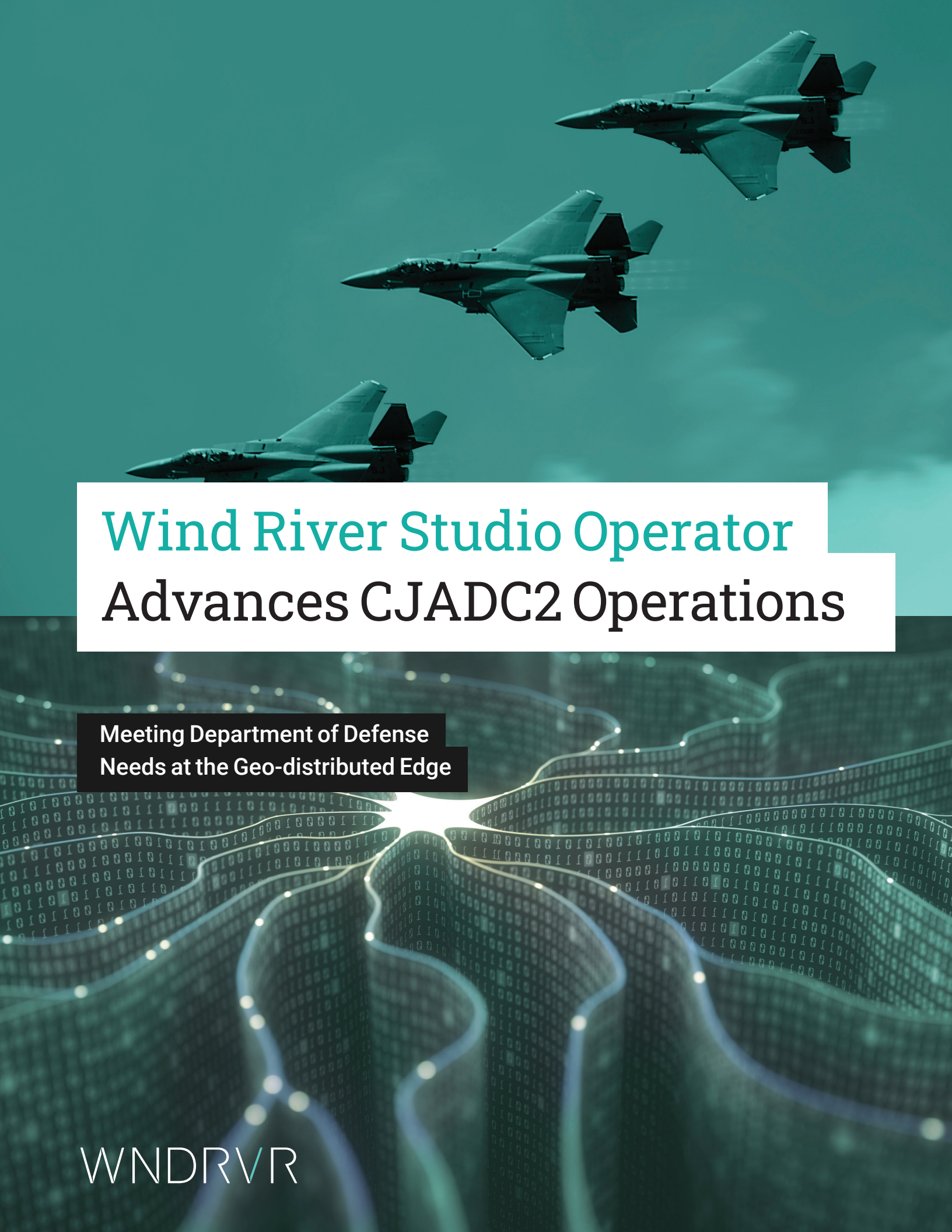

Wind River Studio Operator Advances CJADC2 Operations

Meeting Department of Defense Needs at the Geo-distributed Edge

WNDRVR

The Cloud-Native Transformation of Modern Defense

Many vertical markets, including telecom, industrial, energy, medical, automotive, and aerospace and defense, are undergoing a transformation.

