Reference Implementation - SUSE Rancher

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Contents

Preface

The purpose of this documentation is to provide a reference implementation of deploying SUSE Rancher as a multi-cluster container management platform for organizations that deploy containerized workloads, orchestrated by Kubernetes. SUSE Rancher makes it easy to deploy, manage, and use Kubernetes everywhere, meet IT requirements, and empower DevOps teams.

1 Introduction

Kubernetes has become the container orchestration standard. Most cloud and virtualization vendors now offer it as standard infrastructure. SUSE Rancher users have the choice of creating Kubernetes clusters with Rancher Kubernetes Engine (RKE), lightweight edge-centric K3s, on premise or in cloud Kubernetes services, such as GKE, AKS, and EKS. SUSE Rancher users can also import and manage their existing Kubernetes clusters created using any Cloud Native Computing Foundation (CNCF (https://www.cncf.io/) certified (https://www.cncf.io/certification/cka/) Kubernetes distribution or installer.

1.1 Background

Even on the journey to a full Cloud Native Landscape, classic IT pillars are still valid considerations for the underlying infrastructure. General requirements include the need for a small, purpose-built operating system with a container runtime engine and a container orchestration platform to distribute workloads across a target, clustered instance. The dominant technology for container orchestration is Kubernetes (https://kubernetes.io/). With its large community of developers and a plethora of features and capabilities, Kubernetes has become the defacto standard and is included across most container-as-a-service platforms. With all of these attributes in place, both developer and operation teams can effectively deploy, manage and deliver functionality to their end users in a resilient and agile manner.

Note

As a further reference, the National Institute of Standards and Technology's (NIST) Definition of Microservices, Application Containers and System Virtual Machines (https://csrc.nist.gov/publications/detail/sp/800-180/draft) describes the important characteristics of application containers.

1.2 Motivation

While any developer or organization may simply start with a single, Kubernetes-based deployment, it is very common for that number of cluster instances to rapidly grow. While each of these may have specific focus areas, it becomes imperative to figure out how to use, manage, maintain

and replicate the all of these instances over time. This is where SUSE Rancher leads the industry, being able to manage access, usage, infrastructure and applications across clusters, that are (CNCF (https://www.cncf.io/certification/software-conformance/)) compliant, anywhere from edge, core, on-premise, or cloud.

1.3 Scope

The scope of this document is to provide a quick-start, reference implementation of SUSE Rancher. This can be done in a variety of solution stack, architectural scenarios as a fundamental component of an overall Kubernetes ecosystem.

1.4 Audience

This document is intended for IT decision makers, architects, system administrators and technicians who are implementing a flexible, software-defined Kubernetes management platform. You should 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.

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2 Component model

This section describes the various components being used to create the SUSE Rancher, which enables the management of multiple Kubernetes clusters, as shown in the following figure:

