

Layered Stack Deployment of Rancher Kubernetes Engine

Integrated with Supermicro (R)

Layered Stack Deployment of Rancher Kubernetes Engine: Integrated with Supermicro (R)

SUSE Linux Enterprise Server 15 SP3, Rancher Kubernetes Engine 1.2.16

The purpose of this document is to provide an overview and procedure of implementing SUSE (R) and partner offerings for Rancher Kubernetes Engine (RKE), a Kubernetes distribution that runs entirely within containers on bare-metal and virtualized nodes. RKE solves the problem of installation complexity and the operation is both simplified and easily automated, while entirely accommodating the operating system and platform it is running on.

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Publication Date: 2022-03-28

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1 Introduction

On the digital transformation journey to a full cloud-native landscape, the use of microservices becomes the main approach with the dominant technology for such container orchestration being Kubernetes.¹ With its large community of developers and abundant features and capabilities, Kubernetes has become the de-facto standard and is included across most container-as-a-service platforms. With all of these technologies in place, both developer and operation teams can effectively deploy, manage and deliver functionality to their end users in a resilient and agile manner.

1.1 Motivation

Once on such a digital transformation journey, also relevant to focus on areas like:

Workload(s)

Determine how to manage and launch internally developed containerized, microservice workloads

Kubernetes

As developers and organizations continue their journey from simple, containerized microservices toward having these workloads orchestrated and deployed where ever they need, being able to install, monitor and use such Kubernetes infrastructures is a core need. Such deployments, being Cloud Native Computing Foundation (CNCF²) conformant and certified³ are essential for both development and production workloads.

- Solving common frustrations around installation complexity, Rancher Kubernetes Engine reduces many host dependencies and provides a stable path for deployment, upgrades, and rollbacks for core use cases.


Compute Platform(s)

To optimize availability, performance, scalability and integrity, assess current system or hosting platforms

¹ <https://kubernetes.io/> ↗

² <https://www.cncf.io/> ↗

³ <https://www.cncf.io/certification/software-conformance> ↗

from Independent Hardware Vendors (IHV), such as [Supermicro \(https://www.supermicro.com/en\)](https://www.supermicro.com/en)  ® as the platform for physical, bare metal, hypervisors and virtual machines

1.2 Scope

The scope of this document is to provide a layered *reference configuration* for Rancher Kubernetes Engine. This can be done in a variety of scenarios to create an enterprise Kubernetes cluster deployment anywhere.

1.3 Audience

This document is intended for IT decision makers, architects, system administrators and technicians who are implementing a flexible, software-defined Kubernetes platform. One should still be familiar with the traditional IT infrastructure pillars — networking, computing and storage — along with the local use cases for sizing, scaling and limitations within each pillars' environments.

2 Business aspect

Agility is driving developers toward more cloud-native methodologies that focus on microservices architectures and streamlined workflows. Container technologies, like Kubernetes, embody this agile approach and help enable cloud-native transformation.

By unifying IT operations with Kubernetes, organizations realize key benefits like increased reliability, improved security and greater efficiencies with standardized automation. Therefore, Kubernetes infrastructure platforms are adopted by enterprises to deliver:

Cluster Operations

Improved Production and DevOps efficiencies with simplified cluster usage and robust operations

Security Policy & User Management

Consistent security policy enforcement plus advanced user management on any Kubernetes infrastructure

Access to Shared Tools & Services

A high level of reliability with easy, consistent access to a broad set of tools and services

2.1 Business problem

Many organizations are deploying Kubernetes clusters everywhere — in the cloud, on-premises, and at the edge — to unify IT operations. Such organizations can realize dramatic benefits, including:

- Consistently deliver a high level of reliability on any infrastructure
- Improve DevOps efficiency with standardized automation
- Ensure enforcement of security policies on any infrastructure

However, simply relying on upstream Kubernetes alone can introduce extra overhead and risk because Kubernetes clusters are typically deployed:

- Without central visibility
- Without consistent security policies
- And must be managed independently

Deploying a scalable kubernetes infrastructure requires consideration of a larger ecosystem, encompassing many software and infrastructure components and providers. Further, the ability to continually address the needs and concerns of:

Developers

For those who focus on writing code to build their apps securely using a preferred workflow, providing a simple, push-button deployment mechanism of their containerized workloads where needed.

IT Operators

General infrastructure requirements still rely upon traditional IT pillars are for the stacked, underlying infrastructure. Ease of deployment, availability, scalability, resiliency, performance, security and integrity are still core concerns to be addressed for administrative control and observability.

Beyond the core infrastructure software layers of managed Kubernetes clusters, organizations may be also be impacted by:

Compute Platform

Potential inconsistencies and impacts of multiple target system platforms for the distributed deployments of the cluster elements, across:

- physical, baremetal, hypervisors and virtual machines

2.2 Business value

With Rancher Kubernetes Engine, the operation of Kubernetes is easily automated and entirely independent of the operating system and platform running. Using a supported version of the container runtime engine, one can deploy and run Kubernetes with Rancher Kubernetes Engine. It builds a cluster from a single command in a few minutes, and its declarative configuration makes Kubernetes upgrades atomic and safe.

By allowing operation teams to focus on infrastructure and developers to deploy code the way they want too, SUSE and the Rancher offerings helps bring products to market faster and accelerate an organization's digital transformation.

SUSE Rancher is a fundamental part of the complete software stack for teams adopting containers. It provides DevOps teams with integrated tools for running containerized workloads while also addressing the operational and security challenges of managing multiple Kubernetes clusters across any targeted infrastructure.

Developers

SUSE Rancher makes it easy to securely deploy containerized applications no matter where the Kubernetes infrastructure runs — in the cloud, on-premises, or at the edge. Using Helm or the App Catalog to deploy and manage applications across any or all these environments, ensuring multi-cluster consistency with a single deployment process.

