

Iron Citadel

A Mission-Scalable Ground System with Embedded AI/ML

Omitron, Inc. — A capability brief for mission operators, planners, and program managers

The Offering

Iron Citadel is a complete ground system suite that scales with the mission. The same platform serves a two-person university CubeSat team, a commercial operator going from five spacecraft to fifty, and a NASA Class A science observatory with its own dedicated operations center. The program grows. The ground system doesn't get rebuilt.

Omitron has spent 25+ years delivering ground systems, flight dynamics, and conjunction assessment to NASA, U.S. Government, and commercial space programs. Iron Citadel is what that experience looks like as a product. A coherent platform, not a stack of one-off integrations.

The suite pulls flight dynamics, conjunction assessment, mission planning, contact scheduling, command & telemetry, the fleet cockpit, operational data trending, simulation, and AI/ML assistance into one role-aware operator workspace. Each tool is good alone. Together they replace the stovepipe of legacy mission-specific ground systems.

Top-line value:

- One suite, every mission class — university CubeSat to flagship NASA mission, no re-platforming
 - Deployment-flexible: on-prem, customer cloud (AWS, Azure, GCP), or Omitron-managed service
 - AI/ML in every operator surface, with a hard read-only / recommend-only safety boundary
 - Mission automation for routine ops; hazardous and critical commanding always require operator two-step authorization
 - 25+ years of ground-system work made into a product, not a reference architecture
 - FIPS 140-2, NIST 800-53, STIG, and CMMC/DFARS compliant baseline; ATO-ready for unclassified and CUI today, classified deployment supported via mission-specific accreditation
 - Training, operator certification, helpdesk, and surge ops support
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The Suite

Iron Citadel is a suite of cooperating tools on a common foundation:

Brand	Role
Iron Specter	Operationally-faithful spacecraft simulator for training, procedure validation, and replay
Iron Conductor	Ground station integration, TT&C profiles, session monitoring, routing, notifications
Iron Helm	Native command & telemetry: script runner, limits monitor, table manager, federation
Iron Mission Deck	Single-pane-of-glass fleet cockpit with normalized alert triage
Iron Watch	Mobile companion to Mission Deck: alerts, fleet glance, two-way acknowledgement on the phone
Iron Composer	Mission planning, scheduling, change-request workflow, real-time and stored command load generation
Iron Foresight	Long-term operational data trending: telemetry, ground-system performance, anomaly history
Iron Beacon	Contact scheduling across ground station networks
Iron TALON	Flight dynamics and orbit operations
Iron OwlEye	Conjunction assessment and risk evaluation
Iron Intelligence	Centralized AI/ML service powering every tool's assistant surface

A unified host shell handles identity and navigation across the suite. A foundation-tier time-series archive holds operational data for any tool that needs historical context.

Core Capabilities

Iron Intelligence: the AI/ML backbone.

Every Iron Citadel tool exposes a context-aware AI assistant. Iron Intelligence has read access across the suite — telemetry, mission plans, alert streams, conjunction reports, trending history, command logs, pass schedules — and offers explanations, correlation, and recommendations.

What it looks like in practice:

- *Why did the battery limit trip?* Reasoning across recent commanding and telemetry trends.
- *What's driving this alert?* Correlation across the active mission plan, a recent Foresight excursion, and a contact failure on the same orbit.
- *How should we respond to this conjunction?* Three candidate maneuver responses with downstream plan impact projected.
- *What did I miss while I was off-console?* A paragraph summarizing the last orbit.

Iron Intelligence is read-only and recommend-only. It never executes a command on the operator's behalf. Operators get AI-accelerated decision support; humans keep authority over every flight-affecting action.

Mission automation.

Routine operations run autonomously, without operator intervention. Iron Composer authors the plan and the runtime executes pre-authorized stored command loads and scripted procedures on schedule. Hazardous commands and any operation classified as critical commanding require operator two-step authorization at the console, regardless of plan state. Lights-out for the routine workload. Operator-in-the-loop for anything that carries real risk. The boundary is enforced in the platform, not in policy or operator discipline.

Iron TALON: flight dynamics.

A modern flight dynamics environment covering orbit determination, maneuver design and reconstruction, ephemeris generation (definitive and predicted), propagation, station-keeping cadence, ground-track products, and the routine flight dynamics deliverables every operational program needs. TALON outputs feed Iron Composer for plan generation and Iron Beacon for contact prediction without operator hand-off. No file-shuffle. No format conversion. No version drift between FD and ops. Iron Intelligence has read access to FD products and can answer questions like "*why did our predicted pass slip by 40 seconds?*" in plain language.