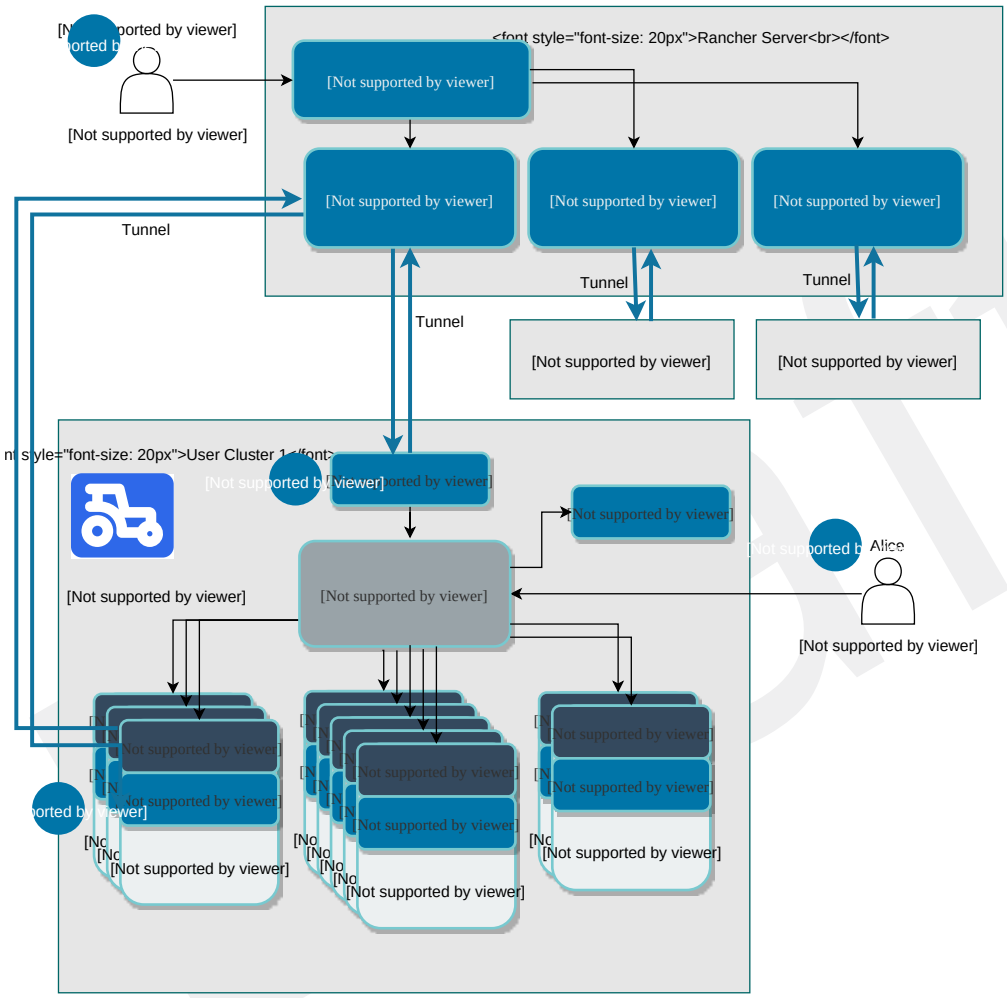

FIGURE 2.1: KUBERNETES CLUSTER MANAGEMENT BY SUSE RANCHER

2.1 Component overview

SUSE (https://www.suse.com)®, the Open Open Source Company, works with an ecosystem of partners and communities to deliver enterprise-grade, open source software-defined infrastructure and application delivery solutions backed by superior service and support. The leading Linux operating system meets the most widely-adopted enterprise Kubernetes management platform. SUSE and Rancher are now one company!

Innovate Everywhere

> Our goal is to give you the freedom to innovate everywhere — from the data center, to the cloud, to the edge and beyond. We are driven by the power of many: everything we do is empowered by the skills, creativity and vision of our employees, partners, customers and community.

By utilizing these software products from the SUSE portfolio:

- Multi-cluster Management Server - SUSE Rancher
- Kubernetes Platform - K3s
- Operating System - SUSE Linux Enterprise Micro

one can build the necessary infrastructure and services to administer and manage multiple Kubernetes clusters. Further details of these SUSE products are described in the following section.

2.1.1 Software - SUSE Rancher

Many organizations are deploying Kubernetes clusters everywhere – on-premises, in the cloud 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, relying on upstream Kubernetes alone can introduce overhead and risk because Kubernetes clusters are typically deployed:

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

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SUSE Rancher is a complete cluster and container management platform built on Kubernetes itself. It addresses these challenges by delivering the following key functions, as shown in the following figure:

