

SUSE® Telco Cloud

SUSE Telco Cloud on Intel Xeon 6 SoC-based Supermicro Systems

Validated reference design for high-density, low-latency, AI-ready telco edge deployments

SUSE® Telco Cloud

SUPERMICRO® IoT SuperServer SYS-112D-42C-FN8P

SUPERMICRO® IoT SuperServer SYS-212D-72C-FN8P

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Summary

This joint solution showcases the SUSE® Telco Cloud platform running on Intel® Xeon® 6 SoC-based SUPERMICRO® IoT SuperServer systems to deliver an AI-accelerated 5G telco platform. It enables vRAN and edge AI workloads using cloud-native automation, deterministic low latency, and strong performance-per-watt, helping operators modernize networks for AI-driven services.

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1 Introduction

Telecommunications operators are transforming their networks to support 5G-Advanced, ORAN, massive MEC scale-out, and AI-driven automation. These transformations demand infrastructure that simultaneously delivers extreme packet-processing performance, deterministic low latency, integrated AI acceleration, and dramatically lower power and space footprints.

This reference configuration documents the successful validation of the SUSE® Telco Cloud stack, featuring SUSE® Rancher Prime, running on a Supermicro IoT SuperServer powered by Intel® Xeon® 6 SoC processors. This solution proves that a single-socket, CPU-only platform can replace legacy accelerator-heavy designs.

1.1 Scope

This document details a validated reference configuration for deploying SUSE® Telco Cloud on Supermicro IoT SuperServer systems powered by Intel® Xeon® 6 SoC processors. It covers the solution architecture, hardware and software components, deployment methodology, and performance validation for CPU-only, AI-ready telco edge and vRAN use cases.

1.2 Audience

This reference configuration is intended for:

- telecommunications network architects, infrastructure and platform engineers, and operations teams responsible for designing, deploying, and managing 5G and AI-enabled telco edge infrastructure.
- technical decision-makers evaluating platform modernization strategies, including IT and network leadership seeking to reduce infrastructure complexity, power consumption, and total cost of ownership.
- system integrators, solution architects, and other partner organizations involved in designing or validating telco edge solutions.

1.3 Acknowledgments

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- Vesselin Matev, Partner Solutions Manager, SUSE
- Terry Smith, Ecosystem Solution Innovation Director, SUSE
- Suresh S, Partner Solution Architect, SUSE

2 Market challenge

Telecommunications operators today face an **unprecedented convergence of pressures** that legacy infrastructure was never designed to handle. Traffic volumes are exploding, driven by nationwide 5G rollout, massive IoT deployments, ultra-high-definition video streaming, private 5G networks, and enterprise edge services. At the same time, service-level agreements have become far more stringent. **Sub-millisecond end-to-end latency and microsecond-level jitter** are now mandatory for ORAN fronthaul/midhaul transport, Ultra-Reliable Low-Latency Communication (URLLC), industrial automation, and Extended Reality (XR) applications.

Compounding this is the **rapid integration of artificial intelligence** into every layer of the network. Modern RAN and core functions increasingly rely on embedded machine-learning models for dynamic beamforming, traffic prediction, interference management, anomaly detection, and closed-loop automation through RIC platforms. These AI-driven capabilities demand significant inferencing throughput directly at the edge, yet most existing deployments still depend on fixed-function RAN infrastructure defined before the AI boom.

Power consumption, cooling capacity, and physical space have emerged as hard limits at thousands of edge and far-edge sites. Rising energy prices and sustainability mandates are pushing OPEX ever higher, while the continued reliance on specialized appliances, external accelerators, and vendor-locked platforms **dramatically inflates both CAPEX and lifecycle management overhead**. Validation cycles lengthen, software updates become risky, and multi-vendor interoperability remains a constant friction point.

At the same time, regulators and enterprises are imposing **stricter requirements for data sovereignty**, hardware-rooted confidential computing, and verifiable platform integrity. Operators must modernize at speed while simultaneously reducing cost, power, complexity, and risk - an equation that traditional architectures can no longer solve.

3 Solution

The combination of Intel Xeon 6 SoC based telco-optimized systems by Supermicro and the SUSE Telco Cloud stack directly addresses every dimension of these challenges with a **single, fully integrated platform** that is **ready for massive scale-out** today.

At the foundation sits the Intel Xeon 6 SoC, a purpose-built processor family that delivers up to 72 Performance-cores, enormous per-core caches for deterministic packet processing, and fully integrated Intel vRAN Boost. Native Intel AMX matrix extensions provide massive AI inferencing throughput without external accelerators, while on-die Intel QAT handles compression and cryptography at line rate. With up to 128 PCIe Gen5 lanes and CXL 2.0 readiness, the platform offers unmatched I/O flexibility and future-proof expansion.


The 1U SUPERMICRO® IoT SuperServer SYS-112D-42C-FN8P (<https://www.supermicro.com/en/products/system/iot/1u/sys-112d-42c-fn8p>) and 2U SUPERMICRO® IoT SuperServer SYS-212D-72C-FN8P (<https://www.supermicro.com/en/products/system/iot/2u/sys-212d-72c-fn8p>) IoT SuperServer systems turn these silicon advantages into deployable reality. Outdoor-rated and air-cooled compact designs with redundant Titanium power supplies fit perfectly into constrained edge sites. The integrated E830 NIC delivers nanosecond-accurate Precision Time Protocol (PTP) and SyncE synchronization essential for vRAN and ORAN deployments. The 1U system is already an [official O-RAN Alliance hardware reference design for outdoor macrocells](https://specifications.o-ran.org/specifications) (<https://specifications.o-ran.org/specifications>).

SUSE completes the solution with SUSE Telco Cloud, its hardened, modular, cloud-native software stack. Specifically designed to meet the strict demands of the telecommunications industry, it enables operators to host both VNFs and CNFs on the same platform. Built on [SUSE Linux Micro](https://www.suse.com/products/micro/) (<https://www.suse.com/products/micro/>), [RKE2](https://documentation.suse.com/cloudnative/rke2/latest/en/introduction.html) (<https://documentation.suse.com/cloudnative/rke2/latest/en/introduction.html>), and [SUSE Rancher Prime](https://www.suse.com/products/rancher/) (<https://www.suse.com/products/rancher/>), the platform provides a secure, carrier-grade foundation for 5G, fixed access, OSS/BSS, and edge infrastructure. SUSE Telco Cloud is built entirely on open source and has been rigorously validated to deliver reliable performance at scale. Its AI-ready, disaggregated architecture supports zero-touch automation and the flexibility to integrate best-of-breed network functions efficiently and sustainably.

SUSE Telco Cloud offers automated lifecycle management for infrastructure components, support for multi-cloud and edge deployments with consistent operations, and enhanced observability through integrated monitoring tools. Furthermore, it ensures security at scale, from OS hardening to container scanning, while its foundation in open standards and ecosystem support effectively prevents vendor lock-in. A key differentiator is SUSE's robust edge computing capa-

bilities, as SUSE Telco Cloud is optimized for constrained environments. This allows telcos to deploy CNFs and VNFs in remote or decentralized locations with minimal overhead - a flexibility essential for new 5G-powered services like smart city infrastructure and industrial IoT. The solution also facilitates zero-touch provisioning and seamless orchestration at the edge, which dramatically reduces operational complexity and deployment times. Ultimately, with its modular, open architecture, SUSE Telco Cloud allows operators to unlock efficiencies in the core, deploy innovative services at the edge, and adapt rapidly to future market demands.

The solution unites Intel's fully-integrated vRAN Boost and AI acceleration, Supermicro's rugged edge-system engineering and global supply-chain excellence, and SUSE's zero-touch, GitOps-driven telco cloud stack. The result is a **true single-box, CPU-only telco cloud node** that simultaneously replaces the legacy BBU, external L1 accelerator (FPGA/in-line card), SmartNIC, timing card, and discrete AI inference appliances. Under a 95% CPU load on the isolated cores, the platform **successfully achieves a measure of latency of sub 5 μ s**. This achievement demonstrates that a consolidated, CPU-only architecture in a single, outdoor-rated system can deliver guaranteed, deterministic, low-latency performance. Thus, it meets the requirements of the most demanding 5G and ORAN use cases that previously had to be spread across multiple devices.

With this, operators can realize **dramatic gains** (<https://www.intel.com/content/dam/www/central-libraries/us/en/documents/2025-02/vran-xeon6-soc-p-cores-solution-brief-final.pdf>) :

- Up to 2.4x higher increase in RAN capacity (compared to the previous generation) per node
- Up to 70% lower power consumption, better performance per watt (compared to the previous generation) per site
- Up to 3.2x AI RAN inference performance per core[NP1] gain (compared to the previous generation)


Moreover, the supply-chain risk is minimized through Supermicro's Tier-1 scale and regional manufacturing, while SUSE Telco Cloud enables fully-automated, reproducible deployments across tens of thousands of sites with zero touch provisioning. The entire platform is open, disaggregated, and future-proof, supporting everything from today's RAN deployments to tomorrow's AI-native 6G edge networks.

4 Solution component overview

4.1 Intel® Xeon® 6 SoC

The Intel Xeon 6 SoC provides outstanding energy-efficient performance across networking use cases, including vRAN deployments. The Performance-cores (P-cores) are optimized for high throughput and low latency, with built-in acceleration for packet and signal processing, load balancing, and AI.

Intel Xeon 6 SoC features are detailed in the figure below.



Memory	Integrated Ethernet	PCI Express & Compute Express Link	Integrated Accelerators ¹	
4 or 8 Channels DDR5	Up to 8 Ports Total	Up to 48 Lanes PCIe Total	Intel® Media Transcode Accelerator	Intel® Dynamic Load Balancer
Up to 6400 MT/s	2x 100 Gbps	Up to 32 Lanes PCIe 5.0 with 16 Lanes of CXL 2.0	Intel® QuickAssist Technology	Intel® Advanced Matrix Extensions
2 DPC at up to 5200MT/s	4x 50 Gbps	Up to 16 Lanes PCIe 4.0	Intel® vRAN Boost	Intel® Data Streaming Accelerator
8x 25 Gbps/ 10 Gbps/ 1 Gbps/ 100 Mbps				

UP TO **72** Performance-cores

FIGURE 1: INTEL XEON 6 SOC FEATURES

By leveraging Intel Xeon 6 SoC processors, enterprises and network operators can scale up performance for AI and analytics workloads at the edge. Performance expectations are detailed in the following figure.

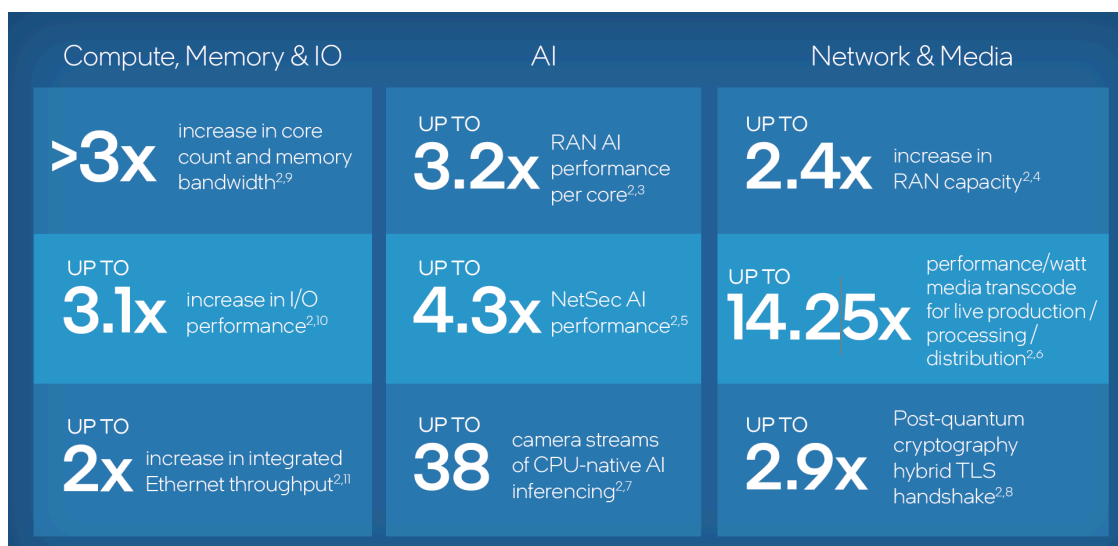


FIGURE 2: INTEL XEON 6 SOC PERFORMANCE BOOSTS

Building on this foundation, Intel vRAN Boost integrates vRAN acceleration directly into the SoC. Intel vRAN Boost is sized to provide ample headroom, even in the most intense use-cases and with high-core-count options. This overhead allows for future software optimizations that increase server capacity without the risk of hitting acceleration limits. And, independent software vendors and developers using the O-RAN Acceleration Abstraction Layer standardized DPDK interface can optimize their vRAN software stacks for vRAN Boost hardware acceleration and easily move from one generation of Intel vRAN Boost to the next.

