2026 NDIA MICHIGAN CHAPTER
GROUND VEHICLE SYSTEMS ENGINEERING
AND TECHNOLOGY SYMPOSIUM
APPLIED ARTIFICIAL INTELLIGENCE (AAI)
AUGUST 11-13, 2026 - NOVI, MICHIGAN

SHRIKE NANO: ON-BODY AI-ENABLED DIGITAL FIRES FROM UNMANNED AIRCRAFT FEEDS

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ABSTRACT

Shrike Nano provides forward observers and small unmanned aerial system (sUAS) operators with an integrated solution to enhance target prosecution using sUAS video feeds and indirect fire systems. Operable within the Android Tactical Assault Kit (ATAK) ecosystem, Shrike Nano functions as a software plugin that interacts seamlessly with existing tools, including UAS Tool, Robot Picker, and Network Monitor. By utilizing either aided threat recognition (AiTR) or manual targeting workflows, along with passive single-camera geolocation, operators can nominate targets and correct shot placement via digital messaging to enterprise fires terminals such as the Advanced Field Artillery Tactical Data System (AFATDS). The system offers key advantages, including operator standoff capabilities, accurate geolocation, and streamlined fires messaging workflows, all while leveraging low-observable platforms. Shrike Nano seeks to bridge gaps in traditional targeting processes by providing a cohesive and efficient sensor-to-shooter workflow that reduces cognitive load and enables faster, more reliable fire missions at the tactical edge.

Citation: A. Baharanyi, G. Tozzi, “Shrike Nano: On-Body AI-Enabled Digital Fires from Unmanned Aircraft Feeds,” In *Proceedings of the Ground Vehicle Systems Engineering and Technology Symposium* (GVSETS), NDIA, Novi, MI, Aug. 11-13, 2026.

1. INTRODUCTION

Modern maneuver forces require faster and more reliable sensor-to-shooter workflows to support distributed targeting operations [1]. Traditional forward observer processes often rely on manual target identification, voice communications, and multiple systems that are not fully integrated, which can increase cognitive load and delay fire mission execution. As small unmanned aerial systems (sUAS) become increasingly available at the tactical edge, there is a growing need to integrate aerial sensing capabilities directly into digital fires networks to accelerate target acquisition and engagement timelines.

Shrike Nano was developed to address this gap by enabling forward observers to rapidly detect, geolocate, and engage targets using sUAS video feeds integrated within the Tactical Assault Kit (TAK) ecosystem [2]. The system leverages artificial intelligence–assisted target recognition, passive geolocation algorithms, and integration with digital fires systems such as the Advanced Field Artillery Tactical Data System (AFATDS). Together, these capabilities support the "Find, Fix, and Finish" elements of the targeting cycle by enabling operators to transition quickly from aerial reconnaissance to fire mission generation [3].

To evaluate the operational feasibility of this approach, Shrike Nano was integrated and tested with elements of the 3rd Brigade Combat Team, 101st Airborne Division (Air Assault) during training events at Fort Campbell, Kentucky, including brigade-level Combined Arms Live Fire Exercises (CALFEX).

These events demonstrated the potential for AI-enabled targeting systems to support digital fires workflows in maneuver environments while also revealing integration challenges related to network reliability, UAS metadata consistency, and system interoperability across the fires architecture. The results provide insight into the technical and operational considerations required to scale AI-assisted targeting systems within brigade formations.

2. CONCEPT AND COMPONENTS

2.1. SYSTEM OVERVIEW

Shrike Nano is a portable targeting system designed to enhance forward observer capabilities by integrating sUAS sensing, AI-assisted target recognition, and digital fires networks. Shrike Nano is designed as a rapidly deployable targeting aid for forward observers and drone operators, enabling single-operator employment of sUAS-enabled digital fires workflows.

The system operates within the TAK ecosystem and leverages existing tactical hardware commonly available within forward observer kits.

