

# SOFTWARE DEVELOPMENT ACTION PLAN

---

**Version:** 1.1 (Revised) | **Classification:** CUI | **Distribution:** Internal Consortium Only

## DIU AI-Assisted Triage & Treatment (PROJ00628)

---

**Veteran Vectors (Prime) | Authentic Consortium**

**Date: February 24, 2026**

All software components developed by Veteran Vectors as consortium prime; hardware firmware developed by hardware consortium partner.

---

## 1. EXECUTIVE SUMMARY

---

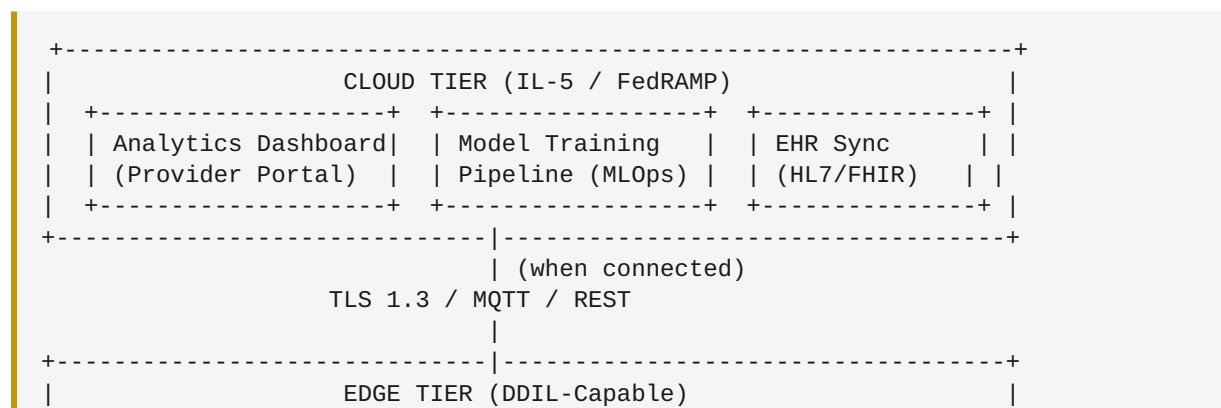
This action plan defines the software architecture, development roadmap, toolchain, cost estimates, and data flows for the AI-Assisted Triage & Treatment system. The software platform is the **primary differentiator** for the Authentic Consortium -- layering advanced AI/ML analytics on COTS hemodynamic monitoring hardware to deliver battlefield-ready decision support.

