White Paper

Hyper Converged Infrastructure at the Edge

Accelerating Agility and Security at the Tactical Edge

RGS
Rancher Government Solutions

Introduction

The tactical edge has emerged as a critical frontier in cloud computing, challenging traditional ideas of centralized data processing and application management. In these often remote, resource constrained environments, where connectivity is not guaranteed and real-time processing is critical, the limitations of traditional edge to cloud and on-premises data center technologies become glaringly apparent.

Enter Rancher Government. With an exclusive focus on U.S. Government military and civilian use cases, we have developed the **Rancher Government Hyperconverged Infrastructure (HCI) Edge Solution**, which is tailored to the unique demands of the Tactical Edge. Powered by Harvester, Rancher's innovative Kubernetes-as-Infrastructure product, the Rancher Government HCI Edge highlights the power of open source and open standards software. It transcends the limitations of traditional cloud and data center technologies by offering a modular, versatile, and highly configurable stack.

Rancher Government's HCI Edge Solution is also specifically designed for adaptability, capable of being deployed on a range of hardware platforms – from conventional servers to more unconventional edge devices of varying size – without the need for operator intervention. It is a solution that is not just about adapting to the edge but thriving in it, delivering a cloud-native platform that is secure, scalable, and sustainable, regardless of the hardware footprint or operating environment.

If the edge is the new frontier of computing, then the Rancher Government HCI Edge Solution is the tip of the spear. It offers a blueprint for success that is rooted in the advanced capabilities of Kubernetes, the cloud, and tailored to the dynamic and varied requirements of edge computing environments and use cases.

Challenges At the Tactical Edge

U.S. Government and military missions requiring a platform to run, build, and manage applications in a cloud-agnostic way, using cloud-native tools are today leveraging Kubernetes to deliver these capabilities. As a result, companies have developed a large ecosystem of innovative tools and internal knowledge built around the Kubernetes stack.

This traditional infrastructure, predominately reliant on managed Virtual Machines within static, vertically integrated environments, is undergoing a radical transformation. Renowned for its ability to efficiently build, run, and manage applications across diverse environments, these legacy virtualized workloads are falling short when taken out of the data center or cloud to the tactical edge.

When it comes to missions such as JADC2, which will cover a very wide variety of use cases across the Department of Defense (DoD), issues such as DDIL (Disconnected, Denied, Intermittent and/or Limited bandwidth) not only become the primary use case, but they also become the normal operating environment. DDIL itself can make traditional infrastructure and the cloud automation, lifecycle management, monitoring, and container security processes and applications that run on it become useless or at the very least extremely difficult.

Hardware and Software Limitations

One of the most pressing challenges is the dependency of software on specific hardware configurations. Traditional cloud infrastructures, when transposed to edge environments, frequently underperform.

Cloud infrastructure and hardware-paired solutions from major cloud providers have proven to be less effective than advertised at the tactical edge. Their implementation often ties specific hardware vendors and components to specific infrastructure software versions, many without a full Bill of Materials (BOMs). This results in tight coupling between hardware and software platforms, some even tied to leasing models. This tight dependency increases cost and severely hampers operational efficiency, flexibility, and lifecycle management.

Additionally, much of the existing Kubernetes infrastructure is tightly integrated with cloud-specific, proprietary, closed-source technologies. This coupling hinders multi-cloud strategies, makes automation much more difficult, and creates an inherently inflexible design resulting in unmanageable code to deliver for the mission.

Difficulties with Automation and Infrastructure as Code

While automation and infrastructure as code are becoming more common in the cloud, their application at the tactical edge is proving to be more challenging and is often abandoned. Surrendering to the challenges of the tactical edge becomes a major roadblock to operational efficiency, scaling, and mission acceleration.

Challenges with AI/MLOps

GPU-based workloads servicing AI/ML pipelines that generate, feed, and exercise models have become prolific in the cloud within recent years. The power and capability of technologies such as general-purpose AI cannot be overstated in its usefulness to the operators at the edge.

However, leveraging that technology and capability becomes extraordinarily difficult when operating in an airgap environment or location with limited or no connectivity. With the Rancher Government HCI Edge Solution GPU workloads can not only be run at the edge where the sensors and data are located, they can also manage GPU resources exactly how they would be managed in the cloud while running the exact same applications.

