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Kubernetes platform comparison: Red Hat OpenShift, SUSE Rancher and Canonical Kubernetes

How to choose the right Kubernetes distribution for your business

August 2021

Executive summary

Adopting a container-first approach represents an unrivalled opportunity for enterprises to increase efficiency and resource utilisation, improve security, introduce automation and accelerate innovation – so it's no surprise that Gartner predicts more than 75% of global organisations will be running containerised applications in production by 2022.[1]

Kubernetes has established itself as the leading open source platform for managing containerised workloads and services, but the Kubernetes ecosystem is vast and complex. There are numerous different versions of Kubernetes to choose from, and it can be difficult to understand which is best suited to an organisation's specific requirements.

This whitepaper aims to address this challenge by providing a detailed snapshot of the Kubernetes landscape at time of writing, comparing three leading enterprise-grade Kubernetes distributions – Canonical Kubernetes, Red Hat OpenShift and SUSE Rancher – across 19 key capabilities, with scores summarised in a table at the end of the report. Canonical Kubernetes proves to be the most flexible, advantageous and cost-effective distribution.

1. https://www.gartner.com/en/newsroom/press-releases/2020-06-25-gartner-forecasts-strong-revenue-growth-for-global-co

Key considerations for enterprise Kubernetes

1. CNCF conformant

CNCF certification is a conformance program that ensures each vendor's Kubernetes distribution supports the required APIs and provides timely updates. Choosing a CNCF certified Kubernetes installation allows enterprises to guarantee the adaptability, predictability and interoperability of the product. It also prevents vendor lock-in, providing the flexibility to pivot to alternative solutions as capabilities and requirements evolve.

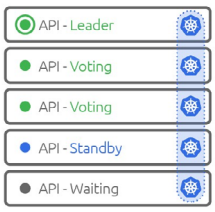
Canonical Kubernetes, Red Hat Openshift and SUSE Rancher are all CNCF certified.

2. Lifecycle operations

When beginning a Kubernetes journey, it's easy to get caught up in development and deployment without thinking about how the cluster will be maintained long-term. Many solutions around Kubernetes address the early phases of the Kubernetes lifecycle – Day 0 and Day 1 – but the real challenge begins at Day 2.

When it comes to Day 2 operations, both Canonical Kubernetes and OpenShift leverage operators to deliver full lifecycle automation. However, where OpenShift's operators are mostly designed to work in isolation, Canonical Kubernetes operators can be composed together to deliver highly complex applications and services. Canonical Kubernetes is deployed using Juju, and it has been designed with operators in mind, making long-term challenges like maintenance and upgrades easier to solve.

Rancher supports upstream operators, but does not deliver the same degree of lifecycle automation out of the box as Canonical Kubernetes or OpenShift.



3. High availability

Minimising downtime maximises reliability and productivity, which is why high availability is a standard characteristic of all leading Kubernetes solutions. Canonical Kubernetes, Rancher and OpenShift all deliver highly available clusters.

4. Cluster upgrades

With new Kubernetes versions available every quarter, it is important for enterprises to ensure that their solution has a reliable upgrade strategy that keeps it up-to-date with the upstream without compromising stability or disrupting ongoing operations. In that regard, Canonical Kubernetes, OpenShift, and Rancher all offer automated upgrades with zero downtime.

Canonical Kubernetes pulls ahead with respect to the granular control that enterprises can exert over the upgrade process. Users can precisely sequence and stagger updates to each component, enabling them to fully upgrade a cluster while ensuring there is zero impact to the workloads running on top.

