Reference Implementation - SUSE Rancher

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Contents

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Preface

The purpose of this documentation is to provide an overview and procedure for implementing SUSE Rancher (https://rancher.com/products/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

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 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 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

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 Cloud Native Computing Foundation (CNCF [2]) compliant, anywhere from edge, core, on-premise, or cloud. SUSE Rancher optimizes creating and managing Kubernetes clusters like:

- Rancher Kubernetes Engine (RKE (https://rancher.com/products/rke/)),
- Rancher Kubernetes Engine Government (RKE2 (https://github.com/rancher/rke2/)) and
- lightweight edge-centric K3s (https://rancher.com/products/k3s/)

and across on-premise, hybrid-cloud or in cloud-based Kubernetes services, such as

- baremetal, physical nodes,
- virtual machines,
- Amazon Elastic Kubernetes Service [3],

1 https://kubernetes.io/

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

3 https://aws.amazon.com/eks

- Azure Kubernetes Service [4] and
- Google Kubernetes Engine [5]

SUSE Rancher users can also import and manage existing Kubernetes clusters created that are based upon CNCF [6] certified [7] Kubernetes distributions or installer.

1.2 Scope

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

1.3 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.

4 https://azure.microsoft.com/en-us/overview/kubernetes-on-azure/

5 https://cloud.google.com/kubernetes-engine

6 https://www.cncf.io/

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

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2 Business aspect

By unifying their IT operations with Kubernetes, organizations realize key benefits like increased reliability, improved security and greater efficiencies with standardized automation. However, relying on upstream Kubernetes often isn't enough for teams deploying Kubernetes into production. Therefore, Kubernetes management platforms are adopted by enterprises to deliver:

- Simplified Cluster Operations: improved DevOps efficiencies with simplified cluster operations
- Consistent Security Policy & User Management: best-practice security policy enforcement and advanced user management on any infrastructure
- Access to Shared Tools & Services: a high level of reliability with easy, consistent access to shared tools and services

2.1 Business problem

So, if you're ready to deploy your container-based application at scale with Kubernetes, you're likely faced with a bewildering array of software vendors, cloud providers, and open source projects that all promise painless, successful Kubernetes deployments.

Further, you need to continually address the needs and concerns of your:

Developers

Most of whom don't care about IT infrastructure, per se. They just want to write code and build their apps securely using their preferred workflow, then have push-button deployment 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.

2.2 Business value

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

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

Developers

SUSE Rancher makes it easy for you to securely deploy containerized applications no matter where your Kubernetes infrastructure runs – on-premises, in the cloud or at the edge. Use of 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 production-grade Kubernetes clusters from datacenter to cloud to the edge, it also unites them with centralized authentication, access control and observability. It lets you streamline cluster deployment on bare metal, private clouds, or public clouds and secure them using global security policies.

NOTE

For further information, visit SUSE (https://www.suse.com/company/about/) and Rancher (https://rancher.com/why-rancher/).