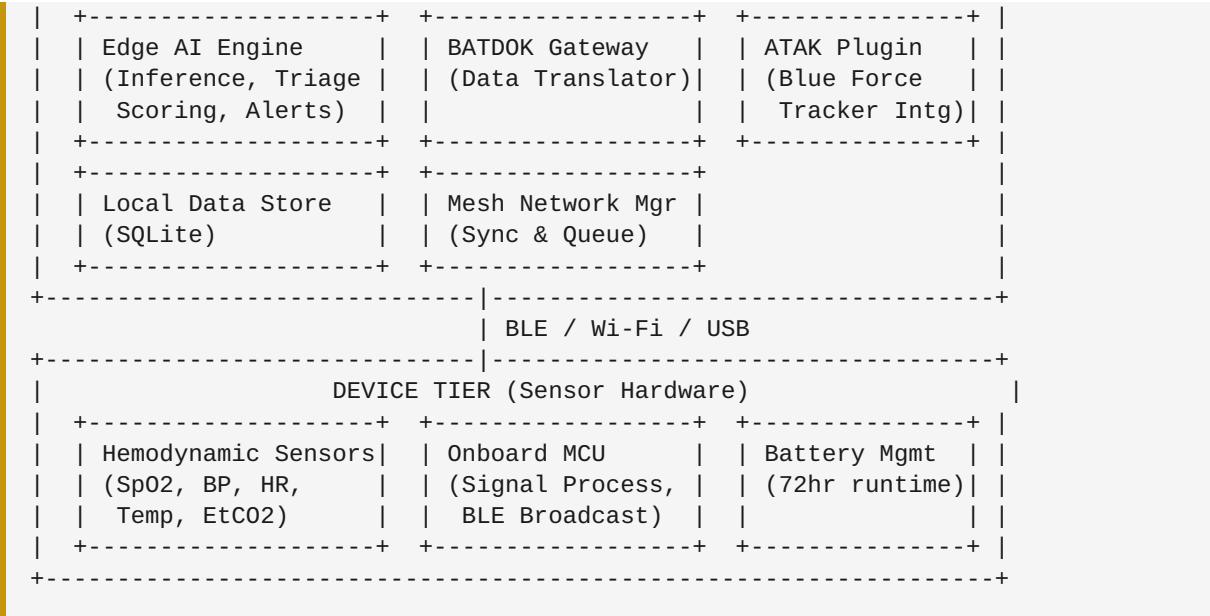
---

## 2. SYSTEM ARCHITECTURE

---

### 2.1 High-Level Architecture





## 2.2 Component Breakdown

Component	Function	Technology	Owner
<b>Edge AI Engine</b>	Real-time inference, triage scoring (MARCH/TCCC), trend detection, deterioration alerts	C++ inference via ONNX Runtime C API; Python for development and testing only	Veteran Vectors
<b>BATDOK Gateway</b>	Translate sensor data into BATDOK-compatible format for medic tablet	HL7 FHIR adapter, custom serial protocol	Veteran Vectors
<b>ATAK Plugin</b>	Overlay patient status on Blue Force Tracker; CASEVAC request automation	Java/Kotlin (Android ATAK SDK)	Veteran Vectors
<b>EHR Sync Module</b>	Bidirectional sync with Theater Medical Information Program (TMIP) / MHS GENESIS	HL7 FHIR R4, REST APIs	Veteran Vectors
<b>Cloud Analytics</b>	Aggregate data, model retraining, provider dashboards, population health	AWS GovCloud (IL-5) / Azure Gov, React dashboard	Veteran Vectors
<b>Mesh Network Manager</b>	Store-and-forward queue for DDIL; sync when connectivity resumes	MQTT broker (Mosquitto), conflict-free replicated data types (CRDTs)	Veteran Vectors

Component	Function	Technology	Owner
Device Firmware	Sensor signal processing, BLE broadcast, power management	C/Embedded (Zephyr RTOS or FreeRTOS)	Hardware Partner
MLOps Pipeline	Model versioning, training data management, A/B deployment	MLflow, DVC, containerized training (Docker)	Veteran Vectors

## 3. AI/ML MODEL STRATEGY

### 3.1 Triage Classification Model

- **Purpose:** Classify casualty status per TCCC MARCH protocol (Massive hemorrhage, Airway, Respiration, Circulation, Hypothermia)
- **Inputs:** Heart rate, SpO2, blood pressure (continuous/non-invasive), respiratory rate, skin temperature, trend deltas
- **Output:** Triage category (Immediate/Delayed/Minimal/Expectant) + confidence score + recommended interventions
- **Architecture:** Gradient-boosted ensemble (XGBoost) for initial deployment; LSTM-based temporal model for v2
- **Training Data:** MIMIC-III/IV, DoD Trauma Registry (JTTR), PhysioNet datasets, consortium clinical partner data
- **Edge Deployment:** PyTorch -> ONNX export -> ONNX Runtime Mobile (C++ API); quantized INT8 for low-power inference (<50ms latency design target, to be validated on candidate hardware in Week 2)

### 3.2 Deterioration Early Warning

- **Purpose:** Predict hemodynamic deterioration 15–30 minutes before clinical onset
- **Architecture:** Temporal convolutional network (TCN) on sliding window of vitals
- **Alert Mechanism:** Audible/visual alert on medic device + push to ATAK overlay

### 3.3 Model Governance

- All models versioned and traceable per FDA Software as a Medical Device (SaMD) guidelines

- Pre-defined performance thresholds (sensitivity >95%, specificity >85% for critical triage categories)
  - Human-in-the-loop: AI recommends, medic decides -- no autonomous treatment actions
- 

## 4. DEVELOPMENT ROADMAP

### Phase 1: Prototype (Weeks 1-8 | Mar-Apr 2026)

Week	Milestone	Deliverables
1-2	Architecture finalization & local environment setup	Design docs, CI/CD pipeline, Docker Compose local dev environments (GovCloud provisioning in parallel, available ~Week 5)
3-4	Edge AI engine v0.1 + sensor integration	Working inference on dev hardware, BLE data ingestion
5-6	BATDOK gateway + ATAK plugin alpha	Data flowing from sensor -> edge -> BATDOK/ATAK
7-8	Integration testing + Pitch Day prep	30-unit deployment packages (contingent on hardware availability by Week 6), demo environment, pitch materials

