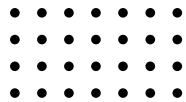




WINMATE



WHITEPAPER

WHY EDGE AI IS MANDATORY FOR NEXT-GENERATION VEHICLE PLATFORMS

Ensuring Real-Time Safety, Operational Continuity,
and Data Control in Real-World Environments

Winmate – Your Best-Mate in Rugged Solutions

INTRODUCTION

Vehicle Mounted Computers (VMCs) have traditionally been deployed as control and display terminals, operating in structured and predictable environments. They were designed to handle basic functions such as data visualization, vehicle diagnostics, and communication with onboard systems through GPS, CAN bus, and I/O interfaces. However, modern industrial vehicles and public-safety fleets are no longer operating under such controlled conditions.

Today's vehicles—such as forklifts, mobile cranes, and law enforcement patrol cars—operate in highly dynamic environments where human workers, other vehicles, and unexpected obstacles constantly move into blind spots. Traditional sensor-based systems lack the ability to perceive and understand these surroundings in real time. As a result, safety risks increase, operational efficiency declines, and reaction time becomes a critical limitation.

As vehicle operations grow more complex, decision-making can no longer rely solely on static sensor data or delayed responses. Real-time perception, situational awareness, and immediate action are now essential. Vehicles must not only collect data, but also interpret visual information and respond instantly to changing conditions. This shift marks a fundamental evolution in the role of the vehicle-mounted computer.

Traditional VMC architectures, built on legacy CPUs, are not designed to process multi-camera video streams or execute advanced AI workloads such as object detection, human recognition, and motion tracking within sub-100 millisecond response windows. These limitations prevent conventional systems from meeting the safety and performance demands of modern vehicle operations.

To address these challenges, the vehicle-mounted computer must evolve into an AI-enabled vehicle platform—one capable of real-time perception, decision-making, and action directly at the edge. By integrating high-performance AI computing into a rugged, vehicle-grade system, VMCs can move beyond passive monitoring and become intelligent systems that actively enhance safety, efficiency, and operational effectiveness.

The transition from traditional VMCs to AI vehicle platforms is no longer a future concept—it is a necessary step for vehicles operating in today's demanding, real-world environments.




WHY EDGE AI IS MANDATORY

The challenges faced by modern vehicle operations—limited perception, real-time response requirements, and harsh operating conditions—cannot be effectively addressed by traditional centralized or cloud-based computing models. In safety-critical vehicle environments, even minimal latency or intermittent connectivity can result in unacceptable risks.

Vehicles operating in warehouses, construction sites, ports, or urban areas often experience unstable or limited network connectivity. Relying on cloud-based AI processing introduces delays and potential points of failure, making it unsuitable for real-time perception and decision-making tasks. Safety systems must continue to function reliably, regardless of network availability.

Edge AI overcomes these limitations by enabling all perception, analysis, and decision logic to run directly on the vehicle. By processing data locally, vehicles can respond instantly to dynamic situations, protect sensitive operational data, and maintain continuous operation under all conditions.

As a result, AI intelligence must be embedded within the vehicle itself—not as an optional enhancement, but as a foundational requirement. This shift sets the stage for high-performance edge AI computing platforms capable of operating reliably in real-world vehicle environments.

A decorative footer graphic at the bottom of the page, consisting of a dark grey triangle on the left and a red triangle on the right, meeting at a white diagonal line.

NVIDIA JETSON ORIN NANO: THE AI ENGINE

1. Real-Time AI Computing at the Edge

Modern vehicle applications require immediate perception and response. NVIDIA Jetson Orin Nano delivers the real-time AI computing performance needed to process complex workloads directly on the vehicle. By enabling sub-100 millisecond responses, it allows vehicles to detect, analyze, and react to dynamic situations without delay.

2. Advanced AI Workloads Beyond Legacy CPUs

Traditional embedded and x86-based CPUs are not designed to handle multi-camera video streams or advanced AI inference tasks. Jetson Orin Nano enables critical AI functions such as object detection, human recognition, tracking, and scene understanding—capabilities that are essential for safety-critical and autonomous-assist vehicle operations.

3. Optimized Architecture for Edge AI

Jetson Orin Nano is purpose-built for AI inference at the edge. Its architecture efficiently processes visual and sensor data while maintaining low latency and energy efficiency. This makes it well-suited for continuous operation in vehicle environments where performance, power, and thermal constraints must be carefully balanced.

4. Accelerated Development with NVIDIA AI Ecosystem

Beyond hardware performance, Jetson Orin Nano is supported by NVIDIA's mature AI software ecosystem. Proven frameworks and optimization tools enable faster AI model deployment and tuning, significantly reducing development complexity and time-to-market for AI-enabled vehicle solutions.