3 Component model

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

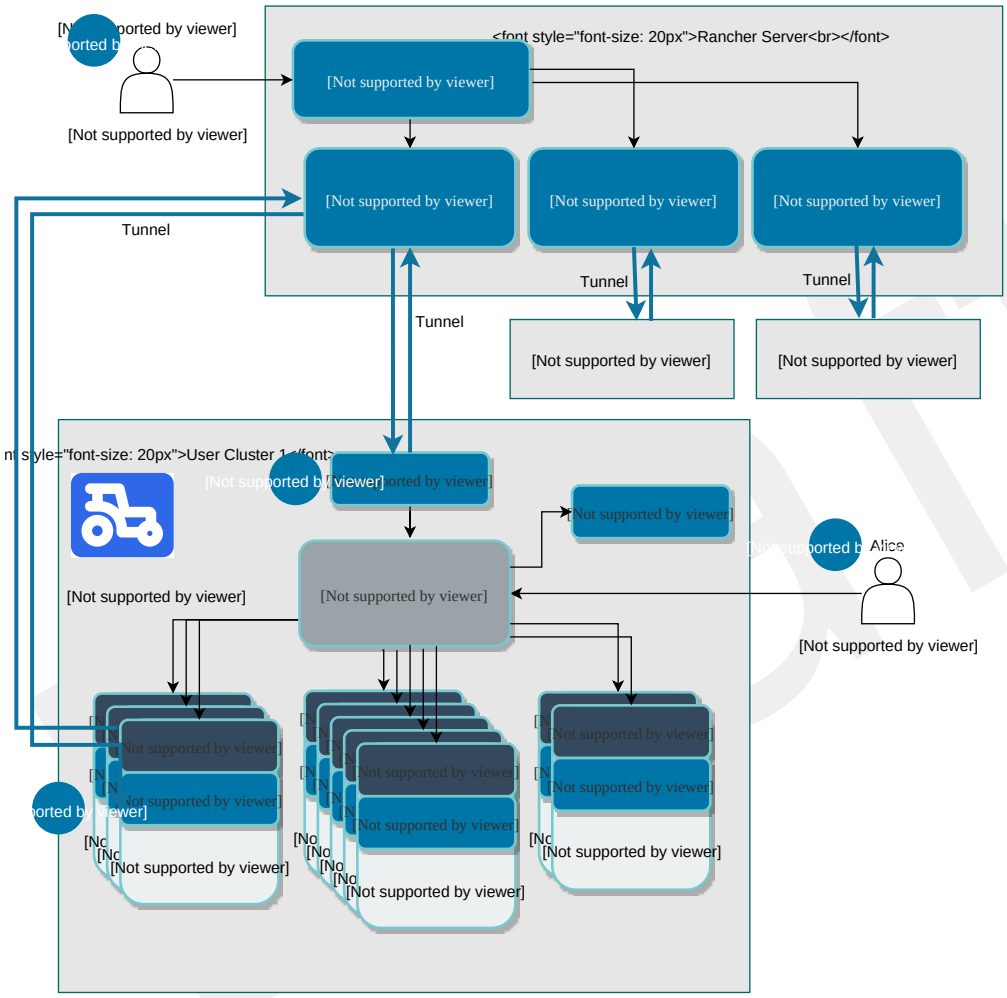

FIGURE 3.1: FIXME - KUBERNETES CLUSTER MANAGEMENT BY SUSE RANCHER

3.1 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
- Compute Platform

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.

3.1.1 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:

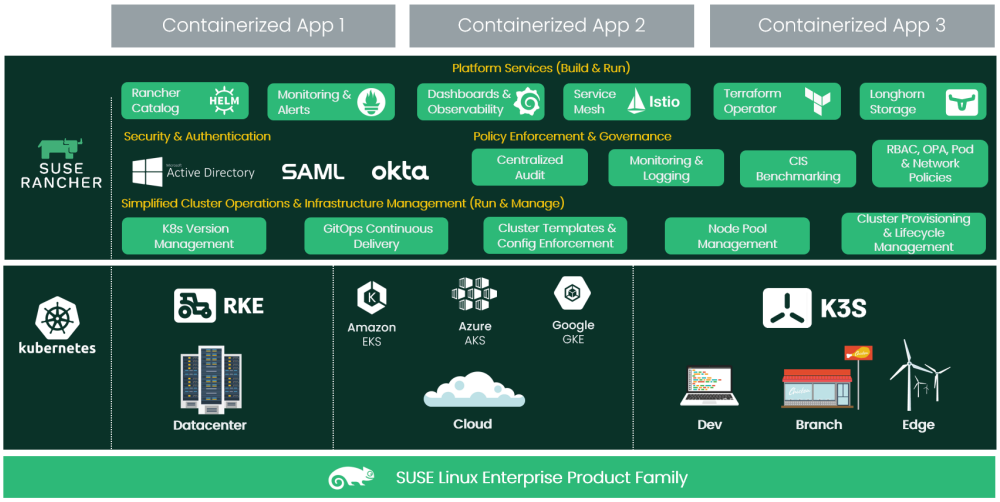

FIGURE 3.2: OVERVIEW OF SUSE RANCHER

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.