This means MLOps platforms, pipelines, and applications designed to generate and exercise model data in the cloud can do so at the edge without needing to phone home. This significantly reduces data bandwidth needs and ensures efficiency of operations even when encountering limited or poor connectivity in hostile, resource constrained environments.

Shortcomings of Existing Data Center Technologies

Existing on-premises datacenter technologies, built on legacy designs, face difficulties in adapting to the tactical edge. Their large physical footprint and manual configuration requirements, along with strict hardware requirements and a history of software-enforced obsolescence, by way of the deprecation of core Operating System drivers and chipset support, limit their ability in diverse edge environments.

Shrinking these technologies for edge-compatible devices is challenging and cost-prohibitive. These technologies are also often tightly coupled to specific hardware, which limits hardware options, increases costs, and reduces the availability of edge-centric features.

How Does RGS Handle the Edge?

Rancher Government has established itself as a leader in edge computing solutions, specifically tailored to the unique and operational security needs of the U.S. Government and military. Rancher Government aligns with the needs and high stakes demands of public sector operations, delivering premium enterprise software subscriptions and engineering resources around the Rancher Kubernetes suite of solutions.

The strength of Rancher's stack lies in its dual nature of being both open source and open standard, with a large, vibrant ecosystem of third-party Kubernetes tools, services, and applications. At the core of Rancher Government's philosophy is the prioritization of U.S. Government customers and missions, treating their primary use cases and common security requirements as first-class citizens.