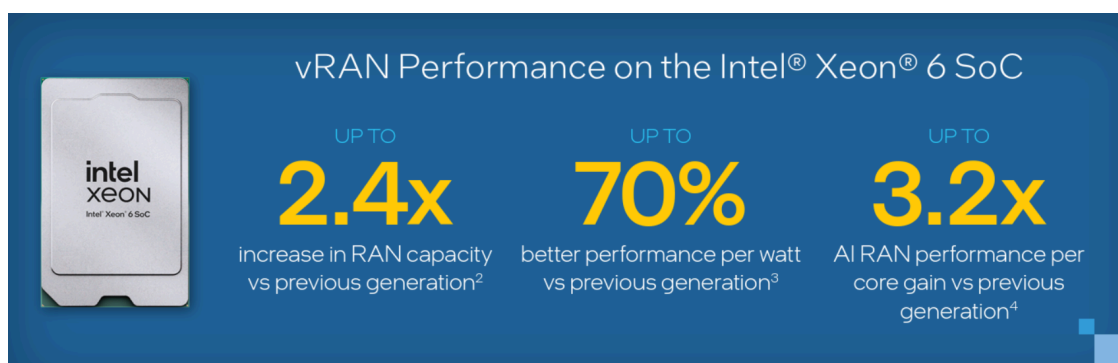


FIGURE 3: INTEL XEON 6 SOC VRAN PERFORMANCE

4.2 SUPERMICRO® IoT SuperServer

The 1U SUPERMICRO® IoT SuperServer SYS-112D-42C-FN8P is designed for telco edge applications.

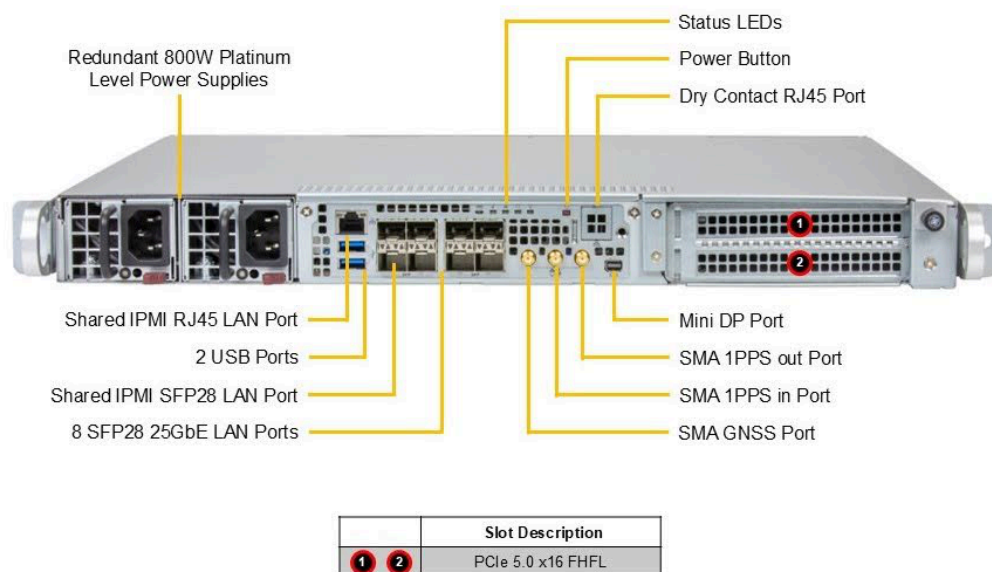


FIGURE 4: SUPERMICRO® IOT SUPERSERVER SYS-112D-42C-FN8P FRONT VIEW

Key features are noted in the table below.

SUPERMICRO® IoT SuperServer SYS-112D-42C-FN8P	
CPU	Intel® Xeon® 6 SoC 6726P-B 42-core processor with Intel QAT and Intel vRAN Accelerator
Networking	Integrated Intel E830 8 SFP28 25 GbE LAN ports 1 RJ45 1 GbE LAN port (IPMI)
Form factor	1U short-depth server (43 × 437 × 399 mm)
Power	Redundant 800W Platinum-level power supplies AC or DC options available

SUPERMICRO offers both 1U and 2U options. For more details, visit the product pages:

- SUPERMICRO® IoT SuperServer SYS-112D-42C-FN8P (<https://www.supermicro.com/en/products/system/iot/1u/sys-112d-42c-fn8p>) ↗
- SUPERMICRO® IoT SuperServer SYS-212D-72C-FN8P (<https://www.supermicro.com/en/products/system/iot/2u/sys-212d-72c-fn8p>) ↗

4.3 SUSE® Telco Cloud

The SUSE Telco Cloud platform provides a validated, carrier-grade, cloud-native foundation. Its disaggregated, AI-ready architecture allows telco enterprises to scale infrastructure sustainably while seamlessly deploying GenAI, predictive AI, and latency-sensitive applications at the edge.

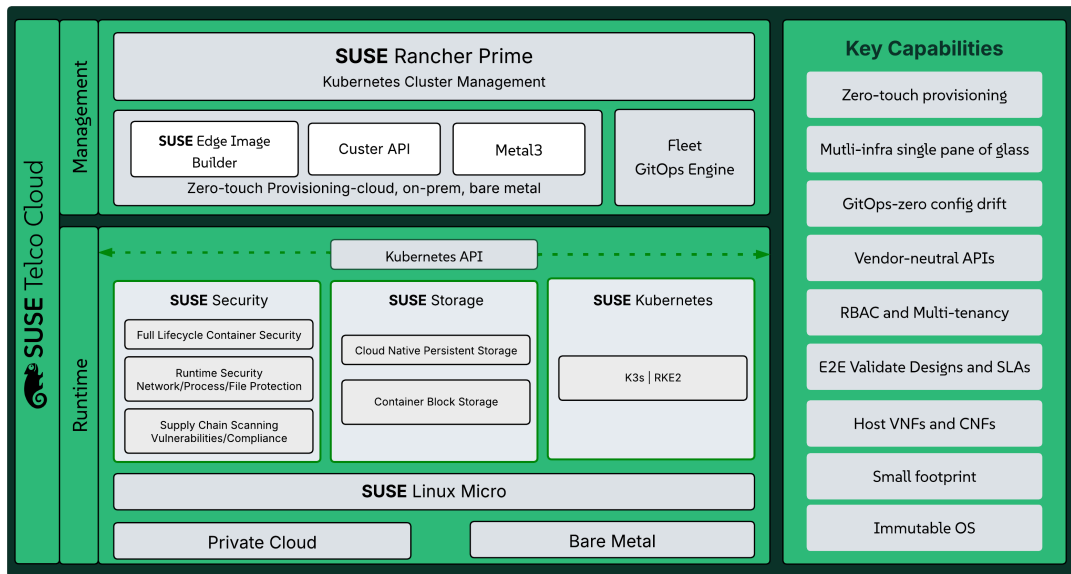


FIGURE 5: SUSE TELCO CLOUD ARCHITECTURE

Key capabilities of SUSE Telco Cloud include:

Capability	Strategic Value
Unified Management Plane	Centralized control and observability for Kubernetes clusters running on RKE2, K3s, and other CNCF-certified Kubernetes distributions, including AKS, EKS, and GKE
Fleet GitOps Automation	Declarative management for thousands of clusters, preventing configuration drift
Zero-Touch Provisioning	Automated deployment and lifecycle management for telco-grade workloads across core, cloud, and far-edge environments
Edge Optimization	Lightweight K3s-based architecture and hardened SUSE Linux Micro operating system for consistency and high performance in resource-constrained or disconnected edge sites
Policy-Driven Governance	Consistent compliance and security across multi-tenant telco environments
Carrier Grade Security	FIPS 140-3 validated cryptography, CIS Benchmark compliance, and centralized RBAC/SSO to meet stringent telco security standards

See the [SUSE Telco Cloud documentation \(https://documentation.suse.com/suse-edge/3.4/html/edge/atip.html\)](https://documentation.suse.com/suse-edge/3.4/html/edge/atip.html) for more information.

5 Deployment prerequisites and requirements

Some specific considerations for SUSE Telco Cloud deployments are highlighted here. For further details, see [SUSE Telco Cloud: Requirements & Assumptions \(https://documentation.suse.com/suse-edge/3.4/html/edge/atip-requirements.html\)](https://documentation.suse.com/suse-edge/3.4/html/edge/atip-requirements.html).

5.1 Hardware

Some hardware deployment considerations are listed below.

- **Management Cluster**

- Must have network connectivity to the target server management/BMC API.
- Must have network connectivity to the target server control plane network.
- For multi-node Management Clusters, an additional reserved IP address is required.

- **Managed hosts**

- Must support out-of-band management via Redfish, iDRAC, or iLO interfaces.
- Must support deployment via virtual media (PXE is not currently supported).
- Must have network connectivity to the Management Cluster for access to the Metal3 provisioning APIs.

5.2 Software

You will need some software tools to deploy and manage the environment. They can be installed either on the Management Cluster or on a host with access to the Management Cluster. They include:

- Kubectl (<https://kubernetes.io/docs/reference/kubectl/kubectl/>)
- Helm (<https://helm.sh/>)
- Clusterctl (<https://cluster-api.sigs.k8s.io/user/quick-start.html#install-clusterctl>)
- Container runtime, such as Podman (<https://podman.io/>) or Rancher Desktop (<https://rancherdesktop.io/>)

Additionally, the SUSE Linux Micro OS image must be downloaded from the [SUSE Customer Center](https://scc.suse.com/) (<https://scc.suse.com/>) or [SUSE Linux Micro Downloads](https://www.suse.com/download/sle-micro/) page (<https://www.suse.com/download/sle-micro/>). The selected image file at the time of publication is SL-Micro.x86_64-6.1-Base-GM.raw.xz.

5.3 Network

Follow the official SUSE Telco Cloud guidelines and recommendations described in [SUSE Telco Cloud: Network Requirements](https://documentation.suse.com/suse-edge/3.4/html/edge/atip-requirements.html#id-network) (<https://documentation.suse.com/suse-edge/3.4/html/edge/atip-requirements.html#id-network>).

5.4 Ports

For details on port requirements, see [SUSE Telco Cloud: Port Requirements \(https://documentation.suse.com/suse-edge/3.4/html/edge/atip-requirements.html#id-port-requirements\)](https://documentation.suse.com/suse-edge/3.4/html/edge/atip-requirements.html#id-port-requirements).

