Navigating Open RAN

Lessons From Working With Large Telcos

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What we'll discuss today

▸ Understanding Open RAN Evolution

▸ Lessons Learned

▸ Summary

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The RAN Triplets

Virtualized RAN

Radio Access Network (RAN) functions are software-based

Run as Virtual Machines on generic (x86) compute

Use of commercial off-the-shelf (COTS) hardware

Requires hypervisor on for VM based RAN components

Considered a super-set of Cloud RAN

Cloud RAN

Not to be confused with Centralized RAN (C-RAN)

RAN functions are now *cloud-native*, not just VMs

Typically implemented as containers with micro-services

Requires container management layer e.g. Kubernetes

Not necessarily use public-cloud providers (AWS, Azure, GCP, etc)

Open RAN

Industry movement to driver *Open-ness* in RAN

Use of open architectures and open interfaces between RAN functions

Orthogonal to Virtualized RAN (vRAN) and Cloud RAN (C-RAN)

Driven by industry groups such as Operator-led O-RAN Alliance and Telecom Infra Project (TIP)

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Key Tenants of Open RAN*

- Use of open and interoperable interfaces, fully virtualized components, and an artificial intelligence assisted smart RAN network

- Minimize proprietary hardware and promote the use of commercial off-the-shelf (COTS) hardware and merchant silicon

- Define and drive standardization and subsequent adoption of application programming interfaces (APIs), along with the use of open source software for vRAN deployments
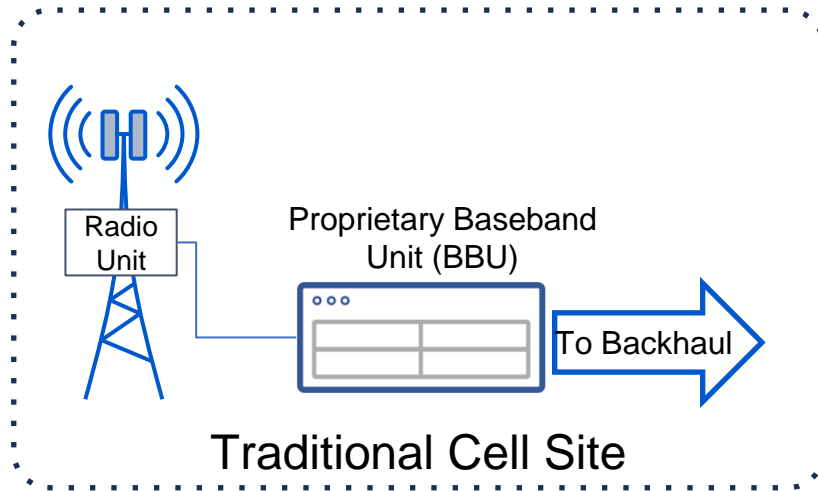
RAN Relationships

Source:Devopedia 2021.

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* As defined by the O-RAN Alliance
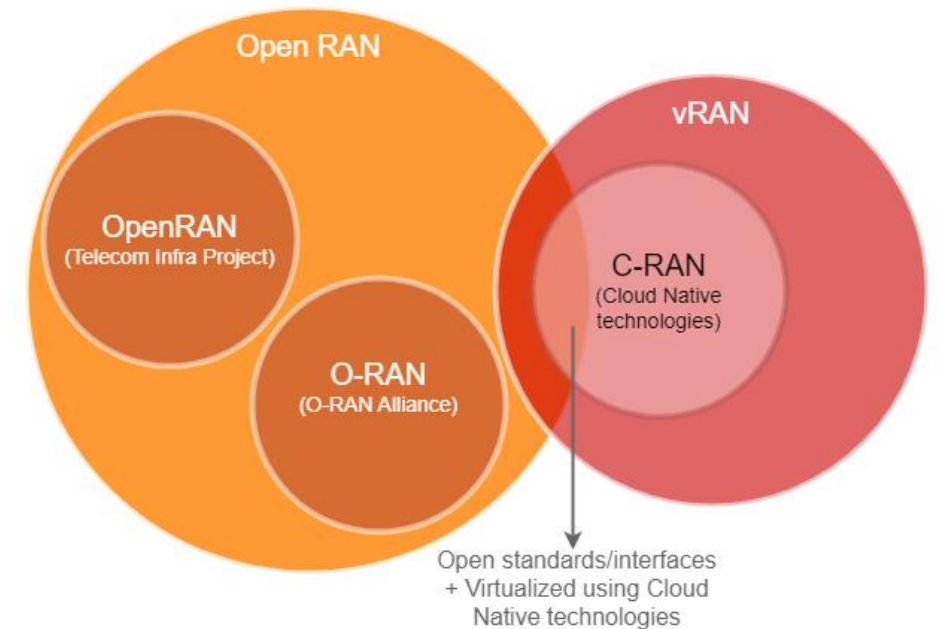
RAN Disaggregation and Decomposition

