

EDGE COMPUTE WHITE PAPER 20 November 2022

Edge Compute for the Data-Centric AI-Enabled Battlefield

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EDGE COMPUTE EXECUTIVE SUMMARY

Executive Summary

Leveraging artificial intelligence (AI) and machine learning (ML), enabled by advanced computing systems, is the key to reduce the cognitive burden on the warfighter. AI teammates, in the form of data-crunching engines and autonomous vehicles, are a risk-reduction and force-protection multiplier, helping our Soldiers win the fight.

Operating in a contested environment with restricted bandwidth and degraded communications makes the tactical use of cloud-based computing and AI a liability. Compute must happen on-premise at the edge. This edge AI capability must reside on edge computing hardware.

System's most recent rugged AI edge computing hardware solution is **Kite-Strike™ II**, a next-generation, fully rugged small form factor (SFF) embedded compute solution, providing a massive leap forward in edge AI processing technologies and capabilities. Kite-Strike II is purpose-built for demanding computer vision and sensor fusion data processing workloads for edge AI and autonomous mission-critical applications, helping shift the workload from soldier to machine.



Figure 1: System's Kite-Strike II rugged mission computer

EDGE COMPUTE BACKGROUND

Background

There is widespread proliferation of high-definition (HD) sensors in the modern battlespace, creating enormous amounts of "Big Data." Data is collected at numerous ingest points and streamed to processing nodes, providing the foundation for rapid decision making.

The United States (US) Department of Defense (DoD) has developed a concept of operations called **Joint All-Domain Command and Control (JADC2)**¹ with the intent to create a unified network connecting sensors from all service branches across all domains, also referred to as multi-domain operations (MDO) or all-domain operations (ADO). In a JADC2 environment, **actionable data** is paramount; the data-rich foundation of the modern battlespace must be

¹ Source: <https://www.defense.gov/News/Releases/Release/Article/2970094/dod-announces-release-of-jadc2-implementation-plan/>

ingested, and executed at the nodal edge to feed into the JADC2 ecosystem.

The JADC2 ecosystem is founded on continuously ingesting, processing, analyzing, and disseminating oceans of information to facilitate ultra-rapid decision making (measured in milliseconds) from any sensor to any shooter. At the Association of the United States Army's 2021 annual meeting and exposition, Army Secretary Christine Wormuth said, "Make no mistake – data and software will be as important as ammunition on the future battlefield."²

To realize the vision of JADC2, The US DoD has adopted a strategy to move from a network-centric to a data-centric organization, mandating that "it is the responsibility of all DoD leaders to treat data as a weapon system and manage, secure, and use data for operational effect."³

Successfully harnessing and exploiting all of this data requires artificial intelligence (AI) and machine learning (ML) to augment human capacities. The data can't be sent to the cloud because of latency, bandwidth, and security considerations; it must be processed and exploited at the point of ingest or in very close proximity, i.e. at the edge, typically in a deployed vehicle or platform.

Computational processing capability must reside "on-prem" to ensure the low latency and near real-time speed demanded of AI-based applications. Robust tactical level in-vehicle networks (IVN), where the majority of AI edge processing is conducted, are vital to the success of the overarching network. This edge-AI capability must reside on edge-computing hardware, hardened to survive austere

environments and size, weight, and power (SWaP) optimized for integration into vehicles with stringent space and power constraints.

System's solution to the problem of conducting tactical AI edge processing for data-centric operations is Kite-Strike II, a next-gen rugged edge AI mission computer.

EDGE COMPUTE PRODUCT BRIEF

Product Brief

Kite-Strike II is a next-gen fully rugged SFF embedded compute solution, providing a massive leap forward in edge-deployed processing technologies and capabilities. Kite-Strike II is purpose-built for demanding computer vision and sensor fusion data processing workloads for edge AI and autonomous mission-critical applications.

Integrating the **NVIDIA Jetson AGX Orin** system-on-module (SOM), the world's most powerful embedded AI computing engine, Kite-Strike II delivers the maximum performance per watt on the market today. Introduced at the 2022 Association of the United States Army (AUSA) Annual Meeting and Exposition, Kite-Strike II is the **world's first MIL-SPEC rugged Jetson AGX Orin** compute solution.

The Jetson AGX Orin SOM features 275 TeraOPS (TOPS) of peak compute with an Ampere-based GPU up to 2048 CUDA cores and 64 Tensor cores and an ARM-based CPU up to 12 cores.

Kite-Strike II is engineered using a **Modular Open Standards Approach (MOSA)**, utilizing open architectures, common and widely accepted standards and interfaces, and commercial off-the-shelf (COTS) technologies and components.

Kite-Strike II provides robust IO and immense system expansion for all-domain mission and

² Source: https://www.army.mil/article/251180/ausa_2021_secretary_of_the_armys_keynote_speech_11_october_2021

³ Source: <https://media.defense.gov/2020/Oct/08/2002514180/-1/-1/0/DOD-DATA-STRATEGY.PDF>

Kite-Strike II is the world's first MIL-SPEC rugged NVIDIA Jetson AGX Orin mission computer.

SFF SWaP-optimized



Robust IO and highly expandable

**275
TOPS**

Performance

**-46 to
+75C**

Operating Temp Range

platform use. Base system IO includes multiple GbE, CAN, USB 3.0, and serial, as well as a single HDMI/DVI video output. Native high-speed PCIe-based system expansion capabilities including dual 10GbE copper; SDI, Camera Link, GigE Vision, and/or analog video capture and video output; HEVC video encode; LTE; GPS; ARINC 429 and MIL-STD-1553. Kite-Strike II offers fixed m.2 and removable u.2 NVME storage options.

