WHITE PAPER

Basic Information (Page 1)

Field	Detail
Company Name	Veteran Vectors LLC
Proposal Title	VitalEdge AI: AI-Assisted Hemodynamic Monitoring and Triage Decision Support
Area of Interest	AI-Assisted Triage & Treatment (PROJ00628)
Company Website	www.veteranvectors.com
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CAGE Code	[CAGE]
UEI (SAM.gov)	[UEI]
Small Business	Yes -- Service-Disabled Veteran-Owned Small Business (SDVOSB)
Prior DIU Awards	N/A
Consortium Partners	Authentic Consortium (Medical Device OEM Partner, Cloud/Cyber Partner, Manufacturing Partner, Clinical SME Partner)

Part 1: Introduction

The AI-Assisted Triage & Treatment challenge seeks portable, network-capable hemodynamic status monitoring for forward combat medical environments. Current battlefield triage relies on subjective assessment by combat medics operating under extreme stress, limited visibility, and degraded communications -- resulting in delayed or inaccurate casualty prioritization that directly impacts survival rates during the critical "golden hour."

Veteran Vectors, leading the Authentic Consortium, proposes **VitalEdge AI** -- an integrated AI-powered hemodynamic monitoring and triage decision support platform purpose-built for Tactical Combat Casualty Care (TCCC) in Disconnected, Intermittent, and Limited-bandwidth (DDIL) environments. VitalEdge AI combines ruggedized COTS-based hemodynamic sensors with edge AI inference to deliver real-time triage classification, deterioration early warning, and seamless integration with BATDOK, ATAK, and electronic health records.

Our solution addresses the core operational gap: delivering objective, AI-augmented hemodynamic intelligence to combat medics at the point of injury -- without dependence on persistent network connectivity. VitalEdge AI operates autonomously at the edge, syncing data to cloud analytics when connectivity permits and maintaining full functionality in completely disconnected scenarios.

The Authentic Consortium brings together complementary capabilities: Veteran Vectors provides AI/ML software development, edge computing expertise, and veteran-driven mission understanding; our medical device partner contributes FDA 510(k)-cleared hemodynamic sensing hardware; our cloud/cyber partner delivers IL-5 ATO and FedRAMP compliance; and our manufacturing partner enables production scale to 15,000 units per year by May 2027.

Part 2: System Effectiveness

Clinical Efficacy

VitalEdge AI delivers hemodynamic monitoring across the TCCC MARCH assessment protocol (Massive hemorrhage, Airway, Respiration, Circulation, Hypothermia). The system continuously monitors heart rate, SpO2, non-invasive blood pressure, respiratory rate, and skin temperature, applying AI-driven trend analysis to classify casualty triage status (Immediate, Delayed, Minimal, Expectant). VitalEdge AI targets greater than 95% sensitivity for critical triage categories, validated through clinical simulation studies against MIMIC-III/IV and DoD Joint Theater Trauma Registry (JTTR) datasets prior to fielding.

The AI engine provides two core clinical capabilities: 1. **Real-Time Triage Classification:** Automated TCCC triage scoring based on multi-parameter hemodynamic fusion, trained on MIMIC-III/IV clinical datasets and DoD JTTR data. The model outputs triage category, confidence score, and recommended interventions aligned with TCCC guidelines. In mass casualty (MASCAL) scenarios, the system simultaneously monitors multiple patients from a single medic device, automatically sorting casualty priority by severity to optimize triage workflow. 2. **Deterioration Early Warning:** A temporal convolutional network continuously

analyzes vital sign trends to detect hemodynamic deterioration indicators, with a design target of 15--30 minute advance warning before clinical onset. This prediction window is consistent with published literature on early warning score systems and will be validated against labeled clinical datasets during development.

Human Factors

VitalEdge AI is designed for combat medics (68W) operating under stress, fatigue, and reduced visibility. The user interface prioritizes single-glance triage status via color-coded displays on the BATDOK tablet. Audible and haptic alerts for deterioration events require no screen interaction. The wearable sensor applies in under 30 seconds with gloved hands. All AI outputs are advisory -- the medic retains full clinical decision authority.

Systems Integration

VitalEdge AI integrates with the DoD medical information ecosystem: - **BATDOK:** Native data feed via HL7 FHIR, displaying real-time vitals and triage scores on the medic's tablet - **ATAK:** Custom plugin overlays patient status on Blue Force Tracker, enabling commanders and CASEVAC coordinators to view casualty locations and severity in real time - **EHR:** Bidirectional sync with MHS GENESIS/TMIP for continuity of care from point of injury through Role 3/4 facilities

FDA 510(k) Strategy

The consortium's medical device partner provides a predicate device pathway for hemodynamic monitoring hardware. The VitalEdge AI software layer pursues FDA Software as a Medical Device (SaMD) classification under IEC 62304, with risk management per ISO 14971 and quality management per ISO 13485. Clinical validation leverages DoD trauma datasets and controlled simulation studies to support 510(k) clearance.

Part 3: Technical Feasibility

System Architecture

VitalEdge AI employs a three-tier architecture designed for DDIL resilience:

Device Tier: Ruggedized COTS hemodynamic sensors (SpO2, continuous BP, HR, respiratory rate, temperature) communicate via BLE 5.0 to the edge compute unit. Sensors

are wearable (wristband/finger clip) and standoff-capable via short-range wireless telemetry, enabling monitoring of casualties without direct physical attachment during transport. The 72-hour battery life design target is achieved through low-power BLE duty cycling, optimized sampling rates, and sleep-mode management. Hardware meets MIL-STD-810H environmental compliance.