- Disaggregation allows RAN software to run on COTS hardware instead of special-purpose hardware

- Decomposition breaks down monolithic RAN function (i.e. Based Band Unit or BBU) into components as follows::
  - Distributed Unit (DU) for baseband processing and other latency sensitive low level functions
  - Centralized Unit (CU) for high level functions that are not latency sensitive

- Cloud-native DU and CU functions can be collocated or spread across the mobile network

- Introduction of DU and CU functions create new network domains – fronthaul and midhaul - in addition to traditional backhaul

- xHaul collectively refers to fronthaul, midhaul and/or backhaul networks

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Traditional vs Cloud/Open RAN Cell Site

Radio Unit

Proprietary Baseband Unit (BBU)

To Backhaul

Traditional Cell Site

RAN Software (DU, CU)

Radio Unit

C   W

Bare Metal Hardware

To xHaul

Open/Cloud RAN Cell Site

- Specialized hardware at the cell site

- Non-virtualized/containerized RAN components

- Radio Unit and Baseband Unit (BBU) provided by the same vendor
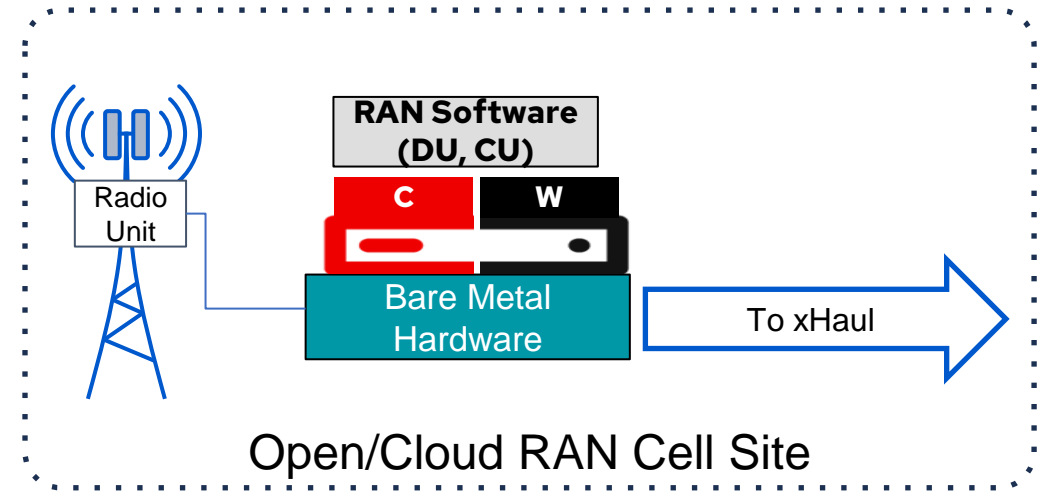
- COTS hardware (Server) at the cell site

- Container as a Service (Caas) platform (e.g Kubernetes) to host cloud-native RAN components

- Open interface between RU and DU/CU fosters competition

- Multiple placement option for CU and DU

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Open RAN Components Placement and Resulting xHaul Domains

Why is Open RAN Challenging?