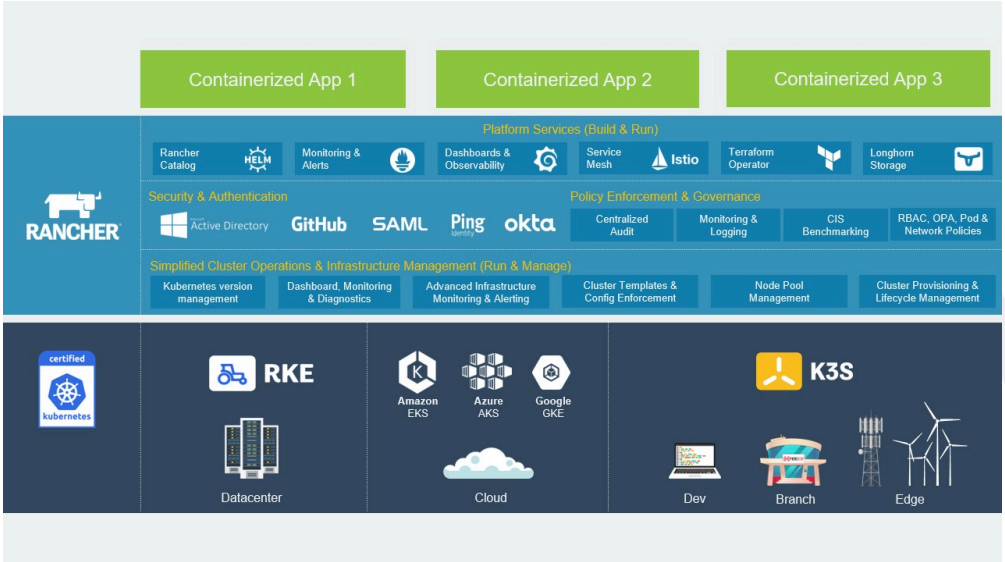

FIGURE 2.2: OVERVIEW OF SUSE RANCHER

Certified Kubernetes Distributions

SUSE Rancher supports any certified Kubernetes distribution. For on-premises workloads, we offer the Rancher Kubernetes Engine (RKE). For the public cloud, we support all the major distributions, including Amazon Elastic Kubernetes Service (EKS), Microsoft Azure Kubernetes Service (AKS), and Google Kubernetes Engine (GKE). For edge, branch and desktop workloads we offer K3s, a certified lightweight distribution of Kubernetes.

Simplified Cluster Operations

SUSE Rancher provides simple, consistent cluster operations including provisioning, version management, visibility and diagnostics, monitoring and alerting, and centralized audit.

Security, Policy and User Management

SUSE Rancher lets you automate processes and applies a consistent set of user access and security policies for all your clusters, no matter where they’re running.

Shared Tools & Services

SUSE Rancher provides a rich catalog of services for building, deploying and scaling containerized applications, including app packaging, CI/CD, logging, monitoring and service mesh.

As SUSE Rancher relies upon being deployed on a Kubernetes platform, the next section describes such a suggested component layer.

2.1.2 Software - K3s

K3s is packaged as a single binary, which is about 50 megabytes in size. Bundled in that single binary is everything needed to run Kubernetes anywhere, including low-powered IoT and Edge-based devices. The binary includes:

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

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). K3s bundles the Kubernetes components:

- kube-apiserver,
- kube-controller-manager,
- kube-scheduler,
- kubelet and
- kube-proxy