5.5 Services

For details on supported services, such as DHCP and DNS, see the [SUSE Telco Cloud: Services \(DHCP, DNS, etc.\) \(https://documentation.suse.com/suse-edge/3.4/html/edge/atip-requirements.html#id-services-dhcp-dns-etc\)](https://documentation.suse.com/suse-edge/3.4/html/edge/atip-requirements.html#id-services-dhcp-dns-etc).



Important

For telco workloads, it is important to disable or configure properly some of the services running on the nodes to avoid any impact on the workload performance running on the nodes.


See [SUSE Telco Cloud: Disabling Systemd Services \(https://documentation.suse.com/suse-edge/3.4/html/edge/atip-requirements.html#id-disabling-systemd-services\)](https://documentation.suse.com/suse-edge/3.4/html/edge/atip-requirements.html#id-disabling-systemd-services) for details.


6 Edge Image Builder

For the long-term stability and maintainability of the environment, it is paramount to have easily auditable, reproducible, and customized base images. [Edge Image Builder \(EIB\) \(https://documentation.suse.com/suse-edge/3.4/html/edge/components-eib.html\)](https://documentation.suse.com/suse-edge/3.4/html/edge/components-eib.html), one of the components of SUSE Telco Cloud, helps mitigate these concerns by providing a simple and quick mechanism to customize SUSE Linux Micro base images for a variety of scenarios. EIB can produce an image that contains all of the configuration and workload artifacts (such as, RPMs and container images) needed for telco deployments. EIB can enable true zero-touch provisioning, even in low-bandwidth connections and air-gapped environments. A single image can be reused across multiple nodes, including advanced situations such as deploying HA Kubernetes clusters and individualized network configurations per node. By leveraging a declarative, YAML-based definition format, EIB easily fits into existing GitOps and CI/CD pipelines, generating reproducible images with full accountability of their contents.

EIB is an open source project. Visit the official [EIB repository \(https://github.com/suse-edge/edge-image-builder\)](https://github.com/suse-edge/edge-image-builder) for more information.

6.1 Management Cluster EIB definition

Follow the steps outlined in this section to generate the EIB ISO image for the Management Cluster. For further details, see [SUSE Telco Cloud: Setting up the Management Cluster \(https://documentation.suse.com/suse-edge/3.4/html/edge/atip-management-cluster.html\)](https://documentation.suse.com/suse-edge/3.4/html/edge/atip-management-cluster.html) .

1. Generate the `eib-image` directory structure (<https://documentation.suse.com/suse-edge/3.4/html/edge/atip-management-cluster.html#mgmt-cluster-directory-structure>)  as illustrated below.

You can find examples of the directory structure and files in the SUSE® Edge GitHub repository, under [telco cloud examples \(https://github.com/suse-edge/telco-cloud-examples\)](https://github.com/suse-edge/telco-cloud-examples) .

```
.
├─ base-images
├─ custom
│   └─ files
│       ├── basic-setup.sh
│       ├── metal3.sh
│       ├── mgmt-stack-setup.service
│       └─ rancher.sh
│   └─ scripts
│       ├── 02-tmpfs-cni.sh
│       ├── 99-alias.sh
│       └─ 99-mgmt-setup.sh
├─ kubernetes
│   ├── config
│   │   └─ server.yaml
│   ├── helm
│   │   └─ values
│   │       ├── certmanager.yaml
│   │       ├── longhorn.yaml
│   │       ├── metal3.yaml
│   │       ├── neuvector.yaml
│   │       └─ rancher.yaml
│   └─ manifests
│       └─ neuvector-namespace.yaml
├─ mgmt-cluster-34-61-defaultNet.yaml
└─ network
    └─ mgmt-cluster-network.yaml
```



Important

The SUSE Linux Micro OS image must be downloaded from the [SUSE Customer Center \(https://scc.suse.com/\)](https://scc.suse.com/) or [SUSE Linux Micro Downloads page \(https://www.suse.com/download/sle-micro/\)](https://www.suse.com/download/sle-micro/), and it must be located under the base-images directory.

2. Follow [Building updated SUSE Linux Micro images with KIWI \(https://documentation.suse.com/suse-edge/3.4/html/edge/guides-kiwi-builder-images.html\)](https://documentation.suse.com/suse-edge/3.4/html/edge/guides-kiwi-builder-images.html) to create your KIWI (<https://osinside.github.io/kiwi/>) ISO image.
3. Add your KIWI ISO image to the base-images directory.
4. Update the following files:
 - a. In the `kubernetes/helm/values/metal3.yaml` file, change `ironicIP` to your mgmt cluster IP address (for example, 172.30.8.11).
 - b. In the `kubernetes/helm/values/rancher.yaml` file, change `hostname` to your mgmt cluster IP address (for example, 172.30.8.11).
 - c. In the `network/mgmt-cluster-network.yaml` file, update the network settings to match your environment.

See the example listing below:

```
routes:
  config:
    - destination: 0.0.0.0/0
      metric: 100
      next-hop-address: 172.30.0.1
      next-hop-interface: eth0
      table-id: 254
dns-resolver:
  config:
    server:
      - 8.8.8.8
interfaces:
  - name: eth0
    type: ethernet
    state: up
    mac-address: 3C:EC:EF:C0:4E:56
    ipv4:
      address:
```

```
- ip: 172.30.8.11
  prefix-length: 20
  dhcp: false
  enabled: true
ipv6:
  enabled: false
```

5. Modify the `eib/mgmt-cluster-34-61-defaultNet.yaml` file as follows:

- a. For the **encryptedPassword** parameter, replace `$ROOT_PASSWORD` with the root password for your Management Cluster.



Tip

Generate this password with:

```
openssl passwd -6 PASSWORD
```

Be sure to replace `PASSWORD` with your desired password.



Note

The final SUSE Rancher password will be configured from the file, `custom/files/basic-setup.sh`.

- b. For the **sccRegistrationCode** parameter, replace `$SCC_REGISTRATION_CODE` with your registration code for SUSE Linux Micro from the [SUSE Customer Center \(https://scc.suse.com/\)](https://scc.suse.com/).

6. Build the EIB image using `podman`.

```
podman run --rm --privileged -it -v $PWD:/eib \
registry.suse.com/edge/3.4/edge-image-builder:1.3.0 \
build --definition-file mgmt-cluster-34-61-defaultNet.yaml
```

You should see output like the following as the EIB image is built:

```
SELinux is enabled in the Kubernetes configuration. The necessary RPM packages will
be
downloaded.
Downloading file: rancher-public.key 100% |
SUSE Telco Cloud ... * (<75 characters) Your Guide Title
the value in the file.
```

```

(2.4/2.4 kB, 17 MB/s)
Setting up Podman API listener...
Pulling selected Helm charts... 100% |
(8/8, 3 it/s)
Generating image customization components...
Identifier ..... [SUCCESS]
Custom Files ..... [SUCCESS]
Time ..... [SKIPPED]
Network ..... [SUCCESS]
Groups ..... [SKIPPED]
Users ..... [SUCCESS]
Proxy ..... [SKIPPED]
Resolving package dependencies...
Rpm ..... [SUCCESS]
Os Files ..... [SKIPPED]
Systemd ..... [SKIPPED]
Fips ..... [SKIPPED]
Elemental ..... [SKIPPED]
Suma ..... [SKIPPED]
Populating Embedded Artifact Registry... 100% |
(19/19, 21 it/min)
Embedded Artifact Registry ... [SUCCESS]
Keymap ..... [SUCCESS]
Configuring Kubernetes component...
Downloading file: rke2_installer.sh
Downloading file: rke2-images-core.linux-amd64.tar.zst 100% |
(701/701 MB, 82 MB/s)
Downloading file: rke2-images-calico.linux-amd64.tar.zst 100% |
(362/362 MB, 470 MB/s)
Downloading file: rke2-images-multus.linux-amd64.tar.zst 100% |
(39/39 MB, 468 MB/s)
Downloading file: sha256sum-amd64.txt 100% |
(4.3/4.3 kB, 32 MB/s)
Kubernetes ..... [SUCCESS]
Certificates ..... [SKIPPED]
Cleanup ..... [SKIPPED]
Building ISO image...
Kernel Params ..... [SKIPPED]
Build complete, the image can be found at: eib-mgmt-cluster-x86_64-image-61-34.iso

```

6.2 Downstream Cluster EIB definition

Follow the steps below to generate the EIB RAW image for Downstream Clusters.

1. The directory `eib-edge-34-61` contains all the necessary files to generate the EIB RAW image for Downstream Clusters with some telco packages and performance scripts.

You can get a copy of the file contents in [Fully automated directed network provisioning \(https://documentation.suse.com/suse-edge/3.4/html/edge/atip-automated-provisioning.html\)](https://documentation.suse.com/suse-edge/3.4/html/edge/atip-automated-provisioning.html).

```
.
├── base-images
│   └── SL-Micro.x86_64-6.1-Base-RT-Kiwi.raw
├── custom
│   ├── files
│   │   ├── performance-settings.sh
│   │   └── sriov-auto-filler.sh
│   └── scripts
│       ├── 01-fix-growfs.sh
│       ├── 02-tmpfs-cni.sh
│       ├── 03-performance.sh
│       └── 04-sriov.sh
├── edge-cluster.yaml
├── network
│   └── configure-network.sh
```

2. Add your KIWI ISO image as a base-image in the `base-images` directory.
3. The configuration file, `edge-cluster.yaml`, details the packages and scripts that will be included in the image. As with the Management Cluster, modify the following parameters in `edge-cluster.yaml` according to your environment:
 - a. For the **encryptedPassword** parameter, replace `$ROOT_PASSWORD` with the root password for your Management Cluster.
 - b. For the **sccRegistrationCode** parameter, replace `$SCC_REGISTRATION_CODE` with your registration code for SUSE Linux Micro from the [SUSE Customer Center \(https://scc.suse.com/\)](https://scc.suse.com/).
4. Build the EIB image.

```
podman run --rm --privileged -it -v $PWD:/eib \
registry.suse.com/edge/3.4/edge-image-builder:1.3.0 \
build --definition-file edge-cluster.yaml
```

The output should be similar to:

```
Setting up Podman API listener...
Generating image customization components...
Identifier ..... [SUCCESS]
Custom Files ..... [SUCCESS]
Time ..... [SKIPPED]
Network ..... [SUCCESS]
Groups ..... [SKIPPED]
Users ..... [SUCCESS]
Proxy ..... [SKIPPED]
Resolving package dependencies...
Rpm ..... [SUCCESS]
Os Files ..... [SKIPPED]
Systemd ..... [SUCCESS]
Fips ..... [SKIPPED]
Elemental ..... [SKIPPED]
Suma ..... [SKIPPED]
Embedded Artifact Registry ... [SKIPPED]
Keymap ..... [SUCCESS]
Kubernetes ..... [SKIPPED]
Certificates ..... [SKIPPED]
Cleanup ..... [SUCCESS]
Building RAW image...
Kernel Params ..... [SUCCESS]
Build complete, the image can be found at: eibimage-34-61-rt-telco.raw
```

7 Deployment details

Recommended deployment patterns include:

- **vRAN Consolidation Nodes**
Use Intel® Xeon® 6 SoC to migrate from accelerator-heavy architectures to single-socket.
- **Edge AI + Network Services Nodes**
Deploy compact nodes at MEC sites for RAN intelligence, telemetry analysis, and enterprise edge computing.

Telco operators can use the following deployment checklist:

1. Performance and sizing

- a. Profile RAN, Core, and Edge workloads (packet rate, concurrency, inference rate).
- b. Select Intel® Xeon® 6 SoC SKUs based on core density and memory requirements.
- c. Validate CPU-only acceleration options for vRAN.

