Rancher Kubernetes Engine - Getting Started

SUSE Linux Enterprise Server 15-SP2, Rancher Kubernetes Engine 1.2.7

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The purpose of this document is to provide an overview and procedure of implementing SUSE (R) 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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SUSE LLC
1800 South Novell Place
Provo, UT 84606
USA
https://documentation.suse.com

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1 Introduction

On the digital transformation journey to a full cloud native landscape, utilization 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 defacto 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

As developers and organizations continue their journey from simple, containerized microservices towards 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 (CNCF [2]) conformant [3] and certified [4] 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.

1.2 Scope

The scope of this document is to provide a simplified, *getting started* approach for Rancher Kubernetes Engine. This can be done in a variety of scenarios to create an enterprise Kubernetes cluster deployment anywhere.

1 https://kubernetes.io/

2 https://www.cncf.io/

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

4 https://www.cncf.io/certification/cka/

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 Architectural overview

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

2.1 Solution architecture

The figure below illustrates the high-level architecture of Rancher Kubernetes Engine:

FIGURE 2.1: ARCHITECTURE OVERVIEW - RANCHER KUBERNETES ENGINE

FixMe-Authentication Proxy

A user is authenticated via Rancher Kubernetes Engine and then, if authorized, can access both the Rancher Kubernetes Engine environment and the downstream clusters and workloads.

FixMe-API Server

This provides the programmatic interface backend for user, command-line interactions with Rancher Kubernetes Engine and the managed clusters.

FixMe-Data Store

The purpose of this service is to capture the configuration and state of Rancher Kubernetes Engine and the managed clusters to aid in backup and recovery processes.

FixMe-Cluster Controller

Interacting with a cluster agent on the downstream cluster, the cluster controller allows the communication path for users and services to leverage for workloads and cluster management.

FixMe-Once setup, users can potentially interact with Rancher Kubernetes Engine through the web-based user interface (UI), the command-line interface (CLI), and programatically through the application programming interface (API). Depending upon the assigned roles, group membership and privileges, a user could:

- manage all clusters, users, roles, projects
- deploy new clusters, import other clusters, or remove existing ones
- manage workloads across respective or labeled clusters
- simply view clusters or workloads, or just benefit from what is running

FixMe-To aid in planning, training or assessing functionality like in a [proof-of-concept (*proof-of-concept*)] deployment, Rancher Kubernetes Engine can be installed on a single node as described later in this document.

FixMe-TIP: The Rancher Kubernetes Engine backup operator can then be used to migrate from the single node to an installation on a high-availability Kubernetes cluster [1]

FixMe-NOTE: Regardless of the deployment target, Rancher Kubernetes Engine should always run on a node or cluster that is separate from the downstream clusters that it manages. Running user workloads on this cluster is not advised.

1 https://rancher.com/docs/rancher/v2.5/en/backups/migrating-rancher/

3 Component model

FixMe-This section describes the various components being used to create a Rancher Kubernetes Engine deployment, in the perspective of top to bottom ordering. Once completed, the Rancher Kubernetes Engine instance enables the management of multiple Kubernetes clusters, as shown in the following figure:

3.1 Component overview

By utilizing:

- Kubernetes Platform - Rancher Kubernetes Engine

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

3.2 Software - Rancher Kubernetes Engine

FixMe-Rancher Kubernetes Engine is packaged as a single binary, which is about 50 megabytes in size. Bu ndled in that single binary is everything needed to run Kubernetes anywhere, inc luding low-powered IoT and Edge-based devices. The binary includes:

- the container runtime
- any important host utilities like
    - iptables, socat and du.

FixMe-The only OS dependencies are the Linux kernel itself and a proper dev, proc and sysfs mounts (this is done automatically on all modern Linux distributions). {pn _K3s} bundles the Kubernetes components:

- kube-apiserver,
- kube-controller-manager,
- kube-scheduler,

- kubelet and
- kube-proxy

into combined processes that are presented as a simple server and agent model, a s represented in the following figure:

FIGURE 3.1: FIXME-OVERVIEW OF RANCHER KUBERNETES ENGINE

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 included:

- containerd,
- Flannel,
- CoreDNS,
- ingress controller and
- a simple host port-based service load balancer.

