Reference Configuration - SUSE Rancher

SUSE Linux Enterprise Server 15-SP2, K3s 1.20.6, SUSE Rancher 2.5.8

Reference Configuration - SUSE Rancher: Including integration content from Cisco

SUSE Linux Enterprise Server 15-SP2, K3s 1.20.6, SUSE Rancher 2.5.8

The purpose of this document is to provide an overview and procedure of implementing SUSE (R) and partner offerings for 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.

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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

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 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]) conformant and certified [3], anywhere across edge, on-premise data centers, or cloud service providers. SUSE Rancher optimizes creating and managing Kubernetes clusters like:

- Lightweight edge-centric K3s (https://rancher.com/products/k3s/)
- Rancher Kubernetes Engine (RKE (https://rancher.com/products/rke/))
- and other Kubernetes clusters that are based upon CNCF certified Kubernetes distributions or installations

and deployed across various supported (https://rancher.com/support-maintenance-terms) infrastructure elements.

Once on such a digital transformation journey, some of the next focus areas are:

- Compute Platform

1 https://kubernetes.io/

2 https://www.cncf.io/

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

- To optimize availability, performance, scalability and integrity, assess current system platforms or acquire and utilize new variations from:
  - Independent Hardware Vendors (IHV), such as Cisco (https://www.cisco.com/) ® , as the platform for physical, baremetal, hypervisors and virtual machines

1.2 Scope

The scope of this document is to provide a layered *reference configuration* for SUSE Rancher. This can be done in a variety of solution layered stacks, to become a fundamental component of a managing multiple 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. One should still be familiar with the traditional IT infrastructure pillars — networking, computing and storage — along with the local use cases for sizing, scaling and limitations within each pillars' environments.

2 Business aspect

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

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

Cluster Operations
: Improved Production and DevOps efficiencies with simplified cluster usage and robust operations

Security Policy & User Management
: Consistent security policy enforcement plus advanced user management on any Kubernetes infrastructure

Access to Shared Tools & Services
: A high level of reliability with easy, consistent access to a broad set of tools and services

2.1 Business problem

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

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

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

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

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

Developers

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

IT Operators

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

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

Compute Platform

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

- physical, baremetal, hypervisors and virtual machines

2.2 Business value

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

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

Developers

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

IT Operators

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

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

Compute Platform

Utilizing the above software application and technology solutions with the server platforms offered by Cisco (https://www.cisco.com/) Unified Computing System (UCS (https://www.cisco.com/c/en/us/products/servers-unified-computing/index.html)) brings increased productivity, reduced total cost of ownership, and scalability into your computing realm. Cisco UCS is based upon industry-standard, x86-architecture servers with Cisco innovations and delivers a better balance of CPU, memory, and I/O resources. This balance brings processor power to life with more than 150 world-record-setting benchmark results that demonstrate leadership in application areas including virtualization, cloud computing, enterprise applications, database management systems, enterprise middleware, high-performance computing, and basic CPU integer and floating-point performance metrics.

- Match servers to workloads - The breadth of the server product line makes the process of matching servers to workloads straightforward, enabling you to achieve the best balance of CPU, memory, I/O, internal disk, and external storage-access resources using the blade, rack, multinode, or storage server form factor that best meets your organization's data center requirements and preferred purchasing model.

- Powered by AMD EPYC processors or Intel Xeon Scalable processors

- Industry-leading bandwidth - Cisco UCS virtual interface cards have dramatically simplified the deployment of servers for specific applications. By making the number and type of I/O devices programmable on demand, enables organizations to deploy and repurpose server I/O configurations without ever touching the hardware.
- Lower infrastructure cost - Designed for lower infrastructure cost per server, is a choice that makes scaling fast, easy, and inexpensive in comparison to manually configured approaches.
- Rack server deployment flexibility - Cisco UCS C-Series Rack Servers unique in the industry because they can be integrated with Cisco UCS connectivity and management or used as standalone servers
    - Integrated Management Controller (IMC) - Running in the system's Baseboard Management Controller (BMC), when a Cisco UCS C-Series Rack Servers is integrated into a Cisco UCS domain, the fabric interconnects interface with the IMC to make the server part of a single unified management domain. When a server is used as a standalone server, direct access to the IMC through the servers's management port allows a range of software tools (including Cisco Intersight) to configure the server through its API.