Legacy RAN	Open RAN
Proprietary Interfaces	Open Interfaces
Specialized Hardware	Standard COTS Hardware
Limited Supplier Selection	Multiple, Expanding Supplier Options
Minimal Integration	Extensive Integration
Simple Life Cycle Management (LCM)	Complex Life Cycle Management (LCM)

The OPEN RAN *CHALLENGE*

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Lessons from working with large telcos over the last decade

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# Lesson 1: Choose your Technology Partner(s) Wisely

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Choosing your technology partners

- Open RAN is more than just RAN software
  - Hardware, CaaS/Cloud Software, Management and orchestration, large management

- Hardware Vendor:
  - Quality hardware is critical to RAN signal processing
  - Use of Hardware accelerators to complement CPU
  - RAN Nodes are placed in remote locations, hence reliability, hardening and remote management of HW is critical

- Cloud Software:
  - Container management is a key part of O-RAN planning
  - Kubernetes is the defacto standard for Open/Cloud RAN deployments
  - Cloud Platform must be able to adapt for placement across the network including non-RAN workloads used to support the RAN
  - Use of Horizontal cloud platform (for usability beyond RAN) is critical for telco's long term success

The more partners you have, the more complex (and costly) it will be to manage
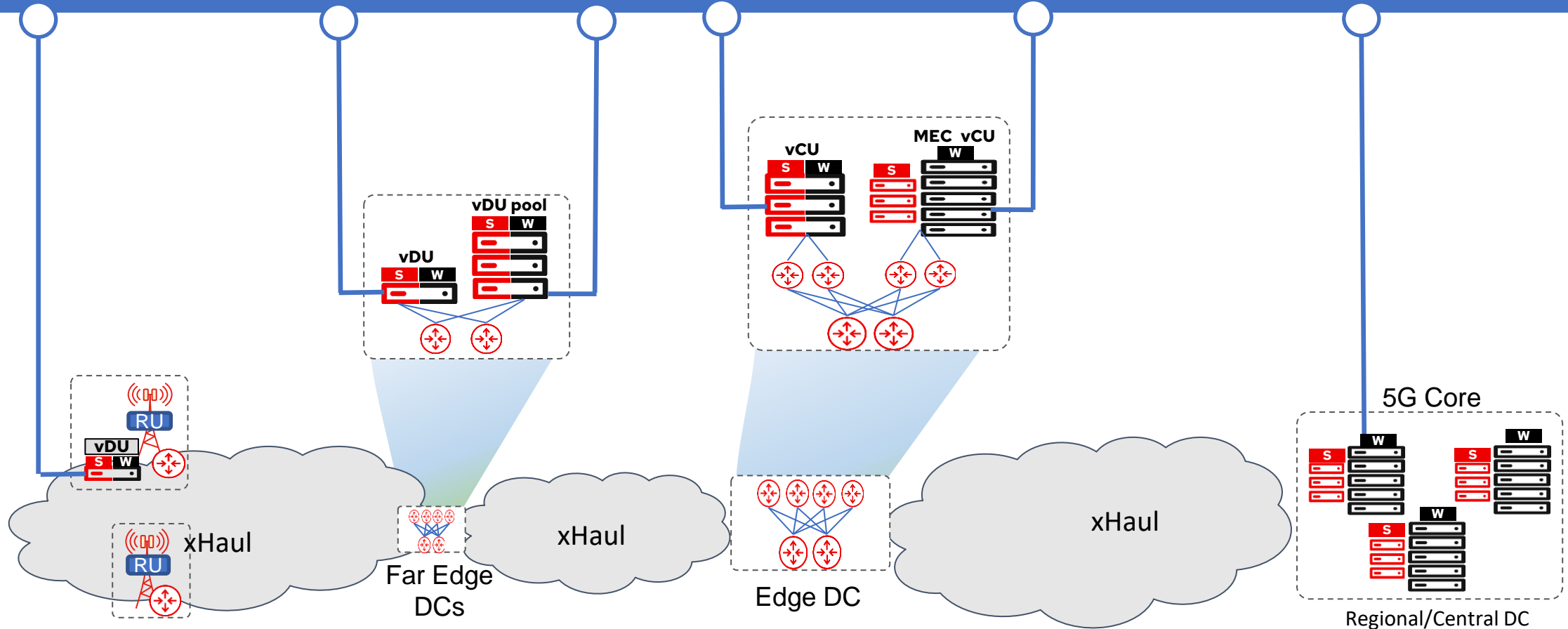
Strike a balance while selecting your technology partners

Multi-vendor benefits

Operational Complexity Costs

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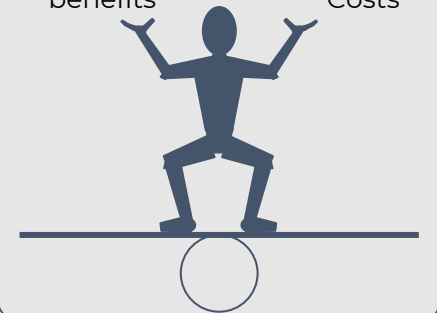
Lesson Summary:
Look Beyond Open RAN: Choose the *RIGHT* technology vendor for the *Network*