Iron OwlEye: conjunction assessment.

OwlEye ingests conjunction data messages from external screening services, evaluates risk against operator-defined thresholds, maintains per-spacecraft conjunction history, and surfaces emerging threats into the Mission Deck triage queue. Maneuver decision workflows run alongside Iron TALON. Iron Intelligence drafts maneuver candidates, projects downstream impacts on the active mission plan,

and flags operator decisions that diverge from the historical pattern for similar events. The operator approves. The platform handles the paperwork.

The operator trio: Iron Composer, Iron Helm, and Iron Mission Deck.

Iron Composer authors the mission plan with constraint-aware scheduling, change-request workflow, and both real-time and stored command load generation. Iron Helm executes the plan on the spacecraft over standard ground-station interfaces with script runner, limits monitor, table manager, and federated command authority across distributed operations teams. Iron Mission Deck, the fleet cockpit, aggregates state, alerts, and pending actions from every tool in the suite into one view, with deep links back to the source tool for any action that needs authority. Tightly coupled in workflow. Independently deployable.

Alerting and notifications.

The suite carries one alert vocabulary. Limit violations from Iron Helm, plan deviations from Iron Composer, conjunction warnings from Iron OwlEye, contact failures from Iron Beacon, and trend excursions from Iron Foresight all normalize into the Mission Deck triage queue with correlation grouping and severity ranking. Operators acknowledge, assign, note, suppress, or escalate from one surface.

Off-console operators get alerts on their phones via SMS, email, and PWA push to Iron Watch. Two-way acknowledgement, assignment, and escalation from the phone is supported for the on-call flow. Commanding from the phone is structurally prohibited under all circumstances.

Iron Specter: simulation and training.

An operationally-faithful spacecraft simulator. Three-pass physics, systems, and outputs modeling. The simulator behaves identically to a real spacecraft on the commanding interface, which is what crew training, procedure validation, fault rehearsal, and what-if replay against captured truth state actually require. The commanding interface is real-spacecraft-equivalent TCP today. Link-layer encryption (CCSDS SDLS and customer KMS integration) is on the roadmap. Specter is the training simulator and the analysis simulator; the same configuration drives both.

Iron Conductor, Iron Beacon, Iron Foresight, and the foundation tier.

Iron Conductor centralizes ground-station configuration, session monitoring, routing fabric, and the notification engine. Iron Beacon books contacts across ground station networks from a single booking surface and reconciles against actual pass quality after the fact. Supported networks include NASA (NSN with DTE and SR services, plus DSN), AFSCN, and commercial networks including KSAT, SSC, Viasat, and AWS Ground Station. Iron Foresight delivers long-term operational data trending — telemetry, ground-system performance, contact quality, anomaly history — with AI-driven pattern detection across the fleet. A foundation-tier time-series archive backs every tool that needs historical data.

Iron Citadel in Practice

The same suite serves very different operators. Four profiles.

A university CubeSat team.

Two people, one CubeSat. The team needs the same disciplined ground system as a flagship and cannot afford a flagship's cost. Iron Citadel deploys as a small single-host footprint with the full security baseline and the full documentation set. The Iron Intelligence assistant is the same one a large operator runs. Iron Specter trains the next class of student operators against the live spacecraft model. Iron Composer enforces the operational constraints the faculty advisor cares about. Iron Helm executes the plan over whichever ground station the team has access to. When the team graduates to a three-spacecraft follow-on, nothing changes platform-wise. They add spacecraft.

A commercial operator growing from five to fifty.

The classic re-platforming inflection point. With Iron Citadel the operator never hits it. Mission Deck's fleet matrix expands with the constellation. Iron Composer schedules cross-spacecraft activities against shared resources. Iron Beacon books pass time across multiple networks as the contact budget tightens. Iron Foresight shifts from per-spacecraft inspection to cross-fleet correlation with its ability to analyze spacecraft together in plots and statistical reviews. Iron Watch puts on-call alerts on operators' phones. Iron Intelligence's assistance scales with the operator: more spacecraft means more context for the assistant, not more cognitive load on the operator.

A large-constellation operations center.