IT Operators

SUSE Rancher not only deploys and manages production-grade Kubernetes clusters from datacenter to cloud to the edge, it also unites them with centralized authentication, access control and observability. Further, it streamlines cluster deployment on bare metal or virtual machines and maintains them using defined security policies.

With this increased consistency of the managed Kubernetes infrastructure clusters, organizations benefit from an even higher level of the Cloud Native Computing model where each layer only relies upon the API and version of the adjacent layer, such as:

Compute Platform

Supermicro is a leading innovator of server and storage solutions. By developing and using a Building Block approach, Supermicro can bring cutting edge solutions to market faster with our partners faster than other suppliers. Supermicro has a wide range of servers which are optimized for various workloads. Customers are able to take advantage of the latest technologies sooner, and with less impact on the environment through the Supermicro resource saving architecture. The Supermicro product line ranges from small, low power systems for the Edge, to larger multiprocessor systems in the data center.

3 Architectural overview

This section outlines the core elements of the Rancher Kubernetes Engine solution, along with the suggested target platforms and components.

3.1 Solution architecture

The figure below illustrates the high-level architecture overview of Kubernetes components on instances like Rancher Kubernetes Engine:

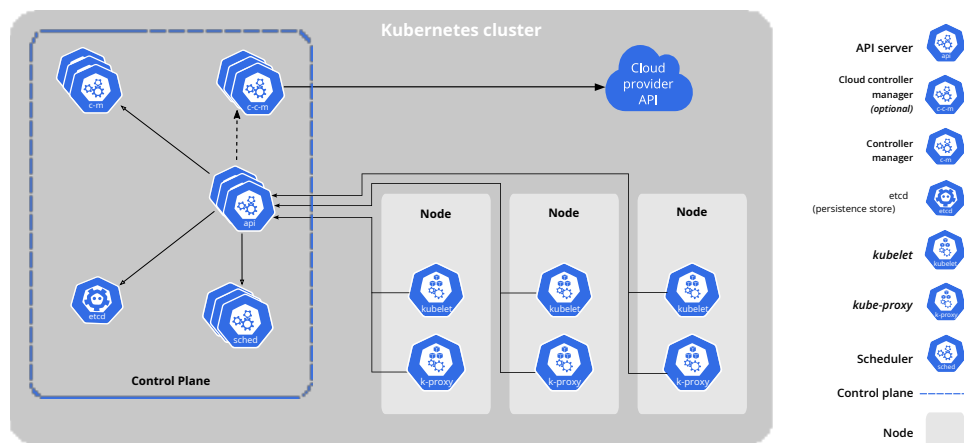


FIGURE 3.1: ARCHITECTURE OVERVIEW - RANCHER KUBERNETES ENGINE

A Kubernetes cluster consists of a set of nodes machines, called workers or agents, that host and run containerized applications in Pods. Every cluster has at least one worker node. The control plane manages the worker nodes and the Pods in the cluster. The provider API is a generic element that allows external interaction with the Kubernetes cluster.

Control Plane Components

The control plane's components make global decisions about the cluster (for example, scheduling), and detecting and responding to cluster events.

- kube-apiserver
 - The API server is a component of the Kubernetes control plane that exposes the Kubernetes API
- etcd

- Consistent and highly-available key value store used as Kubernetes' backing store for all cluster data.
- kube-scheduler
 - Control plane component that watches for newly created Pods with no assigned node, and selects a node for them to run on.
- kube-controller-manager
 - Control plane component that runs controller processes.

Node Components

Node components run on every node, maintaining running pods and providing the Kubernetes runtime environment.

- kubelet
 - An agent that runs on each node in the cluster. It makes sure that containers are running in a Pod.
- kube-proxy
 - A network proxy that runs on each node in your cluster, implementing part of the Kubernetes Service concept.



Note

Regardless of the deployment instance, Rancher Kubernetes Engine could always be deployed directly by SUSE Rancher or imported as a managed, downstream cluster.

4 Component model

This section describes the various components being used to create a Rancher Kubernetes Engine solution deployment, in the perspective of top to bottom ordering. When completed, the Rancher Kubernetes Engine instance can be used as the application infrastructure for cloud-native workloads and can be imported into SUSE Rancher for management.

4.1 Component overview

By using:

- Kubernetes Platform - Rancher Kubernetes Engine
- Operating System - SUSE Linux Enterprise Server
- Compute Platform
 - Supermicro Supermicro SuperServer

you can create the necessary infrastructure and services. Further details for these components are described in the following sections.

4.2 Software - Rancher Kubernetes Engine

Rancher Kubernetes Engine is a CNCF-certified Kubernetes distribution that runs entirely within Docker containers. It solves the common frustration of installation complexity with Kubernetes by removing most host dependencies and presenting a stable path for deployment, upgrades, and rollbacks.

With Rancher Kubernetes Engine [RKE], the operation of Kubernetes is easily automated and entirely independent of the operating system and platform you are running. As long as you can run a supported version of Docker, you can deploy and run Kubernetes with RKE. It builds a cluster from a single command in a few minutes, and its declarative configuration makes Kubernetes upgrades atomic and safe.

