Cloud-native telco with Elisa and Nokia's 5G Cloud RAN and Red Hat OpenShift

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Welcome, introductions and agenda

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Nokia Corporate update
Nokia Cloud RAN Solution update

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Elisa "who are we"
Cloud RAN pilot status update
Cloud RAN pilot future steps

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Red Hat update how we support the
Nokia and Elisa and ecosystem

Networks that put the world's people, machines and devices in sync

NOKIA

Mobile networks
to deliver continuous connectivity

Data center networks
to power the infrastructure for the cloud and AI era

Software
to deploy, operate and automate networks

Non-terrestrial networks
to connect the hardest to reach places

Fixed networks
to transport the world's data across buildings and cities

Private networks
to accelerate digitalization for industries

Cybersecurity
to protect networks, people, devices, and applications
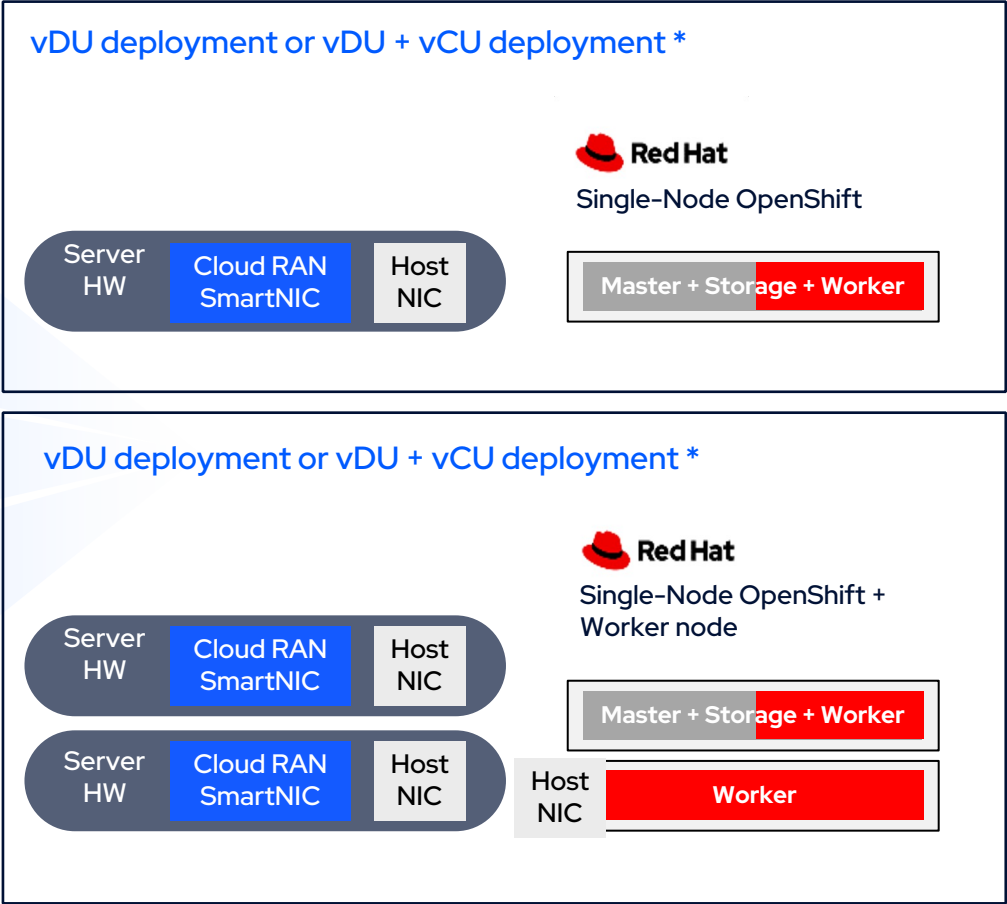
Homes Schools Hospitals Offices Roads Railways Airports Ports Warehouses Data centers Factories Energy utilities Mining