Lesson 2: Using a Systems Integrator (SI) don't solve all your problems

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Developing In House Skills is Imperative, whether using SI or not

- Traditional RAN is a closed proprietary system

- Vendor provides pre-integrated, pre-tested RAN solution and owns the responsibility to provide a functional RAN solution

- By contrast, Open RAN is just that - OPEN

- Internal competencies need to be developed to ensures operators evolves their Open RAN solution intelligently

- An SI may help operationalize hardware, cloud, and RAN software

- Telcos need to put their thumb on the scale to bring parties to the table, make them work together, and keep the peace

- Require skill uplift within your own team as well as strong vendor management skills

- Ongoing LCM across Open Ran components require operator needs to maintain SI knowledge for ongoing Open RAN LCM

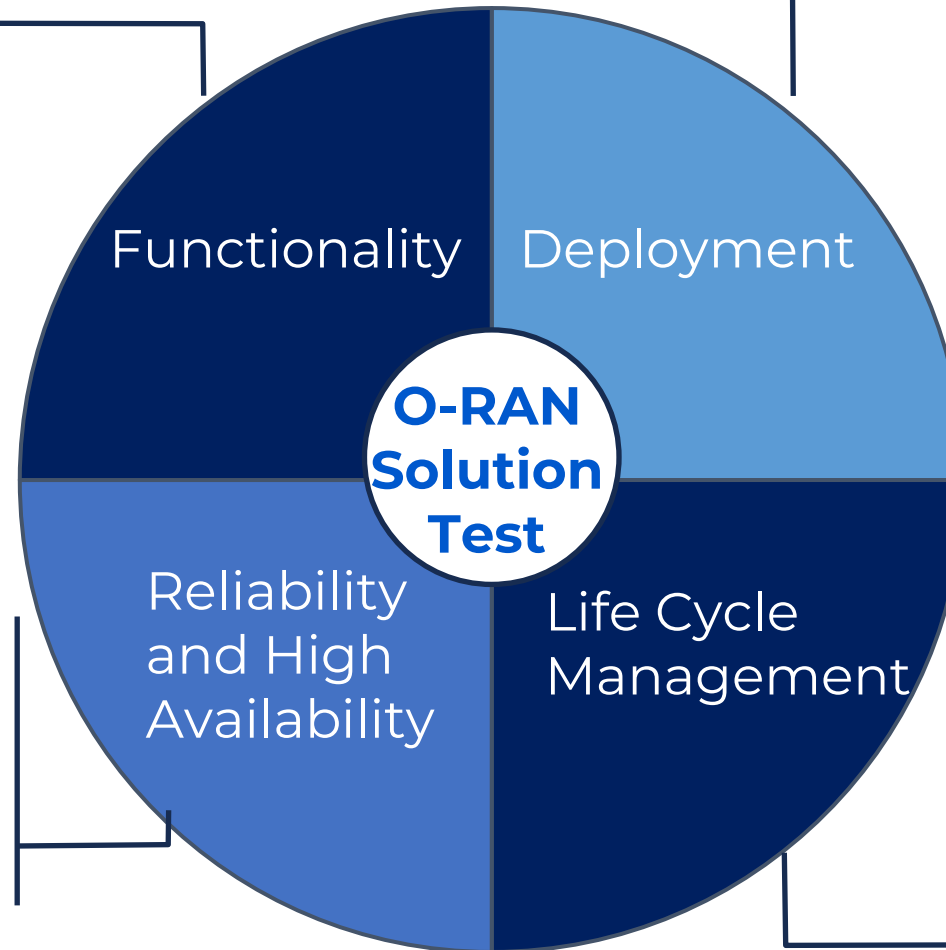**NANOG**™

Lesson 3: Test, Retest and Test Again

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Test, Retest, and Test Again

- Multi-disciplinary, muti-faceted, your-scenario specific testing is critical

- Tradition RAN uses Physical Network Function (PNF) with vertically integrated, single vendor stack

- Open RAN test methodology must account for "solution" level testing, instead of just feature ad function test

- High level test buckets stay the same, but test methodology must also accommodate multiple partner

- "Solution performance" must match or exceed legacy PNF only performance

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Open RAN Test Focus

- Features as well as solution tests
- RAN Software (i.e Containerized Network Function (CNF)) Test,
- Kubernetes and CaaS Platform,
- Networking and specialized features such as timing and synchronization.