Previously isolated devices and systems are now intelligent, connected, and enabled with compute capabilities to host applications supported by artificial intelligence (AI) and machine learning (ML), running at the edge. Furthermore, there is an urgent need to process and transform the massive amounts of data generated at the edge, without transporting that data to a central location.

Wind River® Studio is a cloud infrastructure technology stack developed for the new geo-distributed intelligent edge. It addresses the deployment and operational challenges involved in moving software workload from centralized data centers to the distributed edge computing demanded by today's mission-critical systems. These challenges include massively distributed compute, heterogeneous platforms, degraded and intermittent connectivity, lack of physical security, and operations at scale.

The mission of the Department of Defense Combined Joint All-Domain Command and Control (DoD CJADC2) is to achieve decision-making superiority powered by AI in near real time on a unified network that connects databases, sensors, weapons, and warfighters across all armed forces. This goal aligns perfectly with the intelligent edge and geo-distributed cloud computing capabilities provided by Studio Operator.

In 2024, the United States Air Force plans to deliver prototypes of command-and-control center connectivity based on mission-critical cloud infrastructure. Cloud-based command and control intends to integrate a variety of air defense data sources to support homeland defense with near real-time decision making. The other armed forces are also undergoing the same edge transformation through initiatives including the U.S. Army's Project Convergence, the U.S. Navy's Project Overmatch, and the Space Development Agency's National Defense Space Architecture (NDSA). U.S allies have their own initiatives, such as Combat Cloud, that are similar to CJADC2. They are also working with the U.S. to achieve interoperability with CJADC2.

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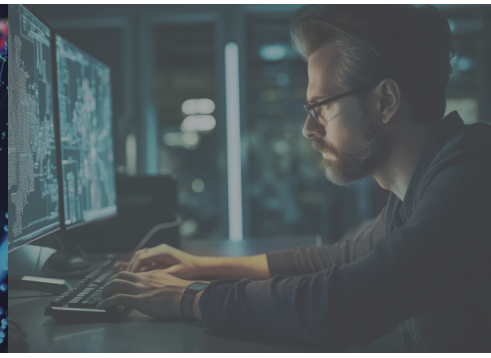
A Platform to Meet DoD Requirements



Studio Operator provides a distributed, cloud-native Kubernetes infrastructure for hosting tactical workloads across geo-distributed deployment of autonomous, centrally managed subclouds, even under conditions of intermittent and degraded connectivity.

It addresses the requirements for deploying and operating a distributed network at the edge — requirements that are often initially ignored. Wind River is extending the intelligent edge even further through innovations such as VxWorks® containers that bring OCI-compliant containers into the edge.