Edge Tier: ARM-based ruggedized edge compute unit runs the AI inference engine (ONNX Runtime C++ API, INT8 quantized), BATDOK gateway, ATAK plugin, and local data store (SQLite). All triage classification and early warning functions operate locally with zero cloud dependency. MQTT-based mesh networking enables multi-casualty monitoring from a single medic device (up to 7--10 simultaneous patients via BLE multiplexing, with mesh overflow to additional edge devices). Store-and-forward queuing ensures no data loss during DDIL operations.

Cloud Tier: AWS GovCloud (IL-5) hosts aggregate analytics, model retraining pipelines (MLflow), EHR synchronization, and provider dashboards. Sync occurs opportunistically via TLS 1.3-encrypted channels. The cloud tier is enhancement-only -- all critical functions operate at the edge.

Networking & DDIL Strategy

The system is DDIL-native, not DDIL-tolerant. Core triage and monitoring functions require zero network connectivity. MQTT with conflict-free replicated data types (CRDTs) enables automatic data reconciliation upon reconnection. Mesh networking between multiple edge devices provides local area coverage for mass casualty events.

Information Security

- Data at rest: AES-256 encryption (FIPS 140-3 validated modules)
- Data in transit: TLS 1.3 / MQTT over TLS; BLE 5.0+ with LE Secure Connections and application-layer encryption for PHI
- Authentication: CAC/PIV-based access control
- Authorization: Role-Based Access Control (RBAC)
- Compliance: IL-5 ATO pathway, FedRAMP alignment, STIG-hardened containers, CMMC Level 2 / NIST SP 800-171 Rev 2
- PHI protection: Compliant with DoD 6025.18-R (DoD Health Information Privacy Regulation)
- Supply chain: CycloneDX SBOM, signed reproducible builds, dependency vulnerability scanning

Technical Risk

Risk	Mitigation
Edge compute performance for AI inference	ONNX Runtime optimized for ARM; INT8 quantization; <50 ms inference latency design target, validated on candidate hardware during Week 2 of development
Sensor accuracy in field conditions	Clinical validation protocol against reference devices; environmental testing per MIL-STD-810H
BATDOK/ATAK integration complexity	Early engagement with PM Soldier Medical Devices and TAK Product Center for API access
DDIL data consistency	CRDT-based merge strategy with clinical priority override rules

Part 4: System Scalability & Economics

Production Scale Path

- **May 2026 (Sword Demo):** 30 fully functional units assembled from COTS sensors + edge compute hardware with VitalEdge AI software load. Software provisioning automated via CI/CD pipeline.
- **Manufacturing Ramp:** 100 units (Q3 2026), 500 units (Q4 2026), 2,000 units (Q1 2027), 15,000 units/yr run rate by Q2 2027. Consortium manufacturing partner operates an ISO 13485-certified facility with existing DoD medical device production capability.
- **140,000 patients/year capacity:** Cloud analytics tier architected for horizontal scaling via Kubernetes (EKS) auto-scaling. TimescaleDB time-series storage handles concurrent patient streams with sub-second query latency.
- **Lifecycle Support:** OTA software updates for continuous improvement, field-replaceable sensor components, and fleet management dashboard for remote monitoring and diagnostics.

Supply Chain

Hardware sensors are sourced from FDA-cleared COTS manufacturers with existing DoD supply chain relationships. Edge compute hardware leverages commercially available

ruggedized tablets and gateways. No sole-source dependencies exist for critical components; a dual-source strategy covers sensors and compute hardware.

Unit Economics

Volume	Hardware/Unit	Software/Unit	Total/Unit
30 (prototype)	~$3,500	$0 (dev included)	~$3,500
1,000	~$1,800	$350	~$2,150
15,000/yr	~$950	$85	~$1,035

Software cost reduction is driven by amortized development investment and cloud infrastructure optimization at scale. Hardware cost reduction is driven by volume manufacturing agreements.

Part 5: Commercial Viability

Competitive Edge

VitalEdge AI differentiates from existing hemodynamic monitors (Masimo, Philips, Zoll) through: 1. **AI-First Architecture:** Competitors offer sensor hardware with basic vital sign display. VitalEdge AI adds predictive triage classification and deterioration early warning -- capabilities no current battlefield monitor provides. 2. **DDIL-Native Design:** Existing systems assume persistent connectivity for analytics. VitalEdge AI delivers full AI inference at the edge with zero cloud dependency. 3. **Military Integration:** Purpose-built BATDOK and ATAK integration, not aftermarket adapters. Blue Force Tracker overlay for CASEVAC coordination is unique in the market. 4. **Veteran-Owned, Mission-Driven:** Veteran Vectors' founding team includes combat veterans who have experienced the triage challenge first-hand, driving design decisions rooted in operational reality.

Financial Health & IP Protection

Veteran Vectors is an established SDVOSB with active DoD AI/ML contracts providing sustained revenue. The company maintains sufficient operating capital to fund software development through the prototype phase. The Authentic Consortium's cost-sharing structure distributes investment risk: the medical device partner bears hardware and FDA costs, the

cloud/cyber partner leads ATO investment, and Veteran Vectors funds software development. No single-point-of-failure financial dependency exists within the consortium.

VitalEdge AI's sustained competitive advantages include proprietary triage classification algorithms trained on unique clinical-military datasets, purpose-built BATDOK/ATAK integration requiring TAK Product Center certification, and first-mover advantage in DDIL-native AI triage -- a capability that would require incumbents 18--24 months to replicate.

Dual-Use Market

VitalEdge AI has direct commercial applicability to civilian emergency medical services (EMS), disaster response (FEMA/NDMS), and remote/austere medicine (oil rigs, mining, maritime). The DDIL-native architecture translates directly to connectivity-challenged civilian environments. FDA 510(k) clearance for military use establishes the regulatory foundation for commercial market entry.

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