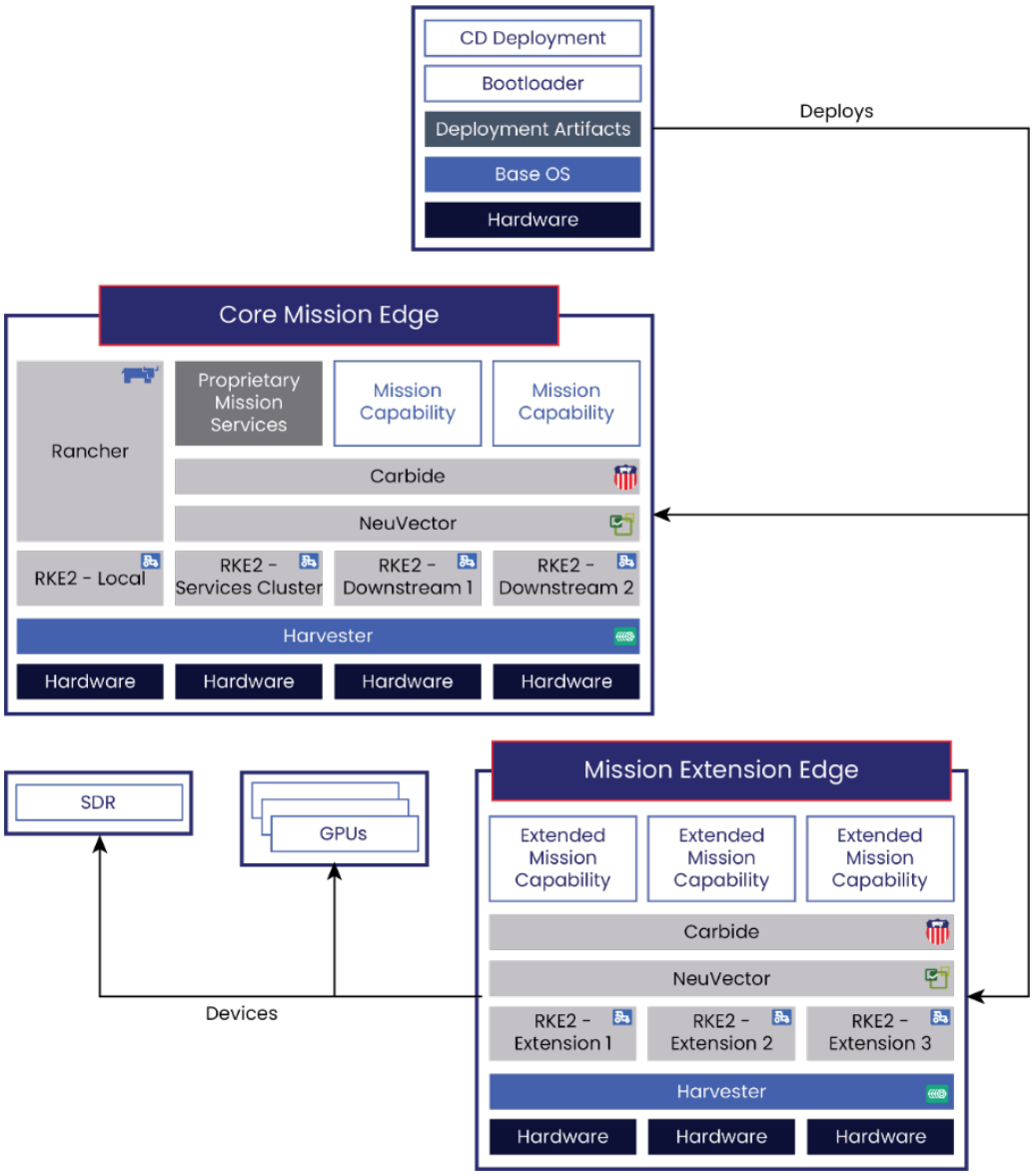

Figure showing Rancher's stack architecture, highlighting its open-source/open-standard nature.

A key advantage of the Rancher stack is its architecture, where all components are loosely coupled and based on open standards. This structure allows for diverse configurations that effectively remove cloud-specific dependencies, reduce vendor lock-in, and support a broad range of other open-standard tools. In line with this approach, Rancher frequently

collaborates with other vendors to deliver integrated, 'better together' products across all divisions of the Department of Defense, Intelligence Community, and Civilian sectors.

When addressing tactical edge computing challenges, Rancher's stack demonstrates remarkable flexibility, in that deployments commonly used in cloud environments are equally at home on small footprint devices designed for resource constrained and disconnected environments.

The tools used in the Rancher stack are built from the ground up with the U.S. Government mission top of mind. This ensures a secure-by-design, secure-by-default approach and full air-gap support and enablement. In addition, Rancher Government subscription customers get advanced hardening features and STIG (Secure Technical Implementation Guide) compliance automation via Rancher Government Carbide our secure software supply chain solution.

When considering Rancher Government's Edge capabilities in the context of the shortcomings of existing legacy solutions it is clear that our HCI Edge Solution is a transformational new application platform entirely decoupled from hardware, that can operate on nearly any hardware footprint, using automation to deploy a full software stack, and ensure sustainable and scalable success in a variety of operational contexts.

Addressing the Challenges at the Tactical Edge

Rancher Government addresses the complex challenges at the Tactical Edge through its innovative Hyperconverged (HCI) Edge Solution. This approach is powered by Harvester, Rancher's leading bare metal Kubernetes-as-Infrastructure product, offering unparalleled flexibility in configuration to tailor solutions specifically for diverse missions, including comprehensive software stacks.

The cornerstone of this solution is its ability to deploy and extend the Rancher Government HCI Edge on various hardware platforms, including heterogeneous edge hardware. This is achieved through installing a fully configured stack onto either blank or pre-existing, unconfigured devices without operator intervention and execution within an airgap environment for heightened security and reliability. Where competitors struggle to overcome tactical edge challenges, Rancher Government's HCI Edge Solution overcomes them with ease.

Breaking Cloud-Specific Limitations

The Rancher Government HCI Edge Solution's design strategically moves away from cloud-specific, closed-source technologies, embracing Harvester's core capability to run both containers and Virtual Machines side-by-side anywhere. This is managed through the strong orchestration, API, and scheduling capabilities delivered by Kubernetes.

With the infrastructure layer now based on RKE2, Rancher's secure-by-default Kubernetes distribution, a common language for defining both the infrastructure and the application platform emerges. This integration significantly reduces complexity for rapid deployment, upgrades, and dynamic mission capability, streamlining processes at the tactical edge.

Introducing Hardware Agnosticism

Unlike traditional cloud infrastructures, the Rancher Government HCI Edge Solution is designed to operate on many hardware platforms, highlighting its complete decoupling from specific hardware requirements. The HCI Edge stack can run on nearly any device providing an AMD64 architecture, further increasing its interoperability.

Harvester, the core of the Rancher Government HCI Edge, is open source, designed and optimized to support the broadest range of hardware devices in the market. This versatility further enhances the ability to integrate heterogeneous hardware, allowing for the use of various servers or machines, even perfectly good hardware that may have been prematurely retired or from a different hardware vendor. This approach ensures that essential services remain uninterrupted and adaptable, regardless of deployment scenarios.