3.1.2 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:

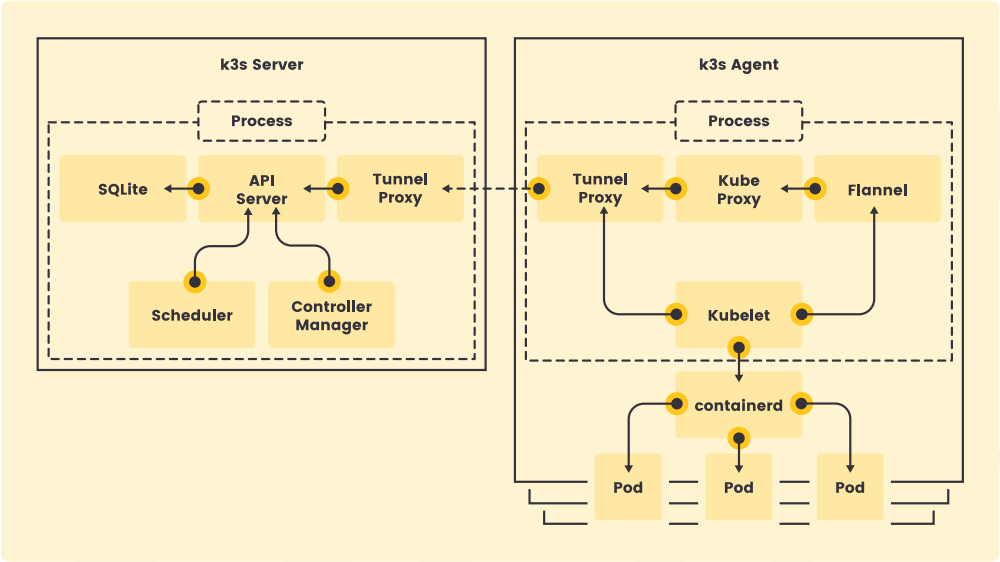

FIGURE 3.3: OVERVIEW OF K3S

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.

3.1.3 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.

3.1.4 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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4 Deployment

This section describes the process steps to deploy each of the components needed to create the SUSE Rancher solution. The content ordering is listed from the bottom layer upto the top.

4.1 Deployment overview

The deployment stack is represented in the following figure:

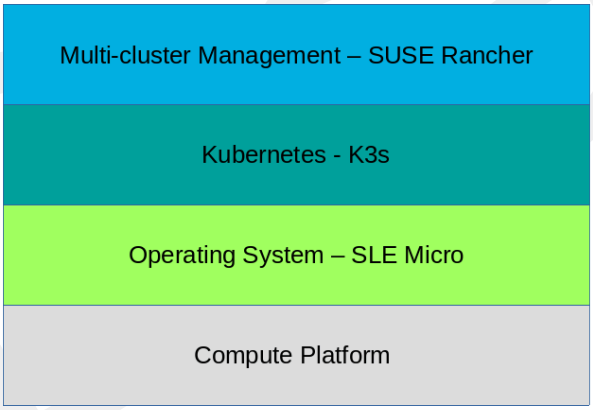

FIGURE 4.1: SUSE RANCHER DEPLOYMENT STACK

4.1.1 Compute platform deployment configuration

For each node:

- Validate the necessary CPU, memory and interconnect quantity and type are present for each node and intended role. Refer to the recommended CPU/Memory/Disk/Networking requirements as noted in the SUSE Rancher Hardware Requirements (https://rancher.com/docs/rancher/v2.x/en/installation/requirements/#cpu-and-memory-for-rancher-before-v2-4-0).
    - Network : Prepare an IP addressing scheme and optionally create both a public and private network, along with the respective subnets and desired VLAN designations. If a Baseboard Management Controller is present, consider using a distinct management network for controlled access.
    - and if using bare-metal nodes …
        - Ensure that a pair of local, direct attached disk drives is present on each node (SSDs are preferred); these will become the target for the operating system installation.
        - Boot Settings : Manage the boot node and select UEFI mode, with the primary device being hard disk.
        - BIOS/uEFI settings are reset to defaults for a known baseline, consistent state or perhaps with desired, localized values.