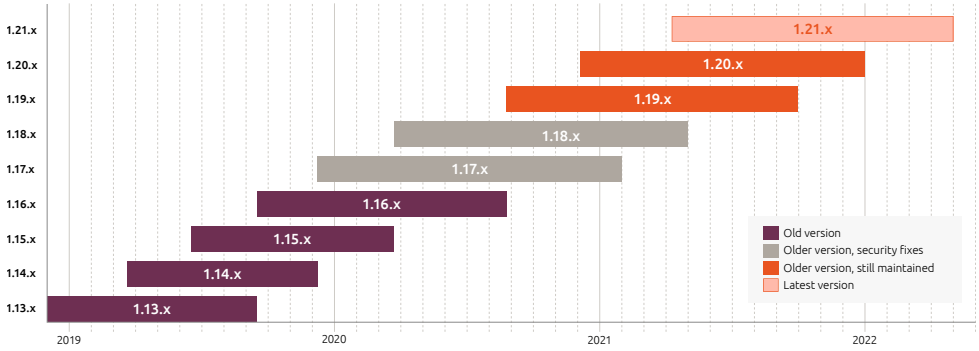
5. Support lifecycle

Sometimes it isn't viable for an enterprise to keep fully up-to-date with the most recent upstream Kubernetes release. To ensure Kubernetes deployments remain secure, it's essential to know how long a vendor supports each version.

OpenShift supports the latest 3 minor Kubernetes releases, supporting each for a total of 9 months. For the first 3 months, a given version receives "full support", with urgent fixes released as they become available, and other fixes delivered in periodic patches. For the remaining 6 months, the version receives "maintenance support", during which time non-urgent fixes are only delivered at Red Hat's discretion.

Rancher supports the N-1 to N-4 most recent Kubernetes releases per Rancher management server release, which happens twice a year. Every minor Rancher management server release is maintained for 15 months, after which only security updates are made available. The fact that support for Kubernetes releases is tied to the Rancher release schedule can limit flexibility, and means that the most recent upstream Kubernetes version is not always supported.

Canonical Kubernetes supports the 5 most recent Kubernetes releases. The 3 latest versions receive full feature and product updates alongside security patches, while the older 2 versions receive security updates only. This broader support approach eliminates issues with hybrid clouds where cloud providers are slow to adopt current Kubernetes revisions and continue to support older versions.



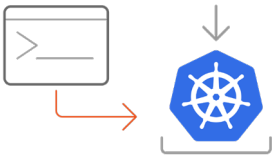
6. Edge support

Operating at the edge creates new challenges for Kubernetes: scale, size and accessibility of resources can soon become limiting factors. To address these challenges, Canonical offers MicroK8s – a lightweight, zero-ops Kubernetes distribution purpose-built for edge and IoT environments. Similarly, K3s from Rancher is a minimal footprint distribution designed to excel in resource-constrained, remote locations.

Both K3s and MicroK8s drastically simplify the process of deploying, optimising and maintaining Kubernetes at the edge. One of the main differences between MicroK8s and K3s is their decisions around the Kubernetes API. MicroK8s provides full compatibility with the upstream K8s API, whereas K3s offers a more opinionated subset of the API to provide a slightly smaller binary.

While OpenShift can be extended to run on edge devices, Red Hat does not offer a dedicated, lightweight Kubernetes distribution for edge computing. This means that users must contend with the full complexity and size of OpenShift and its numerous components.

7. Single-node edition



For users looking to run Kubernetes on a single device, there exist lightweight distributions dedicated to providing single node clusters and abstracting some of the inherent Kubernetes complexity. Both Canonical Kubernetes and Rancher support single-node clusters via MicroK8s and K3s respectively. As of this writing, Red Hat does not officially support any single node OpenShift solution.

Both MicroK8s and K3s allow extending the clusters into multiple nodes. MicroK8s provides a way for users to build self-healing, highly available clusters with only a few commands and no configuration, whereas K3s requires more manual work for doing the same.

8. Managed Kubernetes offering

Kubernetes brings unprecedented levels of automation and a ubiquitous platform for enterprise workloads. However, Kubernetes itself is a highly complex technology, and not all businesses have the expertise or time to maintain it in-house. A fully managed Kubernetes cluster eliminates this issue by enabling users to consume Kubernetes as a service. The vendor takes care of operating the cluster while users focus on delivering their core business value.

With Canonical Kubernetes, enterprises can opt for fully managed clusters on bare metal, OpenStack, or any public cloud. Canonical will build and operate the cluster, with in-house experts available 24/7 to stand-up and scale the deployment. What's more, users can choose to fully take over operational control at any time, and even redeploy or replicate the deployment using the exact same tools. Red Hat OpenShift Managed Services functions in much the same way, but its support for private cloud and bare metal deployments is limited to specific hardware. Rancher does not currently offer a fully managed Kubernetes service.