3

Nokia 5G Cloud RAN with Red Hat OpenShift

Red Hat is used in both Nokia RAN and Core

Cloud infrastructure SW

Selected CaaS SW and cluster options

Distributed

vDU deployment or vDU + vCU deployment *

Red Hat

Single-Node OpenShift

| Server HW | Cloud RAN SmartNIC | Host NIC |

Master + Storage + Worker

vDU deployment or vDU + vCU deployment *

Red Hat

Single-Node OpenShift + Worker node

| Server HW | Cloud RAN SmartNIC | Host NIC |

| Server HW | Cloud RAN SmartNIC | Host NIC |

Master + Storage + Worker

Host NIC | Worker

Centralized

vCU deployment

Red Hat

OpenShift multi-node cluster

| Server HW | W | Host NIC |

| Server HW | W | Host NIC |

| Server HW | W | Host NIC |

| Server HW | M | S | W | Host NIC |

| Server HW | M | S | W | Host NIC |

| Server HW | M | S | W | Host NIC |

Worker

Worker

. . .

Worker

Master + Storage + Worker

Master + Storage + Worker

Master + Storage + Worker

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Nokia Cloud RAN Solution

Our customers benefit from the maximum flexibility and best products

Nokia · Partner

	Reference Configuration		Other configurations	
CNF	5G vDU, vCU	CNF LCM	5G vDU, vCU	CNF LCM
CaaS	Red Hat OCP	Edge Cloud automation	Multiple CaaS options	Edge Cloud automation
HW	HW OEM supplier	HW management	Webscale or other HW	HW management

DELL Technologies · Hewlett Packard Enterprise · Red Hat

- Reference configuration focused on industry-leading 3rd party HW providers
- Access to Nokia feature-rich cloud RAN SW through plug-in SmartNIC

- Webscale fully managed infrastructure, managed service
- Webscale provides their full ecosystem to the customer
- Access to Nokia feature-rich cloud RAN SW through plug-in SmartNIC

Nokia Cloud RAN Solution is built on industry-standard HW with Partners

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Elisa in brief

2.8M customers

€2.2BN revenue 2024

6,100 Elisians in 20+ countries

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HOME MARKETS

ELISA INDUSTRIQ
INTERNATIONALLY

Consumer Customers

Corporate Customers

International Software Services

Production

Group support functions

Market position

#1 in Finland

#2 in Estonia
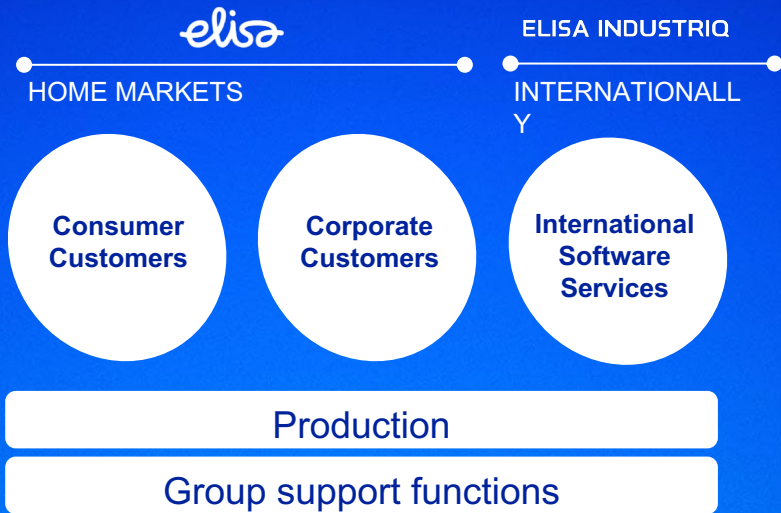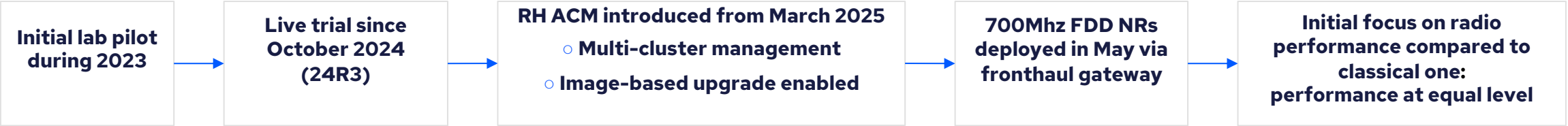
With over 140 years of experience