2. Ecosystem and integration

- a. Use OEM-validated RAN and Core blueprints.
- b. Verify compatibility with cloud-native orchestration stacks (K8s, CNF frameworks).
- c. Validate DPDK, vRAN Boost and AI acceleration paths.

3. Power and thermal design

- a. Update site power budgets for higher consolidation ratios.
- b. Plan airflow and thermal envelopes for high-density edge PoPs.




4. Security and compliance

- a. Enable hardware security features and confidential computing.
- b. Map regulatory requirements for data protection and sovereignty.

5. Operational deployment

- a. Verify telemetry and observability frameworks.
- b. Test fail-over, redundancy and RAN real-time behavior.
- c. Align lifecycle refresh with OEM roadmaps.

7.1 SUSE Telco Cloud direct network provisioning

Directed network provisioning (<https://documentation.suse.com/suse-edge/3.4/html/edge/atip-automated-provisioning.html>)  is a feature that allows you to automate the provisioning of Downstream Clusters. This is a useful feature when you have many Downstream Clusters to provision and want to automate the process. Metal³ (<https://metal3.io>)  is an open source project that provides tools for managing bare-metal infrastructure in Kubernetes. With its Cluster API (CAPI) (<https://cluster-api.sigs.k8s.io>)  integrations, Metal³ can manage infrastructure resources across many infrastructure providers via broadly adopted vendor-neutral APIs.

7.1.1 Management Cluster deployment

The process of deploying the Management Cluster is outlined here.

1. Load the Management Cluster EIB ISO generated previously in the SUPERMICRO BMC.

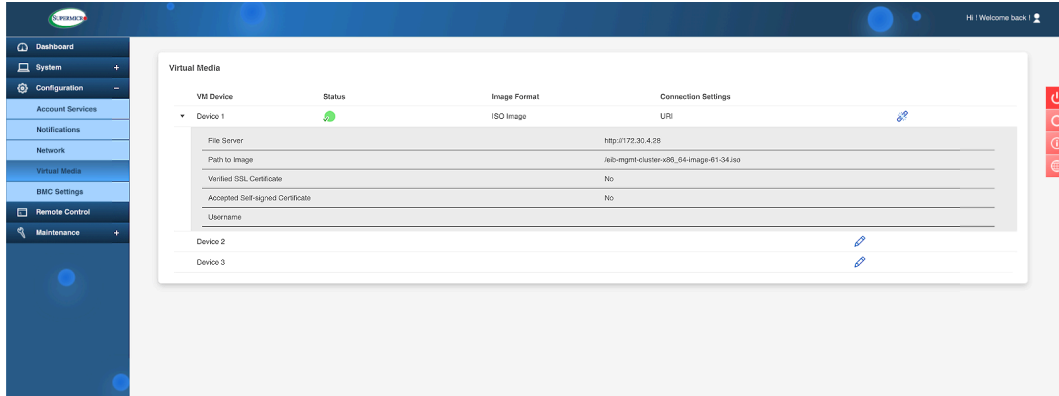


FIGURE 6: SET THE PATH TO THE MANAGEMENT CLUSTER EIB ISO IMAGE

2. Boot the server from Virtual Media function.

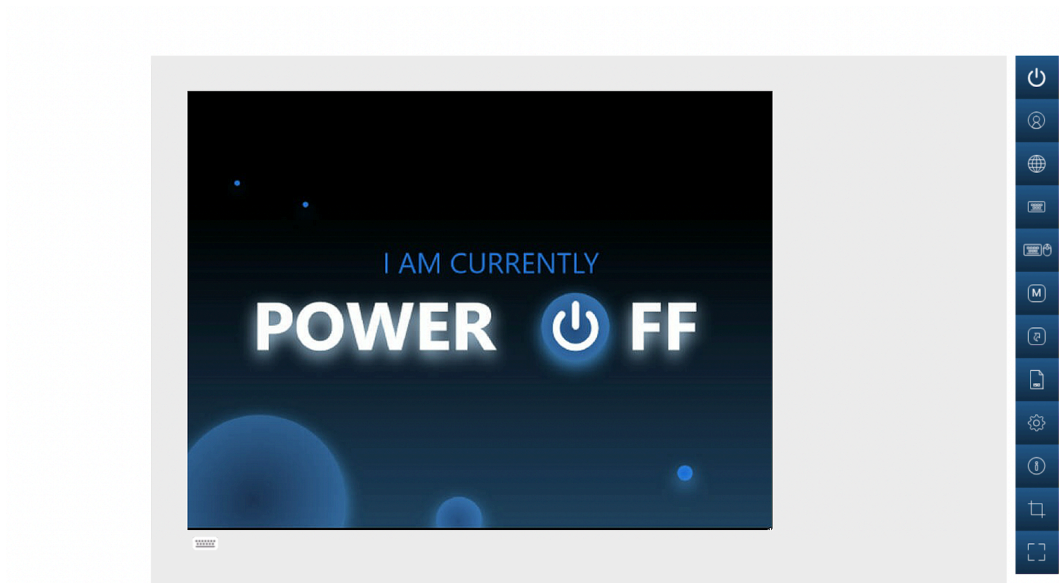


FIGURE 7: POWER ON THE SERVER



FIGURE 8: BOOT THE ISO IMAGE

3. The installation starts automatically without any manual interaction. This includes installation and configuration of SUSE Linux Micro and RKE2 with all required Helm charts. This process is illustrated in the following screenshots.