3 Architectural overview

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

3.1 Solution architecture

The figure below illustrates the high-level architecture of the SUSE Rancher installation that manages multiple downstream Kubernetes clusters:

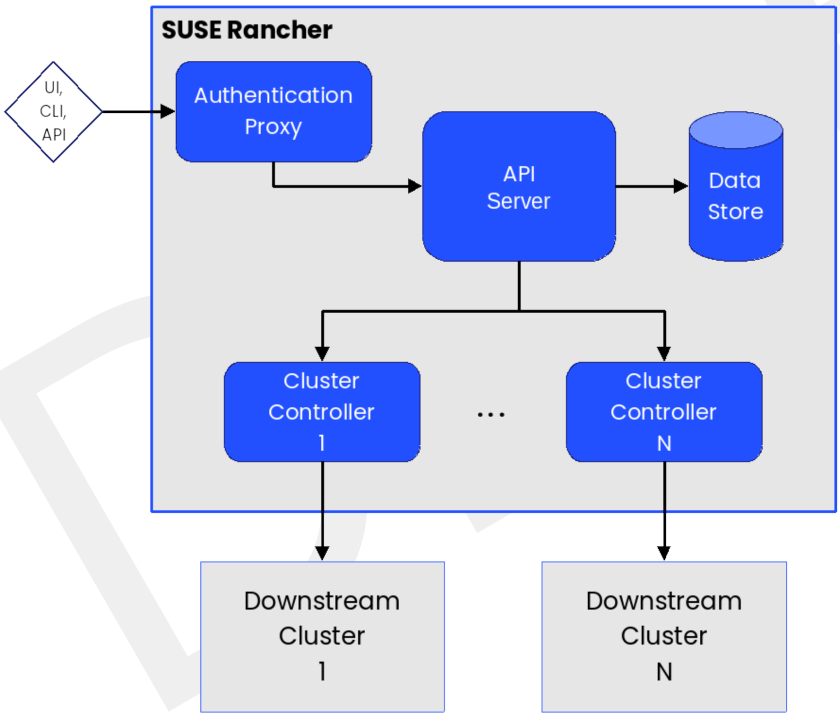

FIGURE 3.1: ARCHITECTURE OVERVIEW - SUSE RANCHER

Authentication Proxy

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

API Server

This provides the programmatic interface backend for a user, utilizing command-line interactions with SUSE Rancher and the managed clusters.

Data Store

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

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.

Once setup, users can potentially interact with SUSE Rancher 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

For the best performance and security, the recommended deployment is a dedicated Kubernetes cluster for the SUSE Rancher management server. Running user workloads on this cluster is not advised. After deploying SUSE Rancher, one can then create or import clusters for orchestrated workloads.

4 Component model

This section describes the various components being used to create a SUSE Rancher solution deployment.

4.1 Component overview

By utilizing:

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

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

4.2 Software - SUSE Rancher

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

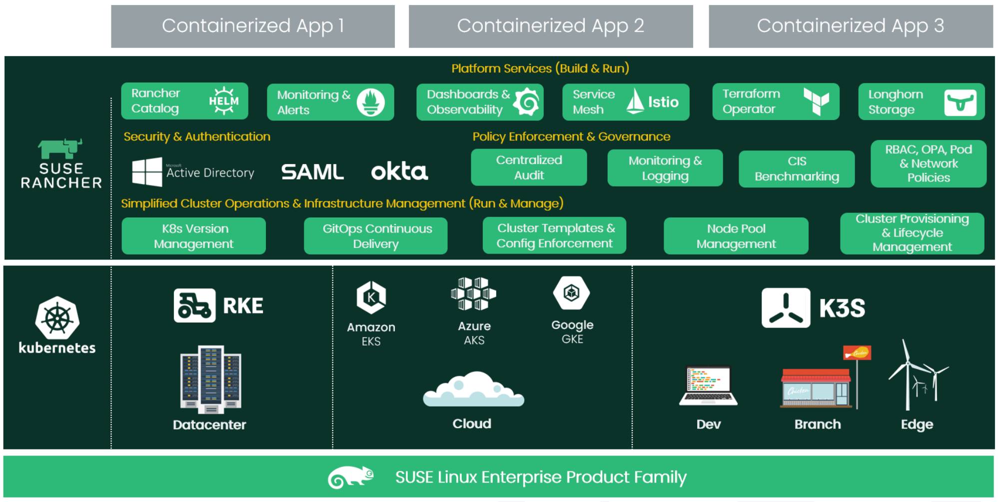

FIGURE 4.1: OVERVIEW OF SUSE RANCHER

Certified Kubernetes Distributions

SUSE Rancher supports management of any certified Kubernetes distribution. That includes:

- for development, edge, branch workloads, SUSE offerings like K3s (https://rancher.com/products/k3s/), a certified lightweight distribution of Kubernetes
- for on-premises workloads, a SUSE offering Rancher Kubernetes Engine (RKE (https://rancher.com/products/rke/)), a certified Kubernetes distribution for both bare-metal and virtualized servers
- for the public cloud, hosted Kubernetes services like
  - Amazon Elastic Kubernetes Service (EKS [1]),
  - Azure Kubernetes Service (AKS [2]) and
  - Google Kubernetes Engine (GKE [3]).

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

Simplified Cluster Operations and Infrastructure Management

SUSE Rancher provides simple, consistent cluster operations including provisioning and templates, configuration and lifecycle version management, along with visibility and diagnostics.

Security and Authentication

SUSE Rancher incorporates and leverages various single-signon services, to automate processes and apply a consistent set of user access and security policies for all the managed clusters, no matter where they're running.

Policy Enforcement and Governance

SUSE Rancher includes audit and security guideline enforcement, monitoring and logging functions, along with user, network and workload policies distributed across all managed clusters.

Platform Services

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

Given SUSE Rancher relies upon being deployed on a Kubernetes platform, the next sections describe the suggested component layering approach.

4.3 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

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

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

- 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

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

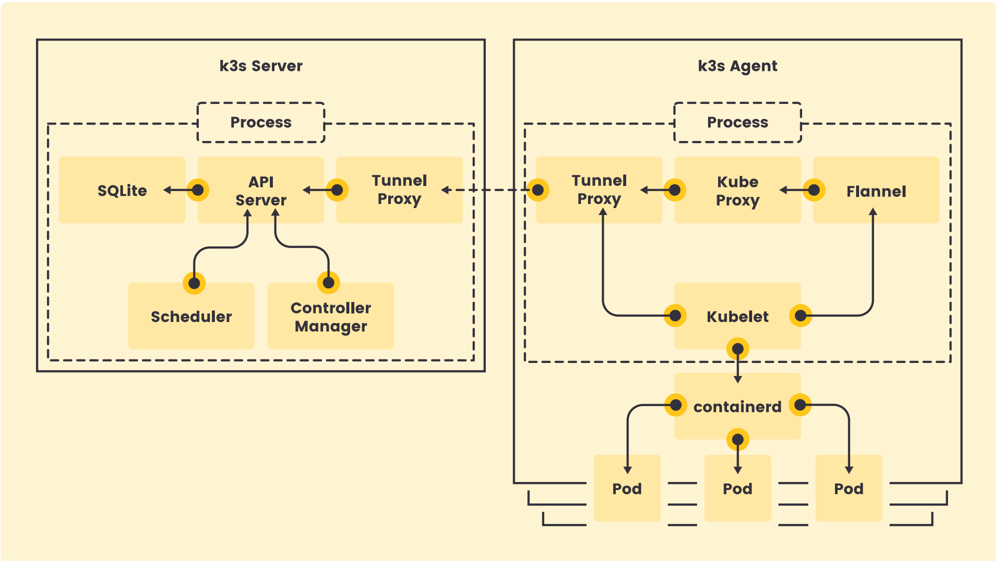

FIGURE 4.2: OVERVIEW OF K3S

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, these are also included:

- 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

4.4 Software - SUSE Linux Enterprise Server

SUSE Linux Enterprise Server (SLES (https://www.suse.com/products/server/)) is an adaptable and easy-to-manage platform that allows developers and administrators to deploy business-critical workloads on-premises, in the cloud and at the edge. It is a Linux operating system that is adaptable to any environment – optimized for performance, security and reliability. As a multimodal operating system that paves the way for IT transformation in the software-defined era, this simplifies multimodal IT, makes traditional IT infrastructure efficient and provides an engaging platform for developers. As a result, one can easily deploy and transition business-critical workloads across on-premise and public cloud environments.