For home markets Finland & Estonia

- Telecom
- Entertainment
- IT and cyber services

For international markets

- Telecom software
- Industrial software
- Energy management

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Nokia Cloud RAN piloting at Elisa

| Initial lab pilot during 2023 | → | Live trial since October 2024 (24R3) | → | RH ACM introduced from March 2025
 ○ Multi-cluster management
 ○ Image-based upgrade enabled | → | 700Mhz FDD NRs deployed in May via fronthaul gateway | → | Initial focus on radio performance compared to classical one: performance at equal level |
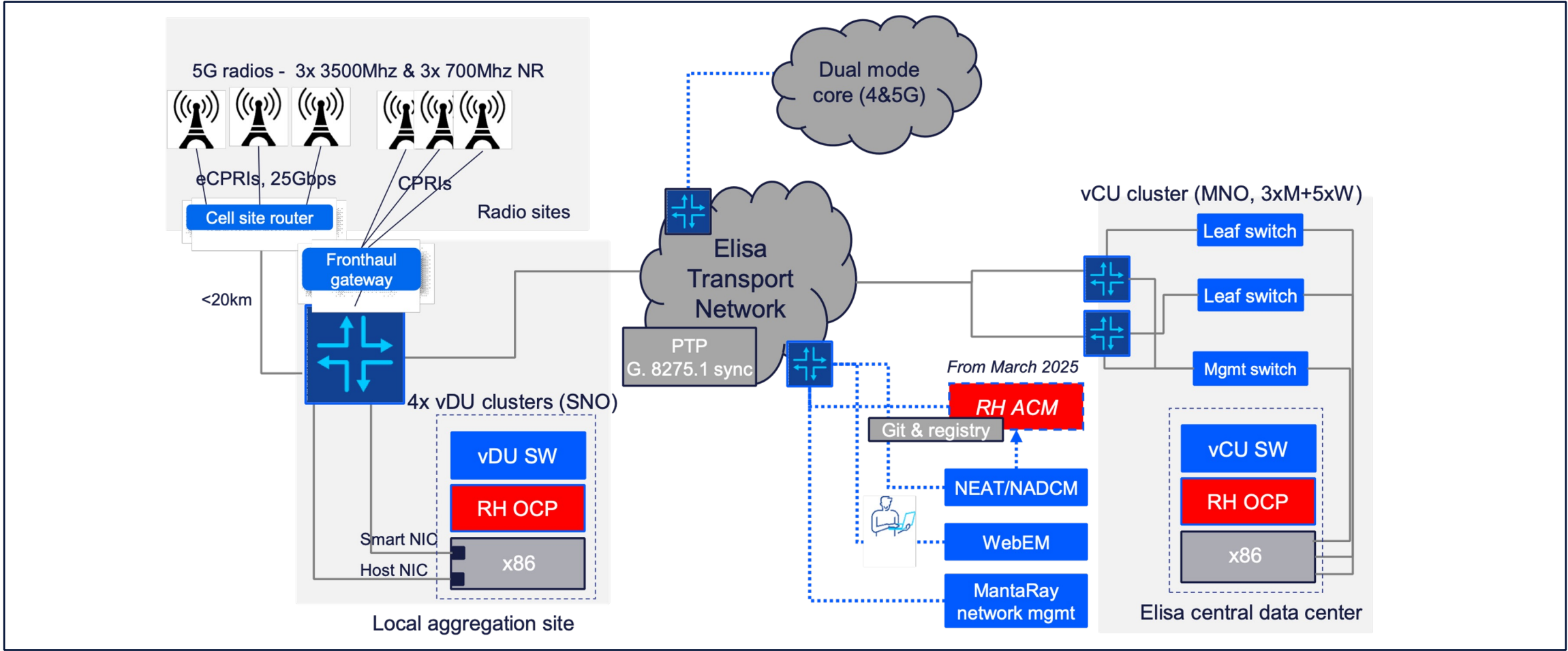
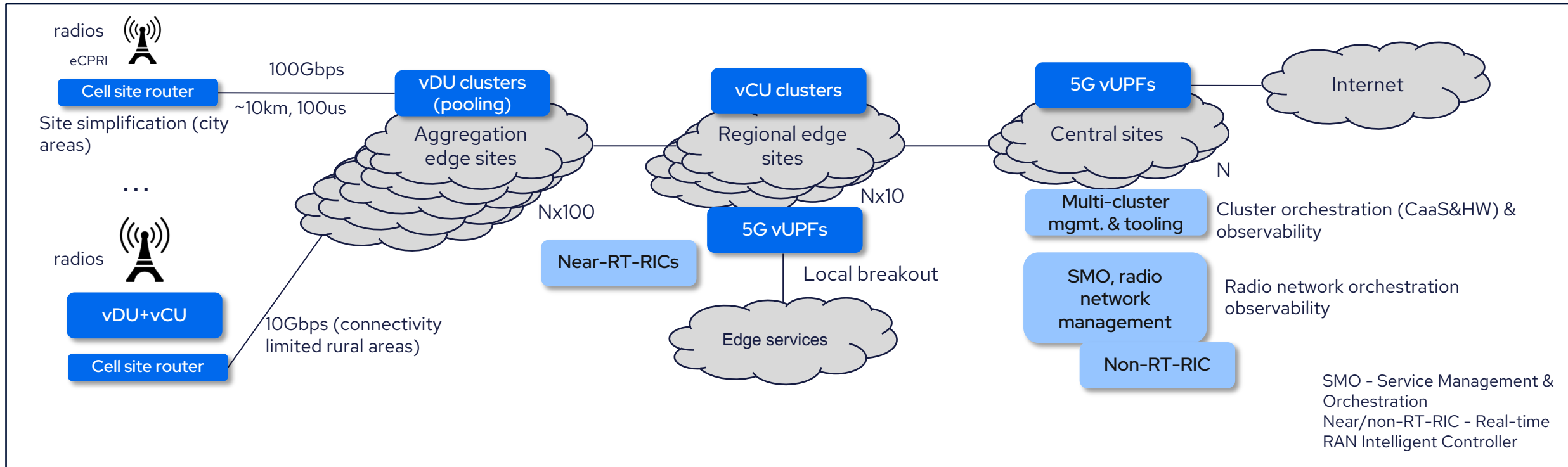# Piloting & evaluation continues