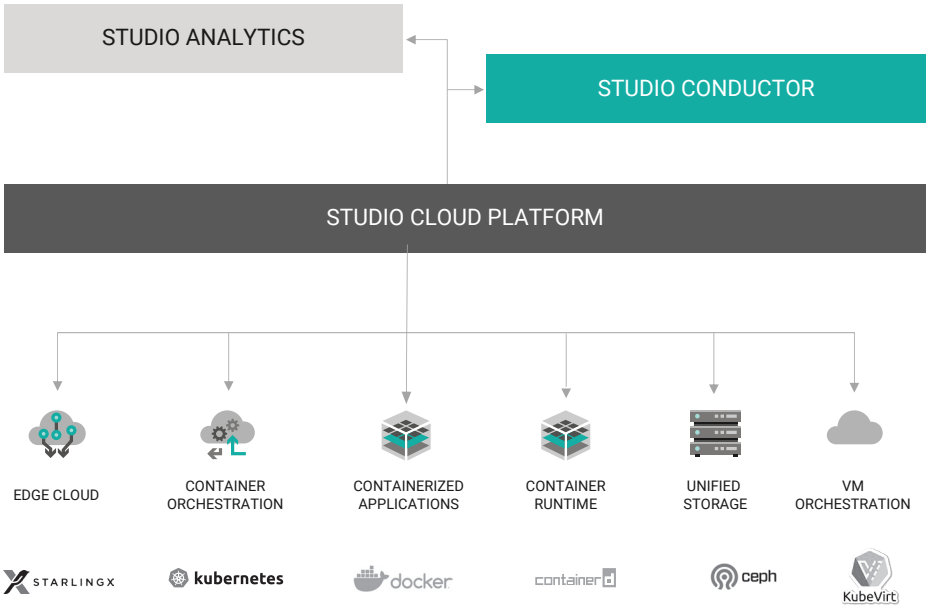


Figure 1. Wind River Studio provides a single, end-to-end operations platform

The core components of Studio Operator capabilities include:

- **Wind River Studio Cloud Platform:** A foundational platform already in use by telco operators, based on the open source StarlingX project and scalable Kubernetes
- **Wind River Studio Conductor:** Orchestration and automation at scale for the entire lifecycle, from day 0–1 deployment through day 2 operations
- **Wind River Studio Analytics:** Full stack monitoring and analytics solution to collect, analyze, and visualize data from across the entire infrastructure and applications to provide meaningful operational insights for the entire distributed cloud

A Platform to Meet DoD Requirements (cont'd.)

Studio Operator provides features that speak directly to the needs of CJADC2:

Cloud-native design: Studio Cloud Platform provides a software-defined, cloud-native infrastructure hardened for high-availability geo-distributed operation. Support for containers and Kubernetes is a fundamental requirement for the platform, necessary for mission-oriented, AI-enabled CJADC2 workloads.

Scalability: Scalability of the entire system (large number of geo-distributed locations) and scalability of the cluster at each location are both critical capabilities. Studio Operator supports scaling sites to meet the smaller compute requirements at the far edge (for aircraft and ground vehicles, for example) and at more central locations such as command-and-control sites that might require many server-class platforms. System scalability is essential to support the deployment and operation of tens, hundreds, or thousands of geo-distributed clouds. A major U.S. telecommunications operator is currently deploying Studio Cloud Platform at 30,000 sites, with more to come.

Small footprint: Scaling down is also important at the edge and is often driven by size, weight, and power (SWaP) requirements. Studio Cloud Platform can scale to a single node on a site at the edge, and on some processors it only requires a single core of overhead. This is much smaller than many Kubernetes-based clouds, which require multiple hosts for management and storage. Wind River is continuing to shrink the footprint even further and working to support more heterogeneous platforms to support CJADC2 goals.

Ultra-low latency: Ultra-low latency is critical in the DoD environment. Latency increases as a cloud grows geographically, yet reliable and immediate communication is a must, meaning that the far-edge infrastructure must react in microseconds. Studio Operator offers deterministic, tunable performance optimized for your specific configuration.

Autonomy: Distributed clouds must support sites that are limited in connectivity or even disconnected at times, without their operation being affected. This is a problem in critical infrastructure such as 5G networks, industrial facilities, and automotive; it is an even greater problem in CJADC2 situations, where the links may not only be limited by default (e.g., in satellite or point-to-point links) but may also be contested or degraded by the need for mobility or by the tactical environment. Studio Operator is designed to allow every site to operate autonomously with minimal management traffic. If a site is disconnected, it continues to operate and will resynchronize if and when it reconnects to central management.

Reliability/availability: Related to autonomy, reliability and high availability are critical to a distributed cloud. Each site must be able to locally detect and recover from failures. Studio Operator is designed to meet six-nines availability through advanced fault detection and automatic fault resolution. At the application level, Kubernetes provides some of this capability, but Studio Operator goes beyond this to detect issues faster, take action faster, and even keep Kubernetes itself up and running.

A Platform to Meet DoD Requirements (cont'd.)