What is provided with Rancher Kubernetes Engine

- CNCF Certification

- Rancher Kubernetes Engine CNCF certification means that every release supports the same APIs as upstream Kubernetes. This gives enterprises the confidence that their Kubernetes resources are portable between RKE and other CNCF-certified Kubernetes distributions.
- Simplified installation
 - Installation is via a single binary and it uses a single YAML file, meaning that even non-experts can deploy Kubernetes with a single command. The command connects to remote hosts via SSH, so Rancher or any staff member with SSH access can deploy and manage RKE instances anywhere in the world.
- Automated Operation
 - When used with SUSE Rancher, operators can perform automated installation and upgrades of RKE clusters with a few clicks.
- Vendor Independence
 - RKE is not locked into a specific vendor operating system, Kubernetes Management Platform or proprietary tooling.
- Safe, Atomic Upgrades
 - Since RKE is built using containers, it does not have any touch points with the underlying operating system beyond the container engine. Containers make it easy to upgrade to a new version and to roll back to the previous version if necessary.
- 24x7 Enterprise-level Support

- Ensures around-the-clock support from technical experts when you need it.

The fundamental roles for the nodes and core functionality of Rancher Kubernetes Engine are represented in the following figure:

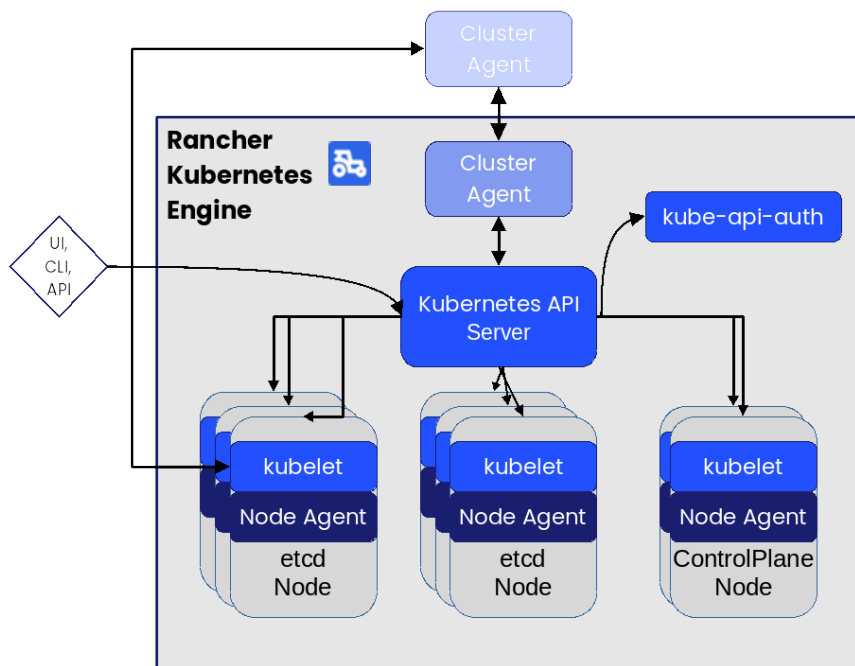


FIGURE 4.1: COMPONENT OVERVIEW - RANCHER KUBERNETES ENGINE

- Kubernetes API Server,
 - interacts with kubelet on all the nodes, plus addresses authentication, user interface (UI), command line interface (CLI) and API for external access and cluster management via SUSE Rancher cluster controller to agent

While all Rancher Kubernetes Engine roles can be installed on a single system, for the best availability, performance and security, the recommended deployment of a Rancher Kubernetes Engine cluster is a pair of nodes for the control plane role, at least three etcd role-based nodes and three or more worker nodes.

Rancher Kubernetes Engine can run as a complete cluster on a single node or can be expanded into a multi-node cluster. Besides the core Kubernetes components, these are also configurable and included:

- Multiple Kubernetes versions
- CoreDNS, Metrics, Ingress controller
- CNI : Canal, Calico, Flannel, Weave
- Support for a Windows worker agent node (only with Flannel)
- Fleet Agent : for GitOps deployment of cloud-native applications

All of these components are configurable and can be swapped out for your implementation of choice. With these included components, you get a fully functional and CNCF-conformant cluster so you can start running apps right away.



Tip

Learn more information about Rancher Kubernetes Engine at <https://rancher.com/docs/rke/latest/en/>.

While all Rancher Kubernetes Engine roles can be installed on a single system, a multi-node cluster, is a more production-like approach and will be described in the deployment section.



Tip

To improve availability, performance and security, the recommended deployment of a Rancher Kubernetes Engine cluster is a pair of nodes for the control plane role, at least three etcd role-based nodes and three or more worker nodes.

4.3 Software - SUSE Linux Enterprise Server

SUSE Linux Enterprise Server (SLES (<https://www.suse.com/products/server/>)) is an adaptable and easy-to-manage platform that allows developers and administrators to deploy business-critical workloads on-premises, in the cloud and at the edge. It is a Linux operating system that is

adaptable to any environment – optimized for performance, security and reliability. As a multimodal operating system that paves the way for IT transformation in the software-defined era, this simplifies multimodal IT, makes traditional IT infrastructure efficient and provides an engaging platform for developers. As a result, one can easily deploy and transition business-critical workloads across on-premises and public cloud environments.

Designed for interoperability, SUSE Linux Enterprise Server integrates into classical Unix and Windows environments, supports open standard interfaces for systems management, and has been certified for IPv6 compatibility. This modular, general purpose operating system runs on four processor architectures and is available with optional extensions that provide advanced capabilities for tasks such as real time computing and high availability clustering. SUSE Linux Enterprise Server is optimized to run as a high performing guest on leading hypervisors and supports an unlimited number of virtual machines per physical system with a single subscription. This makes it the perfect guest operating system for virtual computing.

