

# Reference Implementation - K3s

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SUSE Linux Enterprise Server 15-SP2, K3s  
1.21.2

## Reference Implementation - K3s:

SUSE Linux Enterprise Server 15-SP2, K3s 1.21.2

The purpose of this document is to provide an overview and procedure of implementing SUSE (R) offerings for K3s, an official CNCF sandbox project that delivers a lightweight yet powerful certified Kubernetes distribution designed for production workloads across resource-restrained, remote locations or on Edge IoT devices.

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SUSE LLC

1800 South Novell Place

Provo, UT 84606

USA

<https://documentation.suse.com> ↗

# Contents

<b>1</b>	<b>Introduction</b>	<b>1</b>
1.1	Motivation	1
1.2	Scope	1
1.3	Audience	2
<b>2</b>	<b>Business aspect</b>	<b>3</b>
2.1	Business problem	3
2.2	Business value	3
<b>3</b>	<b>Architectural overview</b>	<b>5</b>
3.1	Solution architecture	5
<b>4</b>	<b>Component model</b>	<b>7</b>
4.1	Component overview	7
4.2	Software - K3s	7
4.3	Software - SUSE Linux Enterprise Server	9
4.4	Compute Platform	10
<b>5</b>	<b>Deployment</b>	<b>11</b>
5.1	Deployment overview	11
5.2	Compute Platform	12
5.3	SUSE Linux Enterprise Server	12
5.4	K3s	14

## 6 Summary 19

## 7 References 20

## Glossary 22

## A Appendix 25

A.1 Compute Platform Bill of Materials 25

A.2 Software Bill of Materials 25

A.3 Documentation Configuration / Attributes 27

## 8 Legal Notice 28

## 9 GNU Free Documentation License 29

# 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<sup>1</sup> 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<sup>2</sup> ) conformant and certified<sup>3</sup> are essential for both development and production workloads.

For simplified scenarios, like edge, remote or IoT, this is where K3s leads the industry, being simple and secure.

## 1.2 Scope

The scope of this document is to provide a general *reference implementation* of K3s. This can be done in a variety of scenarios to create an edge-oriented, lightweight Kubernetes cluster deployment.

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<sup>1</sup> <https://kubernetes.io/> ↗

<sup>2</sup> <https://www.cncf.io/> ↗

<sup>3</sup> <https://www.cncf.io/certification/software-conformance> ↗

## 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.

Draft

## 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

Kubernetes is the leading solution to address edge computing use cases in industry verticals such as manufacturing, transportation, power generation, healthcare, retail and banking. Typical edge systems that leverage Kubernetes to run complex workloads include energy meters, aircraft engines, gas & oil rigs, cruise ships, high-speed trains, retail scanners, wind turbine base stations, internet-connected cars, ATMs and much more.

For such target edge systems, which are often unattended, resource constrained and remote, orchestrating containerized workloads on Kubernetes deployments may seem overbearingly complex.

## 2.2 Business value

After two years of research and development in June 2020, K3s was donated to the CNCF. The donation is a testament of the commitment to the open source community and their mission to run Kubernetes everywhere.



## Perfect for Edge

K3s is a highly available, certified Kubernetes distribution specifically designed for production workloads in unattended, resource-constrained, remote locations or inside IoT appliances.

## Simplified & Secure

K3s is packaged as a tiny, single binary that reduces the dependencies and steps needed to install, run and auto-update a production Kubernetes cluster. For workloads, automated Manifest and Helm Chart management deployments can be utilized. Also, multiple architectures, like x86\_64, ARM64, and ARMv7, are supported with binaries and images available.

Given its extensive Kubernetes capabilities, K3s can also be a suitable choice for:

- embedded platforms,
- continuous integration and continuous deployment platforms,
- branch locations or individual developer deployments, and
- even core or cloud production instances



### Tip

When K3s is imported and combined with SUSE Rancher, organizations are equipped with an easy, complete and reliable management solution for Kubernetes at the edge.

## 3 Architectural overview

This section outlines the core elements of the K3s solution, along with the suggested target platforms and components.