At a high level, Shrike Nano consists of four major components:

1. sUAS sensing platform
2. Edge compute processing for target detection and geolocation
3. TAK-based operator interface
4. Digital fires network integration

The system ingests real-time video and telemetry from small, unmanned aircraft such as the Skydio X10D and PDW C100 through the ATAK UAS Tool [4]. Video frames and metadata streams are processed by the Shrike Nano ATAK plugin, where AI-assisted threat recognition algorithms identify potential targets within the video feed.

Once a target is detected, the system applies a passive geolocation algorithm to estimate the target's position using video metadata. The resulting target coordinates are published to the ATAK Common Operating Picture (COP), allowing friendly forces to visualize the detected targets in real time.

Forward observers can then designate targets directly from the interface, generating a digital call-for-fire message that can be transmitted to AFATDS through the tactical network. This architecture enables Shrike Nano to function as a closed-loop targeting system capable of supporting rapid engagement timelines.

2.2. FIRES INTEGRATION

The critical objective of the 3/101 integration effort was to validate Shrike Nano's ability to operate within the existing digital fires architecture used by brigade combat teams. During training and live-fire events, the system was integrated with several components of the fires network, including ATAK, UAS Tool, tactical radios, and AFATDS.

Shrike Nano generates target coordinates from sUAS reconnaissance and packages this information into digital Call for Fire (CFF) messages. These messages are transmitted through the fires network and passed to AFATDS using Variable Message Format (VMF) messages. During training events conducted at Fort Campbell, the system successfully demonstrated end-to-end message transmission from the operator's EUD to AFATDS via TSM and MUOS [5].

This digital workflow allows the forward observer to move directly from aerial reconnaissance to fires request generation without manual coordinate entry. By reducing the number of intermediate steps required to produce a fire mission, Shrike Nano shortens the time required to transition from target detection to fire for effect.

As expected, field testing also revealed that the success of digital fires integration is heavily dependent on the reliability of the supporting network architecture. During CALFEX events, degraded communications, terrain masking, and radio range limitations occasionally prevented consistent end-to-end message delivery.

These findings reinforce the importance of treating Shrike Nano integration as a systems engineering problem rather than a standalone application. Successful employment requires synchronization across the entire fires stack, including UAS platforms, software versions, radios, and AFATDS configurations.

2.3. UAS TOOL INTEGRATION

Shrike depends strongly on UAS Tool, an Android Tactical Assault Kit (ATAK) plugin providing ground control of multiple aircraft platforms. UAS Tool performs initial processing of Real-Time Streaming Protocol (RTSP) data produced by the aircraft including demultiplexing streamed images into image-metadata pairs using native ATAK functionality. The benefit to Shrike of integration with UAS Tool is that the latter handles integration with new airframes and provides a platform-agnostic feed that Shrike can ingest.

Shrike picks up image and metadata pairs from a last-in, first-out (LIFO) queue, ensuring that the most recent image is processed irrespective of the system's processing time.

Shrike runs on an ATAK EUD fitted with a ground control station case that provides physical buttons and joysticks to allow aircraft operation while leaving the screen unobstructed. Operators typically fly the aircraft via the UAS Tool plugin until it arrives at the area of interest. Once on site, operators shift to Shrike plugin to identify and nominate targets. The UAS Tool plugin continues to operate in the background, and the operator retains control of the aircraft via the case's physical control while using the Shrike plugin.

2.4. AIDED THREAT RECOGNITION

Shrike offers aided threat recognition (AiTR) to assist operators in identifying potential targets using sUAS video feeds, with the intent of reducing cognitive load and improving reaction time [6]. Work with operators under field conditions suggests that while operators are comfortable not relying solely on AiTR for target nomination, they appreciate the queuing that even low-confidence detections provide while surveilling the target area.