### Phase 2: Demonstration (Weeks 9-12 | May 2026 -- Sword Exercise)

Week	Milestone	Deliverables
9	Field-ready software load on 30 units	Validated firmware + software images
10-11	Sword 2026 live demo	Operational demo with live medics, real-time triage display
12	After-action report + data collection	Performance metrics, user feedback, model accuracy report

## Phase 3: Scale (Months 4-14 | Jun 2026 - May 2027)

Month	Milestone	Deliverables
4-8	FDA 510(k) submission support (led by medical device partner; Veteran Vectors provides SaMD documentation)	Clinical validation data, SaMD documentation per IEC 62304, risk file per ISO 14971
6-10	Cloud tier deployment / IL-5 ATO (led by cloud/cyber partner)	GovCloud infrastructure, SSP, ATO package, 3PAO assessment
8-10	Manufacturing software integration	Factory provisioning tools, OTA update system
10-14	Scale to 15,000 units/yr	Automated provisioning, fleet management dashboard

## 5. TECHNOLOGY STACK & TOOLS

### 5.1 Development Tools

Category	Tool	Purpose
Language (Edge)	Python 3.11+ / C++17	AI inference / performance-critical paths
Language (Mobile)	Kotlin / Java	ATAK plugin development
Language (Cloud)	Python / TypeScript	Backend services / frontend dashboard
ML Framework	PyTorch -> ONNX export	Model training -> edge deployment
Edge Runtime	ONNX Runtime Mobile (C++ API)	Optimized inference on ARM/embedded
Database (Edge)	SQLite	Local time-series storage (lightweight, edge-optimized)
Database (Cloud)	PostgreSQL + TimescaleDB	Aggregate analytics
Message Broker	Eclipse Mosquitto (MQTT)	DDIL-resilient pub/sub

Category	Tool	Purpose
Containerization	Docker / Podman	Consistent build & deploy
Orchestration	Direct container deployment (prototype); K3s (Phase 3 fleet); EKS (cloud)	Streamlined prototype deployment; K3s for fleet-scale management in Phase 3
CI/CD	GitHub Actions + ArgoCD	Build, test, deploy automation
MLOps	MLflow + DVC	Model versioning, experiment tracking
Monitoring	Prometheus + Grafana	System health, model performance
Security	HashiCorp Vault, STIG compliance tools	Secrets management, hardening
Documentation	MkDocs + Confluence	Technical docs, compliance artifacts

## 5.2 Development Environments

- **Local Dev:** Docker Compose stack simulating full 3-tier architecture
- **Integration/Test:** AWS GovCloud staging environment
- **Production (Prototype):** Hardened edge compute units + IL-5 cloud instance

## 6. COST ESTIMATES

### 6.1 Software Development Costs (Phase 1-2: Prototype through Sword Demo)

Role	FTEs	Duration	Rate/Hr	Cost
Technical Lead / Architect	1	12 weeks	\$225	\$108,000
ML Engineer (Triage Models)	1	12 weeks	\$200	\$96,000
Edge Software Engineer	1	12 weeks	\$190	\$91,200
ATAK/Mobile Developer	0.5	8 weeks	\$185	\$29,600
BATDOK Integration Engineer	0.5	8 weeks	\$185	\$29,600
DevOps / Cloud Engineer	0.5	12 weeks	\$195	\$46,800

Role	FTEs	Duration	Rate/Hr	Cost
QA / Test Engineer	0.5	8 weeks	\$170	\$27,200
<b>Subtotal Labor</b>				<b>\$428,400</b>

*Note: Labor rates are fully-burdened rates inclusive of fringe, overhead, G&A, and fee for Veteran Vectors employees.*

Non-Labor Item	Cost
Cloud infrastructure (GovCloud dev/staging)	\$22,000
Development hardware / sensor dev kits (5 units)	\$25,000
ATAK developer licenses & SDK access	\$5,000
ML training compute (GPU instances, commercial cloud for non-sensitive training)	\$10,000
Security scanning tools (STIG, DISA)	\$5,000
Travel (Pitch Day + Sword 2026)	\$20,000
Management reserve (8%)	\$41,000
<b>Subtotal Non-Labor</b>	<b>\$128,000</b>

| **TOTAL PHASE 1-2 | \$556,400 |**

## 6.2 Software Development Costs (Phase 3: Scale to 15K/yr)

Item	Annual Cost
Engineering team (sustained development)	\$850,000
Cloud infrastructure (IL-5 production)	\$120,000
FDA SaMD compliance / regulatory (Veteran Vectors SW documentation; medical device partner owns 510(k) submission costs separately)	\$200,000
ATO / cybersecurity compliance (cloud/cyber partner leads; Veteran Vectors provides system documentation)	\$150,000
MLOps / model maintenance	\$60,000
Management reserve (8%)	\$110,000
<b>Total Phase 3 (Annual, Veteran Vectors scope only)</b>	<b>\$1,490,000</b>