FixMe-All of these components are optional 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. Rancher Kubernetes Engine is now a CNCF Sandbox project, being the first Kubernetes distribution ever to be adopt ed into sandbox.

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

As Rancher Kubernetes Engine can be deployed on a single node, only some prerequisites for the underlying operating system are needed and will be detailed in the deployment section.

4 Deployment

This section describes the process steps for the deployment of the Rancher Kubernetes Engine solution. This simplified target stack begins as a functional *proof-of-concept*, has tips on migration towards *production*, provides *scaling* guidance and includes the base preparations required from the underlying layer.

4.1 Deployment overview

The deployment stack is represented in the following figure:

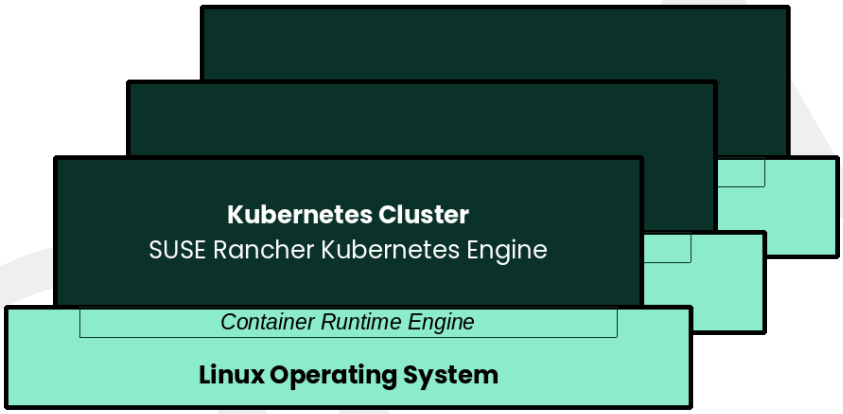

FIGURE 4.1: RANCHER KUBERNETES ENGINE DEPLOYMENT STACK

4.2 Rancher Kubernetes Engine

The underlying Linux operating system can be:

- A cloud-host virtual machine (VM)
- An on-premise VM or a bare-metal server node

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/) can be utilized.

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 hostnames
    - Network Time Protocol (NTP) - an external network-accessible service to obtain and synchronize system times to aid in timestamp 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/login) (SCC) or
        - an organization's 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-SP2/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).

2. On the target node with a default installation of SUSE Linux Enterprise Server operating system, log into 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/15.2/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. Identify the appropriate, desired version of the Rancher Kubernetes Engine binary (e.g. vX.Y.Z), by reviewing the "Releases" on the Download (https://github.com/k3s-io/k3s/) web page.

Deployment Process

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

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

+ . Download the Rancher Kubernetes Engine binary according to the instructions on this webpage: https://rancher.com/docs/rke/latest/en/installation/. Follow the directions on that page, but with the following exceptions:

- Create the cluster.yml file with the command `rke config`

Note

See https://rancher.com/docs/rke/latest/en/example-yamls/ and https://rancher.com/docs/rke/latest/en/config-options/ for full 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"
    - Update the cluster.yml file before continuing with the step "Deploying Kubernetes with RKE"
        1. 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:

```
authentication:
  strategy: x509
  sans: ["rancher.susealliances.com"]
```

- 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
- When ready, run `rke up` to create the RKE cluster
- 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 pathname 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*
  - While a single Rancher Kubernetes Engine node works perfectly fine, 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 addional 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
- 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/) for details on how to directly utilize this Kubernetes cluster. Furthermore, by reviewing the SUSE Rancher product documentation (https://rancher.com/docs/rancher/v2.x/en/) this solution can also be:

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

5 Summary

Using components and offerings from SUSE and the Rancher portfolio streamlines 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

- FixMe-Using Rancher Kubernetes Engine enables you to simplify Kubernetes cluster deployment and management of the the infrastructure components.

Modernize

Bring applications and data into modern computing

- FixMe-With Rancher Kubernetes Engine, the digital transformation to containerized applications can benefit from the ability both to manage many target clusters, for each of the respective user bases and to facilitate the actual workload deployments.

Accelerate

Accelerate business transformation through the power of open source software

- FixMe-Given the open source nature of Rancher Kubernetes Engine and the underlying software components, you can simplify management 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.