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

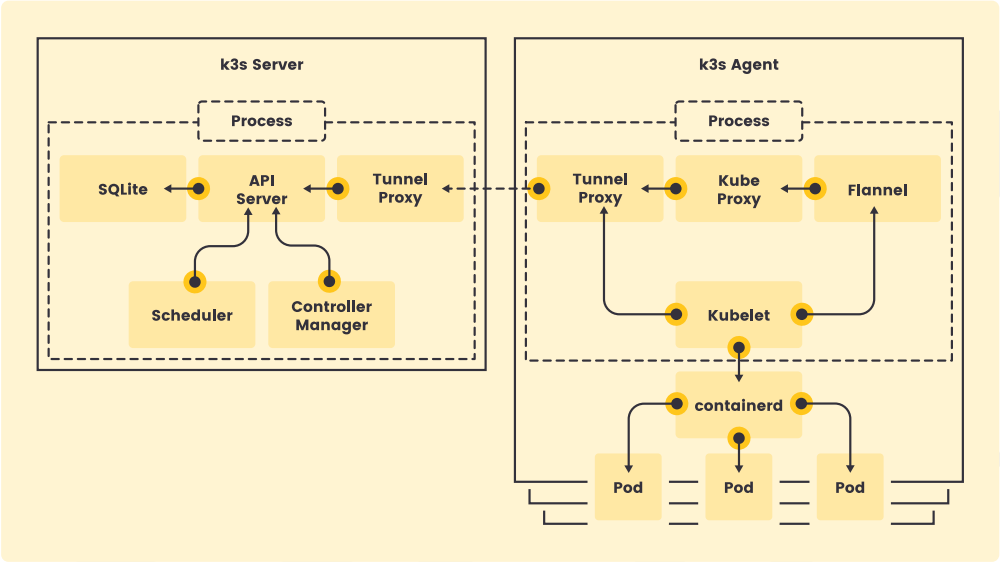

FIGURE 2.3: OVERVIEW OF K3S

K3s can run as a complete cluster on a single node or can be expanded into a multi-node cluster. Besides the core Kubernetes components, we also run

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

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. K3s is now a CNCF Sandbox project, being the first Kubernetes distribution ever to be adopted into sandbox.

Learn more information about K3s at https://k3s.io

Given that K3s relies upon being deployed on a Linux operating system, the next section describes that target component layer.

2.1.3 Software - SUSE Linux Enterprise Micro

SUSE Linux Enterprise Micro is built from ground up for edge applications. It leverages the enterprise-hardened technology components of SUSE Linux Enterprise and merges that with what developers want from a modern, immutable OS platform. As a result, you get an ultra-reliable infrastructure platform that is also simple to use and comes out-of-the-box with best-in-class compliance.

Furthermore, SUSE's flexible subscription model ensures enterprise assurance for any edge, embedded or IoT deployment without vendor lock-in. A free, evaluation copy can be downloaded (https://www.suse.com/download/sle-micro/) or if the organization already has subscriptions, both install media and updates can be obtained from SUSE Customer Center (https://scc.suse.com/login).

With the flexibility of SUSE Linux Enterprise Micro, multiple compute platform variants can be considered, as outlined in the next section.

2.1.4 Compute Platform Options

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-premise or hosted by cloud service providers

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Tip

Any SUSE YES (https://www.suse.com/yessearch/) certified platform can be used for the nodes of this deployment, as long as the certification refers to the major version of the underlying SUSE operating system required by its release.

Note

A sample bill of materials, in the *Appendix A, Appendix*, cites the necessary quantites of all components, along with a reference to the minimum resource requirements needed by the software components.

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3 Deployment

FixMe - add overview

3.1 Deployment overview

FixMe - Add simplistic drawing showing stack and user perspective

3.1.1 Hardware deployment configuration

FixMe - cite required network infrastructure

FixMe - cite host/node BMC/CPU/Mem/Disk/Nework prep

3.1.2 Operating System Deployment

Core Infrastructure Components / Services

- 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/) 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)

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Note

As each node is deployed, it can be pointed to the respective update service and update notification and applicate will be managed by the configuration management web interface.

Process

Follow these steps

- Download the SUSE Linux Enterprise Micro (https://www.suse.com/download/sle-micro/) product (either for the ISO or Virtual Machine image)
- The installation process is described and can be performed with default valuesaside from your local network addressing, per the product documentation. Simply follow:
  - the Installation Quick Start (https://documentation.suse.com/sle-micro/5.0/single-html/SLE-Micro-installation/#article-installation) for
    - manual installation
    - raw image deployment
  - or AutoYaST Guide (https://documentation.suse.com/sle-micro/5.0/single-html/SLE-Micro-autoyast/#book-autoyast) for unnatttended installations

Tip

An additional consideration is, for the first node deployed, to create an additional IP address on the host network interface card. This can be used for the SUSE Rancher access, which may also become managed by a load-balancer if a multi-node cluster becomes the base.

3.1.3 Kubernetes Deployment

This design leverage the K3s Kubernetes distribution. K3s is a highly available, CNCF certified Kubernetes distribution capable of deploying any Kubernetes production workload. K3s is packaged as a single binary with minimal software dependencies. This signficantly reduces the expertise and effort required install, run, and maintain a production ready Kubernetes cluster.