9. Container runtime and registries

Container runtimes are responsible for creating, starting and managing containers at a low-level on the underlying nodes of a Kubernetes cluster. They are thus a core component of any Kubernetes deployment, and must be installed on every node in a cluster. When evaluating Kubernetes distributions with respect to container runtimes, the differentiating factor is the breadth of runtime options that each distribution supports, and the use-cases that these runtimes enable. The primary runtime options are Containerd, Kata Containers and CRI-O.

Containerd is a high-level container runtime that can manage the complete container lifecycle, delivering simplicity, robustness and portability. Containerd can be seen as the industry-standard container runtime, and it is the default in upstream Kubernetes. Canonical Kubernetes and Rancher support containerd.

Kata Containers puts the emphasis on security, providing deeper isolation between containers by placing them inside lightweight VMs. Canonical Kubernetes and Red Hat Openshift support Kata Containers.

CRI-O is a container runtime designed by Red Hat specifically for Kubernetes. It can work alongside any other Open Container initiative (OCI) compatible runtime to enable considerable flexibility.

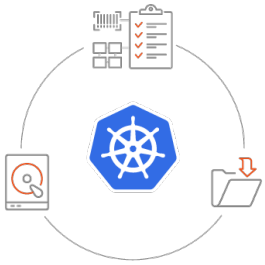
The container registry is another fundamental building block of a successful Kubernetes strategy. The registry is where container images are stored, and these images are critical to application development and scalability. Container registries come in various flavours, and Canonical Kubernetes, Red Hat Openshift and Rancher all support private registries, public cloud registries and DockerHub.

10. Networking

Networking in Kubernetes is facilitated by a Container Network Interface (CNI), which enables Kubernetes components and applications to communicate with one another. There are a wide variety of networking solutions to choose from, but not all Kubernetes distributions support all networking software. With that in mind, organisations should take care to select a Kubernetes distribution that either supports the specific networking solution they are looking to use, or offers the greatest breadth of choice.

- Canonical Kubernetes supports Flannel, Canal, Calico, Tigera EE, Multus, SR-IOV, CIlium and Juniper Contrail.
- Red Hat Openshift supports OpenShift SDN, Flannel, Calico, Nuage, Kuryr, OvS, Multus and SR-IOV.
- Rancher supports Canal, Calico, Flannel and Weave.

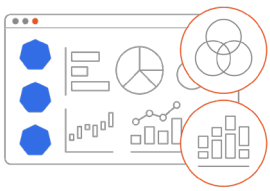
11. Storage



Storage on Kubernetes is inherently challenging, since the dynamic nature of containers is at odds with the concept of persistent storage. There are a variety of storage solutions that enterprises can leverage to overcome this difficulty. Again, Canonical Kubernetes stands out as it supports the most popular storage technologies, that balance cutting edge features yet are mature enough for production use.

- Canonical Kubernetes supports Ceph, NFS, Cloud Storage, NetApp, vSphere, FlexVolume and PureStorage.
- Red Hat Openshift supports Ceph/Rook, Red Hat OpenShift Data Foundation, GlusterFS, NFS, Cinder and Flexvolume.
- SUSE Rancher supports GlusterFS, NFS, vSphere and Longhorn.

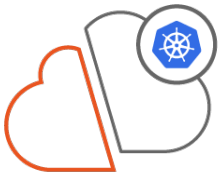
12. Monitoring and operations management



The ability to monitor the status of a Kubernetes deployment from a single, centralised location is invaluable. With effective monitoring solutions, enterprises can easily track resource utilisation, application performance and bottlenecks, enabling them to proactively manage and optimise their Kubernetes clusters.