4.4 Compute Platform

Leveraging the enterprise grade functionality of the operating system mentioned in the previous section, many compute platforms can be the foundation of the deployment:

- Virtual machines on supported hypervisors or hosted on cloud service providers
- Physical, baremetal or single-board computers, either on-premises or hosted by cloud service providers



Note

To complete self-testing of hardware with [SUSE YES Certified Process \(https://www.suse.com/partners/ihv/yes/yes-certified-process\)](https://www.suse.com/partners/ihv/yes/yes-certified-process), you can download and install the respective SUSE operating system support-pack version of SUSE Linux Enterprise Server and the YES test suite. Then run the tests per the instructions in the test kit, fixing any problems encountered and when corrected, re-run all tests to obtain clean test results. Submit the test results into the SUSE Bulletin System (SBS) for audit, review and validation.



Tip

Certified systems and hypervisors can be verified via [SUSE YES Certified Bulletins \(https://www.suse.com/yessearch/\)](https://www.suse.com/yessearch/) and then can be leveraged as supported nodes for this deployment, as long as the certification refers to the respective version of the underlying SUSE operating system required.

Supermicro servers take advantage of the latest CPU technologies available. The new servers have been shown to produce more work per watt than ever before. Thus, additional workloads can not only be performed in less time, but at a lower cost as well. Supermicro systems can support up to 6TB of memory per socket.

4.4.1 SYS-120C-TN10R Rack Servers



Note

The Supermicro SYS-120C-TN10R is SUSE YES Certified Hardware.

The [SYS-120C-TN10R](https://www.supermicro.com/en/products/system/Cloud/1U/SYS-120C-TN10R) (<https://www.supermicro.com/en/products/system/Cloud/1U/SYS-120C-TN10R>) Rack Servers provide the following attributes:

ULTIMATE FLEXIBILITY

- CPU: Up to 270W and 40 cores
- Memory: 4TB DDR4-3200 memory in 16 DIMM slots w/ support of Intel Optane PMEM 200 series
- Storage: Up to 10x all hybrid drive bays (NVMe/SAS/SATA) + Flexible internal storage options (dual NVMe M.2 / SATADOM)
- Expansion: Up to 2 standard PCIe 4.0 FHHL expansion slots + 2 AIOM for OCP 3.0 NIC; Building block solution for different applications and environment
- 860W Platinum level redundant PWS

EFFICIENT AND COST-EFFECTIVE

- Cost optimized for large volume deployment

- Tool-less mechanical design for rapid deployment
- Hot-swap storage and PWS for easy maintenance.
- IPMI, serial port and service tag for easy management

COMPACT

- Compact system design makes no waste of internal space
- < 600mm chassis depth
- Fully utilized system resource with 12 NVMe, 4 PCIe 4.0 x16 + 2 PCIe 4.0 x8 expansion

SECURE

- Security is top priority
- TPM 1.2/2.0, signed firmware, Silicon Root of Trust
- Secure Boot, System Erase
- FIPS Compliance, Trusted Execution Environment

APPLICATION READY

- Balanced architecture between CPUs and optimized for scalable compute, database, GPU, tiered storage and I/O intensive applications
- Support open standards like OpenBMC and OCP 3.0

KEEP IT GREEN

- Optimized thermal design
- High efficiency Platinum level PWS (AC/DC)
- Reduced waste with bulk packaging and customizable accessories

4.4.2 SYS-620C-TN12R Rack Servers



Note

The Supermicro SYS-620C-TN12R is SUSE YES Certified Hardware.

The [SYS-620C-TN12R](https://www.supermicro.com/en/products/system/Cloud/2U/SYS-620C-TN12R) (<https://www.supermicro.com/en/products/system/Cloud/2U/SYS-620C-TN12R>)  Rack Servers provide the following attributes:

ULTIMATE FLEXIBILITY

- CPU: Up to 270W and 40 cores
- Memory: 4TB DDR4-3200 memory in 16 DIMM slots w/ support of Intel Optane PMEM 200 series
- Storage: Up to 12 all hybrid drive bays (NVMe/SAS/SATA) + Flexible internal storage options (dual NVMe M.2 / SATADOM)
- Expansion: Up to 6 standard PCIe 4.0 expansion slots + 2 AIOM for OCP 3.0 NIC; Up to 2 FHFL DW GPUs or 6 LP GPUs
- Building block solution for different applications and environment
- 1200W Titanium level redundant PWS

EFFICIENT AND COST-EFFECTIVE

- Cost optimized for large volume deployment
- Tool-less mechanical design for rapid deployment
- Hot-swap storage and PWS for easy maintenance.
- IPMI, serial port and service tag for easy management

COMPACT

- Compact system design makes no waste of internal space
- < 650mm chassis depth
- Fully utilized system resource with 12 NVMe, 4 PCIe 4.0 x16 + 2 PCIe 4.0 x8 expansion

SECURE

- Security is top priority
- TPM 1.2/2.0, signed firmware, Silicon Root of Trust
- Secure Boot, System Erase
- FIPS Compliance, Trusted Execution Environment

APPLICATION READY

- Balanced architecture between CPUs and optimized for scalable compute, database, GPU, tiered storage and I/O intensive applications
- Cost and performance optimized down to component level
- Support open standards like OpenBMC and OCP 3.0

WE KEEP IT GREEN

- Optimized thermal design
- High efficiency Titanium level PWS (AC/DC)
- Reduced waste with bulk packaging and customizable accessories



Note

A sample bill of materials, in the [Chapter 9, Appendix](#), cites the necessary quantities of all components, along with a reference to the minimum resource requirements needed by the software components.

5 Deployment

This section describes the process steps for the deployment of the Rancher Kubernetes Engine solution. It describes the process steps to deploy each of the component layers starting as a base functional *proof-of-concept*, having considerations on migration toward *production*, providing *scaling* guidance that is needed to create the solution.

