Rancher Kubernetes Engine Government - 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 Government (RKE2), a Kubernetes distribution that runs entirely within containers on bare-metal and virtualized nodes. RKE2 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. Also being a hardened, FIPS-enabled version, it adopts a compliance-based approach towards security, targeting standard risk management frameworks and best practices with the goal of stronger defense for cloud-native apps.

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Contents

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.

With core focus on security and compliance, Rancher Kubernetes Engine Government inherits close alignment with upstream Kubernetes and provide usability, ease-of-operations, and deployment model for core use cases.

1.2 Scope

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

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 Government 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 Government:

FixMe

3 Component model

FixMe-This section describes the various components being used to create a Rancher Kubernetes Engine Government deployment, in the perspective of top to bottom ordering. Once completed, the Rancher Kubernetes Engine Government 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 Government

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 Government

FixMe

As Rancher Kubernetes Engine Government 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 Government 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:

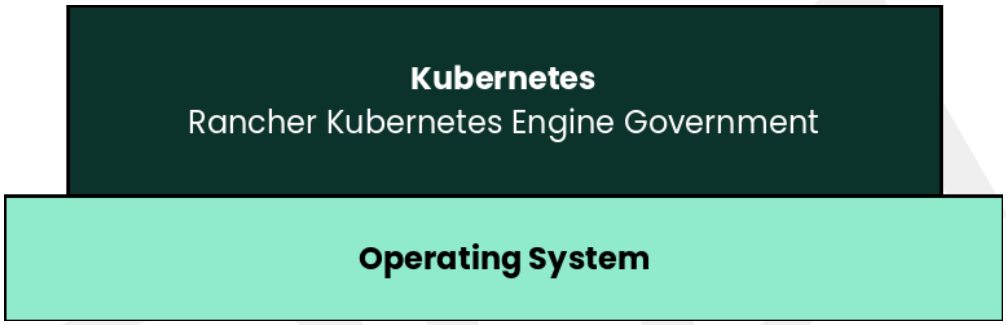

FIGURE 4.1: RANCHER KUBERNETES ENGINE GOVERNMENT DEPLOYMENT STACK

4.2 Rancher Kubernetes Engine Government

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. Identify the appropriate, desired version of the Rancher Kubernetes Engine Government binary (e.g. vX.YY.ZZ+rke2r1), by reviewing the "Releases" on the Download (https://github.com/rancher/rke2/) web page.

Deployment Process

Perform the following steps to install the first Rancher Kubernetes Engine Government server on one of the nodes to be used for the Kubernetes control plane

1. Set the following variable with the noted version of Rancher Kubernetes Engine Government, as found during the preparation steps.

```
RKE2_VERSION=""
```

2. Install the appropriate version of Rancher Kubernetes Engine Government:

    - Download the installer script:

```
curl -sfL https://get.rke2.io | INSTALL_RKE2_VERSION=${RKE2_VERSION} sh -
```

*Set the following variable with the URL that will be used to access the SUSE Rancher server. This may be based on one or more DNS entries, a reverse-proxy server, or a load balancer:

```
RKE2_subjectAltName=
```

- Create the RKE2 config.yaml file:

```
mkdir -p /etc/rancher/rke2/
cat <<EOF> /etc/rancher/rke2/config.yaml
write-kubeconfig-mode: "0644"
tls-san:
  - "${RKE2_subjectAltName}"
EOF
```

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- Start and enable the RKE2 service, which will begin installing the required Kubernetes components:

```
systemctl enable --now rke2-server.service
```

- Include the Rancher Kubernetes Engine Government binary directories in this user's path:

```
echo "PATH=${PATH}:/opt/rke2/bin:/var/lib/rancher/rke2/bin/" >> ~/.bashrc && source
 ~/.bashrc
```

- Monitor the progress of the installation:

```
export KUBECONFIG=/etc/rancher/rke2/rke2.yaml
watch -c "kubectl get deployments -A"
```

Note

For the first two to three minutes of the installation, the initial output will include the error phrase "The connection to the server 127.0.0.1:6443 was refused - did you specify the right host or port?". As Kubernetes services get started this will be replace with "No resources found". About four minutes after beginning the installation, the output will begin showing the deployments being created, and after six to seven minutes the installation should be complete.