- RAN Nodes placed in remote locations (Cell Sites, Far Edge, Near Edge, etc)
- Deployment includes the whole stack, and not just a Physical Network Function
- Automated deployment (e.g. GitOps pipeline) is the best way to guarantee multi-component deployment

Functionality

Deployment

O-RAN Solution Test

Reliability and High Availability

Life Cycle Management

- Five 9's is "solution-level" and not just limited to physical devices, dual power supply, or supervisor
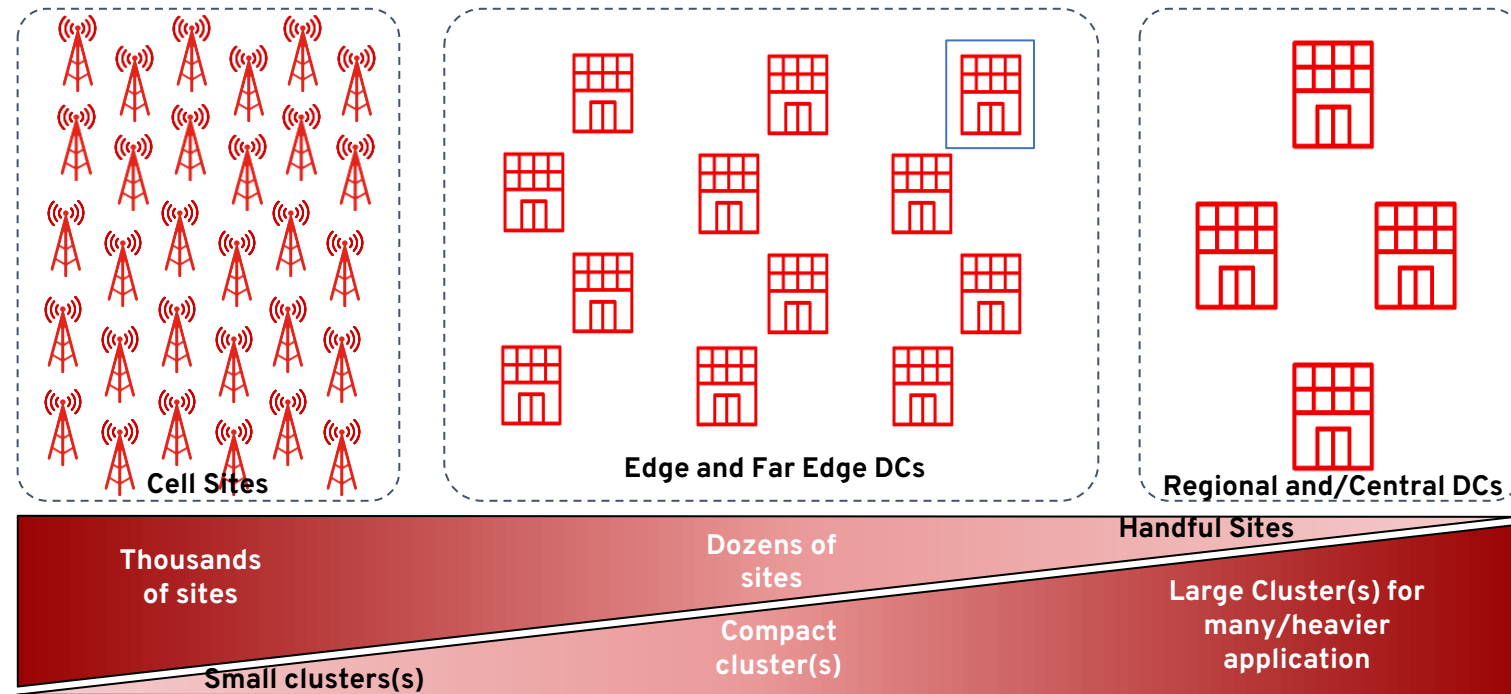- Containers and cloud native software turns reliability concept on its head through a pet vs cattle debate