Site implementation options to consider

Pooling benefits vs fronthaul costs

- Higher efficiency through vDU pooling
- Effect of interference coordination to optimise performance and customer experience

- Moderate CU pooling benefits expected
- Possible synergies with distributed core and AI functions

- Automation of life-cycle mgmt (GitOps), agentic AI (e.g. AI-RAN)
- Observability, visualisation

radios

eCPRI

Cell site router

Site simplification (city areas)

...

radios

vDU+vCU

Cell site router

100Gbps

~10km, 100us

10Gbps (connectivity limited rural areas)

vDU clusters (pooling)

Aggregation edge sites

Nx100

vCU clusters

Regional edge sites

Nx10

5G vUPFs

Near-RT-RICs

Local breakout

Edge services

5G vUPFs

Central sites

N

Internet

Multi-cluster mgmt. & tooling

Cluster orchestration (CaaS&HW) & observability

SMO, radio network management

Radio network orchestration observability

Non-RT-RIC

SMO - Service Management & Orchestration
Near/non-RT-RIC - Real-time RAN Intelligent Controller

- Operational model considerations – internal & external (subcontractors) – process optimisation & automation!
- Costs vs performance: Cloud-RAN vs Classic RAN
- Service continuity aspects: redundancy, in-service upgrades etc.

