Reference Implementation - Rancher Kubernetes Engine

SUSE Linux Enterprise Micro 5.0, Rancher Kubernetes Engine 1.2.7

SUSE Linux Enterp... *

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The purpose of this document is to provide an overview and procedure of implementing SUSE (R) offerings for Rancher Kubernetes Engine (RKE), a Kubernetes distribution that runs entirely within containers on bare-metal and virtualized nodes. RKE solves the problem of installation complexity and the operation is both simplified and easily automated, while entirely accommodating the operating system and platform it is running on.

Publication Date: 2021-06-15

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Contents

1 Introduction

On the digital transformation journey to a full cloud native landscape, utilization of microservices becomes the main approach with the dominant technology for such container orchestration being Kubernetes [1] With its large community of developers and abundant features and capabilities, Kubernetes has become the defacto standard and is included across most container-as-a-service platforms. With all of these technologies in place, both developer and operation teams can effectively deploy, manage and deliver functionality to their end users in a resilient and agile manner.

1.1 Motivation

As developers and organizations continue their journey from simple, containerized microservices towards having these workloads orchestrated and deployed where ever they need, being able to install, monitor and use such Kubernetes infrastructures is a core need. Such deployments, being Cloud Native Computing Foundation (CNCF [2]) conformant [3] and certified [4] are essential for both development and production workloads.

Solving common frustrations around installation complexity, Rancher Kubernetes Engine reduces many host dependencies and provides a stable path for deployment, upgrades, and rollbacks for core use cases.

1.2 Scope

The scope of this document is to provide a general *reference implementation* of Rancher Kubernetes Engine. This can be done in a variety of scenarios to create an enterprise Kubernetes cluster deployment anywhere.

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1 https://kubernetes.io/

2 https://www.cncf.io/

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

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

1.3 Audience

This document is intended for IT decision makers, architects, system administrators and technicians who are implementing a flexible, software-defined Kubernetes platform. One should still be familiar with the traditional IT infrastructure pillars — networking, computing and storage — along with the local use cases for sizing, scaling and limitations within each pillars' environments.

2 Business aspect

Agility is the name of the game in modern application development. This 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 extra 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 infrastructure requires consideration of a larger 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.

2.2 Business value

With Rancher Kubernetes Engine, the operation of Kubernetes is easily automated and entirely independent of the operating system and platform running. Using a supported version of the container runtime engine, one can deploy and run Kubernetes with Rancher Kubernetes Engine. It builds a cluster from a single command in just a few minutes, and its declarative configuration makes Kubernetes upgrades atomic and safe.

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.

3 Architectural overview

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

3.1 Solution architecture

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

FIGURE 3.1: ARCHITECTURE OVERVIEW - RANCHER KUBERNETES ENGINE

FixMe-Authentication Proxy

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

FixMe-API Server

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

FixMe-Data Store

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

FixMe-Cluster Controller

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

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

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

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

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

4 Component model

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

4.1 Component overview

By utilizing:

- Kubernetes Platform - Rancher Kubernetes Engine
- Operating System - ifdef::iSLES[SUSE Linux Enterprise Server] ifdef::iSLEMicro[SUSE Linux Enterprise Micro}]
- Compute Platform

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

4.2 Software - Rancher Kubernetes Engine

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

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

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

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

- kube-scheduler,
- kubelet and
- kube-proxy

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

FIGURE 4.1: FIXME-OVERVIEW OF RANCHER KUBERNETES ENGINE

Rancher Kubernetes Engine can run as a complete cluster on a single node or can be expanded into a multi-node cluster. Besides the core Kubernetes components, these are also included:

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

FixMe-All of these components are optional and can be swapped out for your implementation of choice. With these included components, you get a fully functional and CNCF-conformant cluster so you can start running apps right away. Rancher Kubernetes Engine is now a CNCF Sandbox project, being the first Kubernetes distribution ever to be adopt ed into sandbox.

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

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

4.3 Software - SUSE Linux Enterprise Micro

SUSE Linux Enterprise Micro combines the assurance of enterprise-grade security and compliance with the immutability and portability of a modern, lightweight operating system. The top 4 features are:

Immutable OS

Immutable design ensures the OS is not altered during runtime and runs reliably every single time. Security signed and verified transactional updates are easy to rollback if things go wrong.