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

4.5 Compute Platform

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

Cisco UCS C-Series Rack Servers (https://www.cisco.com/c/en/us/products/servers-unified-computing/ucs-c-series-rack-servers/index.html)

UCS C-Series Rack Servers delivers unified computing in an industry-standard form factor to reduce TCO and increase agility. Each server addresses varying workload challenges through a balance of processing, memory, I/O, and internal storage resources. These servers can be deployed as standalone servers or as part of a Cisco Unified Computing System (Cisco UCS) managed environment to take advantage of Cisco's standards-based unified computing innovations that help reduce customers' Total Cost of Ownership (TCO) and increase their business agility. ~

Server product-line and model options abound in the Cisco UCS C-Series Rack Servers (https://www.cisco.com/c/en/us/products/servers-unified-computing/ucs-c-series-rack-servers/index.html), including:

- Cisco UCS C240 SD M5 is a high-performance compute solution in a dense 2-socket, 2-Rack-Unit, 22" form-factor to handle the most critical real-time compute applications. This front-access server can be deployed as standalone servers or as part of a Cisco Unified Computing System (Cisco UCS) to deliver an exceptional management experience for a variety of applications by:
  - incorporating the 2nd generation of Intel® Xeon® Scalable processors, Intel® Optane™ Memory, and various drive options including All-NVMe, SAS and SATA drives.
  - being density optimized to accommodate space constrained environments while still offering industry-leading performance and expandability. It supports a wide range of workloads from enterprise to edge applications such as Multi-access Edge Compute (MEC).

Note

Cisco UCS Hardware Compatibilty List (https://ucshcltool.cloudapps.cisco.com/public/) provides a lookup tool for Servers & OS Support, for versions of SUSE offerings.

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.

5 Deployment

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

5.1 Deployment overview

The deployment stack is represented in the following figure:

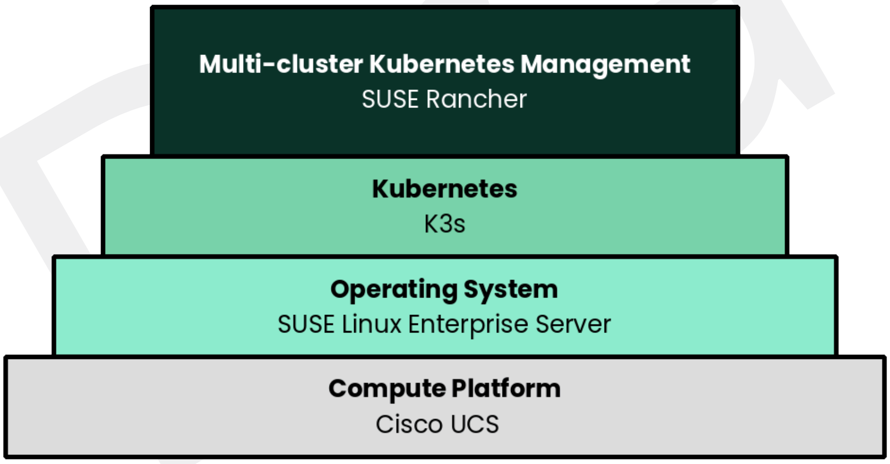

FIGURE 5.1: SUSE RANCHER DEPLOYMENT STACK

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

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

5.2 Compute Platform

The base, starting configuration can reside all within a single Cisco UCS. Based upon the relatively small resource requirements for a SUSE Rancher deployment, a viable approach is to deploy as a virtual machine (VM) on the target nodes, on top of an existing hypervisor, like KVM.

Preparation(s)

For a physical host, like C240 SD M5 (https://www.cisco.com/c/en/us/products/collateral/servers-unified-computing/ucs-c-series-rack-servers/datasheet-c78-743260.html) used in the deployment:

1. If using Cisco UCS Manager
   - Log into the Cisco UCS Manager
     - Select the Equipment tab
     - In the navigation pane expand Rack-Mounts and then Servers
     - Right-click the server and select KVM console
     - In the right pane, click the KVM Console
       - Click the link to launch the KVM console
       - Select the Virtual Media tab and activate Virtual Devices found in Virtual Media tab
       - Click the Virtual Media tab to select CD/DVD
       - Select Map Drive in the Virtual Disk Management window and browse to respective operating system media, open and use the image for a system boot.