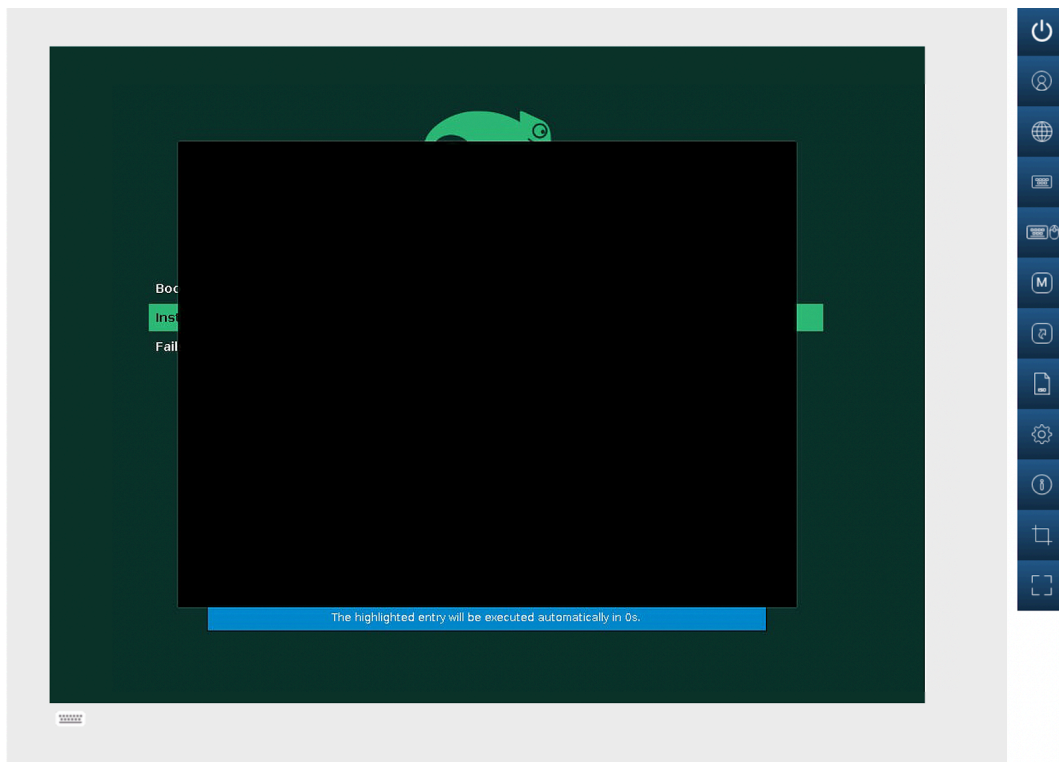


FIGURE 9: BOOT THE INSTALLER

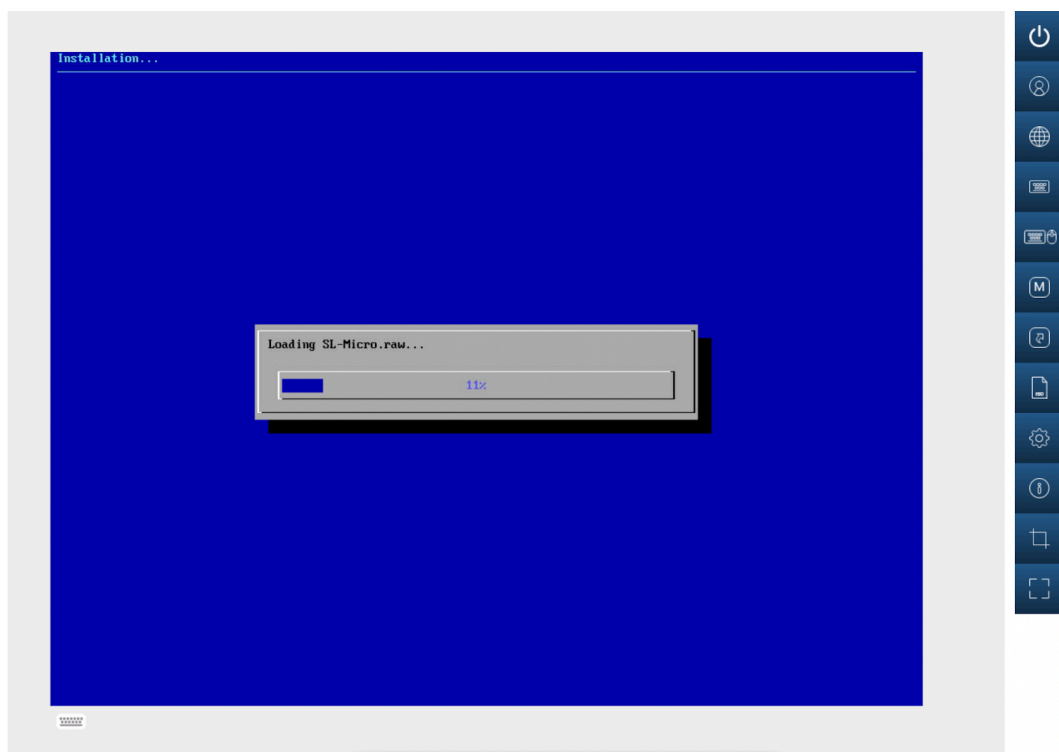


FIGURE 10: LOAD THE SUSE LINUX MICRO RAW IMAGE

```
[*] A start job is running for Combustion (31s / no limit)
Building repository 'rpm-repo' cache [...done]
Loading repository data...
Reading installed packages...
Resolving package dependencies...

The following 10 NEW packages are going to be installed:
git git-core jq libjq1 libonig5 libshadetectcoll1 openssh-server-config-rootlogin perl-Error perl-Git rke2-selinux
10 new packages to install.

Package download size: 7.0 MiB

Package install size change:
      1 23.9 MiB required by packages that will be installed
23.9 MiB 1 - 8 B released by packages that will be removed

Backend: classic_rpmtrans
Continue? [y/n/v/...? shows all options] (y): y
Retrieving: libonig5-6.9.8-sf1.1.1.2.x86_64 (rpm-repo) (1/10), 177.8 KiB
Retrieving: libshadetectcoll1-1.0.3-sf1.1.1.2.x86_64 (rpm-repo) (2/10), 24.5 KiB
Retrieving: openssh-server-config-rootlogin-9.6p1-sf1.1.1.2.x86_64 (rpm-repo) (3/10), 242.4 KiB
Retrieving: perl-Error-0.17029-sf1.1.1.2.noarch (rpm-repo) (4/10), 42.8 KiB
[*] A start job is running for Combustion (32s / no limit)
rke2-selinux-0.21-1.slemicro.noarch.rpm:
  Header U4 RSA/SHA256 Signature, key ID 925ea29ae257814a: NOKEY
rke2-selinux-0.21-1.slemicro.noarch (rpm-repo): Signature verification failed [4-Signatures public key is not available]
Accepting package despite the error. (--no-gpg-checks)

Warning: /mnt/artefacts/rpms/rpm-repo/addrepo0/rke2-selinux-0.21-1.slemicro.noarch.rpm: Header U4 RSA/SHA256 Signature, key ID 9257814a: NOKEY
Looking for gpg key ID E257814A in cache /var/cache/zypp/pubkeys.
Repository rpm-repo does not define additional 'gpgkey=' URLs.
Retrieving: libjq1-1.7.1-sf1.1.1.2.x86_64 (rpm-repo) (6/10), 146.4 KiB
[*] A start job is running for Combustion (32s / no limit)
Retrieving: perl-Git-2.46.0-sf1.1.1.2.x86_64 (rpm-repo) (8/10), 279.0 KiB
Retrieving: jq-1.7.1-sf1.1.1.2.x86_64 (rpm-repo) (9/10), 62.0 KiB
Retrieving: git-2.46.0-sf1.1.1.2.x86_64 (rpm-repo) (10/10), 213.8 KiB

Checking for file conflicts: [...done]
( 1/10) Installing: libonig5-6.9.8-sf1.1.1.2.x86_64 [...done]
( 2/10) Installing: libshadetectcoll1-1.0.3-sf1.1.1.2.x86_64 [...done]
[*] A start job is running for Combustion (33s / no limit)
done10) Installing: perl-Error-0.17029-sf1.1.1.2.noarch [...done]
( 5/10) Installing: rke2-selinux-0.21-1.slemicro.noarch [...done]
Warning: /var/cache/zypp/packages/rpm-repo/addrepo0/rke2-selinux-0.21-1.slemicro.noarch.rpm: Header U4 RSA/SHA256 Signature, key ID 9257814a: NOKEY
[*] A start job is running for Combustion (36s / no limit)
```

FIGURE 11: INSTALL COMPONENTS

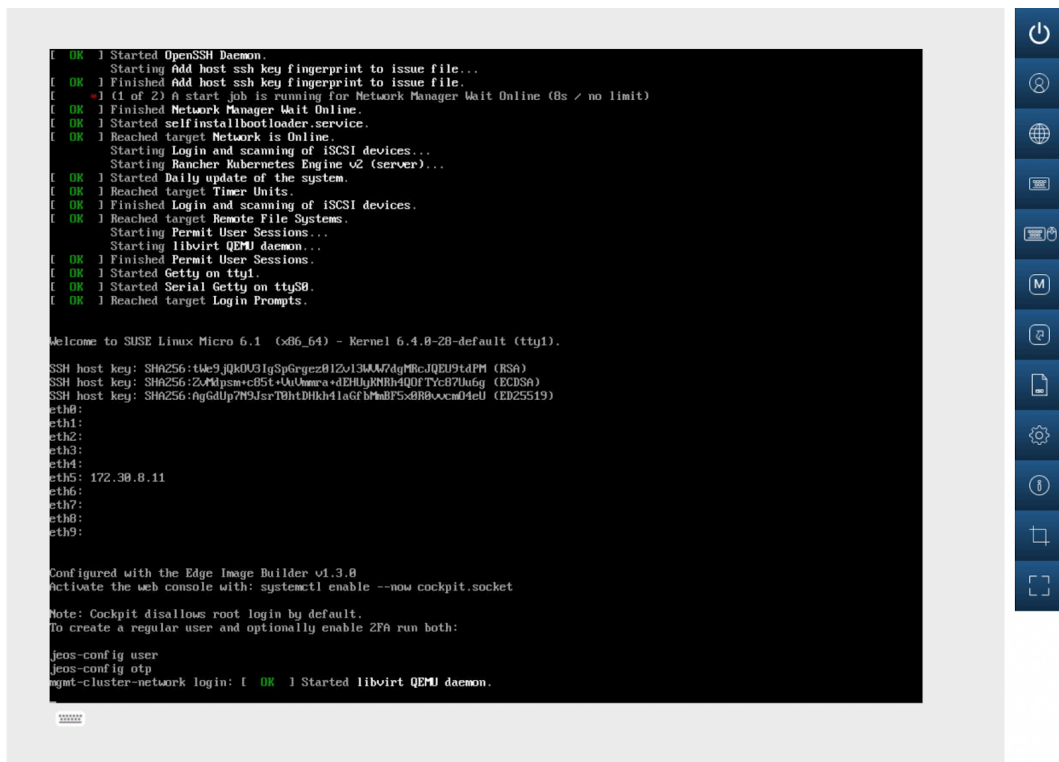


FIGURE 12: START SERVICES AND COMPLETE INSTALLATION

4. At this stage, the system is ready and the Management Cluster has been deployed. Kubeconfig is configured with the user provided in the EIB definition file by default. Verify that the cluster is ready.

```
kubectl get nodes
```

You should see output similar to the following:

NAME	STATUS	ROLES	AGE	VERSION
mgmt-cluster-network	Ready	control-plane,etcd,master	37s	v1.33.3+rke2r1

5. Verify that SUSE Rancher Prime is available.
 - a. Access the SUSE Rancher Prime UI by opening your Web browser to <https://rancher-172.30.8.11.sslip.io:8443/>.
 - b. Log in with the credentials configured in the file, `custom/files/basic-setup.sh`, during the EIB process.

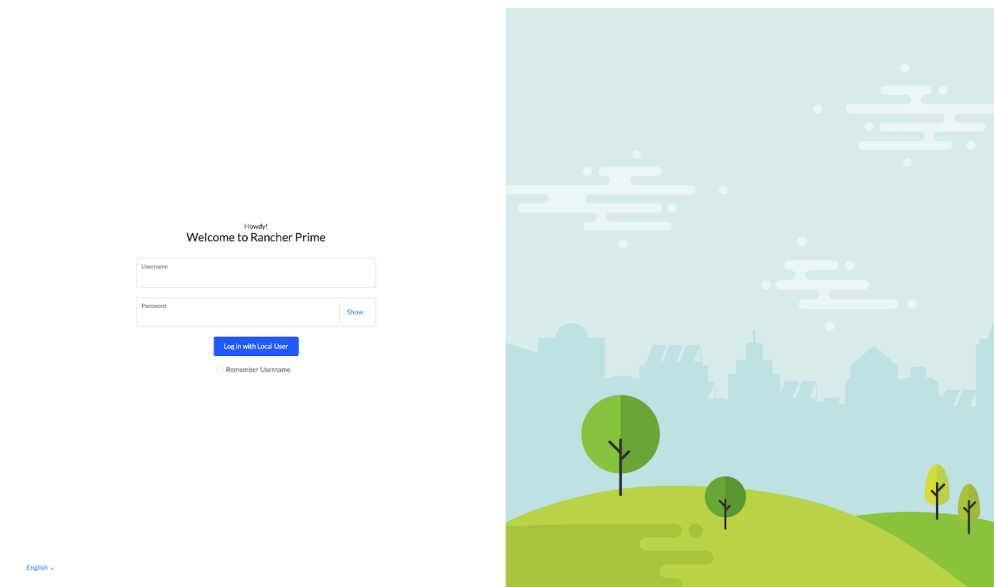


FIGURE 13: SUSE RANCHER PRIME UI LOGIN SCREEN

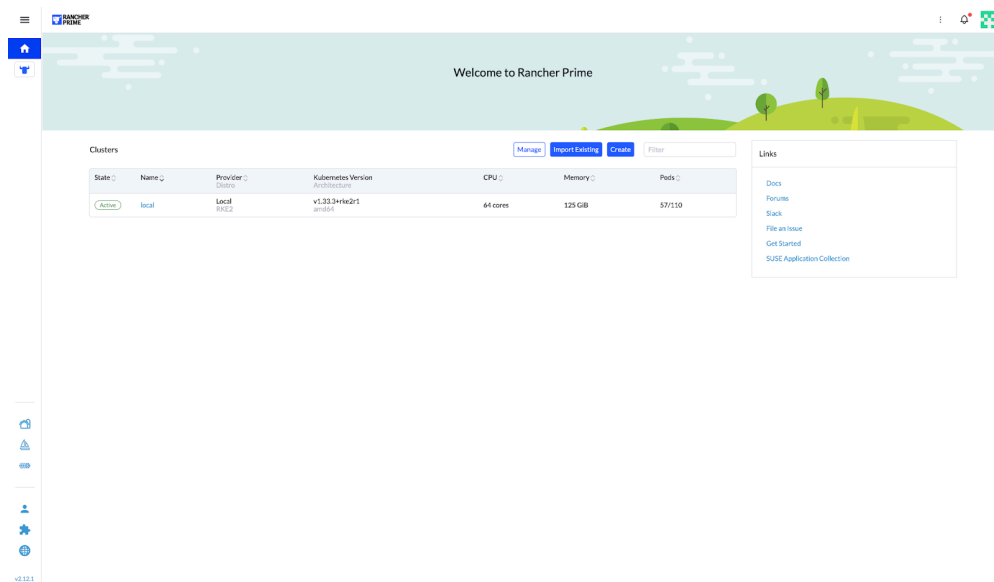


FIGURE 14: SUSE RANCHER PRIME UI DASHBOARD

7.1.2 Downstream Cluster deployment

To deploy the Downstream Cluster (provision the operating system and RKE2 cluster automatically), you need to create manifest files from the Management Cluster. These files include the BareMetalHost definition file (bmh.yaml) and the Provision file (capi.yaml).

1. Create a BaremetalHost definition file (`bmh.yaml`).

For reference, see [Section 11.1.1, “Sample BareMetalHost definition file \(bmh.yaml\)”](#).

2. Apply the manifests using `kubectl` (alternatively it could be applied using Rancher UI):
The manifests should be applied using `kubectl` (an alternative method is to apply them via the Rancher UI):

```
kubectl apply -f manifests-examples/bmh.yaml
```

3. Check that inspection has started to retrieve all hardware information from the server to fill the BareMetalHost object in RKE2.

```
mgmt-cluster-network:~ # kubectl get bmh
```

NAME	STATE	CONSUMER	ONLINE	ERROR	AGE
lab-sm1	inspecting		true		11s

4. You can retrieve the configuration and hardware details of the downstream cluster hosts with:

```
kubectl get bmh lab-sm1 -o yaml
```

For reference, see [Section 11.1.2, “Sample BareMetalHost details”](#).