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Supporting Nokia Cloud RAN piloting at Elisa
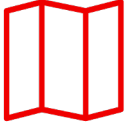
Telco Reference Design Specification

- Published reference design guidelines (RDS)
- Enabling tools to optimize Cluster configurations

Hardware Enablement

- CPUs & NICs validation to meet Telco specific requirements
- Roadmap: working closely with CPU, GPU and key vendors to enable faster TTM

Operational Improvements

- Optimizing the Day 2 activities through state of Cluster HW awareness
- "Shift Left" operational improvements
- Utilize the image mode at full extend
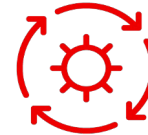
Alignment with O-RAN and Standards Bodies

- O-RAN O-Cloud functionality implementation through O2 Interface
- SNO provisioning and DU Profile configuration
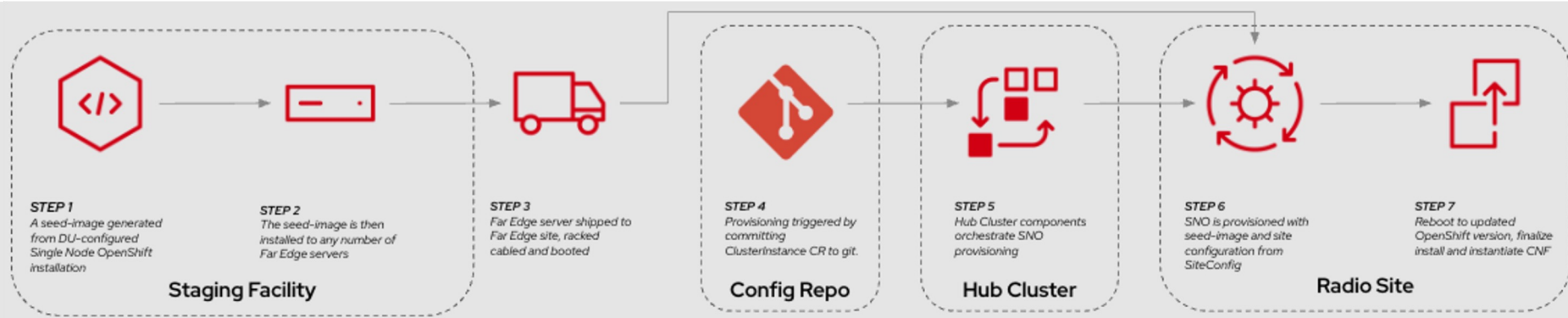- Multi-Node provisioning

Reference material:
- Telco RAN DU reference design (OpenShift Container Platform 4.18)
- Telco core reference design (OpenShift Container Platform 4.18)
- Comparing cluster configurations

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Operational Improvements

Image Based Install (IBI)

Benefit: Significant reduction in installation time for DU configured SNO at far edge site.
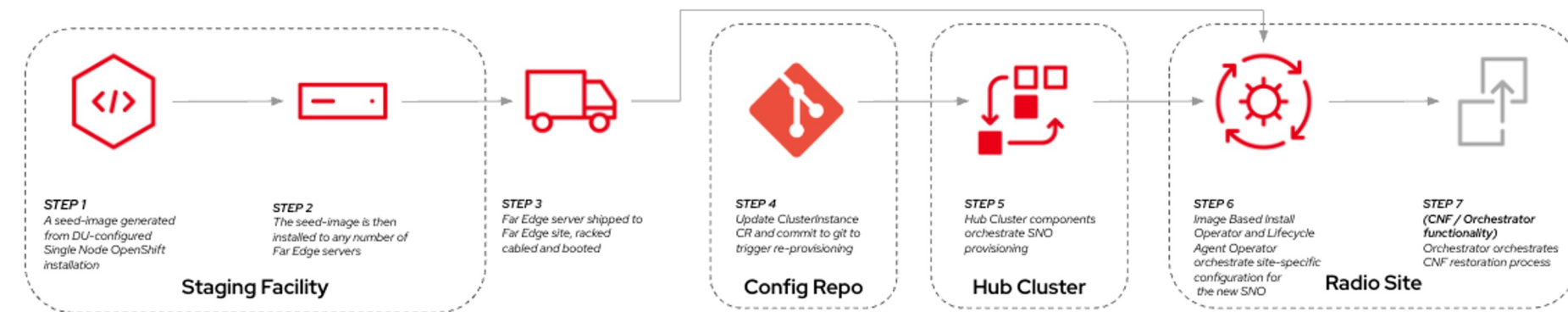
GA in 4.17