5.1 Deployment overview

The deployment stack is represented in the following figure:

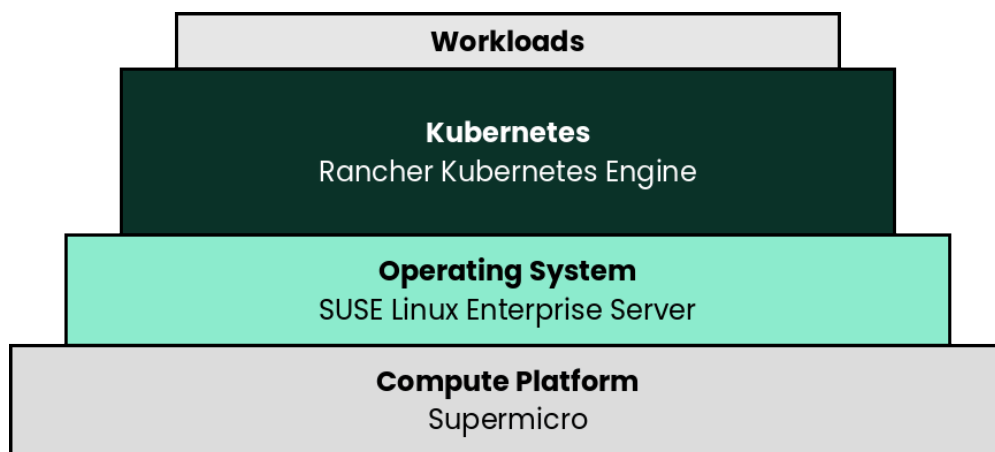


FIGURE 5.1: DEPLOYMENT STACK - RANCHER KUBERNETES ENGINE

and details are covered for each layer in the following sections.




Note

The following section's content is ordered and described from the bottom layer up to the top.

5.2 Compute Platform

The base, starting configuration can reside all within a single server. Based upon the relatively small resource requirements for a Rancher Kubernetes Engine deployment, a viable approach is to deploy directly on baremetal or as a virtual machine (VM) on the target nodes, on top of an existing hypervisor, like KVM. For physical host, there are tools that can be used during the setup of the server, see below:

- The [Supermicro Baseboard Management Controller \(https://www.supermicro.com/en/solutions/management-software/bmc-resources\)](https://www.supermicro.com/en/solutions/management-software/bmc-resources)  (BMC) provides remote access to multiple users at different locations for networking. It also allows a system administrator to monitor system health and manage computer events remotely, including media redirection of software image files used for installing operating systems and and HTML5 web console interaction.

5.3 SUSE Linux Enterprise Server

As the base software layer, use an enterprise-grade Linux operating system. For example, SUSE Linux Enterprise Server.

Preparation(s)

To meet the solution stack prerequisites and requirements, SUSE operating system offerings, like [SUSE Linux Enterprise Server \(https://www.suse.com/products/server/\)](https://www.suse.com/products/server/)  can be used.

1. Ensure these services are in place and configured for this node to use:

- Domain Name Service (DNS) - an external network-accessible service to map IP Addresses to host names
- Network Time Protocol (NTP) - an external network-accessible service to obtain and synchronize system times to aid in time stamp consistency
- Software Update Service - access to a network-based repository for software update packages. This can be accessed directly from each node via registration to

- the general, internet-based [SUSE Customer Center \(https://scc.suse.com\)](https://scc.suse.com) (SCC) or
- an organization's [SUSE Manager \(https://www.suse.com/products/suse-manager/\)](https://www.suse.com/products/suse-manager/) infrastructure or
- a local server running an instance of [Repository Mirroring Tool \(https://documentation.suse.com/sles/15-SP3/single-html/SLES-rmt/#book-rmt\)](https://documentation.suse.com/sles/15-SP3/single-html/SLES-rmt/#book-rmt) (RMT)



Note

During the node's installation, it can be pointed to the respective update service. This can also be accomplished post-installation with the command line tool named [SUSEConnect \(https://www.suse.com/support/kb/doc/?id=000018564\)](https://www.suse.com/support/kb/doc/?id=000018564).

Deployment Process

On the compute platform node, install the noted SUSE operating system, by following these steps:

1. Download the [SUSE Linux Enterprise Server \(https://www.suse.com/download/sles/\)](https://www.suse.com/download/sles/) product (either for the ISO or Virtual Machine image)
 - Identify the appropriate, supported version of SUSE Linux Enterprise Server by reviewing the support matrix for [SUSE Rancher \(https://www.suse.com/suse-rancher/support-matrix/all-supported-versions/\)](https://www.suse.com/suse-rancher/support-matrix/all-supported-versions/) versions Web page.
2. The installation process is described and can be performed with default values by following steps from the product documentation, see [Installation Quick Start \(https://documentation.suse.com/sles/15-SP3/single-html/SLES-installation/#article-installation\)](https://documentation.suse.com/sles/15-SP3/single-html/SLES-installation/#article-installation)



Tip

Adjust both the password and the local network addressing setup to comply with local environment guidelines and requirements.