5. The same information is represented now in the SUSE Rancher Prime UI:

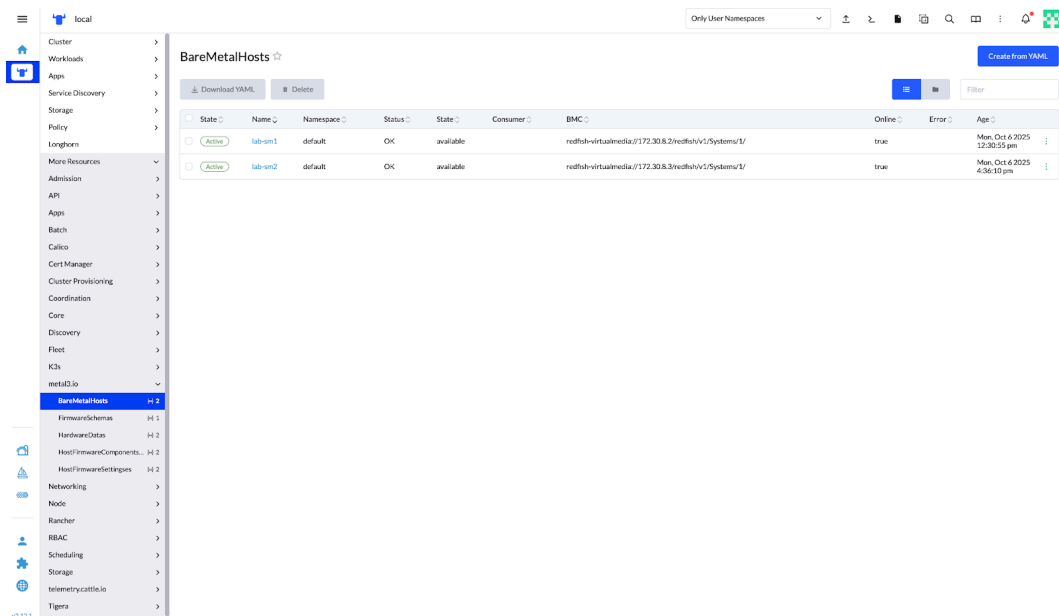


FIGURE 15: SUSE RANCHER PRIME – BARE METAL HOSTS MANAGEMENT VIEW

Verify this with:

```
kubectl get nodes
```

NAME	STATUS	ROLES	AGE
VERSION			
multinode-cluster-t4rwk v1.33.3+rke2r1	Ready	control-plane,etcd,master	12m
multinode-cluster-workers-dxhgg-54cq4 v1.33.3+rke2r1	Ready	<none>	45s

9. Verify that the cluster is provisioned and active with the SUSE Rancher Prime UI.

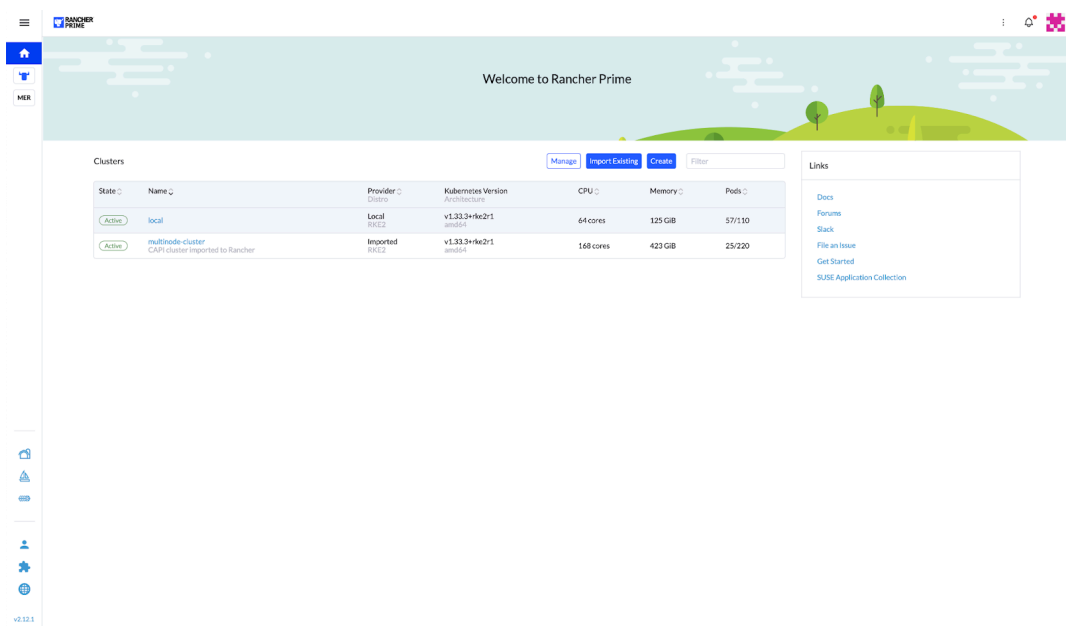


FIGURE 17: SUSE RANCHER PRIME – CLUSTERS OVERVIEW SHOWING ACTIVE DOWNSTREAM CLUSTER

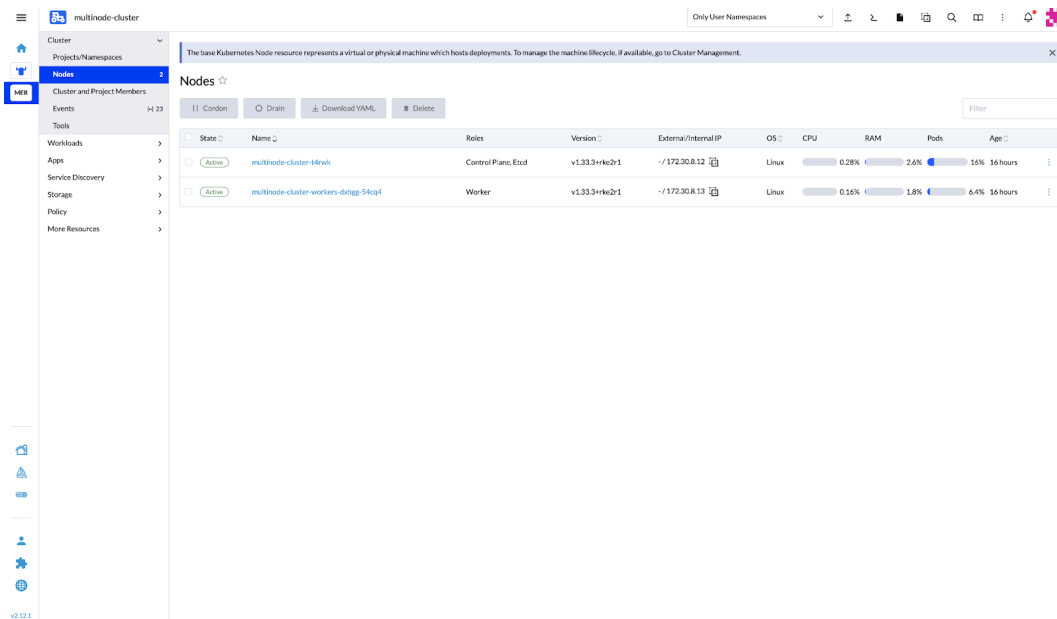


FIGURE 18: SUSE RANCHER PRIME – DOWNSTREAM CLUSTER NODES IN ACTIVE STATE

8 Performance testing

For performance testing, you can use a real-time simulator to replicate specific workloads per CPU during defined time periods. Then, measure CPU latency in scheduling new tasks on both isolated and housekeeping cores. You can use `cyclictest` (see [SLE RT Hardware Testing \(https://documentation.suse.com/sle-rt/15-SP7/html/SLE-RT-all/article-hardware-testing.html\)](https://documentation.suse.com/sle-rt/15-SP7/html/SLE-RT-all/article-hardware-testing.html)), along with a configured a JSON file (<https://github.com/scheduler-tools/rt-app/blob/master/doc/examples/template.json>) to simulate a particular CPU load percentage and quantify the latency associated with scheduling tasks concurrently. You can also use `cyclictest` to produce a histogram to visualize the results, as shown below.

For this document, the authors deployed the described reference configuration with the telco tunings provided in the [Section 11.1.3, “Sample Provision file \(capi.yaml\)”](#) and using SUPERMICRO® IoT SuperServer SYS-112D-42C-FN8P hosts.



Note

Host details provided by `hostnamectl`:

```
Static hostname: (unset)
Transient hostname: suse-wl2.shared.i14y-lab.com
```

```
Icon name: computer-server
Chassis: server #
Machine ID: f0a7cf72a88948968d537e0d471c4656
Boot ID: f2391ee36fcb4caf89508b9be07ca940
Operating System: SUSE Linux Micro 6.1
CPE OS Name: cpe:/o:suse:sl-micro:6.1
Kernel: Linux 6.4.0-30-rt
Architecture: x86-64
Hardware Vendor: Supermicro
Hardware Model: SYS-112D-42C-FN8P
Firmware Version: 1.0
Firmware Date: Mon 2025-08-25
Firmware Age: 1month 2w 1d
```

The authors applied a CPU load of 95 percent on isolated cores with a duration of 7200 seconds, using the command:

```
cyclictest -F /tmp/cyclictest-monitor.pipe -p98 -t36 --affinity=6-41 --mainaffinity=1 :--
interval=1000 --histogram=60 --spike=10 --duration=7200 --quiet
```

The results, plotted below, show that latency remains below five microseconds for the duration of the test.

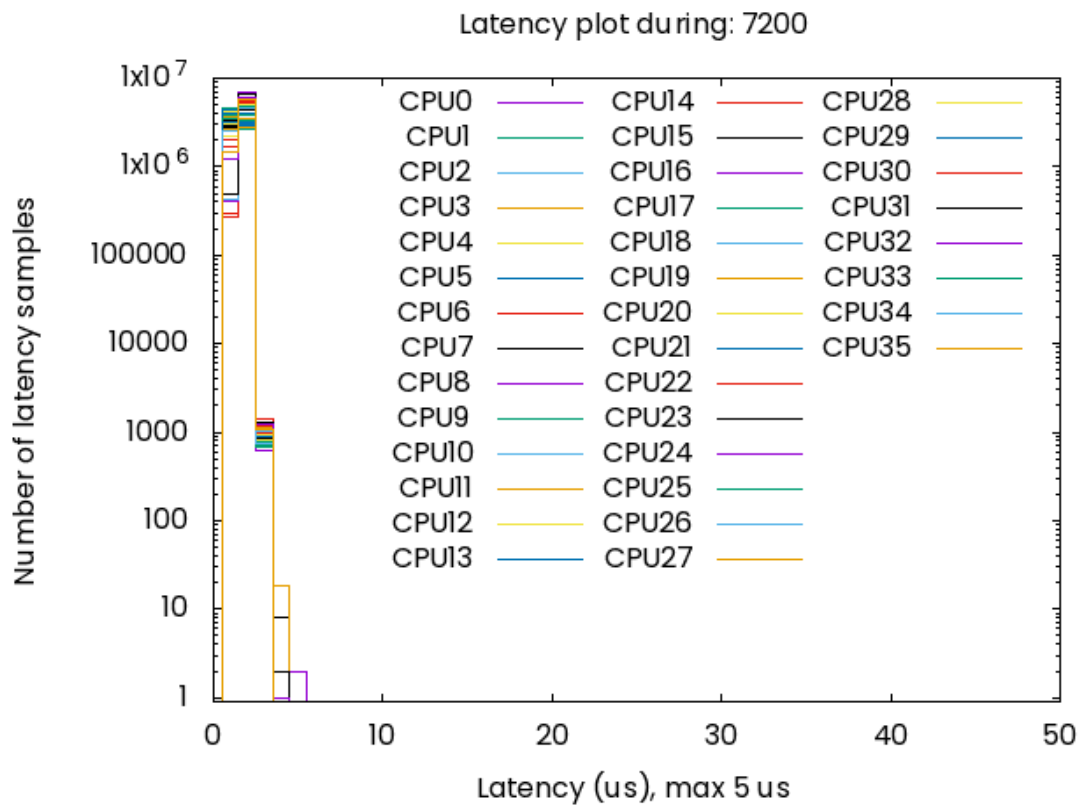


FIGURE 19: REAL-TIME CPU LATENCY DISTRIBUTION

9 Conclusions and next steps

This validated reference design illustrates a high-performance telco edge platform built on SUSE® Telco Cloud, SUPERMICRO® IoT SuperServers, and Intel® Xeon® 6 SoC processors. By utilizing a CPU-only architecture, the design meets stringent telco standards and requirements and scales effectively for AI-native, low-latency workloads. By replacing legacy accelerator-heavy designs with an integrated architectures, operators can significantly improve RAN capacity, power efficiency, and AI inference performance while reducing physical footprint, deployment complexity, and operational risk. Moreover, SUSE Telco Cloud provides a hardened, cloud-native foundation with zero-touch provisioning, consistent lifecycle management, and support for both VNFs and CNFs across core, edge, and far-edge environments.

