Compress the kill cycle with Red Hat Device Edge

- Deploy on any aircraft, pod, sensor, or C2 node
- Ability to comply with cybersecurity requirements

"With Red Hat Device Edge Lockheed Martin is leading the infusion of cutting-edge commercial technology into military capabilities that deliver advanced solutions to our customers. Unlocking these AI technologies can help national security decision makers stay ahead of adversaries, enabling a safer and more secure world."

Justin Taylor
Vice President, F-22 technology, Lockheed Martin[1]

Executive summary

The U.S. Air Force and its mission partners are fielding new mission capabilities on airframes and command-and-control (C2) nodes to compress the kill chain. The find, fix, track, target, engage, assess (F2T2EA) process requires ubiquitous access to data at the strategic, operational and tactical levels. Red Hat® Device Edge embeds captured, analyzed, and federated data sets in a manner that positions the warfighter to use artificial intelligence and machine learning (AI/ML) to increase the accuracy of airborne targeting and mission-guidance systems. Challenges of edge computing on aircraft and other tactical C2 edge nodes include delivering consistent capabilities on diverse hardware (new and old, connected and disconnected), meeting airworthiness security requirements, and efficiently sustaining software at scale. The Air Force can meet these requirements with Red Hat Device Edge, the edge-optimized software platform that is hardware agnostic.

Opportunity: Use edge technology to defeat the adversary

The Air Force and its partners are developing innovative capabilities on airborne and ground systems to gain battlespace advantage, including:

- Coalescing and stratifying data to feed AI/ML at the edge to increase the accuracy of targeting and mission-guidance systems and compresses the mean time to detect (MTTD), make sense and act across all warfighter domains.
- Delivering near real-time data from sensor pods directly to airmen, accelerating the sensor-to-shooter cycle.
- Supporting Agile Combat Employment (ACE) in the highly contested 21st-century battlespace.
- Sharing near real-time sensor fusion data with joint and multinational forces to increase awareness, survivability, and lethality.

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1 Red Hat press release. "Lockheed Martin, Red Hat Collaborate to Advance Artificial Intelligence for Military Missions," 25 Oct. 2022.

Automate sustainment with Red Hat Ansible

- Patching
- Software upgrades
- Initial configuration
- Day 2 operations like reconfiguring or integrating with new sensor or weapons pods
- Continuous compliance checks

Comply with cybersecurity requirements

Red Hat Enterprise Linux:

- Is Common Criteria certified
- Is FIPS 140-2 validated
- Includes Security-Enhanced Linux (SELinux)

Barriers to efficient software deployment and sustainment on diverse edge devices

Barriers to delivering AI/ML and sensor fusion capabilities on aircraft include:

Resource-constrained hardware platforms. Small-form-factor (SFF) devices deployed on sensor and weapons pods need a protected, edge-optimized Linux® distribution. Stripping out unnecessary operating system (OS) features reduces the required size, weight, power, and cost of airborne servers.

Diverse hardware platforms. Software operations teams need to deliver new capabilities consistently on every hardware platform, conventional or new, connected or disconnected. Rewriting software for the variety of servers on airframes is not feasible. The ideal outcome is to write once, deploy anywhere.

Efficient sustainment. After deploying edge capabilities, Air Force software-operations teams and systems integrators need to sustain them over the expected 10-plus year hardware lifespan. It is a massive undertaking. For example, the block 4 capability upgrade for an F-35 combat aircraft, "includes more than 80 software components"[2] that will require regular updates and patching. Automation is essential to save time, avoid manual errors, strengthen security, deliver new capabilities to airmen sooner, free up time, and budget for innovation.

Compliance with cybersecurity requirements. Red Hat Trusted Software Supply Chain experience, affirmed by more than 30 years of curating and securing open source software, uniquely positions the Air Force with authenticated security-focused software capabilities and complies with DoD mandates. Software capabilities do not make it into combat if they fail to meet cybersecurity requirements. Depending on its purpose, software aboard aircraft may need to comply with Federal Information Processing Standards (FIPS) 140-2, FIPS 140-3, or Common Criteria. Most distributions of Kubernetes (the open source platform for managing containerized workloads and services) lack the FIPS-validated cryptographic modules required by Air Force cybersecurity standards. Built using FIPS-validated cryptographic modules, Red Hat platforms can meet stringent security requirements. Workarounds are costly and expensive.

Introducing Red Hat Device Edge

Red Hat Device Edge solves the challenges of moving Air Force capabilities to the edge, closer to the fight, while assuring common operating picture alignment at all warfighter echelons. Red Hat Device Edge is a flexible software platform that supports diverse Air Force workloads consistently on small, resource-constrained devices aboard airframes and in sensor and weapons pods. The package includes:

- A security-focused, edge-optimized OS built from Red Hat Enterprise Linux. Omitting code that is not needed at the edge allows the OS to run on smaller devices with memory and processing constraints.
- An enterprise-ready and supported distribution of MicroShift. Red Hat build of MicroShift is a lightweight Kubernetes container orchestration solution built from the edge capabilities of Red Hat OpenShift®. With MicroShift, Air Force developers and partners can write AI/ML applications once and run them anywhere, including at the edge or in a hybrid cloud.

2 Tirpak, John. "F-35 updates: TR-3 ramps up, talks on future lots continue, logistics contract stalls," Air and Space Forces Magazine, 27 Nov. 2023.

- Red Hat Ansible® Automation Platform for automating tasks like software updates and security patching. (See sidebar, "Automate sustainment with Red Hat Ansible.") With Red Hat Ansible, Air Force teams and systems integrators can deploy and decommission infrastructure components in minutes (not hours or days), establish and maintain desired configuration states across multiple systems, and ensure compliance.