At 100+ spacecraft the cockpit-level view is what saves operators. Mission Deck normalizes alerts across every source tool and presents them in a triaged queue with correlation grouping. Iron Intelligence narrates the queue: explaining each correlation, ranking severity, drafting recommended actions for operator approval. Iron OwlEye keeps conjunction risk visible across the fleet. Iron Conductor manages the routing fabric across multiple ground sites and operator shifts. Mission automation runs the routine pass operations autonomously; operators work the exceptions and the planned mission events.

A NASA Class A science observatory.

A single flagship-class spacecraft with a dedicated mission operations center, a flight dynamics team, a science planning team, and the institutional expectation of a bespoke ground system at every step. Iron Citadel meets that operator on the same footing as the commercial constellation operator next door, with the cost profile and timeline of an off-the-shelf product instead of a multi-year custom build. Iron TALON delivers the flight dynamics products the FD team owns. Iron Composer integrates with the science planning workflow upstream. Iron Helm executes through the dedicated ground stations. Iron Specter serves as the operations training simulator and the procedure validation environment. The flagship operator gets the same platform the CubeSat team gets — which is the point.

Differentiators

Integrated, not bolted together.

Every Iron Citadel tool shares one identity service, one routing fabric, one alert vocabulary, and one operational data archive. Operators don't pivot between disconnected applications with mismatched terminology, interfaces, and inconsistent permissions. Adding a new tool to an existing deployment is configuration, not a custom integration project.

Scales without re-platforming.

The same suite serves a CubeSat operator with a single spacecraft and a commercial constellation operator with hundreds. Mission Deck's fleet matrix, Iron Composer's cross-spacecraft planning, Iron Beacon's multi-network booking, and Iron Foresight's fleet-level trending are constellation-ready and equally usable on a single asset. Operators who outgrow their starting class don't face a forced platform migration.

AI/ML embedded throughout, with explicit safety boundaries.

Iron Intelligence is not a bolt-on chatbot. It's a centralized AI/ML service with read authority across every tool's data and an architectural prohibition on direct command issuance. Mission risk owners get AI-accelerated operations across the workflow: anomaly explanation, alert correlation, plan critique, trending insight, conjunction reasoning. They don't carry the policy and certification cost of fully agentic systems.

Mission automation with operator-in-the-loop on risk.

Routine ops run autonomously per the active plan. Hazardous commanding and operations marked critical require operator two-step authorization at the console. The boundary is platform-enforced, not procedural. Lights-out for the bulk of the workload; human authority on the operations that carry real consequence.

Compliance and security posture in the baseline.

FIPS 140-2 enforcement, NIST 800-53 control mapping, STIG hardening, ATO-ready assessment documentation for unclassified and CUI deployments, and CMMC/DFARS alignment are part of the product. Classified deployment is supported via mission-specific accreditation. PBKDF2-SHA256 password hashing at 600,000 iterations, role-based access control, comprehensive audit trail, and TLS-mandatory deployment are defaults, not options.

Deployment flexibility.

Iron Citadel runs on customer-owned on-premises infrastructure, in a customer cloud account (AWS, Azure, GCP), or as an Omitron-managed service. Programs pick the deployment model that fits their security posture and operational preference. They don't trade deployment options against platform features.

The platform plus the people who built it.

Programs that adopt Iron Citadel get the platform and the Omitron operations team behind it. Hands-on operator certification training, 24x7 reachback for in-flight anomalies, surge ops support during launch and early-orbit, and mission-specific platform extensions are all available from the team that built the product. New operators have answers at their fingertips. Experienced operators have the platform engineers on speed-dial. The moat isn't software alone; it's software plus the people behind it.

Cost economics across a mission portfolio.

One ground system across an organization's mission portfolio means one set of operators trained, one set of procedures validated, one compliance posture maintained, and one upgrade cycle to manage. The recurring per-mission cost of bespoke ground-system builds, and the multi-year rebuild cycle they impose, goes away. Programs add new missions to an existing operations footprint instead of standing up another stovepipe.

About Omitron

For more than 25 years, Omitron has delivered operational ground systems, flight dynamics services, conjunction assessment, mission planning, and mission operations support to U.S. Government and commercial space programs across science, defense, and commercial mission classes. That heritage spans single-spacecraft science missions, multi-spacecraft constellations, and the routine flight dynamics products that keep operational programs flying. Iron Citadel is the productized expression of that experience: a generation of lessons learned in real flight operations, distilled into a coherent, evolvable commercial offering.

Next Steps

We welcome conversations with mission operators, program managers, ground-system architects, and principal investigators across NASA, U.S. Government, academic, commercial, and international space communities.

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