Kite-Strike II offers **time-sensitive networking (TSN) compliant** ethernet networking capabilities, supporting deterministic networking applications and requirements.

Kite-Strike II is designed as a single line replaceable unit (LRU) with a hyperconvergence design approach, combining compute, storage, and networking in a single system. Kite-Strike II is fully configurable and modular with an expansion slice design that allows for rapid engineering cycles and faster time to deployment, minimizing program and schedule risk.

Kite-Strike II is MIL-SPEC rugged with an extended operating temperature range up to -46C to +75C and designed to meet severe temperature, shock, vibration, sand and dust, rain and fluids, humidity, altitude, vehicle and aircraft power, and EMI/EMC environmental standards as outlined in MIL-STD-810H, MIL-STD-1275E, MIL-STD-704F, and MIL-STD-461G.

Kite-Strike II measures 7.87"W x 8.47"D x 4.23"H delivering workstation AI performance and robust capabilities in a small form factor for installation into highly constrained space claims.

Recognition

In October 2022, Kite-Strike II was awarded **"Four-Star Best in Show"** in the Embedded Computing category at the 2022 AUSA Annual Meeting and Exposition. The award was presented by Military Embedded Systems magazine and was the highest-level award.

// Kite-Strike II is purpose-built for demanding computer vision and sensor fusion data processing workloads.

Feature Benefit

High Performance Computing

Best available performance per watt. GPU workstation-class performance with an unparalleled 275 TOPS of peak compute in an ultra-compact form factor. Ampere architecture GPU and ARM-based CPU. Robust integrated features such as tensor cores, DLA engines, 7-way VLIW vision processor, and HEVC encode/decode for AI edge computing vision applications.

Dense IO

Provides multiple interfaces including CAN, USB, GbE, serial. Provides user with the ability to manage network distribution without adding an additional rugged Ethernet switch to include high bandwidth streaming video such as GigE Vision and IP Full Motion Video (FMV). Provides 10GbE TSN networking. Provides mission data storage in the form of 64GB onboard storage and internal m.2 NVME SSD(s).

Low Latency

Ultra-low latency data processing and distribution to include FMV ensuring accuracy and rapid response capability to the warfighter. Unified memory architecture for fast zero copy video processing.

Modular System Expansion

Provides immense native expansion capabilities and modular expansion slice option for system expansion including video capture and encode, LTE, GPS, 10GbE, GbE NIC/switch, additional USB/Serial/CAN, removable SSD, power output. Robust video ingest expansion capabilities including video capture and encode of multiple formats such as SDI, CoaXPress, Camera Link, GigE Vision, RS-170/Analog. Single channel HD DVI or HDMI video output. Expansion option for removable 2.5" u.2 NVME SSD.

Secure

Software full-disk encryption (FDE) and verified boot. AES 256 and FIPS 140-2 removable 2.5" SSD expansion options.

SWaP-Optimized

An ideal embedded system for military and combat vehicle applications that benefit from the Jetson AGX Orin's incredible performance, low power consumption and small form factor in a rugged enclosure.

MIL-SPEC Rugged

Built on a MIL-STD 810H, 1275E/704F, 461G, IP66, wide-range temperature foundation. Its high mission readiness and efficient and reliable operation is not limited by vehicle type or weather and extreme environmental effects, providing an unlimited regional deployment capability.

Standards-Based

Engineered with a standards-based approach utilizing open architectures and COTS technologies. Aligned to OSA/MOSA and GCIA mandates. Non-proprietary, COTS approach allows for program risk-reduction and more affordable and configurable system.

Table 1: Kite-Strike II Features and Benefits

Vehicle 360 Degree Situational Awareness (360SA) Example Use Case



Kite-Strike II is the ideal compute solution for ground combat vehicle 360 degree situation awareness (360SA) target recognition applications as a sensor integration module (SIM) for sensor processing and target interrogation.

Kite-Strike II can be configured to ingest and fuse multiple sensor feeds, host AI and sensor processing algorithms, running on the NVIDIA Jetson AGX Orin SOM, and exploit incoming data and stream over various network and communication channels via GbE and 10GbE TSN-compliant ethernet interfaces.

Kite-Strike meets ground vehicle MIL-STD-810H/1275E/461G rugged environmental specifications including operating and storage temperature, shock and vibration, sand/dust and rain/fluids ingress protection, humidity, altitude, 28VDC power, and EMI/EMC.

Kite-Strike II is engineered using a MOSA and meets PEO GCS' Common Infrastructure Architecture (GCIA). Systel fully adopts a GCIA design approach that includes provisions for adaptability, expandability, upgradability, interoperability, and evolution of technologies. Systel's solution architecture adaptability fosters innovation of subsystem and component design allowing host platforms to more rapidly integrate new technologies.

Kite-Strike II supports and helps enable mission-critical applications at the tactical edge. Purpose-built for deployment in austere environments for demanding AI and ML data-centric mission-critical applications, Kite-Strike II is an ideal edge AI compute solution.



NVIDIA Ampere Architecture: 2048 CUDA Cores and 64 Tensor Cores. 12-Core ARM CPU. 275TOPS.



Highly configurable and modular. Open standards-based architecture. MOSA. GCIA.



MIL-STD-810H, MIL-STD-461G, MIL-STD-1275E, MIL-STD-704F, DO-160G.

The future fight will be won on a data-centric, AI-enabled battlefield, conducted on an edge processing tactical backbone.

System's Kite-Strike II is a next-generation embedded edge AI mission computer, offering powerful performance in an embedded SWaP-optimized form factor. Kite-Strike II provides JADC2-enabling capabilities, featuring high-resolution sensor systems integration and processing capabilities in a MIL-SPEC rugged system. Kite-Strike II is purpose-built for deployment in austere environments for demanding AI and ML data-centric workloads.





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