All three Kubernetes distributions come with robust monitoring and operations management functionality out of the box. OpenShift includes a preconfigured Prometheus monitoring stack with Grafana dashboards. Similarly, Rancher users can activate Prometheus and Grafana with one click in the Rancher UI. Finally, Canonical Kubernetes ships with a standardised set of open source log aggregation and systems monitoring dashboards using solutions such as Prometheus, Grafana, Elasticsearch and Nagios.

13. Multi-cloud deployments



Modern businesses rarely rely on a single cloud platform. Rather, enterprises will typically pursue a multi-cloud strategy where applications are hosted on different public or private clouds (or bare metal) depending on their requirements. As such, the ease with which Kubernetes can be deployed and ported across different platforms should be a key consideration when choosing a distribution.

Canonical Kubernetes utilises Juju to help businesses navigate the complexity of multi-cloud provisioning, installation, and configuration. Juju Charmed Operators ("charms") facilitate the deployment and management of Kubernetes across different cloud providers and instances by utilising the concept of Model-Driven Operations. Juju Models allow the low-level storage, compute, network and software components to be reasoned about as a single entity, with common configuration applied model-wide where appropriate. Charms effectively ship automation rules along the components, turning day 0 to day 2 operations into repeatable and reliable code.

Instead of using model-driven operations that isolate the model from the platform, other vendors rely on templating systems for multi-cloud deployments, providing different configurations optimised to target different clouds. With OpenShift, Ansible can be used to streamline multi-cloud Kubernetes deployments. Similarly, multi-cloud with Rancher leverages Helm charts, with cloud-specific versions of Kubernetes, such as Amazon EKS and Google GKE. These templating systems often lack the flexibility and repeatability of codified applications management, which can result in increased maintenance costs.

14. Native AWS/GCP/Azure integration

Easy multi-cloud deployment is of little use if the Kubernetes distribution cannot run on the target infrastructures. Canonical Kubernetes, OpenShift, and Rancher all offer native integration with the three leading public clouds: Amazon Web Services (AWS), Google Cloud Platform (GCP) and Microsoft Azure.

15. Native Openstack/VMware integration

Turning to private clouds, all three Kubernetes distributions offer native integration with both OpenStack and VMware.

16. Bare metal deployment and automation

Not all workloads are suited to virtualisation, and enterprises will sometimes need to deploy Kubernetes directly on bare metal servers. While all three distributions support bare metal deployments, only Openshift and Canonical Kubernetes come with bare metal provisioning capabilities.

As of OpenShift 4.6, RedHat has made its installation automation option, installer-provisioned infrastructure (IPI), available for bare metal deployments using Metal3. IPI provides end-to-end automation for a consistent user experience across different deployment footprints. However, users must satisfy certain prerequisites to use IPI, and OpenShift configuration via IPI is highly opinionated, with limited scope for customisation.

With Canonical Kubernetes, enterprises can leverage Metal-as-a-Service (MAAS) to fully automate discovery, commissioning, deployment, and configuration of bare metal machines with zero-touch, cloud-style provisioning. Once the machine has been provisioned, Juju integration lets users deploy Canonical Kubernetes just as easily as they would in a public or private cloud. In contrast to OpenShift IPI, MAAS offers greater control over configuration options and a lower barrier to entry with fewer prerequisites.

17. GPGPU support for accelerated workloads

For many workloads, performance can be accelerated by offloading some of the compute-intensive portions of an application from the central processing unit (CPU) to a general-purpose graphics processing unit (GPGPU). GPU acceleration applies to applications on Kubernetes as well, so long as the Kubernetes distribution supports it.

Canonical Kubernetes, OpenShift and Rancher all support GPU acceleration. However, at the edge, MicroK8s offers GPU acceleration where K3s does not.

18. Security

Canonical Kubernetes runs in immutable containers to provide superior security out of the box, and provides security patching for the last 5 releases of Kubernetes as part of its extended security maintenance program (ESM). Integration with K8s RBAC, Active Directory and LDAP, CIS hardening by default, encryption at rest and automatic security updates with no downtime ensure that users get a highly secure Kubernetes deployment. Businesses can also leverage Ubuntu livepatching to protect their host OS with no downtime by patching Linux kernel security vulnerabilities while the system is running. Lastly, Canonical Kubernetes allows for container isolation from the host system with AppArmor.