### 3.1 Solution architecture

The figure below illustrates the high-level architecture of K3s:



FIGURE 3.1: **FIXME - ARCHITECTURE OVERVIEW - K3S**

#### Container Runtime

Containerd & runc Kine as a datastore shim that allows etcd to be replaced with other databases

#### Networking

Flannel for CNI Kube-router for network policy

#### Services

CoreDNS Metrics Server Traefik for ingress Klipper-lb as an embedded service loadbalancer provider Local-path-provisioner for provisioning volumes using local storage

#### Workloads

Helm-controller to allow for CRD-driven deployment of helm manifests

#### Host utilities

iptables/nftables, ebtables, ethtool, & socat

Once setup, users can potentially interact with K3s FixMe - 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:

- kubectl
  - directly on the K3s host or
  - remotely, leveraging the KUBECONFIG file of the {pn\_K3s} cluster's deployment ( FixMe )
- manual or automatic, Manifest or Helm Chart based, workload deployments

## 4 Component model

This section describes the various components being used to create a K3s solution deployment.

### 4.1 Component overview

By utilizing:

- Software
  - 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 - 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

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




FIGURE 4.1: 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> 

As K3s can be deployed on a single or multiple nodes, the next sections describe the suggested component layering approach.

## 4.3 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.


## 4.4 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 K3s 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:

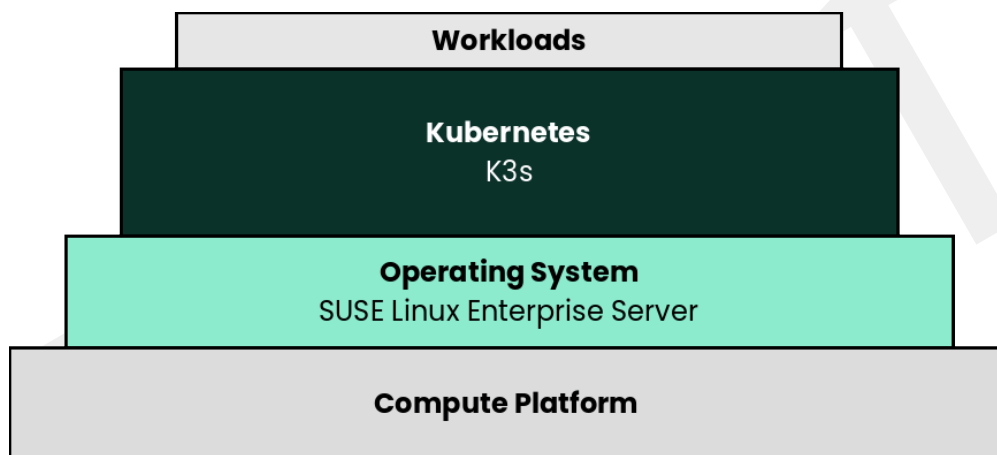


FIGURE 5.1: K3S DEPLOYMENT STACK

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

### 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 \(https://rancher.com/docs/rancher/v2.x/en/installation/requirements/#hardware-requirements\)](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 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 \(https://www.suse.com/products/server/\)](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 \(https://scc.suse.com/login\)](https://scc.suse.com/login) ( SCC ) or
  - an organization's [SUSE Manager \(https://www.suse.com/products/suse-manager/\)](https://www.suse.com/products/suse-manager/) infrastructure or
  - a local server running an instance of [Repository Mirroring Tool \(https://documentation.suse.com/sles/15-SP2/single-html/SLES-rmt/#book-rmt\)](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 \(https://www.suse.com/support/kb/doc/?id=000018564\)](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) (<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) (<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/) (<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 \(https://scc.suse.com/login\)](https://scc.suse.com/login) ( SCC ) or
- an organization's [SUSE Manager \(https://www.suse.com/products/suse-manager/\)](https://www.suse.com/products/suse-manager/) infrastructure or
- a local server running an instance of [Repository Mirroring Tool \(https://documentation.suse.com/sles/15-SP2/single-html/SLES-rmt/#book-rmt\)](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 \(https://www.suse.com/support/kb/doc/?id=000018564\)](https://www.suse.com/support/kb/doc/?id=000018564).

