584/E87 controller
- C MIPI-CSI for MIPI camera
- D Extendable Mini-PCle for LTE module
- E Extendable M.2 for Wi-Fi/BT module
- **F** CANBus for motor controller, distance/ location sensor
- G Ethernet for EtherCAT controller
- H USB for 3D stereo camera, RADAR, LiDAR, UWB

### **UIO40-Express**

Modular I/O Expansion boards for Advantech 2.5" Pico-ITX SBC speed up application development



**UIO-4030** 



1x GbE, 2 x USB2.0, 2 x RS-232



**UIO-4034** 1 x CAN bus, 2 x RS-232



**UIO-4036** 4 x GbE



#### **UIO-4038** 4 x GbE (3 x LAN, 1 x WAN)



**UIO-4040** 128GB ~ 1TB NVMe SSD

1 x RS-485, 1 x RS-232, 1 x 4 DIs & 4 DOs



## Enhance Development with AIM-Linux Software Services

AIM-Linux software service is dedicated to accelerate the software development of Arm-based platforms. It provides a flexible and modular framework aimed at the foundations of industrial markets, focused on long-term BSP maintenance, and oriented towards delivering longevity support to diverse Arm-based SoC platforms. Advantech leverages AIM-Linux to deliver a verified solid foundation (Unified Embedded Platforms) and value-added App add-ons and SDKs that allow users to focus on vertical application development without expending resources and effort on platform integration.





#### **BSP Long-Term Maintenance**

The Advantech long-term maintenance and support policy offers regular BSP updates every half year. It fulfills kernel upgrade and security considerations while designing next-gen products

and/or integrating new peripherals. As the primary platform for ROS, Ubuntu is included with upstream benefits and online security updates directly supported by Canonical.



#### **Peripheral Driver Integration**

Advantech provides peripheral support lists with verified drivers in BSP for robotics applications. These peripherals — including cameras, sensors, and motor controllers — are

ROS compatible for easy integration. Advantech also includes industrial-grade displays and Wi-Fi & 5G wireless modules for fast system integration.



#### AIM-Linux Develoer Center

A one-stop resource hub for comprehensive documentation and information regarding Arm-based embedded computing solutions produced by Advantech. These documents — covering OS release, test commands,



user guides, and reference images — help simplify development.



## **ROS2 Suite for Robotics Application Development**

#### Move robotics applications across architecture and platforms with ease

The ROS2 Suite offers a one-click installer and container-based software packages with pre-validated hardware modules. These features help users develop and build robot applications, like SLAM, motion control, and object recognition. The ROS2 Suite includes SUSI API. SUSI is a set of application interfaces that enables users to monitor and control digital I/O, I2C, and watchdog timers directly. Industry protocols and edge time-series database software are also implemented for ROS industrial applications. General ROS utilities like RViz and Movelt are also pre-integrated to quicken application development and porting on Advantech platforms. In addition, the AI Accelerator SDKs from silicon vendors are consolidated into ROS2 Suite to empower edge intelligence efficiency from the neural processing units inside of processors. This unified software design helps developers to integrate ROS2 applications and to move them across cross-architecture platforms from X86 to Arm or among various Arm-based platforms.



ROS2 Suite				Advant	ech's offerings Third-	party software integration
AI Accelerator SDKs	ROS-Compatible Add-Ons & SDKs 🐳			Integrated Development Utilities		
Tensorflow NP	Remote Control         Powered by         DeviceOn           Device Status, Management, OTA         Hardware			Hardware	>Movelt1	<b>NAV2</b>
TensorRT 📀 NVIDIA.				Control	RQT	rqt_graph
RKNN API <b>Rockchip</b> Rock-X	Protocol Modbus, OPCUA	Security Trusted OS, TPM	Database Edge DB	3031, 3031-AI	RViz	<b>₿</b> GAZEBO
NeuroPilot MEDIATEK	IIIROS 2					
AIM-Linux	Operating Systems					
Software Services	Kernel			Robotics Peripheral Integration		



## **DDS Processing Pipeline on Arm-Based Platforms**

ROS 2 is the software built on top of DDS as its middleware. DDS provides discovery and transportation services between ROS nodes. It also provides more reliable and secure communication. The mechanism is the same whether in one machine or between machines.

With regards to hardware, X86 platforms rely on high-performance processors — such as multi-pipeline and branch prediction — to maximize performance. On the contrary, heterogeneous architecture utilized in arm-based platforms provides a mix of external accelerators through an I/O Coherence Unit (IOCU). This provides greater energy efficiency via dedicated hardware. It enables systems to continue to scale beyond the limitations imposed by ever-shrinking process geometries.