Together, SUSE, SUPERMICRO, and Intel enable operators to modernize their networks without compromise. This partnership helps scale AI-driven services, and prepare users for next-generation 5G-Advanced and 6G use cases, all while lowering TCO and improving sustainability.

Continue your learning journey with these resources:

- SUSE Telco Cloud deployment documentation (<https://documentation.suse.com/suse-edge/3.4/html/edge/atip.html>) ↗
- Intel Xeon 6 SoC Networking and Edge (<https://www.intel.com/content/www/us/en/products/details/processors/xeon/edge.html>) ↗
- Platform and Performance Advantages to Accelerate vRAN Deployments (<https://www.intel.com/content/dam/www/central-libraries/us/en/documents/2025-02/vran-xeon6-soc-p-cores-solution-brief-final.pdf>) ↗
- Leadership AI and Networking Solutions with Intel Xeon 6 SoC (<https://www.intc.com/news-events/press-releases/detail/1728/intel-unveils-leadership-ai-and-networking-solutions-with>) ↗
- SUPERMICRO's SYS-112D-42C-FN8P (<https://www.supermicro.com/en/products/system/iot/1u/sys-112d-42c-fn8p>) ↗ and SYS-212D-72C-FN8P (<https://www.supermicro.com/en/products/system/iot/2u/sys-212d-72c-fn8p>) ↗ specifications

To move forward with transforming your network, contact your SUSE, Intel, or SUPERMICRO account team to arrange a joint solution workshop and receive expert sizing assistance tailored to your specific deployment needs.

10 Frequently Asked Questions (FAQs)

1. What is the AI-Accelerated 5G Telco Platform?

It is a joint solution combining the SUSE Telco Cloud Platform and Intel® Xeon® 6 SoC-based systems by Supermicro to enable AI-powered vRAN and edge workloads with cloud-native operations, low latency, and high efficiency.

2. How does the SUSE Telco Cloud Platform support 5G edge deployments?

It provides a Kubernetes-based, cloud-native foundation optimized for telecom environments, enabling automated lifecycle management, scalability, and reliable operation of distributed edge and network workloads.

3. Why is Intel® Xeon® 6 SoC important for this solution?

Intel Xeon 6 SoC processors deliver integrated capabilities for vRAN processing and AI inference, helping achieve deterministic low latency, strong performance, and improved performance-per-watt on SoC-based systems.

4. What is the role of Supermicro systems in this solution?

Supermicro systems provide the carrier-grade server platforms optimized for edge and telecom environments. They deliver the compute density, I/O capabilities, and thermal efficiency required to run AI inference, vRAN, and edge workloads reliably at distributed 5G edge sites.

5. What types of workloads can run on this platform?

The platform supports cloud-native network functions (CNFs), AI inference applications, vRAN workloads, and modern edge services required for 5G and ORAN environments.

6. How does this architecture help improve power efficiency?

By consolidating AI, vRAN, and edge workloads on a SoC-based platform with optimized performance-per-watt, operators can reduce hardware sprawl and improve energy efficiency.

7. How does this solution support ORAN and modern 5G architectures?

The cloud-native platform supports containerized network functions and open, software-defined components aligned with ORAN and modern 5G design principles.

8. What value does this joint solution bring to telecom operators?

It delivers a validated, integrated platform that accelerates AI-enabled 5G deployment, supports new intelligent services, improves operational efficiency, and provides a future-ready foundation for telco innovation.

11 Appendix

The following sections provide additional information and resources.

11.1 Sample files and output

11.1.1 Sample BareMetalHost definition file (bmh.yaml)

```
apiVersion: v1
kind: Secret
metadata:
  name: lab-sm1-credentials
type: Opaque
```

```

data:
  username: <<< user in base64 >>>
  password: <<< password in base64 >>>
---
apiVersion: metal3.io/v1alpha1
kind: BareMetalHost
metadata:
  name: lab-sm1
  labels:
    cluster-role: control-plane
spec:
  online: true
  bootMACAddress: 7C:C2:55:ED:67:7A
  rootDeviceHints:
    deviceName: /dev/nvme0n1
  bmc:
    address: redfish-virtualmedia://172.30.8.2/redfish/v1/Systems/1/
    disableCertificateVerification: true
    credentialsName: lab-sm1-credentials

```

11.1.2 Sample BareMetalHost details

```

apiVersion: v1
items:
- apiVersion: metal3.io/v1alpha1
  kind: BareMetalHost
  metadata:
    annotations:
      kubectl.kubernetes.io/last-applied-configuration: |
        {"apiVersion":"metal3.io/v1alpha1","kind":"BareMetalHost","metadata":
{"annotations":{},"labels":{"cluster-role":"control-plane"},"name":"lab-
sm1","namespace":"default"},"spec":{"bmc":{"address":"redfish-
virtualmedia://172.30.8.2/redfish/v1/Systems/1/","credentialsName":"lab-sm1-
credentials","disableCertificateVerification":true},"bootMACAddress":"7C:C2:55:ED:67"
"online":true,"rootDeviceHints":{"deviceName":"/dev/nvme0n1"}}}
      creationTimestamp: "2025-10-06T10:30:55Z"
    finalizers:
      - baremetalhost.metal3.io
    generation: 2
    labels:
      cluster-role: control-plane
    name: lab-sm1
    namespace: default
    resourceVersion: "2475116"
    uid: c693353a-f933-4d68-9b4c-2e04571e9075

```



```
spec:
  architecture: x86_64
  automatedCleaningMode: metadata
  bmc:
    address: redfish-virtualmedia://172.30.8.2/redfish/v1/Systems/1/
    credentialsName: lab-sm1-credentials
    disableCertificateVerification: true
  bootMACAddress: 7C:C2:55:ED:67:7A
  online: true
  rootDeviceHints:
    deviceName: /dev/nvme0n1
status:
  errorCount: 0
  errorMessage: ""
  goodCredentials:
    credentials:
      name: lab-sm1-credentials
      namespace: default
      credentialsVersion: "2469066"
  hardware:
    cpu:
      arch: x86_64
      clockMegahertz: 3500
      count: 84
      flags:
        - 3dnowprefetch
        - abm
        - acpi
        - adx
        - aes
        - amx_bf16
        - amx_int8
        - amx_tile
        - aperfmperf
        - apic
        - arat
        - arch_capabilities
        - arch_lbr
        - arch_perfmon
        - art
        - avx
        - avx2
        - avx512_bf16
        - avx512_bitalg
        - avx512_fp16
        - avx512_vbmi2
        - avx512_vnni
```

- avx512_vpopcntdq
- avx512bw
- avx512cd
- avx512dq
- avx512f
- avx512ifma
- avx512vbmi
- avx512vl
- avx_vnni
- bmi1
- bmi2
- bts
- bus_lock_detect
- cat_l2
- cat_l3
- cdp_l2
- cdp_l3
- cldemote
- clflush
- clflushopt
- clwb
- cmov
- constant_tsc
- cpuid
- cpuid_fault
- cqm
- cqm_llc
- cqm_mbm_local
- cqm_mbm_total
- cqm_occup_llc
- cx16
- cx8
- dca
- de
- ds_cpl
- dtes64
- dtherm
- dts
- enqcmd
- epb
- ept
- ept_ad
- erms
- est
- f16c
- flexpriority
- flush_lld

- fma
- fpu
- fsgsbase
- fsrm
- fxsr
- gfni
- hle
- ht
- hwp
- hwp_act_window
- hwp_epp
- hwp_pkg_req
- ibpb
- ibrs
- ibrs_enhanced
- ibt
- ida
- intel_ppin
- intel_pt
- invpcid
- la57
- lahf_lm
- lm
- mba
- mca
- mce
- md_clear
- mmx
- monitor
- movbe
- movdir64b
- movdiri
- msr
- mtrr
- nonstop_tsc
- nopl
- nx
- ospke
- pae
- pat
- pbe
- pcid
- pclmulqdq
- pconfig
- pdcn
- pdpe1gb
- pebs

- pge
- pku
- pln
- pni
- popcnt
- pse
- pse36
- pts
- rdpid
- rdrand
- rdseed
- rdt_a
- rdtscp
- rep_good
- rtm
- sdbg
- sep
- serialize
- sha_ni
- smap
- smep
- smx
- split_lock_detect
- ss
- ssbd
- sse
- sse2
- sse4_1
- sse4_2
- ssse3
- stibp
- syscall
- tm
- tm2
- tme
- tpr_shadow
- tsc
- tsc_adjust
- tsc_deadline_timer
- tsc_known_freq
- tsxldtrk
- umip
- user_shstk
- vaes
- vme
- vmx
- vnmi

```
- vpc1mulqdg
- vpid
- waitpkg
- wbnoinvd
- x2apic
- xgetbv1
- xsave
- xsavec
- xsaveopt
- xsaves
- xtopology
- xtpr
model: GENUINE INTEL(R) XEON(R)
firmware:
  bios:
    date: 06/18/2025
    vendor: American Megatrends International, LLC.
    version: T20250618140143
hostname: suse-w11.shared.i14y-lab.com
nics:
- mac: 7c:c2:55:ed:60:17
  model: 0x8086 0x579e
  name: eno7np1
  speedGbps: 25
- mac: 7c:c2:55:ed:60:18
  model: 0x8086 0x579e
  name: eno8np2
  speedGbps: 25
- mac: 7c:c2:55:ed:60:19
  model: 0x8086 0x579e
  name: eno9np3
  speedGbps: 25
- mac: 7c:c2:55:ed:60:12
  model: 0x8086 0x579e
  name: eno2np0
  speedGbps: 25
- mac: 7c:c2:55:ed:60:13
  model: 0x8086 0x579e
  name: eno3np1
  speedGbps: 25
- mac: 7c:c2:55:ed:60:14
  model: 0x8086 0x579e
  name: eno4np2
  speedGbps: 25
- mac: 7c:c2:55:ed:60:15
  model: 0x8086 0x579e
  name: eno5np3
```

```

    speedGbps: 25
  - ip: 172.30.8.12
    mac: 7c:c2:55:ed:5f:38
    model: 0x8086 0x1533
    name: eno1
    speedGbps: 1
  - ip: fe80::3163:b4a6:5840:3b6f%eno1
    mac: 7c:c2:55:ed:5f:38
    model: 0x8086 0x1533
    name: eno1
    speedGbps: 1
  - mac: 7c:c2:55:ed:60:16
    model: 0x8086 0x579e
    name: eno6np0
    speedGbps: 25
ramMebibytes: 262144
storage:
  - alternateNames:
    - /dev/nvme1n1
    - /dev/disk/by-path/pci-0000:b4:00.0-nvme-1
    model: SAMSUNG MZQL2960HCJR-00A07
    name: /dev/disk/by-path/pci-0000:b4:00.0-nvme-1
    serialNumber: S64FNS0X801971
    sizeBytes: 960197124096
    type: NVME
    wwn: eui.36344630588019710025385300000001
  - alternateNames:
    - /dev/nvme0n1
    - /dev/disk/by-path/pci-0000:b5:00.0-nvme-1
    model: SAMSUNG MZQL2960HCJR-00A07
    name: /dev/disk/by-path/pci-0000:b5:00.0-nvme-1
    serialNumber: S64FNS0X801972
    sizeBytes: 960197124096
    type: NVME
    wwn: eui.36344630588019720025385300000001
systemVendor:
  manufacturer: Supermicro
  productName: SYS-112D-42C-FN8P (To be filled by O.E.M.)
  serialNumber: S956463X5705960
hardwareProfile: unknown
lastUpdated: "2025-10-06T10:41:19Z"
operationHistory:
  deprovision:
    end: null
    start: null
  inspect:
    end: "2025-10-06T10:41:19Z"