Deployment Consideration(s)

To further optimize deployment factors, leverage the following practices:

- *Automation*
 - To reduce user intervention, unattended deployments of SUSE Linux Enterprise Server can be automated
 - for ISO-based installations, by referring to the [AutoY-aST Guide \(https://documentation.suse.com/sles/15-SP3/single-html/SLES-autoyast/#book-autoyast\)](https://documentation.suse.com/sles/15-SP3/single-html/SLES-autoyast/#book-autoyast) ↗

5.4 Rancher Kubernetes Engine

Preparation(s)

1. Identify the appropriate, desired version of the Rancher Kubernetes Engine binary (for example vX.Y.Z) that includes the needed Kubernetes version by reviewing
 - the "Supported Rancher Kubernetes Engine Versions" associated with the respective [SUSE Rancher \(https://www.suse.com/suse-rancher/support-matrix/all-supported-versions/\)](https://www.suse.com/suse-rancher/support-matrix/all-supported-versions/) ↗ version from "Rancher Kubernetes Engine Downstream Clusters" section, or
 - the "Releases" on the [Download \(https://github.com/rancher/rke/\)](https://github.com/rancher/rke/) ↗ Web page.
2. On the target node with a default installation of SUSE Linux Enterprise Server operating system, log in to the node either as root or as a user with sudo privileges and enable the required container runtime engine

```
sudo SUSEConnect -p sle-module-containers/15.3/x86_64
sudo zypper refresh ; zypper install docker
sudo systemctl enable --now docker.service
```

- Then validate the container runtime engine is working

```
sudo systemctl status docker.service
sudo docker ps --all
```

3. For the underlying operating system firewall service, either

- enable and configure the necessary inbound [ports \(https://rancher.com/docs/rke/latest/en/os/#ports\)](https://rancher.com/docs/rke/latest/en/os/#ports) or
- stop and completely disable the firewall service.

Deployment Process

The primary steps for deploying this Rancher Kubernetes Engine Kubernetes are:



Note

Installing Rancher Kubernetes Engine requires a client system (i.e. admin workstation) that has been configured with kubectl.

1. Download the Rancher Kubernetes Engine binary according to the instructions on product [documentation \(https://rancher.com/docs/rke/latest/en/\)](https://rancher.com/docs/rke/latest/en/) page, then follow the directions on that page, but with the following exceptions:
2. Create the cluster.yml file with the command `rke config`



Note

See product documentation for [example-yamls \(https://rancher.com/docs/rke/latest/en/example-yamls/\)](https://rancher.com/docs/rke/latest/en/example-yamls/) and [config-options \(https://rancher.com/docs/rke/latest/en/config-options/\)](https://rancher.com/docs/rke/latest/en/config-options/) for detailed examples and descriptions of the cluster.yml parameters.

- It is recommended to create a unique SSH key for this Rancher Kubernetes Engine cluster with the command `ssh-keygen`
 - Provide the path to that key for the option "Cluster Level SSH Private Key Path"
- The option "Number of Hosts" refers to the number of hosts to configure at this time
 - Additional hosts can be added very easily after Rancher Kubernetes Engine cluster creation
 - For this implementation it is recommended to configure one or three hosts

- Give all hosts the roles of "Control Plane", "Worker", and "etcd"
 - Answer "n" for the option "Enable PodSecurityPolicy"
3. Update the cluster.yml file before continuing with the step "Deploying Kubernetes with RKE"
 4. If a load balancer has been deployed for the Rancher Kubernetes Engine control-plane nodes, update the cluster.yml file before deploying Rancher Kubernetes Engine to include the IP address or FQDN of the load balancer. The appropriate location is under authentication.sans. For example:

```
LB_IP_Host=""
```

```
authentication:
  strategy: x509
  sans: ["${LB_IP_Host}"]
```

5. Verify password-less SSH is available from the admin workstation to each of the cluster hosts as the user specified in the cluster.yml file
6. When ready, run `rke up` to create the RKE cluster
7. After the `rke up` command completes, the RKE cluster will continue the Kubernetes installation process
 - Monitor the progress of the installation:
 - Export the variable KUBECONFIG to the absolute path name of the kube_config_cluster.yml file. I.e. `export KUBECONFIG=~/.rke-cluster/kube_config_cluster.yml`
 - Run the command: `watch -c "kubectl get deployments -A"`
 - The cluster deployment is complete when elements of all the deployments show at least "1" as "AVAILABLE"
 - Use Ctrl+c to exit the watch loop after all deployment pods are running



Tip

To address *Availability* and possible *scaling* to a multiple node cluster, etcd is enabled instead of using the default SQLite datastore.

Deployment Consideration(s)

To further optimize deployment factors, leverage the following practices:

- *Availability*
 - A full high-availability Rancher Kubernetes Engine cluster is recommended for production workloads. For this use case, two additional hosts should be added; for a total of three. All three hosts will perform the roles of control-plane, etcd, and worker.
 1. Deploy the same operating system on the new compute platform nodes, and prepare them in the same way as the first node
 2. Update the cluster.yml file to include the additional node
 - Using a text editor, copy the information for the first node (found under the "nodes:" section)
 - The node information usually starts with "- address:" and ends with the start of another node entry, or the beginning of the "services: " section, i.e.

```
- address: 172.16.240.71
  port: "22"
  internal_address: ""
  role:
  - controlplane
  - worker
  - etcd

. . .

labels: {}
```

```
taints: []
```

- Paste the information into the same section, once for each additional host
 - Update the pasted information, as appropriate, for each additional host
3. When the cluster.yml file is updated with the information specific to each node, run the command `rke up`
- Run the command: `watch -c "kubectl get deployments -A"`
 - The cluster deployment is complete when elements of all the deployments show at least "1" as "AVAILABLE"
 - Use Ctrl + c to exit the watch loop after all deployment pods are running

After this successful deployment of the Rancher Kubernetes Engine solution, review the [product documentation \(https://rancher.com/docs/rke/latest/en/\)](https://rancher.com/docs/rke/latest/en/) for details on how to directly use this Kubernetes cluster. Furthermore, by reviewing the SUSE Rancher [product documentation \(https://documentation.suse.com/cloudnative/rancher-manager/\)](https://documentation.suse.com/cloudnative/rancher-manager/) this solution can also be:

- imported (refer to subsection "Importing Existing Clusters"), then
- managed (refer to subsection "Cluster Administration") and
- accessed (refer to subsection "Cluster Access") to address orchestration of workloads, maintaining security and many more functions are readily available.