Combining this software and hardware with the add-on value of Advantech ROS2 Suite produces solutions uniquely suited for industrial applications — including data acquisition protocols and edge databases. Advantech products can be easily controlled through the ROS packages and free users from platform selection.

## Manage Fleets of AMRs with Ease

The success of AMR projects hinges on the real-time monitoring, upgrade, and remote support of robots. A good device management platform or service helps prevent the losses caused by discontinued operation or prolonged maintenance. Advantech offers a diverse set of proven software tools and services that help robotics developers engender more features with less effort.

#### **Efficient Operations Total Management Remote Access** • Hardware and devices Real-time monitoring • OTA update Software and peripherals Remote control Batch control Open APIs for Integration Troubleshooting Setup booster Production Delivery Scan to **DeviceOn** Control Center Packaging

**G** ...device-enablement platforms improve financial performance across cost, revenue, and operating efficiency, especially for midmarket companies." **McKinsey & Company**<sup>3</sup>

## **DeviceOn RESTful API/SDKs Reduce Time-to-Market and Engender Flexible Integration**

As different AMRs are often deployed at different sites, their OS and peripherals require continuous attention and real-time troubleshooting capabilities. Advantech provides a set of RESTful API/SDKs hosted locally or on Microsoft Azure to ensure security and scalability of business and fleet operation. This applies to solutions within private networks or connected to the Internet. Users can leverage API/SDKs to integrate advanced device management capabilities into their fleet management system or AMR service applications.

#### Over-the-air (OTA) update of firmware/driver/application

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- Firmware, software, and OS
- Customizable rules and script
- On-demand/scheduled, 1-1 or 1-many batch operation
- Secured process by digital signature and MD5 file checksum

#### On-demand and scheduled batch reboot, screenshot, and KVM

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- Manages 10,000+ devices
- Remote control
- Real-time monitoring
- Remote diagnostics
- Notification and alert

#### Container management: build once and run everywhere

**Batch Deploy** 

- Reduced time for AI deployment from months to minutes
- Reproduce, scale up, and manage AI application with ease
- Al brings solutions to production faster
- Hardware and OS agnostic

## **Cloud-to-Edge AI Training and Deployment**

#### Key software to build up edge AI solutions offered by Advantech

Edge AI is all about training, deploying, and improving models quickly and cost-effectively. For developers who intend to save time by leveraging cloud AI training services, Advantech recommends Azure Custom Vision and Edge Impulse, which provide intuitive and low-code interface. Furthermore, Advantech's DeviceOn closes the gap between cloud AI/ML and AI production at the edge. DeviceOn Container Management, OTA Update, and API/SDKs complete a cloud-to-edge AI pipeline from model training, deployment, to inference data acquisition and visualization.



## Wafer Transfer Robot

Smart factory models are of increasing interest to global enterprises. Achieving a low failure rate, enabling 24/7 production line operation, and ensuring labor safety necessitates the deployment of AMRs on the production line or within logistics warehouses. Robots are proving an excellent solution in the semiconductor industry as they can transport/transfer the extremely thin (mere micro-millimeters) and fragile wafers.

#### **Challenges and Demands**

- · Ensuring stability and flexibility while reducing vibration
- · Improving the accuracy of obstacle avoidance
- · Increase safety on human-robot collaboration sites
- · Cobot design needs to be fine-tuned to fit in clean room requirements

#### Solutions and Technologies

- 2.3 TOPS native AI inference capability to assist obstacle avoidance
- ROS/ROS2 ready-to-develop environment for easy ROS applications integration
- Sensor fusion enables AMRs to precisely navigate safely
- Compact design and 3.5Grams vibration tolerances

#### **Benefits**

- Deploy AMRs widely to the production lines and factories with ease
- Enhancement of the processing from sensing, actuation and thinking to integration
- Lower power with higher edge AI performance
- · Lower development efforts with higher efficiency
- Flexible design that accommodates both intralogistics and AMR manipulation demands



## Use Case Industrial Cleaning Robot

Large logistic warehouses and loading areas feature myriad dynamic activities happening at all times simultaneously. Ensuring the cleanliness of the operation area can help avoid accidents and prevent possible AMR misjudgment. Autonomous sweeping robots can run parallel to ongoing operations without hindering the core warehouse tasks. It can clean a large area faster than manual labor and conduct six hours of autonomous cleaning on one charge; producing a more cost-effective and efficient solution.