Security and Compliance

Fully open source and built using open standards, SUSE Linux Enterprise Micro leverages SUSE Linux Enterprise common code base, to provide FIPS 140-2, DISA SRG/STIG, integration with CIS and Common Criteria certified configurations. Includes fully supported security framework (SELinux) with policies.

Architectural Flexibility

Both Arm and x86-64 architectures are supported so you can deploy edge applications with confidence across multiple architectures.

Kubernetes-Ready

You can easily combine SUSE Linux Enterprise Micro with the latest cloud-native technologies including SUSE Rancher, Rancher Kubernetes Engine, Longhorn persistent block storage, and K3s, the world's most popular Kubernetes distribution for use in low resource, distributed edge locations.

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.

4.4 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:

- 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

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.

5 Deployment

This section describes the process steps for the deployment of the Rancher Kubernetes Engine 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:

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

Preparation(s)

For each node used in the deployment:

- Validate the necessary CPU, memory, disk capacity, and network interconnect quantity and type are present for each node and its 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/#hardware-requirements) ↗.
- Further suggestions

- Disk : Use a pair of local, direct attached, mirrored disk drives is present on each node (SSDs are preferred); these will become the target for the operating system installation.
- Network : Prepare an IP addressing scheme and optionally create both a public and private network, along with the respective subnets and desired VLAN designations for the target environment.
  - Baseboard Management Controller : If present, consider using a distinct management network for controlled access.
- Boot Settings : BIOS/uEFI reset to defaults for a known baseline, consistent state or perhaps with desired, localized values.
- Firmware : Use consistent and up-to-date versions for BIOS/uEFI/device firmware to reduce potential troubleshooting issues later

5.3 SUSE Linux Enterprise Micro

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

Preparation(s)

To meet the solution stack prerequisites and requirements, SUSE operating system offerings, like SUSE Linux Enterprise Micro (https://www.suse.com/products/micro/) 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:

1. Download the SUSE Linux Enterprise Micro (https://www.suse.com/download/sle-micro/) product (either for the ISO or Virtual Machine image)
2. The installation process is described and can be performed with default values by following steps from the SUSE Linux Enterprise Micro product documentation, see Installation Quick Start (https://documentation.suse.com/sle-micro/5.0/single-html/SLE-Micro-installation/#article-installation)

> **Tip**
>
> Adjust both the password and the local network addressing setup to comply with local environment guidelines and requirements.

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 Rancher Kubernetes Engine

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>
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Deployment Process

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

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

1. Download the Rancher Kubernetes Engine binary according to the instructions on product documentation (https://rancher.com/docs/rke/latest/en/) page, then follow the directions on that page, but with the following exceptions:
2. Create the cluster.yml file with the command `rke config`

    > **Note**
    >
    > See https://rancher.com/docs/rke/latest/en/example-yamls/ and https://rancher.com/docs/rke/latest/en/config-options/ for full descriptions of the cluster.yml parameters

- It is recommended to create a unique SSH key for this Rancher Kubernetes Engine cluster with the command `ssh-keygen`
  - Provide the path to that key for the option "Cluster Level SSH Private Key Path"
- The option "Number of Hosts" refers to the number of hosts to configure at this time
  - Additional hosts can be added very easily after Rancher Kubernetes Engine cluster creation
  - For this implementation it is recommended to configure one or three hosts
- Give all hosts the roles of "Control Plane", "Worker", and "etcd"
- Answer "n" for the option "Enable PodSecurityPolicy"

3. Update the cluster.yml file before continuing with the step "Deploying Kubernetes with RKE"

4. If a load balancer has been deployed for the Rancher Kubernetes Engine control-plane nodes, update the cluster.yml file before deploying Rancher Kubernetes Engine to include the IP address or FQDN of the load balancer. The appropriate location is under authentication.sans. For example:

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

5. Update the cluster.yml file to work with the SUSE Linux Enterprise Micro read-only fileystem as shown below:

   - Update the network.options block:

```
network:
  plugin: canal
  options: {
   canal_flex_volume_plugin_dir: /opt/kubernetes/kubelet-plugins/volume/
exec/nodeagent~uds,
   flannel_backend_type: vxlan
```

```
}
```

- Update the service.kube-controller.extra_args blocks:

```
kube-controller:
    image: ""
    extra_args: {flex-volume-plugin-dir: /opt/kubernetes/kubelet-plugins/
volume/exec/}
```