```

```

    start: "2025-10-06T10:31:06Z"
  provision:
    end: null
    start: null
  register:
    end: "2025-10-06T10:31:06Z"
    start: "2025-10-06T10:30:55Z"
  operationalStatus: OK
  poweredOn: true
  provisioning:
    ID: a031479c-ffde-4cea-8fdb-334fc5e85f67
    bootMode: UEFI
    image:
      url: ""
    rootDeviceHints:
      deviceName: /dev/nvme0n1
      state: available
  triedCredentials:
    credentials:
      name: lab-sml-credentials
      namespace: default
      credentialsVersion: "2469066"
kind: List
metadata:
  resourceVersion: ""

```

11.1.3 Sample Provision file (capi.yaml)

```

apiVersion: cluster.x-k8s.io/v1beta1
kind: Cluster
metadata:
  name: multinode-cluster
  namespace: default
  labels:
    cluster-api.cattle.io/rancher-auto-import: "true"
spec:
  clusterNetwork:
    pods:
      cidrBlocks:
        - 192.168.0.0/18
    services:
      cidrBlocks:
        - 10.96.0.0/12
  controlPlaneRef:
    apiVersion: controlplane.cluster.x-k8s.io/v1beta1

```

```

    kind: RKE2ControlPlane
    name: multinode-cluster
  infrastructureRef:
    apiVersion: infrastructure.cluster.x-k8s.io/v1beta1
    kind: Metal3Cluster
    name: multinode-cluster
  ---
apiVersion: infrastructure.cluster.x-k8s.io/v1beta1
kind: Metal3Cluster
metadata:
  name: multinode-cluster
  namespace: default
spec:
  controlPlaneEndpoint:
    host: 172.30.8.12
    port: 6443
  noCloudProvider: true

## Control Plane
---
apiVersion: controlplane.cluster.x-k8s.io/v1beta1
kind: RKE2ControlPlane
metadata:
  name: multinode-cluster
  namespace: default
spec:
  infrastructureRef:
    apiVersion: infrastructure.cluster.x-k8s.io/v1beta1
    kind: Metal3MachineTemplate
    name: multinode-cluster-controlplane
  replicas: 1
  version: v1.33.3+rke2r1
  rolloutStrategy:
    type: "RollingUpdate"
    rollingUpdate:
      maxSurge: 0
  registrationMethod: "control-plane-endpoint"
  serverConfig:
    cni: calico
    cniMultusEnable: true
  agentConfig:
    format: ignition
    additionalUserData:
      config: |
        variant: fcos
        version: 1.4.0
        kernel_arguments:

```



```

should_exist:
- intel_iommu=on
- iommu=pt
- idle=poll
- mce=off
- hugepagesz=1G hugepages=40
- hugepagesz=2M hugepages=0
- default_hugepagesz=1G
- irqaffinity=0-5
- isolcpus=domain,nohz,managed_irq,6-41
- nohz_full=16-41
- rcu_nocbs=16-41
- rcu_nocb_poll
- nosoftlockup
- nowatchdog
- nohz=on
- nmi_watchdog=0
- skew_tick=1
- quiet
- rcupdate.rcu_cpu_stall_suppress=1
- rcupdate.rcu_expedited=1
- rcupdate.rcu_normal_after_boot=1
- rcupdate.rcu_task_stall_timeout=0
- rcutree.kthread_prio=99
systemd:
units:
- name: rke2-preinstall.service
  enabled: true
  contents: |
    [Unit]
    Description=rke2-preinstall
    Wants=network-online.target
    Before=rke2-install.service
    ConditionPathExists=!/run/cluster-api/bootstrap-success.complete
    [Service]
    Type=oneshot
    User=root
    ExecStartPre=/bin/sh -c "mount -L config-2 /mnt"
    ExecStart=/bin/sh -c "sed -i \"s/BAREMETALHOST_UUID/${jq -r .uuid /mnt/
openstack/latest/meta_data.json)/\" /etc/rancher/rke2/config.yaml"
    ExecStart=/bin/sh -c "echo \"node-name: ${jq -r .name /mnt/openstack/
latest/meta_data.json}\" >> /etc/rancher/rke2/config.yaml"
    ExecStartPost=/bin/sh -c "umount /mnt"
    [Install]
    WantedBy=multi-user.target
- name: cpu-partitioning.service
  enabled: true

```

```

        contents: |
            [Unit]
            Description=cpu-partitioning
            Wants=network-online.target
            After=network.target network-online.target
            [Service]
            Type=oneshot
            User=root
            ExecStart=/bin/sh -c "echo isolated_cores=6-41 > /etc/tuned/cpu-
partitioning-variables.conf"
            ExecStartPost=/bin/sh -c "tuned-adm profile cpu-partitioning"
            ExecStartPost=/bin/sh -c "systemctl enable tuned.service"
            [Install]
            WantedBy=multi-user.target
- name: performance-settings.service
  enabled: true
  contents: |
      [Unit]
      Description=performance-settings
      Wants=network-online.target
      After=network.target network-online.target cpu-partitioning.service
      [Service]
      Type=oneshot
      User=root
      ExecStart=/bin/sh -c "/opt/performance-settings/performance-settings.sh"
      [Install]
      WantedBy=multi-user.target
  kubelet:
    extraArgs:
      - provider-id=metal3://BAREMETALHOST_UUID
    nodeName: "Node-multinode-cluster"
---
apiVersion: infrastructure.cluster.x-k8s.io/v1beta1
kind: Metal3MachineTemplate
metadata:
  name: multinode-cluster-controlplane
  namespace: default
spec:
  template:
    spec:
      dataTemplate:
        name: multinode-cluster-controlplane-template
      hostSelector:
        matchLabels:
          cluster-role: control-plane
      image:
        checksum: http://172.30.4.28/eibimage-34-61-rt-telco.raw.sha256

```

```

        checksumType: sha256
        format: raw
        url: http://172.30.4.28/eibimage-34-61-rt-telco.raw
---
apiVersion: infrastructure.cluster.x-k8s.io/v1beta1
kind: Metal3DataTemplate
metadata:
  name: multinode-cluster-controlplane-template
  namespace: default
spec:
  clusterName: multinode-cluster
  metaData:
    objectNames:
      - key: name
        object: machine
      - key: local-hostname
        object: machine
      - key: local_hostname
        object: machine
## Workers
---
apiVersion: cluster.x-k8s.io/v1beta1
kind: MachineDeployment
metadata:
  labels:
    cluster.x-k8s.io/cluster-name: multinode-cluster
  name: multinode-cluster-workers
  namespace: default
spec:
  clusterName: multinode-cluster
  replicas: 1
  selector:
    matchLabels:
      cluster.x-k8s.io/cluster-name: multinode-cluster
  template:
    metadata:
      labels:
        cluster.x-k8s.io/cluster-name: multinode-cluster
    spec:
      bootstrap:
        configRef:
          apiVersion: bootstrap.cluster.x-k8s.io/v1beta1
          kind: RKE2ConfigTemplate
          name: multinode-cluster-workers
      clusterName: multinode-cluster
      infrastructureRef:
        apiVersion: infrastructure.cluster.x-k8s.io/v1beta1

```

```

    kind: Metal3MachineTemplate
    name: multinode-cluster-workers
    nodeDrainTimeout: 0s
    version: v1.33.3+rke2r1
---
apiVersion: bootstrap.cluster.x-k8s.io/v1beta1
kind: RKE2ConfigTemplate
metadata:
  name: multinode-cluster-workers
  namespace: default
spec:
  template:
    spec:
      agentConfig:
        format: ignition
      kubelet:
        extraArgs:
          - provider-id=metal3://BAREMETALHOST_UUID
      nodeName: "Node-multinode-cluster-worker"
      additionalUserData:
        config: |
          variant: fcos
          version: 1.4.0
          kernel_arguments:
            should_exist:
              - intel_iommu=on
              - iommu=pt
              - idle=poll
              - mce=off
              - hugepagesz=1G hugepages=40
              - hugepagesz=2M hugepages=0
              - default_hugepagesz=1G
              - irqaffinity=0-5
              - isolcpus=domain,nohz,managed_irq,6-41
              - nohz_full=16-41
              - rcu_nocbs=16-41
              - rcu_nocb_poll
              - nosoftlockup
              - nowatchdog
              - nohz=on
              - nmi_watchdog=0
              - skew_tick=1
              - quiet
              - rcupdate.rcu_cpu_stall_suppress=1
              - rcupdate.rcu_expedited=1
              - rcupdate.rcu_normal_after_boot=1
              - rcupdate.rcu_task_stall_timeout=0

```

```

- rcutree.kthread_prio=99
systemd:
  units:
    - name: rke2-preinstall.service
      enabled: true
      contents: |
        [Unit]
        Description=rke2-preinstall
        Wants=network-online.target
        Before=rke2-install.service
        ConditionPathExists=!/run/cluster-api/bootstrap-success.complete
        [Service]
        Type=oneshot
        User=root
        ExecStartPre=/bin/sh -c "mount -L config-2 /mnt"
        ExecStart=/bin/sh -c "sed -i \"s/BAREMETALHOST_UUID/$(jq -r .uuid /mnt/openstack/latest/meta_data.json)/\" /etc/rancher/rke2/config.yaml"
        ExecStart=/bin/sh -c "echo \"node-name: $(jq -r .name /mnt/openstack/latest/meta_data.json)\" >> /etc/rancher/rke2/config.yaml"
        ExecStartPost=/bin/sh -c "umount /mnt"
        [Install]
        WantedBy=multi-user.target
    - name: cpu-partitioning.service
      enabled: true
      contents: |
        [Unit]
        Description=cpu-partitioning
        Wants=network-online.target
        After=network.target network-online.target
        [Service]
        Type=oneshot
        User=root
        ExecStart=/bin/sh -c "echo isolated_cores=6-41 > /etc/tuned/cpu-partitioning-variables.conf"
        ExecStartPost=/bin/sh -c "tuned-adm profile cpu-partitioning"
        ExecStartPost=/bin/sh -c "systemctl enable tuned.service"
        [Install]
        WantedBy=multi-user.target
    - name: performance-settings.service
      enabled: true
      contents: |
        [Unit]
        Description=performance-settings
        Wants=network-online.target
        After=network.target network-online.target cpu-partitioning.service
        [Service]
        Type=oneshot

```

```


        User=root
        ExecStart=/bin/sh -c "/opt/performance-settings/performance-
settings.sh"
        [Install]
        WantedBy=multi-user.target
---
apiVersion: infrastructure.cluster.x-k8s.io/v1beta1
kind: Metal3MachineTemplate
metadata:
  name: multinode-cluster-workers
  namespace: default
spec:
  template:
    spec:
      dataTemplate:
        name: multinode-cluster-workers-template
      hostSelector:
        matchLabels:
          cluster-role: worker
      image:
        checksum: http://172.30.4.28/eibimage-34-61-rt-telco.raw.sha256
        checksumType: sha256
        format: raw
        url: http://172.30.4.28/eibimage-34-61-rt-telco.raw
---
apiVersion: infrastructure.cluster.x-k8s.io/v1beta1
kind: Metal3DataTemplate
metadata:
  name: multinode-cluster-workers-template
  namespace: default
spec:
  clusterName: multinode-cluster
  metaData:
    objectNames:
      - key: name
        object: machine
      - key: local-hostname
        object: machine
      - key: local_hostname
        object: machine

```

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