6 References

WHITE PAPERS

- A Buyer's Guide to Enterprise Kubernetes Management Platforms - https://info.rancher.com/enterprise-kubernetes-management-buyers-guide
- How to Build an Enterprise Kubernetes Strategy - https://info.rancher.com/how-to-build-enterprise-kubernetes-strategy

BOOKS

- Kubernetes Management - https://info.rancher.com/kubernetes-management-for-dummies-rancher-and-suse-0-0

TRAINING

- SUSE - https://training.suse.com/
  - Rancher - https://rancher.com/training/

WEBSITES

- SUSE - https://www.suse.com
  - SUSE Customer Center (SCC) - https://scc.suse.com/login
  - Products
    - SUSE Rancher - https://rancher.com/products/rancher/ (documentation (https://rancher.com/docs/rancher/v2.x/en/))
    - Rancher Kubernetes Engine (RKE) - https://rancher.com/products/rke/ (documentation (https://rancher.com/docs/rke/latest/en/))
    - K3s - https://rancher.com/products/k3s/ (documentation (https://rancher.com/docs/k3s/latest/en/))
    - SUSE Linux Enterprise Micro (SLEMicro) - https://www.suse.com/products/micro/ (documentation (https://documentation.suse.com/sle-micro/5.0/))
    - SUSE Linux Enterprise Server (SLES) - https://www.suse.com/products/server/ (documentation (https://documentation.suse.com/sles/15-SP2/))

- SUSE Manager - https://www.suse.com/products/suse-manager/ (documentation (https://documentation.suse.com/suma/4.1/))
- SUSE Repository Mirroring Tool (RMT) - https://www.suse.com/products/server/ (documentation (https://documentation.suse.com/sles/15-SP2/single-html/SLES-rmt/#book-rmt))

- Projects
  - Rancher Kubernetes Engine Government (RKE2) - https://github.com/rancher/rke2 (documentation (https://docs.rke2.io/))

Glossary

- Document Scope

  Getting Started

  A guide with the basic steps to quickly and simply deploy the one layer of the referenced component of the SUSE portfolio, with generalized pointers to other required dependency elements.

  Reference Architectures [1]

  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 standalone 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)

1 link: Reference Architecture (https://en.wikipedia.org/wiki/Reference_architecture)

Availability [2]

The probability that an item operates satisfactorily, without failures or downtimes, 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

Security [3]

Security is about ensuring freedom from or resilience against potential harm, including protection from destructive or hostile forces. To minimize risks, one mus 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-Concept [4]

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 (MVP [5]) that has just enough features to satisfy an initial set of requests. After such insights and feedback are obtained and potentially addressed, redeployments may be utilized to iteratively branch into other realms or to incorporate other known working functionality.

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2 link: Availability (https://en.wikipedia.org/wiki/Minimum_viable_product)

3 link: Security (https://en.wikipedia.org/wiki/Security)

4 link: Proof of Concept (https://en.wikipedia.org/wiki/Proof_of_concept)

5 link: Minimum Viable Product (https://en.wikipedia.org/wiki/Minimum_viable_product)

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 utilization 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.

A Appendix

The following sections provide a bill of materials listing for each component layer.

A.1 Compute Platform Bill of Materials

Role	Qty	SKU	Component	Notes
System	1	n/a	• Virtual Machine, • Single Board Computer (SBC) or • Industry Standard Server	Configuration

A.2 Software Bill of Materials

Role	Qty	SKU	Component	Notes
Operating System		1	874-006875	SUSE Linux Enterprise Server, • x86_64, • Priority Subscription, • 1 Year
Configuration: * per node (up to 2 sockets, stackable) or 2 VMs	Kubernetes	1	R-0003-PS1	Rancher Kubernetes Engine,

SUSE Linux Enterp...*

Role	Qty	SKU	Component	Notes
				• x86-64, • Priority Subscription, • 1 Year

Note

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

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This document was built using the following AsciiDoc (https://github.com/asciidoc/asciidoc) and DocBook Authorting and Publishing Suite (DAPS (https://github.com/openSUSE/daps)) attributes:

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 focusRKE1=1@ layerSLES=1@ Appendix=1 ArchOv=1 BP=1 BPBV=1 CompMod=1 DepConsiderations=1
 Deployment=1 GFDL=1 Glossary=1 HWComp=1 HWDepCfg=1 LN=1 RA=1 References=1 Requirements=1
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