6. Verify password-less SSH is available from the admin workstation to each of the cluster hosts as the user specified in the cluster.yml file
7. When ready, run `rke up` to create the RKE cluster
8. After the `rke up` command completes, the RKE cluster will continue the Kubernetes installation process
   - Monitor the progress of the installation:
     - Export the variable KUBECONFIG to the absolute pathname of the kube_config_cluster.yml file. I.e. `export KUBECONFIG=~/rke-cluster/kube_config_cluster.yml`
     - Run the command: `watch -c "kubectl get deployments -A"`
       - The cluster deployment is complete when elements of all the deployments show at least "1" as "AVAILABLE"
       - Use Ctrl+c to exit the watch loop after all deployment pods are running

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

Deployment Consideration(s)

To further optimize deployment factors, leverage the following practices:

- *Availability*

- While a single Rancher Kubernetes Engine node works perfectly fine, a full high-availability Rancher Kubernetes Engine cluster is recommended for production workloads. For this use case, two additional hosts should be added; for a total of three. All three hosts will perform the roles of control-plane, etcd, and worker.

  1. Deploy the same operating system on the new compute platform nodes, and prepare them in the same way as the first node

  2. Update the cluster.yml file to include the addional node

     - Using a text editor, copy the information for the first node (found under the "nodes:" section)

       - The node information usually starts with "- address:" and ends with the start of another node entry, or the beginning of the "services: " section, i.e.

```
- address: 172.16.240.71
  port: "22"
  internal_address: ""
  role:
  - controlplane
  - worker
  - etcd

. . .

  labels: {}
  taints: []
```

     - Paste the information into the same section, once for each additional host

     - Update the pasted information, as appropriate, for each additional host

  3. When the cluster.yml file is updated with the information specific to each node, run the command `rke up`

     - Run the command: `watch -c "kubectl get deployments -A"`

SUSE Linux Enterp... *

- The cluster deployment is complete when elements of all the deployments show at least "1" as "AVAILABLE"
- Use Ctrl+c to exit the watch loop after all deployment pods are running

After this successful deployment of the Rancher Kubernetes Engine solution, review the product documentation (https://rancher.com/docs/rke/latest/en/) for details on how to directly utilize this Kubernetes cluster. Furthermore, by reviewing the SUSE Rancher product documentation (https://rancher.com/docs/rancher/v2.x/en/) this solution can also be:

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

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

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

Modernize

Bring applications and data into modern computing

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

Accelerate

Accelerate business transformation through the power of open source software

- FixMe-Given the open source nature of Rancher Kubernetes Engine and the underlying software components, you can simplify management and make significant IT savings as you scale orchestrated, microservice deployments anywhere you need to and for whatever use cases are needed in an agile and innovative way.

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

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

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

Glossary

- Document Scope

Reference Implementation
: A guide with the basic steps to deploy the highlighted components of the SUSE portfolio, including generalized pointers to other layers and elements. This is considered an introductory approach and a basis for other tested variations.

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.

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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
System	1-3	n/a	• Virtual Machine, • Single Board Computer (SBC) or • Industry Standard Server	Configuration

A.2 Software Bill of Materials

Role	Qty	SKU	Component	Notes
Operating System	1-3	874-007864	SUSE Linux Enterprise Micro, • x86_64, • Priority Subscription, • 1 Year	Configuration: • per node (up to 16 cores, stackable)
Kubernetes	1	R-0003-PS1	Rancher Kubernetes Engine, • x86-64, • Priority Subscription, • 1 Year	Configuration: • provides support of 10 nodes

Note

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

A.3 Documentation Configuration / Attributes

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

```
Automation=1@ Availability=1@ FCTR=1@ FLVR=1@ Integrity=1@ PoC=1@ Production=1@ RI=1@
 Scaling=1@ Security=1@ focusRKE1=1@ layerSLEMicro=1@ Appendix=1 ArchOv=1 BP=1 BPBV=1
 CompMod=1 DepConsiderations=1 Deployment=1 GFDL=1 Glossary=1 HWComp=1 HWDepCfg=1 LN=1
 RA=1 References=1 Requirements=1 SWComp=1 SWDepCfg=1 env-daps=1 iK3s=1 iRKE1=1 iRKE2=1
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