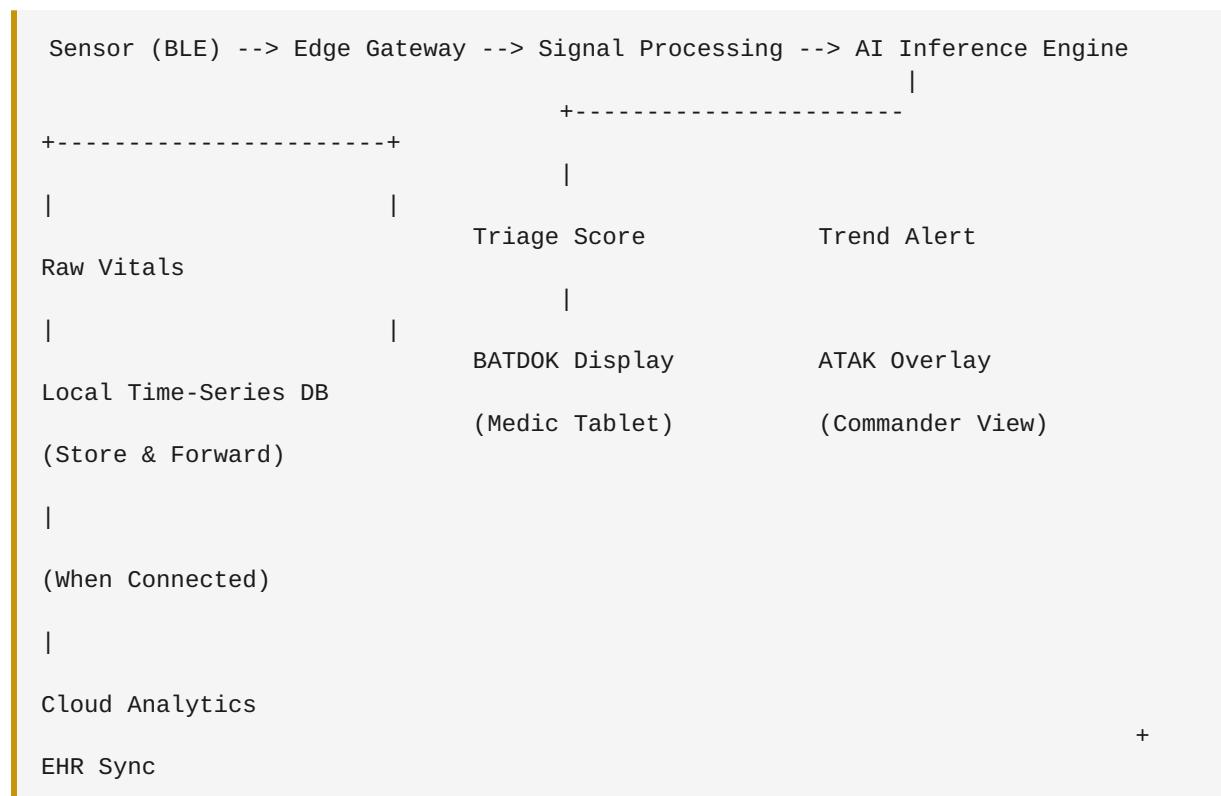
*Note: FDA regulatory consulting (\$300K--\$500K) and 3PAO assessment (\$200K--\$400K) costs borne by respective consortium partners are not included in this Veteran Vectors software development budget.*

## 6.3 Per-Unit Software Cost at Scale

Volume	Software License / Unit	Notes
30 units (prototype)	\$0 (included in dev)	Prototype phase
1,000 units	\$350/unit	Amortized dev cost + cloud
15,000 units/yr	\$85/unit	Full production scale