STEP 1
A seed-image generated from DU-configured Single Node OpenShift installation

STEP 2
The seed-image is then installed to any number of Far Edge servers

Staging Facility

STEP 3
Far Edge server shipped to Far Edge site, racked cabled and booted

STEP 4
Provisioning triggered by committing ClusterInstance CR to git.

Config Repo

STEP 5
Hub Cluster components orchestrate SNO provisioning

Hub Cluster

STEP 6
SNO is provisioned with seed-image and site configuration from SiteConfig

STEP 7
Reboot to updated OpenShift version, finalize install and instantiate CNF

Radio Site

Image Based Break Fix (IBBF)

Benefit: Redeploy DU configured SNO at far edge site after catastrophic hardware failure.

DP in 4.18 via
https://access.redhat.com/articles/7117691

STEP 1
A seed-image generated from DU-configured Single Node OpenShift installation

STEP 2
The seed-image is then installed to any number of Far Edge servers

Staging Facility

STEP 3
Far Edge server shipped to Far Edge site, racked cabled and booted

STEP 4
Update ClusterInstance CR and commit to git to trigger re-provisioning

Config Repo

STEP 5
Hub Cluster components orchestrate SNO provisioning

Hub Cluster

STEP 6
Image Based Install Operator and Lifecycle Agent Operator orchestrate site-specific configuration for the new SNO