Inferencing occurs on the operator's end-user device (EUD) using either the onboard graphics processing unit (GPU) or neural processing unit (NPU). Inference time is typically one of the largest contributors to the overall system cycle time, that is the amount of time that it takes for the system to pick up a queued image-metadata pair and conduct processing required to make the pixels in that image targetable and to update tracked targets. A natural trade-off, therefore, is that of model fidelity versus cycle time. Higher fidelity models may produce a higher proportion of true-positive detections than do lower-fidelity models. But insofar as lower fidelity models inference more quickly and, therefore, reduce cycle time, these models are offered more opportunities to detect a target simply because they can be exposed to more frames over a given period.

The processor on which inferencing is conducted contributes significantly to the inference time. The mobile processors installed in ATAK EUDs are benefitting from the industry's overall drive toward more powerful and efficient on-device AI inference [7]. The recent trend to improving memory throughput and supporting a wider range of data types opens opportunities for optimization, but the long lives of fielded mobile systems relative to their commercial counterparts create strong heterogeneity that engineering teams must account for. Additionally, quantization required to take advantage of data types like four-bit integers may require pipelines and data sets not reasonably available for training in the field in response to adversary adaptation.

Several fielded sUAS platforms conduct onboard AiTR inference. Deploying models to aircraft requires OEM coordination and may provide heterogenous performance due to vendor choices regarding supported architectures. Conducting inference on the EUD from UAS video streams provides a more uniform experience for operators and simplifies development and maintenance of model deployment pipelines at the cost of inference impacts to the cycle time.

2.5. TARGET TRACKING

Shrike reports targets detected via AiTR automatically as Cursor on Target (CoT) messages [8]. This functionality allows reporting of tracks of interest with minimal operator intervention but risks saturating the common operating picture (COP) with spurious tracks as detections occur during each frame refresh.

An important task, then is to perform track association between frames. This is an instance of the well-known data association problem wherein we seek to associate new detections at time t with tracks held by the system at time $t-1$ [9]. The tracking algorithm is another major drive of cycle time with computationally expensive steps like camera compensation and with components that scale quadratically with the number of detections. Tracking algorithm performance is strongly affected by the sUAS' positioning relative to the area under surveillance, so Shrike provides operators with multiple algorithms from which to select.

2.6. GEOLOCATION

Shrike performs passive single-camera geolocation using the camera installed aboard the sUAS with updated positions provided with each frame refresh [10]. The system was designed specifically to support targeting for area-effect weapons with commodity sensors installed aboard small platforms. As such, a degree of initial accuracy is purposefully sacrificed in favor of algorithmic efficiency. Consistent with this approach, Shrike Nano's geolocation performance is benchmarked against observers' visual estimates rather than against more accurate active emitting geolocation equipment. Conversely, the accuracy of subsequent adjustments is prioritized and takes advantage of doctrinally consistent relative corrections.

Shrike receives aircraft position and attitude data as encoded by the sUAS' manufacturer. Implementation of standards by OEMs is occasionally uneven requiring careful attention to the source and processing of reported fields.

3. EMPLOYMENT

3.1. SYSTEM PERFORMANCE AND FIELD OBSERVATIONS

Operational evaluations conducted during training events and CALFEX provided insight into the performance characteristics of the Shrike Nano system in realistic environments. During reconnaissance flights using the PDW C100 platform, the system demonstrated measurable geolocation accuracy at varying distances from the target.

Observed target location error (TLE) during initial testing included approximately 6 meters at a range of 108 meters, 8 meters at a range of 337 meters, and 24 meters at a range of 650 meters. These results validate the baseline capability of the passive geolocation algorithm, while also highlighting the need for improved sensor metadata standardization and calibration across different aircraft platforms.

Live-fire exercises further demonstrated the feasibility of executing digital calls for fire directly from sUAS-derived target data. During CALFEX operations, Shrike Nano successfully generated target coordinates and transmitted digital fire missions through AFATDS, confirming that sensor-to-shooter integration can be achieved within a maneuvering environment.