Deployment Process

On the respective compute module node, determine if a hypervisor is already available for the solution's virtual machines.

1. If this will be the first use of this node, an option is to deploy a KVM hypervisor, based upon SUSE Linux Enterprise Server by following the Virtualization Guide (https://documentation.suse.com/sles/15-SP2/single-html/SLES-virtualization/#book-virt).

- Given the simplicity of the deployment, the operating system and hypervisor can be installed with the SUSE Linux Enterprise Server ISO media and the Cisco IMC virtual media and virtual console methodology.

2. Then for the solution VM, utilize the hypervisor user interface to allocate the necessary CPU, memory, disk and networking as noted in the SUSE Rancher hardware requirements (https://rancher.com/docs/rancher/v2.x/en/installation/requirements/#hardware-requirements).

Deployment Consideration(s)

To further optimize deployment factors, leverage the following practices:

- *Availability*
  - While the initial deployment only requires a single VM, as noted in later deployment sections, having multiple VMs provides resiliency to accomplish high availability. To reduce single points of failure, it would be beneficial to have the multi-VM deployments spread across multiple hypervisor nodes. So consideration of consistent hypervisor and compute module configurations, with the needed resources for the SUSE Rancher VMs will yield a robust, reliable production implementation.

5.3 SUSE Linux Enterprise Server

Utilize an enterprise-grade Linux operating system , like SUSE Linux Enterprise Server, as the base software layer.

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) ↗.

Deployment Process

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

Deployment Consideration(s)

To further optimize deployment factors, leverage the following practices:

- *Automation*

  - To reduce user intervention, unattended deployments of SUSE Linux Enterprise Micro can be automated

- for ISO-based installations, by referring to the AutoYaST Guide (https://documentation.suse.com/sle-micro/5.0/single-html/SLE-Micro-autoyast/#book-autoyast)
- for raw-image based installation, by configuring the Ignition and Combustion tooling as described in the Installation Quick Start (https://documentation.suse.com/sle-micro/5.0/single-html/SLE-Micro-installation/#article-installation)

5.4 K3s

Utilize an enterprise-grade Linux operating system , like SUSE Linux Enterprise Server, as the base software layer.

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, supported version of the K3s binary (e.g. vX.YY.ZZ+k3s1), by reviewing the "Rancher Support Matrix" on the Support and Maintenance Terms of Service (https://rancher.com/support-maintenance-terms) web page.

Deployment Process

Perform the following steps to install the first K3s server on one of the nodes to be used for the Kubernetes control plane

1. Set the following variable with the noted version of K3s, as found during the preparation steps.

```
K3s_VERSION=""
```

2. Install the version of 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 -
```

Tip

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

- Monitor the progress of the installation: `watch -c "kubectl get deployments -A"`
  - The K3s deployment is complete when elements of all the 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 deployment pods are running

Deployment Consideration(s)

To further optimize deployment factors, leverage the following practices:

- *Availability*

- A full high-availability K3s 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 K3s 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, then log into the new nodes as root or as a user with sudo privileges.
  2. Execute the following sets of commands on each of the remaining control-plane nodes:
     - Set the following additional variables, as appropriate for this cluster

```
# Private IP preferred, if available
FIRST_SERVER_IP=""

# From /var/lib/rancher/k3s/server/node-token file on the first
 server
NODE_TOKEN=""

# Match the first of the first server
```

```
K3s_VERSION=""
```

- Install K3s

```
curl -sfL https://get.k3s.io | \
 INSTALL_K3S_VERSION=${K3s_VERSION} \
 K3S_URL=https://${FIRST_SERVER_IP}:6443 \
 K3S_TOKEN=${NODE_TOKEN} \
 K3S_KUBECONFIG_MODE="644" INSTALL_K3S_EXEC='server' \
 sh -
```

- Monitor the progress of the installation: `watch -c "kubectl get deployments -A"`
  - The K3s deployment is complete when elements of all the 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 deployment pods are running
    By default, the K3s server nodes are available to run non-control-plane workloads. In this case, the K3s default behavior is perfect for the SUSE Rancher server cluster as it doesn't require additional agent (aka worker) nodes to maintain a highly available SUSE Rancher server application.

    ### 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.

- (Optional) In cases where agent nodes are desired, execute the following sets of commands, using the same "*K3s_VERSION*", "*FIRST_SERVER_IP*", "*NODE_TOKEN*" and "*K3s_VERSION*" variable settings as above, on each of the agent nodes to add it to the K3s cluster:

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

