WOLF Advanced Technology

AI AT THE TACTICAL EDGE: RUGGED GPU + FPGA SOLUTIONS FOR NEXT-GEN UNMANNED SYSTEMS

– WHITEPAPER

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WOLF ADVANCED TECHNOLOGY

INTRODUCTION

As unmanned vehicles redefine operations across military, aerospace, maritime, and industrial sectors, the demand for embedded, high-performance computing has surged. These platforms require low-latency, power-efficient solutions capable of handling AI inferencing, sensor fusion, and real-time decision-making in rugged, size-constrained environments. Wolf Advanced Technology provides embedded solutions in VPX, VNX, XMC, MXC and other custom small form factors.

NVIDIA GPUs—powered by Jetson (including AGX Orin/Thor), Ada, and the latest Blackwell architectures—offer transformative capabilities for unmanned systems. WOLF leverages these GPUs across VPX, VNX, XMC, and custom rugged small form factor (SFF) platforms, enabling tactical AI where it's needed most: at the edge.

Augmenting GPU processing, WOLF's proprietary FGX FPGA technology enhances system flexibility by capturing, converting, encoding, and displaying video and signals in real time. This makes it possible to interface with a wide range of sensor types and formats, ensuring compatibility and optimal performance across diverse mission profiles.

To meet the stringent safety and regulatory requirements of aerospace and defense applications, WOLF designs products with support for DO-254 and DO-178C safety certification processes. This ensures hardware and software are developed with rigorous verification, traceability, and documentation standards. By aligning with these critical design assurance levels (DALs), WOLF's solutions are not only high-performance but also safety-certifiable for deployment in mission and safety-critical environments such as avionics and autonomous flight systems.

AI AT THE TACTICAL EDGE: NVIDIA GPU SOLUTIONS & TSN

WOLF's solutions are designed for next-generation **Time-Sensitive Networking (TSN)**, which delivers deterministic, low-latency, and highly reliable Ethernet communication. TSN's precise synchronization and guaranteed delivery enable real-time coordination across autonomous systems, from UAV swarms to multi-vessel maritime patrols.

In comparison to traditional Ethernet, TSN offers sub-100µs latency, minimal jitter, high reliability with packet redundancy, and synchronization accuracy within ±100ns. This capability is crucial for applications like real-time sensor fusion, swarm coordination, and precision autonomous navigation.

TSN vs Traditional Ethernet

FEATURE	TRADITIONAL ETHERNET	TSN
Latency	Variable, 1–10 ms	Deterministic, <100 µs
Jitter	High, several ms	Minimal, <1 µs
Reliability	Moderate, congestion loss	High, with frame replication
Time Sync	Not supported	±100 ns accuracy

ACCELERATED AI PERFORMANCE

WOLF's rugged computing platforms are engineered to deliver exceptional AI performance in mission-critical environments, where every millisecond counts. Leveraging NVIDIA's Tensor Core architecture, these systems handle demanding workloads such as object detection, SLAM (Simultaneous Localization and Mapping), and predictive maintenance with ultra-low latency. This speed ensures that autonomous systems can process complex sensor data, make decisions, and act all in real time.

Key performance highlights include:

- **NVIDIA Tensor Core GPUs** – Enable sub-10ms inference latency, critical for real-time object recognition, navigation, and situational awareness.
- **Jetson AGX Orin** – Delivers approximately 274 images/second/watt for ResNet-50 image classification and around 6.7 images/second/watt for RetinaNet object detection.
- **Jetson Xavier NX** – Achieves approximately 112 images/second/watt for ResNet-50 and about 3.1 images/second/watt for RetinaNet.

INTEGRATED FGX FPGA TECHNOLOGY

The WOLF FGX FPGA provides real-time video capture, format conversion, compression, and display, bridging legacy and modern sensor types while reducing processing latency. This enables advanced AI pipelines for diverse mission profiles, whether airborne, maritime, or land based.

TARGET APPLICATIONS

WOLF's rugged platforms support a wide range of missions:

- **ISR UAVs** – Real-time target recognition via EO/IR sensors.
- **UGVs** – Multi-sensor fusion and autonomous navigation.
- **UUVs & MASS** – Obstacle detection and precision navigation in subsea or surface environments.
- **Tactical Robots** – Person tracking and terrain analysis.
- **Loitering Munitions** – Onboard threat classification.