- Thorough planning ensures no interruption to core warehouse activities
- Lightweight and longer-battery-life solutions secure six hours of autonomous cleaning on one charge
- To ensure operational safety, the cleaning robot needs to be capable of instant reaction to obstacles

#### Solutions and Technologies

- Mapping, data logging, storage and real-time monitoring through wireless connection
- Low power consumption to increase efficiency per charge
- Three MIPI-CSI camera inputs and 4.8 TOPS native AI inference capability to assist instant reaction

#### **Benefits**

- Cost-effective and can be easily scaled as digital 3D map data is easy to transfer than human experience
- Manage OTA update of firmware/application/OS/security patches at scale
- The cleaning performance is consistent and can be traced transparently through digital logging





## Outdoor Agricultural Robot

The Agriculture sector has shifted towards a new paradigm — Agriculture 4.0 — where digitalization, automation, and AI play vital roles in crop production, weeding, and pest control. This shift presents challenges and opportunities in the move from manual and animal-driven technologies to mechanized and automated equipment. As a result, robotics and the precision they can provide will soon supersede tractors and engine power in agriculture.

#### **Challenges and Demands**

- Labor shortage in agriculture industry due to population ageing
- Software platform development takes time as different crops require different control and care
- · Harsh environment usage capability is a must

#### Solutions and Technologies

- Flexible selection among all the Jetson series modules for different crops
- LTS BSP support and application software consultancy
- Wide power input (9-24V), wide operating temperature (-20 ~ 60 °C) and low power consumption (5 ~ 15W)

#### **Benefits**

- Shorten time-to-market as evaluation of a unified barebones PC can support product in 3 different segments
- ROS 2 compatible peripherals driver pre-integrated and more I/O possibility for tremendous Improvement of productivity
- Optimized power to make robots last longer on a full charge



## Security Patrol Robot

Distilleries usually store finished liquor in wine barrels in a storage room. If the alcohol leaks and combusts, the result may be a major accident and corresponding financial losses. Avoiding such incidents traditionally relied on staff inspection patrols in shifts. This resulted in high labor costs for a process with low accuracy. The market is now trending towards the use of Security Patrol Robots in place of manual labor to meet future challenges.



#### **Challenges and Demands**

- Reduces inspection accidents and supports 24/7 operation
- The inspection path can be upgraded and real-time inspection information can be reported by Wi-Fi/5G
- · Required compact size and lower power efficiency
- Reliable operation in harsh environment

#### Solutions and Technologies

- Supports Wi-Fi 6, 5G for seamless wireless connectivity
- Supports dual GbE for IP camera
- Wide operation temp. -40 ~ 85  $^\circ\text{C}$

#### **Benefits**

- Shorten the product integration process by leveraging diverse I/O interfaces
- Pre-integrated and verified ROS 2 middleware SDK via the ROS2 Suite and drivers to ease software development
- Leverage DeviceOn to control and remotely monitor the fleet of security patrol robots



## **Product Selection Guide**



\* More I/O supported through UIO40-Express, please refer to the page 23.





Model Name		EPC-R7200	EPC-R7300			
Platform	NVIDIA Jetson Nano	NVIDIA Jetson TX2 NX	NVIDIA Jetson Xavier NX	NVIDIA Jetson Orin Nano 4GB / 8GB	NVIDIA Jetson Orin NX 8GB / 16GB	
Form Factor		Industrial Barebones PC	Industrial Barebones PC			
CPU	4 x Cotex A57	2 x Denver + 4 x A57	6 x Carmel			
AI Processing Unit	0.47 TFLOPS GPU	1.33 TFLOPS GPU	21 TOPS GPU	20 TOPS GPU / 40 TOPS GPU	70 TOPS GPU / 100 TOPS GPU	
VPU	DE: 1xH.265/H.264, 4Kp60 EN: 1xH.265/H.264, 4Kp30 DE: 2xH.265 EN: 1xH.265/H.264, 4Kp30		DE: 2xH.265, 8Kp30 EN: 1xH.265/H.264, 4Kp60	DE: 1xH.265/H.264, 4Kp60 EN: 1080p30	DE: 1xH.265, 8Kp30 EN: 1xH.265/H.264, 4Kp60	
ISP	-			-		
Display	HDMI			HDMI		
I/O Ports	MIPI CSI, GbE, USB 3.0*			MIPI CSI, GbE, USB 3.0*		
Expansion	M.2 2230 Key E, M.2 3052 Key B			M.2 2230 Key E, M.2 3052 Key B, M.2 2280 Key M		
Power Input	DC 9 ~ 24V, 2-pin phoenix			DC 9 ~ 36V, 2-pin phoenix		
Power Consumption	5 ~ 10W	7.5 ~ 15W	10 ~ 20W	5 ~ 15W	10 ~ 25W	
Operating Temp.		-20 ~ 60 °C/-20 ~ 70 °C**	-20 ~ 60 °C/-20 ~ 70 °C**			
Dimensions	152 x 137 x 42 mm			173 x 152 x 50 mm		
Operating System	Ubuntu, Jetson Linux			Ubuntu, Jetson Linux		