Red Hat Device Edge allows applications to operate in denied, disrupted, intermittent, and limited impact (DDIL) environments—that is, when the platform has no reliable network connection.

Programmatic use cases

Deploy Red Hat Device Edge anywhere within the Combined Joint All-Domain Command and Control (CJADC2) architecture. Examples of these use cases:.

> "... 5th and 6th generation combat aircraft ... are consolidated 'sensor-shooter' nodes that can independently close kill chains and facilitate the completion of other missions in localized areas of contested battlespaces."
>
> **Mitchell Institute for Aerospace Studies**[7]

Unmanned aerial systems

Lockheed Martin has successfully demonstrated use of Red Hat Device Edge on the Stalker UAS to advance Joint All-Domain Operations (JADOs).[3] The new software enabled the Stalker to deploy updated, AI-based automated target recognition capabilities. As a result, the Stalker more accurately classified the military target. Potential outcomes include more useful intelligence, surveillance, and reconnaissance (ISR) data and increased situational awareness of the threat environment.

ML and signals processing

The Army is working with Red Hat platforms to support CJADC2 systems in Project Linchpin.[4] The research-focused project is designed to improve the traceability, observability, replaceability, and consumability of ML capabilities for programs like the Army Tactical Intelligence Targeting Access Node (TITAN) project.[5]

Supply chain logistics: ALIS

Developed by Lockheed Martin, Autonomic Logistics Information System (ALIS) receives healthcare reporting codes while the F-35 is in flight so that the Air Force can pre-position parts and technicians. ALIS currently runs on Red Hat Enterprise Linux, giving it a scalable architecture and security compliance on and off missions. With Red Hat Device Edge, the Air Force can also deploy ALIS on compact edge devices aboard sensor pods, weapons systems, and communications systems. In tests, Lockheed-Martin successfully deployed ALIS on a hardware device that weighs 800 pounds less than current devices. Running ALIS on Red Hat Device Edge helps the Air Force modernize ALIS parallel with the move to Operational Data Integrated Network (ODIN).[6]

3 Red Hat press release. "Lockheed Martin, Red Hat Collaborate to Advance Artificial Intelligence for Military Missions," 25 Oct. 2022.

4 "Army awards contracts for first AI program of record," DefenseScoop, 27 Sept. 2023.

5 "Award for Army's next-generation intelligence ground station expected by year end." DefenseScoop ,21 Sept. 2023.

6 "Cloud architecture plan for F-35s gets revised." Airforce Technology, 30 March 2023.

7 "Scale, scope, speed & survivability: Winning the kill chain competition." Mitchell Institute for Aerospace Studies, May 2023.

Red Hat credentials

Red Hat is the #1 overall contributor to Cloud Native Computing Foundation (CNCF)[8] projects. We represent our customers in key communities, driving new capabilities and fixing issues. Using our software to build applications gives the Air Force and airframe OEMs early access to the latest innovations in security and performance. Our technology complies with standards that Air Force systems must comply with, including FIPS 140-2, Common Criteria, and others—inclusive of an early FIPS 140-3 validation submission that is in the review pending state at the time of writing[9].

Solutions for emerging challenges

Accelerating the sensor-to-shooter cycle

Deployed on UAS, Red Hat Device Edge can ingest sensor data and disseminate it to airmen, the joint team, allies, and partners. If the target is an adversary tracked vehicle on the far side of a ridge, a UAS carrying a server running Red Hat Device Edge could transmit video and metadata directly to shooters.

Updating AI models in flight, compressing the air tasking cycle

Suppose the adversary begins using a new visual camouflage technique that prevents visual identification with existing models. Operators could push an updated ML model to support an aircraft or sensor–while airborne–with new target recognition capabilities.

Updating system configuration and patching OSs in flight

New security advisories are released daily for open source software components used to build ML applications. Manual patching and updating is time-consuming, and systems remain vulnerable to cyberattacks while awaiting their turn. With Red Hat Device Edge, Air Force IT teams can automatically apply patches and updates to all connected devices at once. Updates are applied fully or not at all, and can be readily rolled back to the last known good state. Automated patching improves the edge security posture, saves staff time, and avoids human error.

Summary

AI/ML and sensor fusion at the edge provide a battlespace advantage. With Red Hat Device Edge, the Air Force and its airframe original equipment manufacturers (OEMs) can efficiently deploy new mission capabilities on compact devices aboard airborne systems and update them in flight. Automated software deployment, updates, and patching simplify sustainment at scale. And with an OS based on Red Hat Enterprise Linux, Red Hat Device Edge complies with security requirements for airworthiness certification.

Learn about how Red Hat partners deliver mission-critical solutions

8 CNCF. "All CNCF companies stats dashboard." accessed 30 Jan. 2024.

9 *Red Hat. "Compliance activities and government standards: FIPS 140-2 and FIPS 140-3." 16 Feb. 2024.*

About Red Hat

Red Hat is the world's leading provider of enterprise open source software solutions, using a community-powered approach to deliver reliable and high-performing Linux, hybrid cloud, container, and Kubernetes technologies. Red Hat helps customers develop cloud-native applications, integrate existing and new IT applications, and automate and manage complex environments. A trusted adviser to the Fortune 500, Red Hat provides award-winning support, training, and consulting services that bring the benefits of open innovation to any industry. Red Hat is a connective hub in a global network of enterprises, partners, and communities, helping organizations grow, transform, and prepare for the digital future.

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