MISSION IN ACTION

WOLF's technologies are deployed across a wide spectrum of unmanned platforms, each with unique operational challenges. By combining advanced AI processing, sensor fusion, and TSN-enabled communication, these systems achieve rapid, autonomous decision-making in complex and unpredictable environments. The following examples illustrate how WOLF's solutions perform in real-world scenarios across air, land, sea, and subsea domains:

UAV Example: High-altitude surveillance drones process EO imagery in real time, classifying and tracking targets within one second. TSN ensures synchronized communication between AI, flight controls, and secure downlinks.

UGV Example: Ground vehicles fuse LIDAR and EO/IR data for threat detection and adaptive navigation, reacting to hazards in under a second without operator intervention.

USV Example: Patrol vessels integrate radar and sonar data to navigate dense harbors autonomously, avoiding collisions in real time.

UUV Example: Subsea vehicles classify underwater objects and reroute autonomously without surfacing, preserving mission logs for later retrieval.

Hybrid Fleet Example: Coordinated UAV, UGV, USV, and UUV fleets share intelligence via TSN, enabling multi-domain autonomous operations.

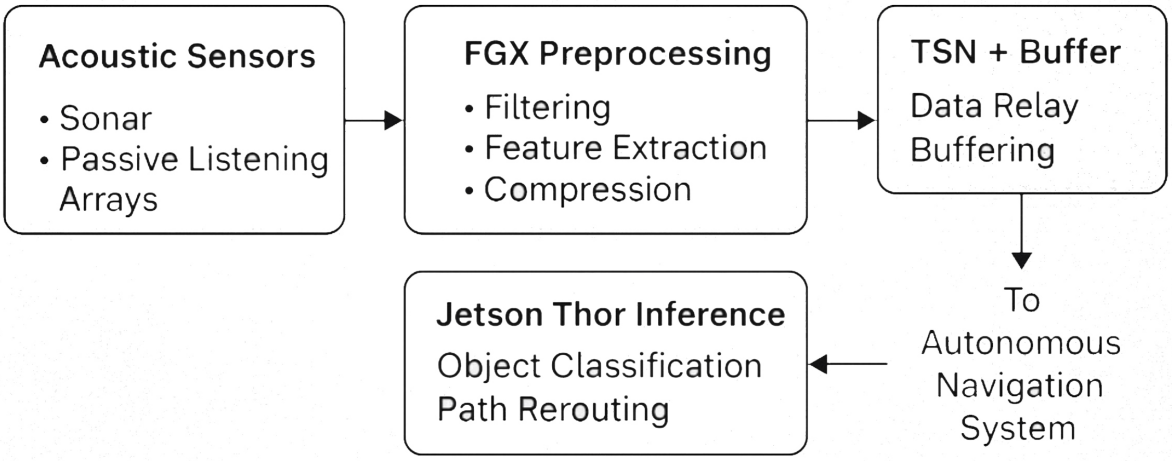
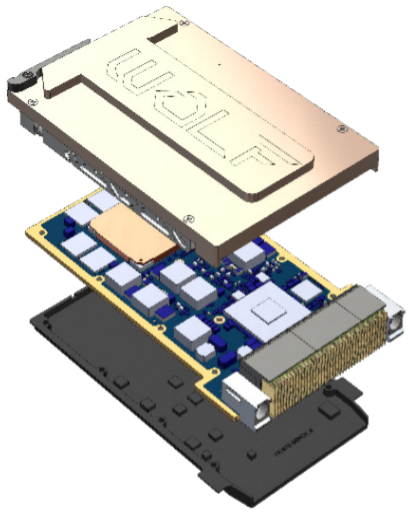


Image 1. Data processing workflow for an unmanned underwater vehicle, showing how sonar and passive listening arrays feed into FGX preprocessing for filtering, feature extraction, and compression, before being transmitted via Time-Sensitive Networking (TSN) to the autonomous navigation system.

RUGGEDIZED FORM FACTORS

To meet the diverse size, weight, and power requirements of unmanned systems, WOLF provides a range of ruggedized form factors tailored to specific mission needs. These designs balance high-performance AI processing with the durability and environmental resilience required for air, land, sea, and subsea deployments. Key integration options include:

VPX 3U	
Dimensions	160Lx100Wx25.4H mm (6.3×3.9×1.0″)
Weight	Approx. 1.3 to 1.5 kg (2.9 to 3.6 lbs)
Operating Temp	-40° to +85°C (Conduction Cooled) -40° to +71°C (Air Cooled)
Module Power	60W to 160W
Video Signal Support	12G/6G/3G-SDI, CoaXPress, ARINC 818-2/3, STANAG-3350 A/B/C, CVBS, RS170, RS343, LVDS, DVI, DisplayPort, Camera/Channel Link, and custom formats
VPX/Open VPX/ VPX REDI Slot Profiles	ANSI/VITA 48 ANSI/VITA 65 (VPX-REDI, OpenVPX) OpenVPX 14.2.7, 14.4.4
SOSA Aligned Slot Profiles	14.6.11-0 Payload Slot Profile 14.6.13-0 Payload Slot Profile, P2B depopulated 14.2.3 Legacy Payload Slot Profile 14.2.16 SBC slot profile 14.4.15 Switch profile