Red Hat OpenShift provides a variety of tools to isolate and protect containers, such as SELinux, which functions in a similar fashion to AppArmor. Red Hat Quay and OpenShift S2I help organisations automate the container building process, ensuring consistency and security across deployments. Red Hat Quay can also be used alongside Clair to scan the integrated container registry and notify developers of any detected vulnerabilities. OpenShift features strong encryption, Kubernetes hardening, identity management and RBAC by default, and users can further enhance security by leveraging a wide array of certified third-party tools.

Rancher also supports K8s RBAC and follows best practices from the CIS Kubernetes benchmark, with robust documentation enabling users to easily harden their deployments and self-assess their security levels. Additionally, Rancher regularly carries out third-party security audits and penetration testing to detect potential vulnerabilities.

19. Supported architectures

The range of supported architectures is another area where Canonical Kubernetes leads the pack, followed by OpenShift and then Rancher:

- Canonical Kubernetes supports x86, ARM, IBM POWER and IBM Z.
- Red Hat OpenShift supports X86, IBM POWER and IBM Z.
- Rancher supports x86 and ARM.

20. Pricing

Canonical Kubernetes offers by far the best price performance of the three distributions, largely due to how easy it is to deploy and manage with Juju automation, and the fact that there are zero license fees for Canonical software. Additionally, enterprise support is available through a highly cost-effective, per-host model.

OpenShift sits at the opposite end of the spectrum. With steep license fees and a per-core support model, the TCO for OpenShift will typically be multiple times higher than that of alternative distributions. What's more, long term operating costs exceed those of Canonical Kubernetes due to the more limited automation of day 2 operations.

Rancher's costs occupy the middle ground between Canonical Kubernetes and OpenShift. While Rancher does not charge license fees, deployment and enterprise support costs are high, and it suffers from the same lack of day 2 automation as OpenShift.

Comparison scorecard

In instances where it is simply a case of having the capability or not, scores are indicated by a check mark (✓) or dash (–) respectively.

In instances where the quality of a capability varies between Kubernetes distributions, a numerical score out of 5 denotes the relative strength of each platform.

	Canonical Kubernetes	Red Hat Openshift	Rancher
CNCF Conformant	✓	✓	✓
Lifecycle operations	●●●●●	●●●●○	●●●○○
High availability	✓	✓	✓
Cluster upgrades	✓	✓	✓
Support lifecycle	●●●●◐	●●●●○	●●●◐○
Edge support	●●●●●	●●●○○	●●●●●
Single-node edition	✓	–	✓
Managed Kubernetes offering	✓	✓	–
Container runtime and registries	●●●●◐	●●●●○	●●●○○
Networking	●●●●●	●●●●●	●●●◐○
Storage	●●●●●	●●●●○	●●●○○
Monitoring and operations management	✓	✓	✓
Multi-cloud deployments	●●●●●	●●●○○	●●●●○
Native AWS/GCP/Azure integration	✓	✓	✓
Native Openstack/VMware integration	✓	✓	✓
Bare metal deployment and automation	●●●●○	●●●○○	●○○○○
GPGPU support for accelerated workloads	✓	✓	✓
Security	●●●●○	●●●●○	●●●○○
Architectures supported	●●●●●	●●●●○	●●●○○
Pricing	$	$$$$$	$$$

Summary

Canonical Kubernetes, Red Hat OpenShift and SUSE Rancher each offer robust, feature-rich Kubernetes deployments that are well-suited to enterprise production environments. That being said, it is clear that Canonical Kubernetes offers superior price performance, breadth of support, multi-cloud integration and lifecycle automation than other Kubernetes platform alternatives.

To learn more about Canonical Kubernetes, visit ubuntu.com/kubernetes or talk to our team today.

Additional Resources

- Kubernetes and Cloud Native operations report
- 5 strategies to accelerate Kubernetes deployment in the enterprise
- Kubernetes from cloud to edge
- How to install Charmed Kubernetes
- How to install MicroK8s
- Canonical managed Kubernetes services

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