```
K3S_URL=https://${FIRST_SERVER_IP}:6443 \
K3S_TOKEN=${NODE_TOKEN} \
K3S_KUBECONFIG_MODE="644" \
sh -
```

5.5 SUSE Rancher

Utilize an enterprise-grade Linux operating system , like SUSE Linux Enterprise Server, as the base software layer.

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).

Deployment Process

While logged into the node, as root or with sudo privileges, install SUSE Rancher:

1. Create the Helm Chart custom resource for cert-manager:

   - Set the following variable with the desired version of cert-manager

     ```
     CERT_MANAGER_VERSION=""
     ```

     > **Note**
     >
     > At this time, the most current, supported version of cert-manager is 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=""
```

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

3. (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.

4. 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://suse-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., `suse-rancher.sandbox.local:443`

Deployment Consideration(s)

To further optimize deployment factors, leverage the following practices

- *Availability*
  - In instances where a load balancer is used to access a K3s cluster, deploying two additional K3s cluster nodes, for a total of three, will automatically make SUSE Rancher highly available.
- *Security*
  - The basic deployment steps described above are for deploying SUSE Rancher with automatically generated, self-signed security certificates. Other options are to have SUSE Rancher create public certificates via Let's Encrypt associated with with a publicly resolvable hostname for the SUSE Rancher server, or to provide preconfigured, private certificates. See SUSE Rancher product documentation (https://rancher.com/docs/rancher/v2.x/en/installation/install-rancher-on-k8s/#3-choose-your-ssl-configuration) for more information.
- *Integrity*
  - This deployment of SUSE Rancher uses the K3s etcd key/value store to persist its data and configuration, which offers several advantages. With a multi-node cluster and this resiliency through replication, having to provide highly-avail-

able storage isn't needed. In addition, backing up the K3s etcd store protects the cluster as well as the installation of SUSE Rancher and permits restoration of a given state.

After this successful deployment of the SUSE Rancher solution, review the product documentation (https://rancher.com/docs/rancher/v2.5/en/) ↗ for details on how downstream Kubernetes clusters can be:

- deployed (refer to sub-section "Setting up Kubernetes Clusters in Rancher") or
- 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 workload, maintaining security and many more functions are readily available.

6 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

- 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 extended, in a distributed computing context, tohhbenefit 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 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.

SUSE Linux Enterp... *

7 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/v2.5/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/4.2/))
- 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

Reference Configuration

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

Reference 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)

Automation [2]

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

---

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

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

Availability [3]

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

Integrity [4]

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

Security [5]

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 [6]

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 [7]) that has just enough features to satisfy an

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

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

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

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

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

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

Production

A deployed environment that target customers or users can interact with and rely upon to meet their needs, plus be operationally sustainable in terms of resource 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
Compute Platform	1-3	UCSC-C240-M5SD	Cisco UCS C240 SD M5	Configuration • 2x Intel 5218 (16-core, 2.3GHz) • 256GB RAM • 2x 600GB SAS 12G 10k HDD (OS) • 2x 1.2-2.4TB SAS 12G 10k HDD (local storage)

A.2 Software Bill of Materials

Role	Qty	SKU	Component	Notes
Operating System	1-3	874-006875	SUSE Linux Enterprise Server, • x86_64, • Priority Subscription, • 1 Year	Configuration: • per node (up to 2 sockets, stackable) or 2 VMs
Kubernetes Management	1	R-0001-PS1	SUSE Rancher,	Configuration: • per instance, includes up to 3

Role	Qty	SKU	Component	Notes
			• x86-64, • Priority Subscription, • 1 Year	Kubernetes nodes
Consulting and Training	1	R-0001-QSO	Rancher Quick Start, • Go Live Services	Terms: • Review of client architecture • Bi-weekly cadence calls for 12 weeks • On-demand consulting (24 hours) • Two developer workshops

Note

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

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