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- Use consistent and up-to-date versions for BIOS/uEFI/device firmware to reduce potential troubleshooting issues later

4.1.2 Operating System Deployment

On each compute platform node, install the noted SUSE operating system. Plan on leveraging and utilizing the following core infrastructure components and 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)

Note

During the installation, the node can be pointed to the respective update service. This can also be accomplished post-installation with the command-line tool, SUSEConnect (https://documentation.suse.com/sle-micro/5.0/single-html/SLE-Micro-installation/#article-installation).

Deployment Process

Follow these steps

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- 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 values aside 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 unatttended 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.

4.1.3 Kubernetes Deployment

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 SUSE Rancher, on this 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.

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Deployment Process

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 scale beyond a single server node. It is not needed if there will be an external load balancer used to access the cluster, or if the cluster will never be expanded beyond a single server node.

   - If needed, use the `ip a` command to determine the interface name (i.e. eth0) and CIDR netmask notation (i.e. /24) of the network interface that will be configured with the extra IP address
   - Set the following variable with the IP address and CIDR notation that will be used to access the Kubernetes API server:

     ```
     SECOND_IP=""
     ```

     - e.g., `SECOND_IP="10.111.2.100/24"`

     

     Note

     If the target interface is not eth0, substitute the name of the interface in place of "eth0" in the commands below.

     ```
     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

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=""
     ```

     - e.g., `K3s_VERSION="v1.20.4+k3s1"`

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 deployments -A"`
     - The deployment is complete when all deployments (coredns, local-path-provisioner, metrics-server, and traefik) show at least "1" as "AVAILABLE"
       - Use Ctrl+c to exit the watch loop after all pods are running

4.1.4 SUSE Rancher Deployment

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 Rancher 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.

Deployment Process

The primary steps for deploying SUSE Rancher are:

1. Create the Helm Chart 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=""
```

        - e.g., `CERT_MANAGER_VERSION="v1.0.4"`
    - Create the cert-manager Helm Chart 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 Helm Chart 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 deployments -A"`
  - The deployment is complete when all deployments (cert-manager, cert-manager-cainjector, cert-manager-webhook) show at least "1" as "AVAILABLE"
  - Use Ctrl + c to exit the watch loop after all pods are running

2. Create the Helm Chart custom resource for SUSE Rancher:
   - Set the following variable to the hostname of the SUSE Rancher server instance

```
HOSTNAME=""
```

     - e.g., `HOSTNAME="suse-rancher.sandbox.local"`

Note

This hostname should be resolvable to an IP address of the K3s host, or a load balancer/proxy server that supports this installation of SUSE Rancher.

   - Create the SUSE Rancher Helm Chart 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 Helm Chart 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

- (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 SUSE 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 SUSE Rancher service. The SUSE Rancher hostname should be resolvable to the appropriate IP address by the local workstation.

- 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 -N -D 8080 user@Linux-host
```

- On the local workstation web browser, change the SOCKS Host settings to "127.0.0.1" and port "8080"

Note

This will route all traffic from this web browser through the remote Linux host. Be sure to close the tunnel and revert the SOCKS Host settings when you're done.

3. 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 service
     - e.g., `https://rancher.sandbox.local`
   - Provide a new Admin password

Important

On the second configuration page, ensure the "Rancher Server URL" is set to the hostname specified when creating the SUSE Rancher HelmChart custom resource and the port is 443.

     - e.g., `rancher.sandbox.local:443`

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 deployment and management of the 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

- 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 (SLE Micro) - https://www.suse.com/products/micro/ (documentation (https://documentation.suse.com/sle-micro/5.0/))
  - Projects
    - Rancher Kubernetes Engine Government (RKE2) - https://github.com/rancher/rke2 (documentation (https://docs.rke2.io/))

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A Appendix

FixMe - Lorem ipsum dolor sit amet, consectetur adipisicing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum.

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 installation resource requirements (https://rancher.com/docs/rancher/v2.x/en/installation/requirements/#cpu-and-memory-for-

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Role	Qty	SKU	Component	Notes
				ranch-er-be-fore-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 Kuber-

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Role	Qty	SKU	Component	Notes
				netes Engine Government

Note

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

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