## 7. DATA FLOW DIAGRAMS

### 7.1 Real-Time Triage Flow



## 7.2 DDIL Sync Flow

```
[CONNECTED MODE]
Sensor -> Edge -> Cloud (real-time sync via MQTT/TLS)

[DISCONNECTED MODE]
Sensor -> Edge -> Local Store (SQLite queue)
|           |
+--> CRDT-based merge log

[RECONNECTION]
Local Store -> Sync Manager -> Cloud
|           |
+--> Conflict resolution (last-write-wins + clinical priority
override)
+--> Backfill analytics dashboard
```

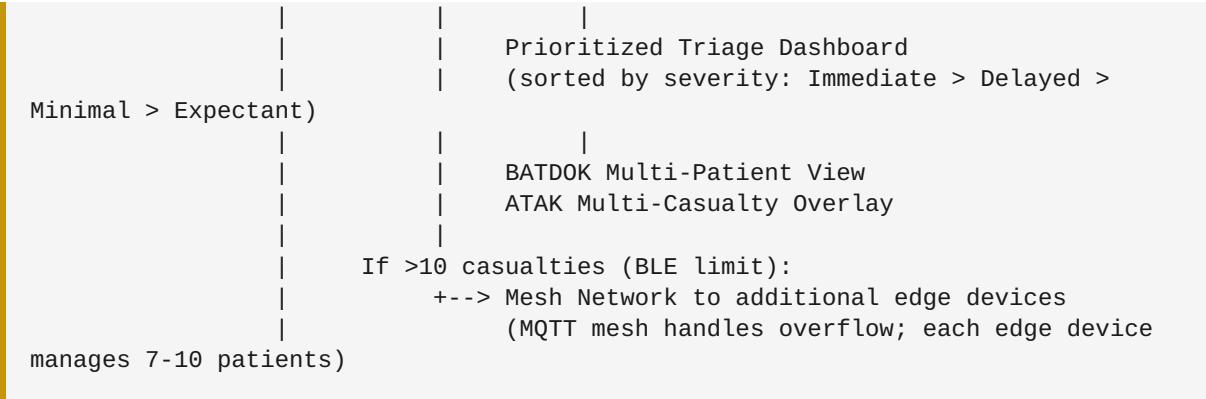
## 7.3 Model Update Flow

```
Cloud: New Training Data -> MLflow Pipeline -> Validated Model -> ONNX Export
|           |
|           Model Registry
|           |
|           OTA Update Package
|           (signed, encrypted)
|           |
|           Edge Device
|           |
|           Canary Deploy ->
|
Validate
|
active
|
previous validated model
|
team
|
for FDA audit trail
|
within 30s, zero monitoring interruption)
```

IF PASS: Promote to  
IF FAIL: Rollback to  
+ alert MLops  
+ log event  
(rollback

## 7.4 Multi-Casualty Data Flow

```
Sensor A (BLE) ---+
Sensor B (BLE) ---+--> Edge Device (BLE multiplexing, max 7-10 simultaneous)
Sensor C (BLE) ---+           |
...              |           +--> Parallel AI Inference (per-patient)
```



## 8. VERIFICATION & VALIDATION STRATEGY

### 8.1 Test Levels (per IEC 62304)

Test Level	Approach	Coverage Target
<b>Unit Testing</b>	Automated (pytest / Google Test); safety-critical modules	>90% code coverage for triage classification and alerting modules
<b>Integration Testing</b>	Edge-to-cloud, sensor-to-BATDOK, sensor-to-ATAK end-to-end	All data paths validated with simulated sensor inputs
<b>System Testing</b>	Full 3-tier stack with representative hardware	Acceptance criteria: <50ms inference, correct triage output, DDIL sync/reconnect
<b>Clinical Validation</b>	Sensitivity/specificity against labeled MIMIC-IV trauma data + controlled simulation	Target: >95% sensitivity, >85% specificity for critical triage categories
<b>Regression Testing</b>	Automated suite run on every model update and code change	Full regression before any deployment; model rollback if performance degrades
<b>Interoperability Testing</b>	BATDOK conformance, TAK Product Center plugin certification, HL7 FHIR validation	Tested against government reference implementations where available

### 8.2 Configuration Management

- Git-based version control with trunk-based development and release branches

- Semantic versioning (MAJOR.MINOR.PATCH) for all software components
  - Unique software build ID embedded in every deployed device image for traceability
  - Full traceability from requirements -> design -> code -> test -> validation per IEC 62304 design controls
- 