At the same time, operational testing revealed several factors that affect system performance in field conditions. These included UAS range limitations, RF interference, variability in aircraft firmware configurations, and instability in some TAK software components. These issues did not prevent mission execution but occasionally required operators to revert to voice communications or adjust procedures during training events.

Despite these challenges, operator feedback from maneuver and fires personnel indicated strong confidence in the system's potential operational value. Soldiers reported that the ability to generate target grids directly from aerial reconnaissance significantly reduced the cognitive workload associated with manual target development.

3.2. LESSONS LEARNED

Several key lessons emerged from the integration and evaluation of Shrike Nano with the 3/101.

First, the integration of AI-enabled targeting systems must be approached as a systems engineering problem rather than a software deployment problem. The system relies on multiple interconnected components, including UAS platforms, TAK software modules, tactical radios, and fires systems. Failures or inconsistencies in any part of this architecture can interrupt the targeting workflow.

Second, metadata consistency across UAS platforms is critical for accurate geolocation. Variations in KLV (key-length-value) metadata formatting and sensor calibration between different aircraft platforms introduced inconsistencies in target location estimates. Standardizing metadata output across platforms is necessary to ensure repeatable performance [11].

Third, training methodology significantly affects operator proficiency. Observations during Fort Campbell training events indicated that soldiers achieved a much stronger understanding of the system when classroom instruction was immediately followed by hands-on flight operations. This approach accelerated the development of operator confidence and reduced setup friction during subsequent missions.

Finally, network architecture remains a key constraint in maneuvering environments. Reliable digital fires integration requires consistent network pathways capable of transporting VMF messages across tactical radios and command systems. Terrain masking and range limitations can degrade these communications, requiring careful planning of relay placement and network configuration.

4. CONCLUSIONS

We explored the performance and operational integration of Shrike Nano, an ATAK plugin designed to enhance real-time situational awareness and support targeting for indirect fires. Recent field experience demonstrates that Shrike Nano meets operational requirements for target detection, geolocation, and tracking within the constraints of existing indirect fires networks. By incorporating AI-enabled digital fires, leveraging unmanned aircraft systems (UAS) feeds, and utilizing interoperable standards such as the ATAK ecosystem, the system demonstrates an effective capability for augmenting decision-making in time-sensitive scenarios.

We also highlighted considerations necessary for setting conditions for successful Shrike Nano employment including network planning. While not inherently a Shrike Nano problem, difficulties associated with robust IP transport affect a number of systems, Shrike Nano included.

Shrike Nano provides a case study in the development of AI-enabled technologies to the problem of making existing tactics, techniques and procedures faster, more responsive, and more lethal while prioritizing warfighter survivability.

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7. ACKNOWLEDGMENT

This work was funded by the US Army DEVCOM AI2C under contract 47QFCA22D0357. The authors recognize the support of the entire AI2C/Booz Allen Shrike Nano development team without whom this work would not have been possible and Soldiers of the 101st Airborne Division (Air Assault) who provided valuable feedback throughout the testing process.

8. ACRONYMS

AFATDS	Advanced Field Artillery Tactical Data System
ATAK	Android Tactical Assault Kit
AiTR	Aided Threat Recognition
CALFEX	Combined Arms Live Fire Exercise
CFF	Call for Fire
COP	Common Operating Picture
CoT	Cursor on Target
EUD	End-User Device
GPU	Graphics Processing Unit
KLV	Key-Length-Value
LIFO	Last In, First Out
MUOS	Mobile User Objective System
NPU	Neural Processing Unit
OEM	Original Equipment Manufacturer
RF	Radio Frequency
RTSP	Real-Time Streaming Protocol
sUAS	Small Unmanned Aerial System
TAK	Tactical Assault Kit
TLE	Target Location Error
TSM	Tactical Scalable Manet
UDP	User Datagram Protocol
VMF	Variable Message Format