K3s - Getting Started

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Contents

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Preface

The purpose of this document is to provide an overview and procedure of implementing SUSE (https://www.suse.com) ® offerings for K3s (https://rancher.com/products/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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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.

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 simplified, *getting started* approach for K3s. This can be done in a variety of scenarios to create an edge-oriented, lightweight Kubernetes cluster deployment.

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 Architectural overview

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

2.1 Solution architecture

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

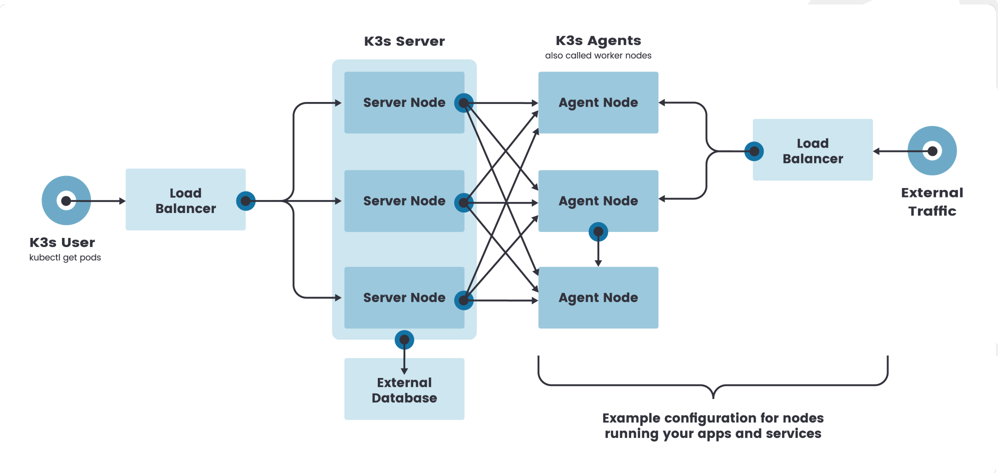

FIGURE 2.1: FIXME - ARCHITECTURE OVERVIEW - K3S

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

To aid in planning, training or assessing functionality like in a *proof-of-concept* deployment, K3s can be installed on a single node running a Linux operating system as described later in this document.

Tip

To improve *Availability*, the {pn_K3s) solution can leverage *scaling* to nodes with different roles (server, agent) and with a shared datastore (embedded etcd or external etd, MariaDB, MySQL, PostgreSQL) from the single node to a *production* installation on a multi-node, high-availability Kubernetes cluster.

3 Component model

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

3.1 Component overview

By utilizing:

- Software
  - Kubernetes Platform - K3s
  - Linux Operating System

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

3.2 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:

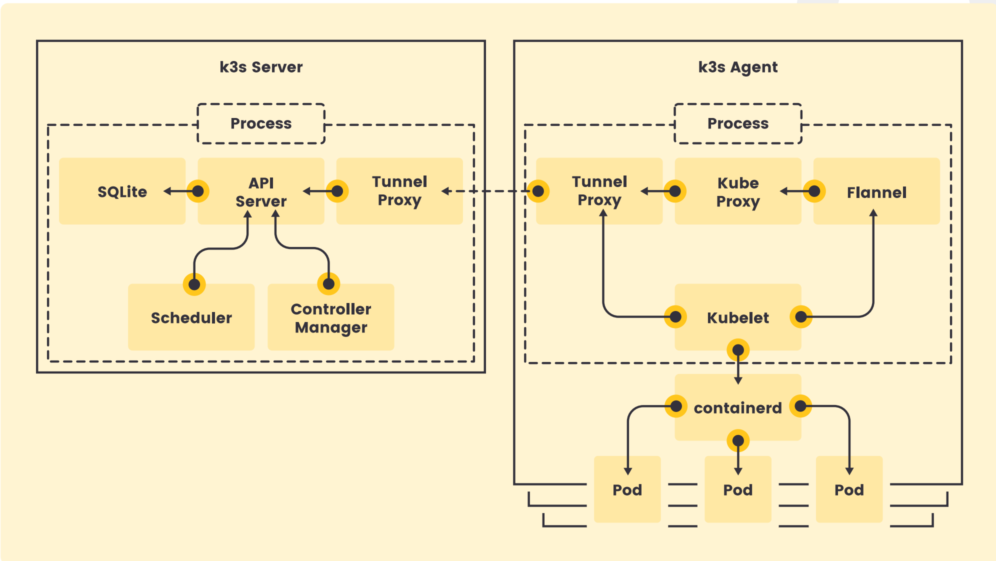

FIGURE 3.1: OVERVIEW OF K3S

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 node, only some prerequisites for the underlying operating system are needed and will be detailed in the *Chapter 4, Deployment* section.

4 Deployment

This section describes the process steps for the deployment of the K3s solution. This simplified target stack begins as a functional *proof-of-concept*, has tips on migration towards *production*, provides *scaling* guidance and includes the base preparations required from the underlying layer.

4.1 Deployment overview

The deployment stack is represented in the following figure:

FIGURE 4.1: K3S DEPLOYMENT STACK

4.2 K3s

The underlying Linux operating system can be:

- A cloud-host virtual machine (VM)
- An on-premise VM or a bare-metal server node

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) ↗.

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/) ↗ web page.

Deployment Process

The primary steps for deploying this K3s Kubernetes instance are:

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 deployment is complete when elements of all the deployments (coredns, local-path-provisioner, metrics-server, and traefik) show at least "1" as "AVAILABLE"
  - Then 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*
  - While a single K3s node works perfectly fine, a full high-availability K3s cluster is recommended for production workloads. The Etcd key/value store (aka database) requires an odd number of nodes be allocated to the K3s plane (aka master nodes). In this case, two additional control-plane nodes 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:

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

```
NODE_TOKEN=""            # From the /var/lib/rancher/k3s/server/node-
token file on the first server
K3s_VERSION=""           # Match the first of the first server
```

```
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 -
```

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.

3. (Optional) In cases where agent nodes are desired, execute the following sets of commands on each of the agent nodes to add it to the K3s cluster:

```
FIRST_SERVER_IP=""       # Private IP preferred, if available
NODE_TOKEN=""            # From the /var/lib/rancher/k3s/server/node-
token file on the first server
K3s_VERSION=""           # Match the first of the first server
```

```
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/) 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.

5 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.

6 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/))

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Glossary

- Document Scope

Getting Started

A guide with the basic steps to quickly and simply deploy the one layer of the referenced component of the SUSE portfolio, with generalized pointers to other required dependency elements.

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)

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

Availability [2]

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

Security [3]

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 [4]

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 [5]) that has just enough features to satisfy an 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.

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

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

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

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

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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.

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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	n/a	• Virtual Machine, • Single Board Computer (SBC) or • Industry Standard Server	Configuration • see resource profiling (https://rancher.com/docs/k3s/latest/en/installation/installation-require-

*

Role	Qty	SKU	Component	Notes
				ments/re-source-pro-filing/)

A.2 Software Bill of Materials

Role	Qty	SKU	Component	Notes
Operating System	1	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	K3s, • x86-64 or aarch64 • Priority Subscription, • 1 Year	Configuration: • provides support of 10 nodes

Note

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

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