Edge security: Studio Operator is designed to function outside of the data center where there is no physical security. Wind River supports a secure development lifecycle (SDL) across our products that is enforced by policy and implemented with standards, processes, and procedures. The SDL is aligned directly with the NIST SP 800-218 recommendations for mitigating the risk of software vulnerabilities and its principles: Prepare the organization, protect the software, produce well-secured software, and respond to vulnerabilities. Software undergoes independent review by our security team, which checks the design, secure coding standards, and risk treatment outcomes.

Lifecycle management, automation, and operations at scale: Deploying and operating a distributed cloud at the scale of CJADC2 requires full lifecycle management of the platform and the applications. Everything must be automated. Platforms must be deployed, configured, monitored, and updated remotely, with no human presence at the site. Likewise, customer applications must be deployed, configured, recovered, and moved without human intervention. Studio Operator incorporates extensive automation capabilities within Cloud Platform and with the Studio Conductor automation platform. Together, these provide automation of the entire system and applications at the edge.

Monitoring: System optimization, workload placement, cybersecurity analysis, forensic analysis, compliance, and business intelligence all rely on logs and telemetry from across the entire geo-distributed system and from different levels in the stack (platform, network, application). Studio Analytics is the part of Studio Operator responsible for full-stack monitoring of infrastructure, cluster, and applications; data aggregation and analysis across the distributed cloud; data analysis of logs and metrics (including ML–based anomaly detection); and context-aware data collection and enrichment across the entire distributed cloud. These capabilities are critical to operating a distributed CJADC2 system.

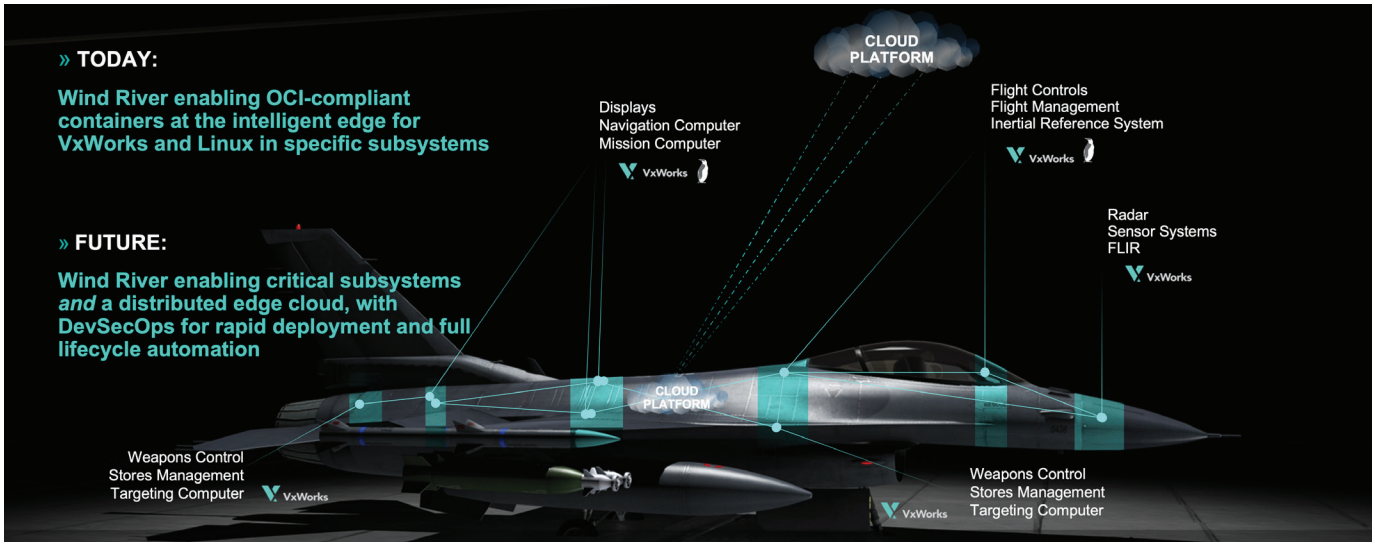


Figure 2. Wind River has optimized and is continually improving mission-critical cloud infrastructure for the DoD

Conclusion

From mission-critical services to private 5G networks, Studio Operator helps build the most resilient network, optimized for the DoD's mission-critical operations and needs.