## 9. SECURITY & COMPLIANCE ARCHITECTURE

Requirement	Approach
<b>IL-5 ATO</b>	AWS GovCloud / Azure Gov; STIG-hardened containers (DISA Container Platform SRG, Kubernetes STIG); continuous monitoring (Prisma Cloud)
<b>FedRAMP</b>	Leverage CSP inherited controls; SSP documentation; 3PAO assessment (Phase 3)
<b>Data at Rest</b>	AES-256 encryption (FIPS 140-3 validated modules or FIPS 140-2 modules within active validation period)
<b>Data in Transit</b>	TLS 1.3 minimum; MQTT over TLS; BLE 5.0+ with LE Secure Connections (FIPS-compliant pairing); application-layer encryption above BLE for PHI
<b>Access Control</b>	CAC/PIV authentication; RBAC; least privilege
<b>Audit Logging</b>	Immutable audit trail; SIEM integration (Splunk/ELK)
<b>CMMC / NIST 800-171</b>	All CUI handling per NIST SP 800-171 Rev 2 controls; CMMC Level 2 compliance pathway
<b>PHI Protection</b>	Patient data handling compliant with DoD 6025.18-R (DoD Health Information Privacy Regulation) and aligned with HIPAA Security Rule controls
<b>FDA SaMD</b>	IEC 62304 software lifecycle; risk management per ISO 14971; ISO 13485 quality management; 21 CFR Part 820 compliance
<b>Supply Chain</b>	SBOM generation (CycloneDX); dependency scanning; signed, reproducible builds
<b>Section 508</b>	Cloud analytics dashboard and provider portal compliant with Section 508 / WCAG 2.1 Level AA
<b>Data Retention</b>	Edge data purged after cloud sync confirmation; retention per DoD policy; device decommissioning per NIST SP 800-88 media sanitization guidelines

---

## 10. KEY RISKS & MITIGATIONS

Risk	Impact	Mitigation
Sensor hardware delays impact software timeline	HIGH	Develop against hardware abstraction layer + simulators from Week 1; hardware partner milestone tracked separately
FDA SaMD classification risk (Class II vs. Class III)	HIGH	Engage FDA Q-Submission (Pre-Submission) in Phase 1 for early classification guidance; limit intended-use claims to "clinical decision support" (not autonomous diagnosis) to maintain Class II 510(k) pathway
Training data access (JTTR DUA may take 3--6 months)	HIGH	Begin DUA process immediately; develop initial models on MIMIC-III/IV (public); validate and fine-tune on JTTR when available; domain adaptation techniques for sensor gap
BATDOK API changes or access restrictions	MEDIUM	Early engagement with PM Soldier Medical Devices for API documentation; fallback to standard HL7 FHIR interface
ATAK plugin certification delays	MEDIUM	Begin TAK Product Center engagement immediately; Phase 1-2 delivers alpha plugin, certification deferred to Phase 3
Edge compute hardware performance	MEDIUM	Performance benchmarking on candidate hardware in Week 2; minimum requirements: ARM Cortex-A class, 4 GB RAM, 32 GB storage; fallback to dedicated inference co-processor if needed
ML model accuracy below threshold	MEDIUM	Ensemble approach; fallback to rule-based TCCC scoring per established clinical guidelines if thresholds not met
Consortium partner integration delays	MEDIUM	Formal interface control documents (ICDs) with each partner by Week 2; weekly consortium integration meetings
IL-5 ATO timeline exceeds prototype phase	LOW	Operate at IL-4 for prototype; IL-5 for production
Key personnel availability	MEDIUM	Cross-train team members; document architecture decisions thoroughly

## 11. DECISION POINTS & NEXT STEPS

---

Decision	Deadline	Owner
Confirm hardware partner & sensor platform	Feb 26, 2026	Consortium Lead
BATDOK API access request submitted	Mar 5, 2026	Tech Lead
ATAK SDK license secured	Mar 10, 2026	Mobile Dev Lead
Cloud environment provisioned (GovCloud)	Mar 15, 2026	DevOps Lead
ML training data agreements executed	Mar 15, 2026	ML Lead
Edge AI prototype (v0.1) on dev hardware	Apr 1, 2026	Edge Lead
Pitch Day rehearsal complete	Apr 4, 2026	All Leads

---

*Prepared by: Veteran Vectors Software Engineering Division | Authentic Consortium*