Deployment Simplification and Automation

The Rancher Government HCI Edge Solution leverages automation to simplify the deployment and management of Kubernetes at the tactical edge, with a specific focus on defining and delivering all components within the stack using the Kubernetes API. This approach includes bare-metal provisioning of nodes and the integration of infrastructure services, such as secret storage and code repositories, as well as the deployment and management of all applications.

This approach ensures the entire infrastructure is defined using Infrastructure as Code (IaC) and managed with embedded Continuous Deployment (CD) tools by default. Consequently, scaling up with additional compute and storage or modifying configurations becomes a straightforward process in the field. This automation, enhanced by the integration of IaC and GitOps, establishes a common language for defining the entire stack from top to bottom, guaranteeing the sustainability and scalability of the platform. Using the Rancher Government HCI Edge Solution, defining an entire edge deployment across many devices can be condensed to a single configuration file (yaml).

Effective and Compact Deployment

The Rancher Government HCI Edge is designed to function efficiently even on small form-factor devices (SFFs). The compact yet powerful nature of Harvester allows for the implementation of numerous SFFs to establish a robust and scalable computing infrastructure with a small physical footprint. This approach establishes the delivery of the necessary computing stack and facilitates the expansion of mission capabilities with additional compute resources as needed.

The deployment of Harvester's HCI Edge capability requires just a single, simple configuration file to define an edge environment. This method reduces costs by eliminating the traditional labor-intensive process of configuring individual systems, which often involves integrating multiple infrastructure components. The result is a significant reduction in cost, setup time, effort, and testing; transforming the way edge computing infrastructures are deployed and managed.

Modular Flexibility, Open-Source Reliability, and Associate Cost-Savings

The Rancher Government HCI Edge's loose coupling approach allows each component to function independently while still working cohesively with the overall system. Such an architecture offers flexibility in deployment and upgrades, significantly reducing the risks and cost associated with being locked into proprietary technologies.

The open-source nature of the Rancher Government HCI Edge stack ensures adaptability and integration with third-party tools and systems; essentially making it future-proof. Traditional on-premises data center technologies are typically tightly coupled to hardware requirements. Traditional on-prem infrastructure providers have a history of deprecating support of older hardware within their upgrade paths. They tend to deliberately phase out software core driver support in their new releases, forcing a hardware refresh to go with the software. The modular engineering of Rancher Government HCI Edge avoids these pitfalls that often result in premature obsolescence of perfectly good and functioning hardware. This can lead to huge cost savings in hardware procurement.

The Future-Ready Edge Computing Solution

While others have struggled to meet the shifting demands of the tactical edge, Rancher Government excels with unmatched capabilities that set a new standard in edge computing. The Rancher Government HCI Edge Solution embodies the essence of innovation, bolstering the power of open source software like Rancher Multi-Cluster Manager (MCM), Harvester, and RKE2. It represents a leap in modern software design, achieving outcomes once deemed either impossible or impractical.

The Rancher Government HCI Edge Solution stands ready to meet the evolving challenges of tomorrow's U.S. Government and military missions. Its combination of agility, scalability, robust security, and adaptability positions it at the forefront of technological innovation and operational efficiency and effectiveness in the demanding world of U.S. Government and military edge computing.

Schedule a demo of this unique capability today and let us show you how Rancher Government can elevate your tactical edge mission, delivering a versatile, cloud-native platform compatible with virtually any device.

About Rancher Government Solutions

Rancher Government is specifically designed to address the unique security and operational needs of the U.S. Government and military as it relates to application modernization, containers, and Kubernetes.

Rancher is a complete open-source software stack for teams adopting containers. It addresses the operational and security challenges of managing multiple Kubernetes clusters at scale while providing DevOps teams with integrated tools for running containerized workloads.

Rancher Government supports all Rancher products with U.S. based American citizens who are currently supporting programs across the Department of Defense, the Intelligence Community, and civilian agencies.

Rancher Government is a U.S. based subsidiary of SUSE, the largest pure-play open-source company in the world. Established in 1992, SUSE has a proven track record of contributing to the open-source community and delivering secure enterprise products and services.

To learn more about Rancher Government's products and solutions visit www.ranchergovernment.com.

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