For this deployment, a single server installed with the SUSE Linux Enterprise Micro immutable operating system will support a single instance of K3s. For maximum flexibility, K3s will be deployed in a manner that would allow expanding the single-node cluster into a highly available, three-node Kubernetes cluster at a later date.

While it is highly recommended that Kubernetes workloads (in this case the SUSE Rancher) be isolated from the Kubernetes control-plane and data-plane; this design will maintain all functions, including the {porfolioName} Server, on the server node. In this specialized case, the SUSE Rancher workload is a known quantity and no other workloads will be run on this Kubernetes cluster. For this reason the SUSE Rancher cluster is more closely aligned with appliance model best practices.

THE PRIMARY STEPS FOR DEPLOYING THIS SINGLE NODE K3S CLUSTER ARE:

1. (Optional) Provide the server with one extra IP address that will be used as the primary address for accessing the K3s cluster API server. This will allow the cluster to grown beyond a single server node. It is not neccessary if there will be an external load balancer used to access the cluster, or if the cluster will never be grown beyond a single server node.
2. Find the appropriate version of the K3s binary
3. Install K3s with embedded etcd enabled

STEP 1: (OPTIONAL) PROVIDE THE SERVER WITH ONE EXTRA IP ADDRESS:

- If needed, use the `ip a` command to determine the netmask for the second IP address, based on the CIDR notation for eth0
- Set the following variable with the IP address and CIDR notation that will be used to access the Kubernetes API server:

```
SECOND_IP=""
```

- For example: `SECOND_IP="10.111.2.100/24"`

```
sudo cp -np /etc/sysconfig/network/ifcfg-eth0 ~/ifcfg-eth0.`date +"%d.%b.%Y.%H.%M"`
cp -p ~/ifcfg-eth0.`date +"%d.%b.%Y"`* ~/ifcfg-eth0
echo "IPADDR_2=${SECOND_IP}" >> ~/ifcfg-eth0
diff /etc/sysconfig/network/ifcfg-eth0 ~/ifcfg-eth0
```

- Ensure the only difference between the original ifcfg-eth0 file and the updated ~/ifcfg-eth0 is the extra "IPADDR_2" line, then run the following commands:

```
sudo mv ~/ifcfg-eth0 /etc/sysconfig/network/ifcfg-eth0
```

```
sudo systemctl restart network.service
ip a
```

- The original server IP address and the additional IP address should be shown with the correct CIDR notation

STEP 2: FIND THE APPROPRIATE VERSION OF THE K3S BINARY:

- At the time of writing, the most current, supported version of K3s for SUSE Rancher is v1.20.4+k3s1. Verify the supported versions at: https://rancher.com/support-maintenance-terms/, under the "Rancher Support Matrix"
- Set the following variable with the desired version of K3s

```
K3s_VERSION=""
```

- I.e. `K3s_VERSION="v1.20.4+k3s1"`

Step 3: Install K3s with embedded etcd enabled:

```
curl -sfL https://get.k3s.io | INSTALL_K3S_VERSION=${K3s_VERSION}
```

```
 INSTALL_K3S_EXEC='server --cluster-init --write-kubeconfig-mode=644' sh -s -
```

- Monitor the progress of the installation: `watch -c "kubectl get pods -n kube-system"`
  - The installation is complete when all pods have a status of "Completed" or a status of "Running" with the number of "READY" pods being "1/1", "2/2", etc.
  - Use Ctrl+c to exit the watch loop after all pods are running

3.1.4 SUSE Rancher Deployment

SUSE Rancher is a complete solution for managing Kubernetes clusters and Kubenetes applications. It addresses the operational and security challenges of managing multiple Kubernetes clusters and applications across any infrastructure. SUSE Rancher streamlines Kubernetes cluster management on bare metal servers, private clouds, and vSphere environements; from the datacenter to the edge. SUSE Rancher unites all of your Kubernetes clusters with global security policies, centralized authentication, access control and observability.