STEP 7
(CNF / Orchestrator functionality) Orchestrator orchestrates CNF restoration process
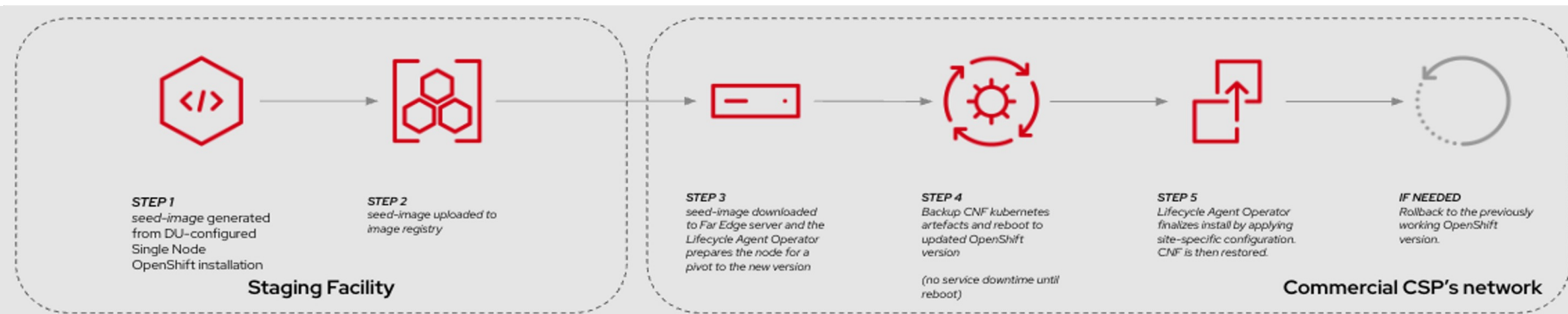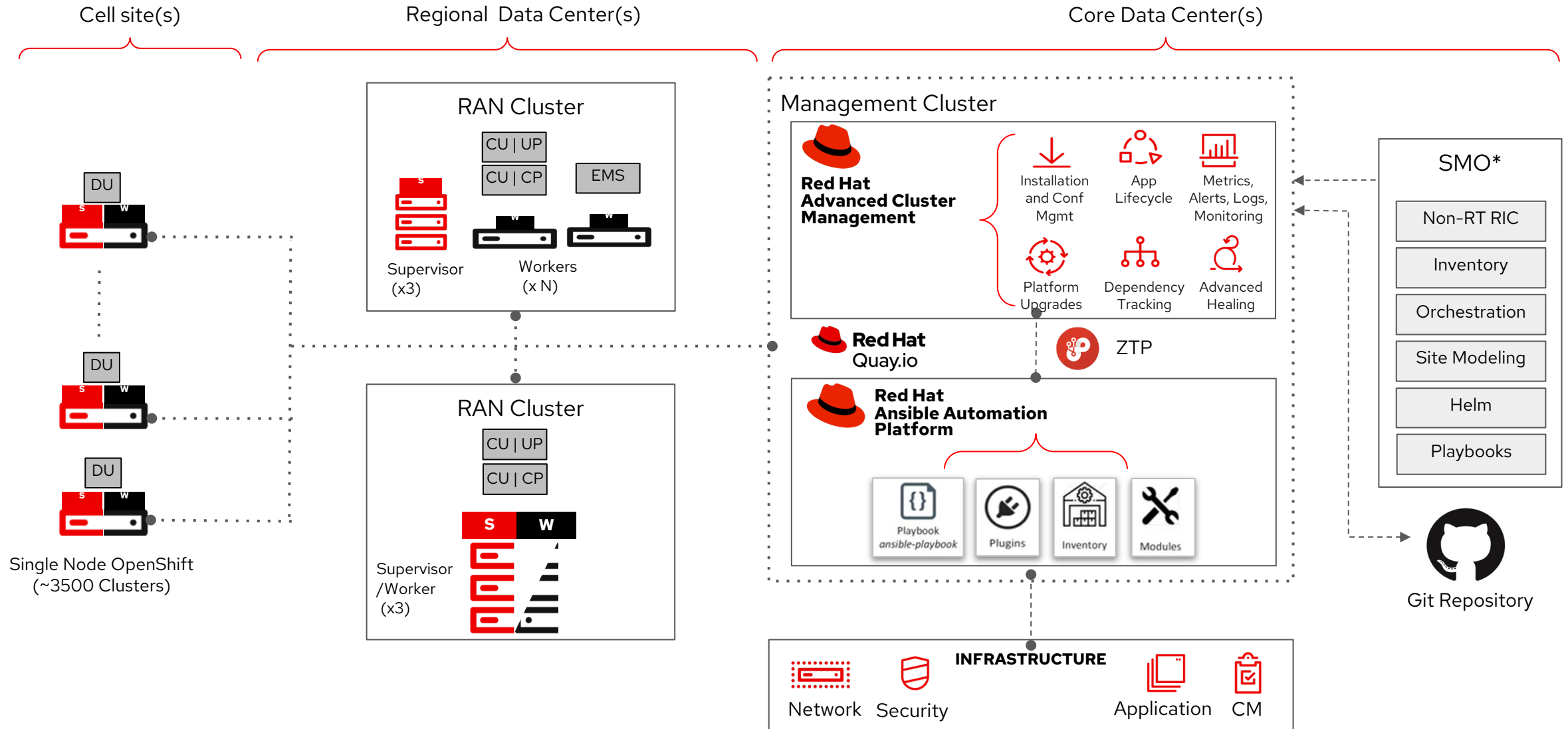
Radio Site

Image Based Upgrades (IBU)

Benefit: Significant reduction in upgrade time and service downtime for DU configured SNO at far edge site.

GA in 4.16 (for 4.14–4.16 upgrade)

STEP 1
seed-image generated from DU-configured Single Node OpenShift installation

STEP 2
seed-image uploaded to image registry

Staging Facility

STEP 3
seed-image downloaded to Far Edge server and the Lifecycle Agent Operator prepares the node for a pivot to the new version

STEP 4
Backup CNF kubernetes artefacts and reboot to updated OpenShift version

(no service downtime until reboot)

STEP 5
Lifecycle Agent Operator finalizes install by applying site-specific configuration. CNF is then restored.