6 Summary

Using components and offerings from [SUSE \(https://www.suse.com\)](https://www.suse.com) and the Rancher portfolio plus [Supermicro SuperServer \(https://www.supermicro.com/en/products/x11/systems\)](https://www.supermicro.com/en/products/x11/systems) Rack Servers streamline the ability to quickly and effectively engage in a digital transformation, taking advantage of cloud-native resources and disciplines. Using such technology approaches lets you deploy and leverage transformations of infrastructure into a durable, reliable enterprise-grade environment.

Simplify

Simplify and optimize your existing IT environments

- Using Rancher Kubernetes Engine enables you to simplify, maintain and scale Kubernetes cluster deployments in a supportable fashion.

Modernize

Bring applications and data into modern computing

- With Rancher Kubernetes Engine, the digital transformation to containerized applications can benefit from the provided, production-quality application infrastructures for each of the respective user bases and to facilitate the actual workload deployments and resilient usage.



Accelerate

Accelerate business transformation through the power of open source software

- Given the open source nature of Rancher Kubernetes Engine and the underlying software components, you can simplify deployment with automation, maintain secure production instance and make significant IT savings as you scale orchestrated microservice deployments anywhere you need to and for whatever use cases are needed, in an agile and innovative way.

7 References



WHITE PAPERS

- **A Buyer's Guide to Enterprise Kubernetes Management Platforms** - https://more.suse.com/FY22_Buyers_Guide_to_Enterprise_Container_Management_Buyers-Guide-to-Kubernetes-Management-Platforms.html 
- **How to Build an Enterprise Kubernetes Strategy** - <https://more.suse.com/FY22-global-web-How-to-Build-Enterprise-K8s-Strategy.html> 













BOOKS









- **Kubernetes Management** - <https://more.suse.com/rs/937-DCH-261/images/002022021-DummiesGuide.pdf> 

TRAINING

- **SUSE** - <https://training.suse.com/> 
- **Rancher** - <https://rancher.com/training/> 

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- **SUSE Customer Center (SCC)** - <https://scc.suse.com> 
- **Products**
 - **SUSE Rancher** - <https://www.suse.com/products/rancher/>  (documentation (<https://documentation.suse.com/cloudnative/rancher-manager/>) 
 - **Rancher Kubernetes Engine (RKE)** - <https://rancher.com/products/rke/>  (documentation (<https://rancher.com/docs/rke/latest/en/>) 
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 - **SUSE Linux Enterprise Server (SLES)** - <https://www.suse.com/products/server/>  (documentation (<https://documentation.suse.com/sles/15-SP3/>) 

- SUSE Manager - <https://www.suse.com/products/suse-manager/>  (documentation (<https://documentation.suse.com/suma/4.3/>) )
- SUSE Repository Mirroring Tool (RMT) - <https://www.suse.com/products/server/>  (documentation (<https://documentation.suse.com/sles/15-SP3/single-html/SLES-rmt/#book-rmt>) )
- Projects
 - Rancher Kubernetes Engine Government (RKE2) - <https://github.com/rancher/rke2>  (documentation (<https://docs.rke2.io/>) )
- Supermicro - <https://www.supermicro.com/en> 
- Supermicro SuperServer - <https://www.supermicro.com/en/products/x11/systems> 

8 Glossary

- Document Scope

Reference Configuration

A guide with the basic steps to deploy the layered stack of components from both the SUSE and partner portfolios. This is considered a fundamental basis to demonstrate a specific, tested configuration of components.

Reference Architectures¹

A guide with the general steps to deploy and validate the structured solution components from both the SUSE and partner portfolios. This provides a shareable template of consistency for consumers to leverage for similar production ready solutions, including design considerations, implementation suggestions and best practices.

Best Practice

Information that can overlap both the SUSE and partner space. It can either be provided as a stand-alone guide that provides reliable technical information not covered in other product documentation, based on real-life installation and implementation experiences from subject matter experts or complementary, embedded sections within any of the above documentation types describing considerations and possible steps forward.

- Factor(s)

Automation²

Infrastructure automation enables speed through faster execution when configuring the infrastructure and aims at providing visibility to help other teams across the enterprise work quickly and more efficiently. Automation removes the risk associated with human error, like manual misconfiguration; removing this can decrease downtime and increase reliability. These outcomes and attributes help the enterprise move toward implementing a culture of DevOps, the combined working of development and operations.

¹ link: [Reference Architecture \(https://en.wikipedia.org/wiki/Reference_architecture\)](https://en.wikipedia.org/wiki/Reference_architecture) ↗

² link: [Infrastructure-as-Code \(https://en.wikipedia.org/wiki/Infrastructure_as_code\)](https://en.wikipedia.org/wiki/Infrastructure_as_code) ↗

Availability³

The probability that an item operates satisfactorily, without failure or downtime, under stated conditions as a function of its reliability, redundancy and maintainability attributes. Some major objectives to achieve a desired service level objectives are:

- Preventing or reducing the likelihood and frequency of failures via design decisions within the allowed cost of ownership
- Correcting or coping with possible component failures via resiliency, automated failover and disaster-recovery processes
- Estimating and analyzing current conditions to prevent unexpected failures via predictive maintenance

Integrity⁴

Integrity is the maintenance of, and the insurance of the accuracy and consistency of a specific element over its entire lifecycle. Both physical and logical aspects must be managed to ensure stability, performance, re-usability and maintainability.

Security⁵

Security is about ensuring freedom from or resilience against potential harm, including protection from destructive or hostile forces. To minimize risks, one must manage governance to avoid tampering, maintain access controls to prevent unauthorized usage and integrate layers of defense, reporting and recovery tactics.