As SUSE Rancher server is a native Kubernetes application, it will run on the single-node K3s cluster. In instances where a load balancer is used to support the K3s cluster, deploying two additional K3s cluster nodes will automatically make SUSE Rancher highly available. SUSE Ranch-

er uses the K3s etcd key/value store to persist its data, which offers several advantages. Providing highly-available storage isn't needed to make SUSE Rancher highly available. In addition, backing up the K3s etcd store protects the cluster as well as the installation of SUSE Rancher.

Note

These deployment steps are specific to K3s. They can be executed from any host or node that has the kubectl tool and the KUBECONFIG file for the K3s cluster.

The steps described here are for deploying SUSE Rancher with self-signed security certificates. Other options are to have SUSE Rancher create public certificates via Let's Encrypt (only with a publicly resolvable hostname for the SUSE Rancher server) and to provide preconfigured, private certificates. See https://rancher.com/docs/rancher/v2.x/en/installation/install-rancher-on-k8s/#3-choose-your-ssl-configuration for more information.

THE PRIMARY STEPS FOR DEPLOYING SUSE RANCHER ARE:

1. Create the HelmChart custom resource for cert-manager
2. Create the HelmChart custom resource for SUSE Rancher
3. Expose SUSE Rancher through a Kubernetes NodePort service
4. (Optional) Create an SSH tunnel to access SUSE Rancher in cases where the exposed server IP address and/or port is not accessible to the client browser
5. Connect to the SUSE Rancher web UI

STEP 1: CREATE THE HELMCHART CUSTOM RESOURCE FOR CERT-MANAGER:

- At the time of writing, the most current, supported version of cert-manager is v1.0.4
- Set the following variable with the desired version of cert-manager

```
CERT_MANAGER_VERSION=""
```

- I.e. `CERT_MANAGER_VERSION="v1.0.4"`
- Create the cert-manager HelmChart custom resource manifest

```
cat <<EOF> cert-manager-helm-crd.yaml
apiVersion: helm.cattle.io/v1
```

```
kind: HelmChart
metadata:
  name: cert-manager
  namespace: kube-system
spec:
  chart: cert-manager
  targetNamespace: cert-manager
  version: ${CERT_MANAGER_VERSION}
  repo: https://charts.jetstack.io
EOF
```

- Create the cert-manager CRDs and apply the HelmChart resource manifest:

```
kubectl create namespace cert-manager
kubectl apply --validate=false -f https://github.com/jetstack/cert-manager/releases/
download/${CERT_MANAGER_VERSION}/cert-manager.crds.yaml
sudo mv cert-manager-helm-crd.yaml /var/lib/rancher/k3s/server/manifests/
```

- Monitor the progress of the installation: `watch -c "kubectl get pods -n cert-manager"`
  - The installation is complete when all pods have a status of "Completed" or a status of "Running" with the number of "READY" pods being "1/1", "2/2", etc.
  - Use Ctrl + c to exit the watch loop after all pods are running

STEP 2: CREATE THE HELMCHART CUSTOM RESOURCE FOR SUSE RANCHER:

- Set the following variable to the hostname of the SUSE Rancher server instance

```
HOSTNAME=""
```

- I.e. `HOSTNAME="suse-rancher.sandbox.local"`
- Create the SUSE-Rancher HelmChart custom resource manifest

```
cat <<EOF> suse-rancher-helm-crd.yaml
apiVersion: helm.cattle.io/v1
kind: HelmChart
metadata:
  name: rancher
  namespace: kube-system
spec:
  chart: rancher
  targetNamespace: cattle-system
```

```
  repo: https://releases.rancher.com/server-charts/stable
  set:
    hostname: ${HOSTNAME}
EOF
```

- Apply the HelmChart resource manifest:

```
kubectl create namespace cattle-system
sudo mv suse-rancher-helm-crd.yaml /var/lib/rancher/k3s/server/manifests/
```

- Monitor the progress of the installation: `watch -c "kubectl get pods -n cattle-system"`
  - The installation is complete when all pods have a status of "Completed" or a status of "Running" with the number of "READY" pods being "1/1", "2/2", etc.
  - Use Ctrl + c to exit the watch loop after all pods are running