- Hardware Lifecycle: Firmware, BIOS and Hardware Drivers
- Software Lifecyle:
  - CaaS and Kubernets platform
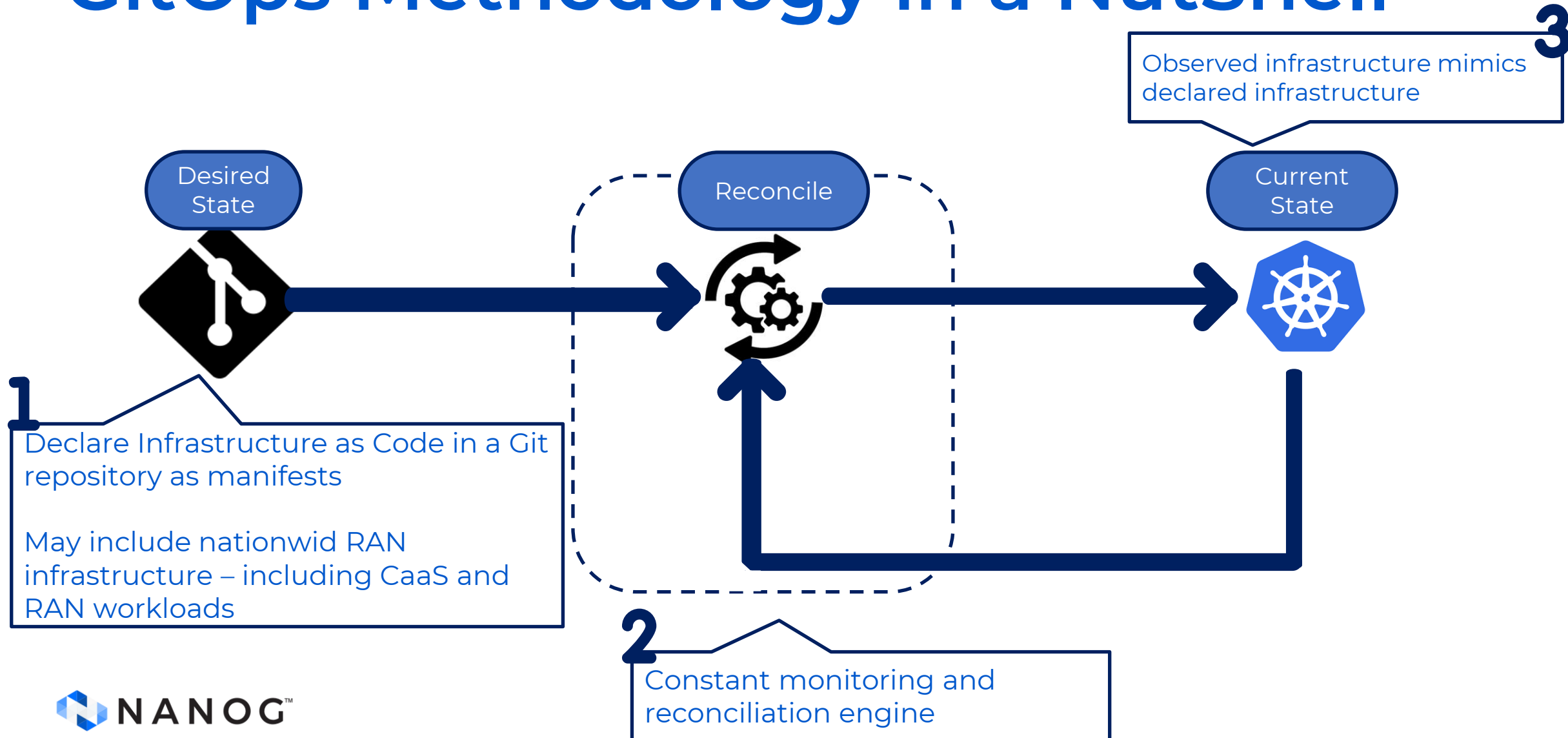 - RAN CNF upgrades, downgrade and re-installs

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Lesson 4: GitOps is helpful for Managing Open RAN Scale

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Scale is Critical in Open RAN

- RAN is an example of an Access network

- # of sites significantly outweighs its aggregation and Core counterparts

- The Open RAN "solution" should be able to scale to hundreds of thousands of nodes