Wind River has extensive experience in building the biggest cloud-distributed networks for global carriers and in providing the most reliable cloud-native network. Wind River solutions are the ideal choice for a mission-critical cloud infrastructure for the DoD and its allies.

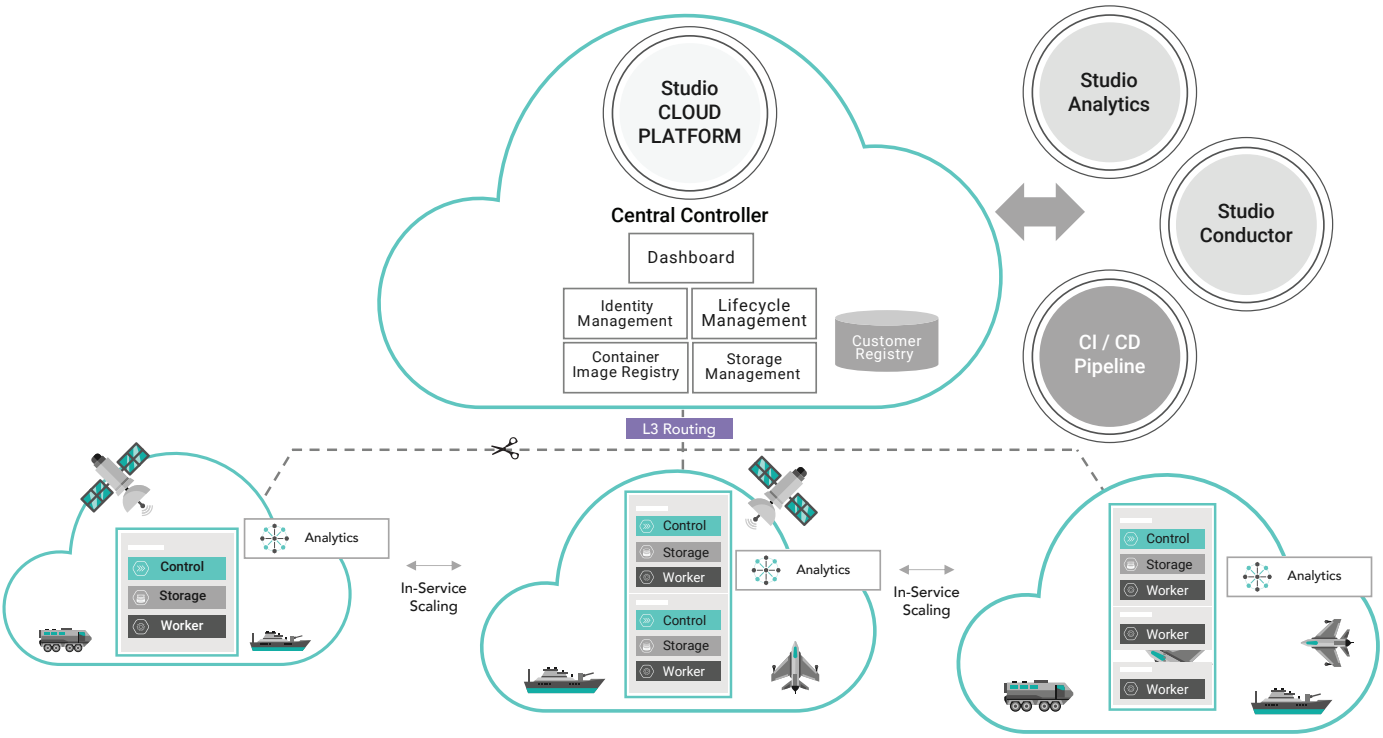


Figure 3. Wind River Studio is designed for distributed cloud operations at scale