2. Identify the appropriate, desired version of the K3s binary (e.g. vX.YY.ZZ + k3s1), by reviewing the "Releases" on the [Download \(https://github.com/k3s-io/k3s/\)](https://github.com/k3s-io/k3s/) 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



#### 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", and "NODE\_TOKEN" 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 -
```

After this successful deployment of the K3s solution, review the [product documentation \(https://rancher.com/docs/k3s/latest/en/\)](https://rancher.com/docs/k3s/latest/en/) for details on how to directly utilize this Kubernetes cluster. Furthermore, by reviewing the SUSE Rancher [product documentation \(https://rancher.com/docs/rancher/v2.5/en/\)](https://rancher.com/docs/rancher/v2.5/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

- Using K3s enables you to quickly and simply deploy a Kubernetes cluster in a wide array of locations, across edge, branch, core and cloud.

### Modernize

Bring applications and data into modern computing

- With K3s, the digital transformation to containerized applications can progress since both developers and production can leverage these deployments for the actual workloads.

### Accelerate

Accelerate business transformation through the power of open source software

- Given the open source nature of K3s and the minimal underlying software components, you can expand into a very distributed ecosystem, bringing computing to where the data exists or arrives, to answer the necessary business needs.



## 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 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 <sup>1</sup>

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 <sup>2</sup>

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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<sup>1</sup> link: [Reference Architecture \(https://en.wikipedia.org/wiki/Reference\\_architecture\)](https://en.wikipedia.org/wiki/Reference_architecture) ↗

<sup>2</sup> link: [Infrastructure-as-Code \(https://en.wikipedia.org/wiki/Infrastructure\\_as\\_code\)](https://en.wikipedia.org/wiki/Infrastructure_as_code) ↗

### Availability<sup>3</sup>

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<sup>4</sup>

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<sup>5</sup>

Security is about ensuring freedom from or resilience against potential harm, including protection from destructive or hostile forces. To minimize risks, one must 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<sup>6</sup>

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<sup>7</sup> ) that has just enough features to satisfy an

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3 link: [Availability \(https://en.wikipedia.org/wiki/Minimum\\_viable\\_product\)](https://en.wikipedia.org/wiki/Minimum_viable_product) ↗

4 link: [Data Integrity \(https://en.wikipedia.org/wiki/Data\\_integrity\)](https://en.wikipedia.org/wiki/Data_integrity) ↗

5 link: [Security \(https://en.wikipedia.org/wiki/Security\)](https://en.wikipedia.org/wiki/Security) ↗

6 link: [Proof of Concept \(https://en.wikipedia.org/wiki/Proof\\_of\\_concept\)](https://en.wikipedia.org/wiki/Proof_of_concept) ↗

7 link: [Minimum Viable Product \(https://en.wikipedia.org/wiki/Minimum\\_viable\\_product\)](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 provide a bill of materials listing for the respective component layer(s) of the described deployment.

### A.1 Compute Platform Bill of Materials

Recommended set of computing platform models, components and resources.

Role	Qty	SKU	Component	Notes
System	1-3	n/a	<ul style="list-style-type: none"><li>• Virtual Machine,</li><li>• Single Board Computer (SBC) or</li><li>• Industry Standard Server</li></ul>	Configuration <ul style="list-style-type: none"><li>• see <a href="https://rancher.com/docs/k3s/latest/en/installation/installation-requirements/resource-profiling/">resource profiling (https://rancher.com/docs/k3s/latest/en/installation/installation-requirements/resource-profiling/)</a> </li></ul>

### A.2 Software Bill of Materials

Recommended set of software, support and services.

Role	Qty	SKU	Component	Notes
Operating System	1-3	874-006875	SUSE Linux Enterprise Server, <ul style="list-style-type: none"> <li>• x86_64,</li> <li>• Priority Subscription,</li> <li>• 1 Year</li> </ul>	Configuration: <ul style="list-style-type: none"> <li>• per node (up to 2 sockets, stackable) or 2 VMs</li> </ul>
Kubernetes Management	1	R-0001-PS1	SUSE Rancher, <ul style="list-style-type: none"> <li>• x86-64,</li> <li>• Priority Subscription,</li> <li>• 1 Year</li> </ul>	Configuration: <ul style="list-style-type: none"> <li>• per deployed instance</li> </ul>
Rancher Management	2	R-0004-PS1	Rancher 10 Nodes <ul style="list-style-type: none"> <li>• x86-64 or aarch64,</li> <li>• Priority Subscription,</li> <li>• 1 Year,</li> </ul>	Configuration: <ul style="list-style-type: none"> <li>• requires priority server subscription</li> </ul>
Consulting and Training	1	R-0001-QSO	Rancher Quick Start, <ul style="list-style-type: none"> <li>• Go Live Services</li> </ul>	



## Note

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RA=1 References=1 Requirements=1 SWComp=1 SWDepCfg=1 env-daps=1 iK3s=1 iRKE1=1 iRKE2=1
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