- Deployment Flavor(s)

Proof-of-Concept⁶

A partial or nearly complete prototype constructed to demonstrate functionality and feasibility for verifying specific aspects or concepts under consideration. This is often a starting point when evaluating a new, transitional technology. Sometimes it starts as a Minimum Viable Product (MVP⁷) that has just enough features to satisfy an

3 link: [Availability](https://en.wikipedia.org/wiki/Availability) (https://en.wikipedia.org/wiki/Availability) ↗

4 link: [Data Integrity](https://en.wikipedia.org/wiki/Data_integrity) (https://en.wikipedia.org/wiki/Data_integrity) ↗

5 link: [Security](https://en.wikipedia.org/wiki/Security) (https://en.wikipedia.org/wiki/Security) ↗

6 link: [Proof of Concept](https://en.wikipedia.org/wiki/Proof_of_concept) (https://en.wikipedia.org/wiki/Proof_of_concept) ↗

7 link: [Minimum Viable Product](https://en.wikipedia.org/wiki/Minimum_viable_product) (https://en.wikipedia.org/wiki/Minimum_viable_product) ↗

initial set of requests. After such insights and feedback are obtained and potentially addressed, redeployments may be used to iteratively branch into other realms or to incorporate other known working functionality.

Production

A deployed environment that target customers or users can interact with and rely upon to meet their needs, plus be operationally sustainable in terms of resource usage and economic constraints.

Scaling

The flexibility of a system environment to either vertically scale-up, horizontally scale-out or conversely scale-down by adding or subtracting resources as needed. Attributes like capacity and performance are often the primary requirements to address, while still maintaining functional consistency and reliability.

9 Appendix

The following sections provide a bill of materials listing for the respective component layer(s) of the described deployment.

9.1 Compute platform bill of materials

Sample set of computing platform models, components and resources.

Role	Qty	SKU	Component	Notes
K3s Server, SUSE Rancher MCM cluster	1-3	SYS-120C-TN10R	CloudDC SuperServer	• items below listed per node
	2	P4X-ICX6330-SRKHM	• CPU : ICX 6330 2P 28C/56T 2.0G 42M 11.2GT 205W 4189 D2	
	16	MEM-DR416L-HL04-ER29	• Memory : MEM-DR416L-HL04-ER29, 16GB DDR4-2933 2Rx8 ECC REG DIMM	
	2	HDS-SMP-HFS7T6GET-FEID430	• NVMe M.2(OS) : KXG60ZNV1T02 PCIe Gen3 x4, NVMe 1.3a 1TB	
	1	AOC-S100G-b2C	• Network AOC : Two QSFP28 100Gbps Ethernet	

Role	Qty	SKU	Component	Notes
			port PCIe 4.0 x 16 host interface,Ro- HS	
	1	AOC-ATG-i2TM	<ul style="list-style-type: none"> • Network AOC : AIOM 2-port 10GBase-T, Intel X550,RoHS 	
	1	SFT-DCMS-SINGLE	<ul style="list-style-type: none"> • Software License : Supermicro Sys- tem Management Software Suite 	

Role	Qty	SKU	Component	Notes
			node license, HF, RoHS/REACH, PBF	
Downstream Kubernetes Cluster Serv- er, Hypercon- verged	1-3	Supermicro SYS-620C- TN12R	CloudDC SuperServer	• items be- low listed per node
	2	P4X-ICX8368-SRKH8	• CPU : ICX 8368 2P 38C/76T 2.4G 57M 11.2GT 270W 4189 D2	
	16	MEM-DR432L-HL03- ER32	• Memory : SK Hynix 32GB DDR4-3200 2Rx8 (16Gb)ECC REG DIMM	
	2	HDS-SMP-HFS7T6GET- FEID430	• NVME M.2(OS) : KXG60ZNV1T02 PCIe Gen3 x4, NVMe 1.3a 1TB	
	12	HDS-SMP- KCM6XRUL3T84Ê	• NVME((OSD Dri- ves) : Kioxia CM6 3.84TB NVMe PCIe 4x4 2.5 15mm SIE 1DWP	
	1	AOC-S100G-b2C	• Network AOC : BCM57508 NetXtreme-E	

Role	Qty	SKU	Component	Notes
			10Gb/25Gb/40Gb/50Gb/100Gb/200Gb Ethernet	
	1	AOC-ATG-i2TM	<ul style="list-style-type: none"> Network AOC : AIOM 2-port 10GBase-T, Intel X550,RoHS 	
	1	SFT-DCMS-SINGLE	<ul style="list-style-type: none"> Software License : Supermicro System Management Software Suite node license, HF, RoHS/REACH, PBF 	

9.2 Software bill of materials

Sample set of software, support and services.

Role	Qty	SKU	Component	Notes
Operating System	1-3	874-006875	SUSE Linux Enterprise Server,	Configuration: <ul style="list-style-type: none"> per node (up to 2 sock-

Role	Qty	SKU	Component	Notes
			<ul style="list-style-type: none"> • x86_64, • Priority Subscription, • 1 Year 	ets, stack-able) or 2 VMs
Kubernetes Management	1	R-0001-PS1	SUSE Rancher, <ul style="list-style-type: none"> • x86-64, • Priority Subscription, • 1 Year 	Configuration: <ul style="list-style-type: none"> • per deployed instance
Rancher Management	2	R-0004-PS1	Rancher 10 Nodes <ul style="list-style-type: none"> • x86-64 or aarch64, • Priority Subscription, • 1 Year, 	Configuration: <ul style="list-style-type: none"> • requires priority server subscription
Consulting and Training	1	R-0001-QSO	Rancher Quick Start, <ul style="list-style-type: none"> • Go Live Services 	



Note

For the software components, other support term durations are also available.

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