IF NEEDED
Rollback to the previously working OpenShift version.

Commercial CSP's network

Zero Touch Provisioning and Automation

Cell site(s)　　Regional　Data Center(s)　　Core Data Center(s)

RAN Cluster

CU | UP
CU | CP
EMS

Supervisor (x3)　　Workers (x N)

DU

DU

DU

Single Node OpenShift
(~3500 Clusters)

RAN Cluster

CU | UP
CU | CP

S　W

Supervisor /Worker (x3)

Management Cluster

Red Hat Advanced Cluster Management

Installation and Conf Mgmt

App Lifecycle

Metrics, Alerts, Logs, Monitoring

Platform Upgrades

Dependency Tracking

Advanced Healing

Red Hat Quay.io

ZTP

Red Hat Ansible Automation Platform

Playbook *ansible-playbook*

Plugins

Inventory

Modules

INFRASTRUCTURE

Network　Security　　Application　CM

SMO*

Non-RT RIC

Inventory

Orchestration

Site Modeling

Helm

Playbooks

Git Repository

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OpenShift 4.19/4.20 Highlight Features

Continued Improvement of OpenShift Platform Plus

- RHEL 9.6/10

- Image-based Break/FIx (IBBF) [TP]

- Event Driven Ansible Hooks with Knowledge Base, at scale [DP]

- Increasing tested PTP Use Cases and Configurations

- Reference Design Specification update

- Schedulable Control plane

- Network Observability Operator

-

Alignment with O-RAN and Standards Bodies

Advance to O-RAN Solution to Developer Preview

- O-Cloud registration in SMO

- CaaS Inventory via O2-IMS

- Cluster Template Infrastructure

- SNO provisioning and DU Profile configuration

- Alerting via the O2-IMS Monitoring API

Hardware Enablement

- Intel Granite Rapids D [DP] (4.19)

- nVIDIA Grace Hopper [DP], (4.19)

- **intel** Sierra Forest CPUs

- **AMD** Turin CPUs

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Red Hat Cloud RAN Roadmap and Summary

- **Red Hat is:**
  - Working on SMO & RAN workload agnostic Cloud RAN components
  - Extending a Hub Cluster functionality to manage CaaS and Hardware for Cloud RAN projects
  - Continue to update the Reference Design Specifications

- **Roadmap areas in for next 6-12 months:**
  - Metal3 managing baremetal hosts through native Kubernetes API
  - Optimizing OCP deployments and Day-2 operations (incl. IBU, IBI …)
  - Observability at scale based on the cloud-native best practices
  - RAN use cases:
    - SNO with DU Profiles
    - MNO with RAN workload
  - RHEL 10

- **Accelerate the building of the O-Cloud partner ecosystem**

- **Continue Advise and assist the ecosystem to adopt cloud native principles and best practices**

Our Solutions are Open!

Nokia and Elisa successfully complete Europe's first Cloud RAN trial powered by In-Line acceleration

Nokia and Elisa successfully complete Europe's first Cloud RAN trial powered by In-Line acceleration

- Europe's first Cloud RAN trial using In-Line acceleration realized in Elisa's 5G network
- Successfully executed 5G data calls, with commercial 5G user equipment, confirming the feature richness and high performance of Nokia's anyRAN approach
- Project confirms Nokia's industry leadership in developing Cloud RAN market, which offers mobile operators more choice in building 5G networks
- First 5G data calls in Cloud RAN marks a significant milestone in Elisa's overall cloudification journey
- Supports Elisa's ambition to pioneer bringing cloud networking benefits, such as scalability and agility, to Finnish customers with highly automated processes

For more details, read the press release: https://www.nokia.com/newsroom/nokia-and-elisa-successfully-complete-europes-first-cloud-ran-trial-powered-by-in-line-acceleration/

Thank you

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