VPX 6U	
Dimensions	160Lx233Wx25.4H mm (6.3×9.2×1.0″)
Weight	3 to 4 kg (6.6 to 8.8 lbs)
Operating Temp	-40° to +85°C (Conduction Cooled) -40° to +71°C (Air Cooled)
Module Power	160W to 300W
Video Signal Support	12G/6G/3G-SDI, CoaXPress, ARINC 818-2/3, STANAG-3350 A/B/C, CVBS, RS170, RS343, LVDS, DVI, DisplayPort, Camera/Channel Link, and custom formats
VPX/Open VPX/ VPX REDI Slot Profiles	ANSI/VITA 48.X ANSI/VITA 65 (VPX-REDI, OpenVPX)
SOSA Aligned Slot Profiles	10.6.3 Payload slot profile 10.6.4 Payload Slot Profile

XMC	
Dimensions	Standard Dimensions: 74Lx149W mm (2.91×5.87″) Shortened Depth Options: 124Lx139W mm (4.88×5.47″)
Weight	Approx. 0.13 to 0.284 kg (0.29 to 0.62 lbs)
Operating Temp	-40° to +85°C (Conduction Cooled) -40° to +71°C (Air Cooled)
Module Power	7.5W (FGX only) to 60W (GPU + FGX + PCIe switch)
Video Signal Support	12G/6G/3G-SDI, CoaXPress, ARINC 818-2/3, STANAG-3350 A/B/C, CVBS, RS170, RS343, LVDS, DVI, DisplayPort, Camera/Channel Link, and custom formats
Slot Profiles	VITA 42: XMC (Switched Mezzanine Card) VITA 61: XMC 2.0
SOSA Aligned Slot Profiles	SOSA Aligned Mapping: Ensures compatibility with Sensor Open Systems Architecture standards

VNX	
Dimensions	78Lx89Wx19H mm (3.5×3.1×0.7″)
Weight	Approximately 0.227 kg (0.5 lbs) for a 19 mm module
Operating Temp	-40° to +85°C (Conduction Cooled) -40° to +71°C (Air Cooled)
Module Power	12W to 35W
Video Signal Support	VITA 90 Standards VITA 90.0: VNX+ Base Standard VITA 90.1: VNX+ Slot Profiles and Naming Conventions VITA 90.2: VNX+ Coaxial/Optical Connectivity and Aperture Blocks VITA 90.3: VNX+ Power Conversion, Energy Storage, and Power Filter Modules VITA 90.4: VNX+ Alternate Mounting, Cooling, Keying, and Retention Mechanisms VITA 90.5: VNX+ Space Use Considerations VITA 90.7: VNX+ Optical and NanoRF Coax Apertures Standard
Connectors	400-Pin

ENVIRONMENTAL & MISSION READINESS

All solutions are designed for extreme conditions, like high altitude, humidity, desert, and arctic environments. They can be certified to MIL-STD-810g. With DO-254 DAL-C safety certification, advanced cooling options, and ruggedized enclosures. They can also deliver reliable performance in shock, vibration, and EMI-heavy scenarios.

- MIL-STD-810g tested; extreme temp, shock, vibration ready
- DO-254 DAL-C safety certification
- Advanced cooling: conduction, air, liquid flow-through
- Rugged enclosures with conformal coating & EMI protection

CONCLUSION

Unmanned systems are rapidly advancing from remote-controlled platforms to fully autonomous assets capable of operating in complex, contested, and communication-limited environments. This transformation demands onboard computing solutions that combine high-speed AI processing, real-time sensor fusion, and absolute reliability. By integrating NVIDIA GPUs with WOLF's proprietary FGX FPGA technology, these systems can process, analyze, and act on mission-critical data in milliseconds—directly at the tactical edge.

Rugged, SWaP-optimized designs ensure that this performance is maintained across every domain, from high-altitude UAVs to subsea exploration vehicles, even in extreme temperatures, vibration, and electromagnetic conditions. With safety-certifiable architectures and domain-specific adaptability, WOLF's platforms give unmanned systems the intelligence, speed, and resilience needed to detect threats, adapt to evolving missions, and execute with precision—delivering a decisive advantage in the next generation of autonomous operations.

For more information, contact:

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