### **UIO40-Express**

Modular I/O Expansion Boards





UIO-4030 1 x RS-485, 1 x RS-232, 1 x 4 DIs & 4 x DOs

1x GbE, 2 x USB 2.0, 2 x RS-232



4 x GbE

**UIO-4038** 

4 x GbE



UIO-4034 1 x CANbus, 2 x RS-232



(3 x LAN, 1 x WAN)



UIO-4040 128GB~1TB NVMe SSD

\* More I/O supported through UIO40-Express, please refer to the column on the right.

\*\* The operating temperature -20 to 70 °C is supported by specific power mode of Jetson modules

### MEMO



ROS2 Suite Software Resource



#### Compatible Peripheral Lists

#### Reference

1. AGV-AMR Market (3rd Edition), LogisticsIQ

2. Gartner Predicts 25% of Supply Chain Decisions Will Be Made Across Intelligent Edge Ecosystems Through 2025, Gartner, January 19, 2022

3. Growing opportunities in the Internet of Things, McKinsey, July 22, 2019

### MEMO

#### **One-Click Installation of ROS2 Suite Packages**

This one-click installation page displays a list of available packages for selection. It guides users through the ROS2 Suite installation process via an easy-to-use interface. Scan the QR code to fill out the form and receive packages. 5

Ubuntus

Rectorio



## What can you expect from the future of Arm-based computing? Let's discuss it in the AIM-Linux Community

#### **Regional Service and Customization Centers**

China Kunshan 86-512-5777-5666	<b>Taiwan</b> Taipei 886-2-2792-7818	Netherlands Eindhoven 31-40-267-7000	<b>Poland</b>   Warsaw 00800-2426-8080	USA   Milpitas, CA 1-408-519-3898
Worldwide Offices				
Asia Pacific	Asia Pacific		Europe	
Taiwan           Toll Free         0800-777-111           Taipei & IoT Campus         886-2-2792-7           Taichung         886-4-2372-5           Kaohsiung         886-7-392-36           China         7           Toll Free         800-810-0345           Beijing         86-10-6298-4           Shanghai         86-21-3632-1           Shenzhen         86-755-8212-           Chengdu         86-28-8545-0           Hong Kong         852-2720-511	Japan           Toll Free         0800-500-1055           Tokyo         81-3-6802-1021           D58         Osaka         81-6-6267-1887           D00         Nagoya         81-0800-500-100           Nagoya         81-0800-500-100           Nogata         81-949-22-2890           Korea         700           Toll Free         080-363-9494/5           Seoul         82-2-3660-9255           Singapore         8           Singapore         65-6442-1000           Malaysia         Kuala Lumpur           Penang         60-3-7725-4188	Australia           Toll Free         1300-308-531           Melbourne         61-3-9797-0100           55         India           Bangalore         91-94-4839-7300           Pune         91-94-2260-2349           55         5	Netherlands         Russia           Eindhoven         31-40-267-7000         Russia           Breda         31-76-523-3100         Moscow           St. Peter         Moscow         St. Peter           Germany         Toll Free         00800-2426-8080/81         Czech Re           Munich         49-89-12599-0         Düsseldorf         Ústí nac           Düsseldorf         49-2103-97-855-0         Ireland         Galway           Paris         33-1-4119-4666         Morth Au         Morth Au           Milan         39-02-9544-961         Morth Au         Toll Free           UK         Newcastle         44-0-191-262-4844         Milpitas	A 8-800-555-01-50 B-812-332-57-27 8-921-575-13-59 B-90blic 1 Orlicí 420-465-524-421 353-91-792444 TICAS merica Def 1-888-576-9668 Def 1-513-742-8895 S 1-408-519-3898 1-949-420-2500
Israel 072-2410527 Turkey 90-212-222-042 Turkey-Bursa 90-224-413-313	Thailand           2         Bangkok         66-02-2488306           4         Vietnam           Hanoi         84-24-3399-115           Hochiminh         84-28-3836-585	-9 55 56	London         44-0-870-493-1433         Ottawa           Spain         Ottawa           Madrid         34-91-668-86-76         Brazil           Sweden         Toll Fre           Stockholm         46-0-864-60-500         São Pa	o 1-815-433-5100 o 1-888-576-9668 e 0800-770-5355 iulo 55-11-5592-5367
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