5. Enabling Intelligent Vehicle Platforms

By integrating high-performance edge AI computing with real-time processing and a robust software ecosystem, NVIDIA Jetson Orin Nano serves as the foundation for intelligent vehicle platforms—transforming vehicle-mounted systems from passive terminals into active, decision-making systems.



WINMATE VEHICLE MOUNTED COMPUTERS

To demonstrate how edge AI computing can be deployed in real vehicle environments, Winmate offers a Vehicle Mounted Computer platform powered by NVIDIA Jetson Orin Nano. This platform is designed to support AI perception workloads while meeting vehicle-grade reliability requirements.

Key Specifications

- AI Processor
NVIDIA® Jetson™ Orin Nano
- Display Options
10.4", 12.1", or 14" industrial-grade displays
Optimized for in-vehicle visibility
- Power Input
Wide-range DC input (10–60 VDC)
Designed for vehicle ignition and unstable power conditions
- Camera Support
Up to 6 × GMSL2 cameras
Enables multi-camera AI perception and 360° awareness
- Vehicle Interface
Native CAN Bus support
Seamless integration with vehicle control and safety systems

Designed for AI-Driven Vehicle Applications

This reference VMC platform enables real-time AI workloads such as object detection, human recognition, and dynamic obstacle awareness directly on the vehicle. Combined with Winmate's rugged mechanical design and vehicle-grade system architecture, it provides a deployable foundation for AI-enabled forklifts, mobile cranes, and public safety vehicles.

Rather than serving as a standalone computing device, this platform illustrates how Winmate Vehicle Mounted Computers function as a scalable foundation for intelligent vehicle systems—bridging AI compute capability with real-world vehicle deployment requirements.





SUMMARY

AI-enabled vehicle platforms are transforming traditional vehicle-mounted computers into intelligent, real-time decision systems. While edge AI solutions may require higher initial investment, their ability to operate reliably in harsh vehicle environments improves safety, efficiency, and long-term system durability—resulting in lower Total Cost of Ownership (TCO). Not all AI-capable devices are suitable for vehicle deployment; selecting the right platform requires vehicle-grade design, reliable power management, and sustained performance. By combining NVIDIA Jetson Orin Nano with rugged vehicle-mounted system engineering, Winmate enables the practical and confident adoption of AI-driven vehicle applications.





About Us

With over 30 years of industry experience, Winmate is a global leader in rugged computing and intelligent edge solutions. From rugged tablets and rugged laptops to panel PCs, industrial displays, Edge AI systems, and robotic controllers, our products are built to support demanding environments across industries. We specialize in providing tailored solutions and hardware customizations to meet the unique needs of customers in sectors such as industrial automation, defense, logistics, automotive, and more. Backed by in-house testing laboratories and a strong global distribution network, Winmate ensures reliable performance, long-term support, and proven durability.

For more information about Winmate, please visit our website: www.winmate.com

Contact Us



Winmate Inc.

No. 18, Zhongxing S. St.,
Sanchong Dist.,
New Taipei City 241017, Taiwan
Tel +886-2-8511-0288
E-mail sales@winmate.com.tw
Website www.winmate.com



Winmate Germany

TL Electronic
Bgm.-Gradl-Straße 1
85232 Bergkirchen-Feldgeding
Tel +49 8131 33204-0
E-mail info@tl-electronic.de
Website www.tl-electronic.de



Winmate USA Inc.

2640 Mathews Street,
Smyrna, GA 30080, USA
Tel +1 678-653-8800
E-mail NASales@winmate.com.tw
Website www.winmate-rugged.com



北京京融电自动化科技有限公司 苏州办事处

215100 江苏省苏州市工业园区唯新路69号
一能科技园3号楼206室
Tel +86-512-6826-6696/6829-6696
E-mail sales@winmate.com.cn
Website www.winmate.com.cn



TTX Canada Inc.

150 Werlich Drive, Units 5&6
Cambridge, Ontario, N1T 1N6 Canada
Tel +1-519-621-1881
E-mail Sales@ttx.ca
Website www.ttx.ca



Winmate Japan

HPC Systems Inc.
LOOP-X 8F,3-9-15 Kaigan,
Minato-ku, Tokyo 108-0022, Japan
Tel +81-3-5446-5535
FAX +81-3-5446-5550
Website www.hpc.co.jp



Winmate Switzerland Primelco Visual Data AG

Neuhofstrasse 25
6340 Baar
Tel +41 41 767 01 70
E-mail product@primelco.ch
Website visualdata.primelco.ch

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