STEP 3: EXPOSE SUSE RANCHER THROUGH A KUBERNETES NODEPORT SERVICE

- Verify that the SUSE Rancher service is currently of the type ClusterIP:

```
kubectl -n cattle-system get svc/rancher
```

- If the SUSE Rancher service is ClusterIP, use the following commands to change it to NodePort and assign it port 30443 on the Linux host:

```
cat <<EOF> patch-NodePort.yaml
spec:
  type: NodePort
  ports:
    - port: 443
      nodePort: 30443
      name: https-internal
EOF
```

```
kubectl patch -n cattle-system svc/rancher --patch "$(cat patch-NodePort.yaml)"
```

- Verify the exposed port for the SUSE Rancher service:

```
kubectl -n cattle-system get svc/rancher | awk -F443: '{print$2}' | awk -F\/ '{print$1}'
```

Step 4: (Optional) Create an SSH tunnel to access SUSE Rancher:

*

```
NOTE: This optional step is useful in cases where NAT routers and/or firewalls prevent
 the client web browser from reaching the exposed {pn_Rancher} server IP address and/or
 port. This step requires that a Linux host is accessible through SSH from the client
 system and that the Linux host can reach the exposed {pn_Rancher} server IP address and
 port.
```

- Create an SSH tunnel through the Linux host to the IP address of the SUSE Rancher server on the NodePort, as noted in Step 3:

```
ssh -L localhost:<NodePort>:<IP of {pn_Rancher}>:<NodePort> -N user@Linux-host
```

- The SSH tunnel syntax rules require a combination of localhost/port and remote-host/port per -L switch. Use multiple -L switches to expose more than one remote-host/port.
- -N tells SSH that it won't send any commands after establishing connection

STEP 5: CONNECT TO THE SUSE RANCHER WEB UI AND CONFIGURE SUSE RANCHER:

- On the client system, use a web browser to connect to the SUSE Rancher server on exposed NodePort
  - I.e. `https://172.16.230.10:NodePort` or (with the SSH tunnel) `https://localhost:NodePort`
- Provide a new Admin password
- IMPORTANT: On the second configuration page, ensure the "Rancher Server URL" is set to the second IP address configured on the Linux host (or the load balancer IP address, if available) and the correct NodePort
  - I.e. `10.111.2.110:30443`

*

4 Deployment considerations

FixMe - Elaborate further on best practices and day2 considerations for the deployments.

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5 Summary

Using components and offerings from SUSE and the Rancher portfolio streamlines your 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 your infrastructure into a durable, reliable enterprise-grade environment.

Simplify

Simplify and optimize your existing IT environments

- Using SUSE Rancher enables you to simplify Kubernetes cluster management and the infrastructure components.

Modernize

Bring applications and data into modern computing

- With SUSE Rancher, 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

- Given the open source nature of SUSE Rancher and the underlying softwware 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.

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6 References

WHITEPAPERS

- 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 (SLE Micro) - https://www.suse.com/products/micro/ (documentation (https://documentation.suse.com/sle-micro/5.0/))

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A Appendix

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A.1 Appendix A: Bill of Materials

Role	Qty	SKU	Component	Notes
System	1-3	n/a	• Virtual Machine, • Single Board Computer (SBC) or • Industry Standard Server	Configuration • see requirements (https://rancher.com/docs/rancher/v2.x/en/installation/requirements/#cpu-and-mem-

*

Role	Qty	SKU	Component	Notes
				ory-for-rancher-before-v2-4-0)
Operating System	1-3	874-007864	SUSE Linux Enterprise Micro, • x86_64, • 1-16 Cores, • Priority Subscription, • 1 Year	Configuration: • 1x per node (up to 16 cores, stackable)
Kubernetes	1	R-0001-PS1	SUSE Rancher, • x86-64, • 1 Instance, • Priority Subscription, • 1 Year	Configuration: • includes up to 3 nodes of K3s • includes up to 3 nodes of Rancher Kubernetes Engine • includes up to 3 nodes of Rancher Kubernetes Engine Government

Note

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

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