- The Rancher Kubernetes Engine Government deployment is complete when elements of all the deployments (coredns, ingress, and metrics-server) show at least "1" as "AVAILABLE"
- Use Ctrl + c to exit the watch loop after all deployment pods are running

Deployment Consideration(s)

To further optimize deployment factors, leverage the following practices:

- *Availability*
  - While a single Rancher Kubernetes Engine Government node works perfectly fine, a full high-availability Rancher Kubernetes Engine Government cluster is recommended for production workloads. The etcd key/value store (aka database) requires an odd number of servers (aka master nodes) be allocated to the Rancher Kubernetes Engine Government cluster. In this case, two additional control-plane servers should be added; for a total of three.
    1. Deploy the same operating system on the new compute platform nodes
    2. Log into the first server node and create a new config.yaml file for the remaining two server nodes:
  - Set the following variables, as appropriate for this cluster

```
FIRST_SERVER_IP=""      # Private IP preferred, if available
SECOND_SERVER_IP=""      # Private IP preferred, if available
THIRD_SERVER_IP=""      # Private IP preferred, if available
NODE_TOKEN=""           # From the /var/lib/rancher/rke2/server/node-token file on the
 first server
RKE2_VERSION=""          # Match the first of the first server (Hint: `kubectl get
 nodes`)
```

- Create the new config.yaml file:

```
echo "server: https://${FIRST_SERVER_IP}:9345" > config.yaml
echo "token: ${NODE_TOKEN}" >> config.yaml
cat /etc/rancher/rke2/config.yaml >> config.yaml
```

Tip

The next steps require using scp and ssh. Setting up passwordless SSH, and/or using ssh-agent,from the first server node to the second and third nodes will make these steps quicker and easier.

- Copy the new config.yaml file to the remaining two server nodes:

```
scp config.yaml ${SECOND_SERVER_IP}:~/
scp config.yaml ${THIRD_SERVER_IP}:~/
```

- Move the config.yaml file to the correct location in the filesystem:

```
ssh ${SECOND_SERVER_IP} << EOF
mkdir -p /etc/rancher/rke2/
cp ~/config.yaml /etc/rancher/rke2/config.yaml
cat /etc/rancher/rke2/config.yaml
EOF

ssh ${THIRD_SERVER_IP} << EOF
mkdir -p /etc/rancher/rke2/
cp ~/config.yaml /etc/rancher/rke2/config.yaml
cat /etc/rancher/rke2/config.yaml
EOF
```

1. Execute the following sets of commands on each of the remaining control-plane nodes:

    - Install Rancher Kubernetes Engine Government

```
ssh ${SECOND_SERVER_IP} << EOF
curl -sfL https://get.rke2.io | INSTALL_RKE2_VERSION=${RKE2_VERSION} sh -
systemctl enable --now rke2-server.service
EOF

ssh ${THIRD_SERVER_IP} << EOF
curl -sfL https://get.rke2.io | INSTALL_RKE2_VERSION=${RKE2_VERSION} sh -
```

```
systemctl enable --now rke2-server.service
EOF
```

- Monitor the progress of the new server nodes joining the Rancher Kubernetes Engine Government cluster: `watch -c "kubectl get nodes"`
  - It takes up to eight minutes for each node to join the cluster
  - A node has deployed correctly when its status is "Ready" and it holds the roles of "control-plane,etcd,master"
  - Use Ctrl + c to exit the watch loop after all deployment pods are running

Note

This can be changed to the normal Kubernetes default by adding a taint to each server node. See the official Kubernetes documentation for more information on how to do that.

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1. (Optional) In cases where agent nodes are desired, execute the following sets of commands on each of the agent nodes to add it to the Rancher Kubernetes Engine Government cluster:

```
FIRST_SERVER_IP=""      # Private IP preferred, if available
NODE_TOKEN=""           # From the /var/lib/rancher/rke2/server/node-token file
 on the first server
RKE2_VERSION=""          # Match the first of the first server
```

```
curl -sfL https://get.rke2.io | INSTALL_RKE2_VERSION=${RKE2_VERSION}
 RKE2_URL=https://${FIRST_SERVER_IP}:6443 RKE2_TOKEN=${NODE_TOKEN}
 RKE2_KUBECONFIG_MODE="644" sh -
```

After this successful deployment of the Rancher Kubernetes Engine Government solution, review the product documentation (https://docs.rke2.io/) 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 Government 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 Government, 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 Government 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,	Configuration: • per node (up to 2 sock-

SUSE Linux Enterp... *

Role	Qty	SKU	Component	Notes
			• x86_64, • Priority Subscription, • 1 Year	ets, stackable) or 2 VMs
Kubernetes	1	R-0003-PS1	Rancher Kubernetes Engine Government, • x86-64, • Priority Subscription, • 1 Year	Configuration: • provides support of 10 nodes

Note

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

A.3 Documentation Configuration / Attributes

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