- That includes the management and orchestration solution

- GitOps have proven to be a worthy mechanism to deploy and manage Far Edge Open RAN at Scale

Cell Sites

Edge and Far Edge DCs

Regional and/Central DCs

Thousands of sites

Dozens of sites

Handful Sites

Small clusters(s)

Compact cluster(s)

Large Cluster(s) for many/heavier application

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GitOps Methodology in a NutShell

Desired State

Reconcile

Current State

3 Observed infrastructure mimics declared infrastructure

1 Declare Infrastructure as Code in a Git repository as manifests

May include nationwid RAN infrastructure – including CaaS and RAN workloads

2 Constant monitoring and reconciliation engine

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Scaling with Central GitOps

Kubernetes Cluster Management with GitOPs

5GC | RIC | IT | SMO/OSS/BSS

vDU pool

vDU | S | W

RU
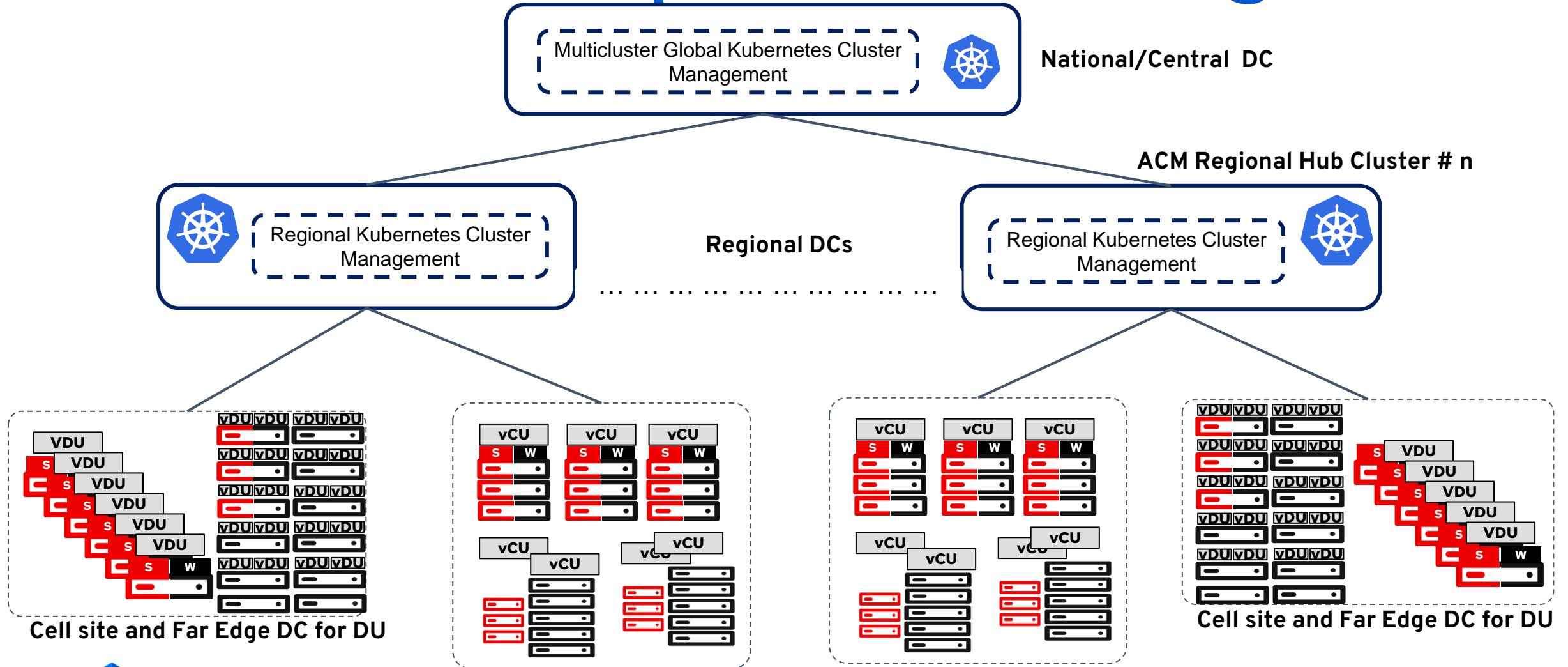
UPF | vCU | MEC

Far Edge DCs

Edge DCs

Regional/Central DC
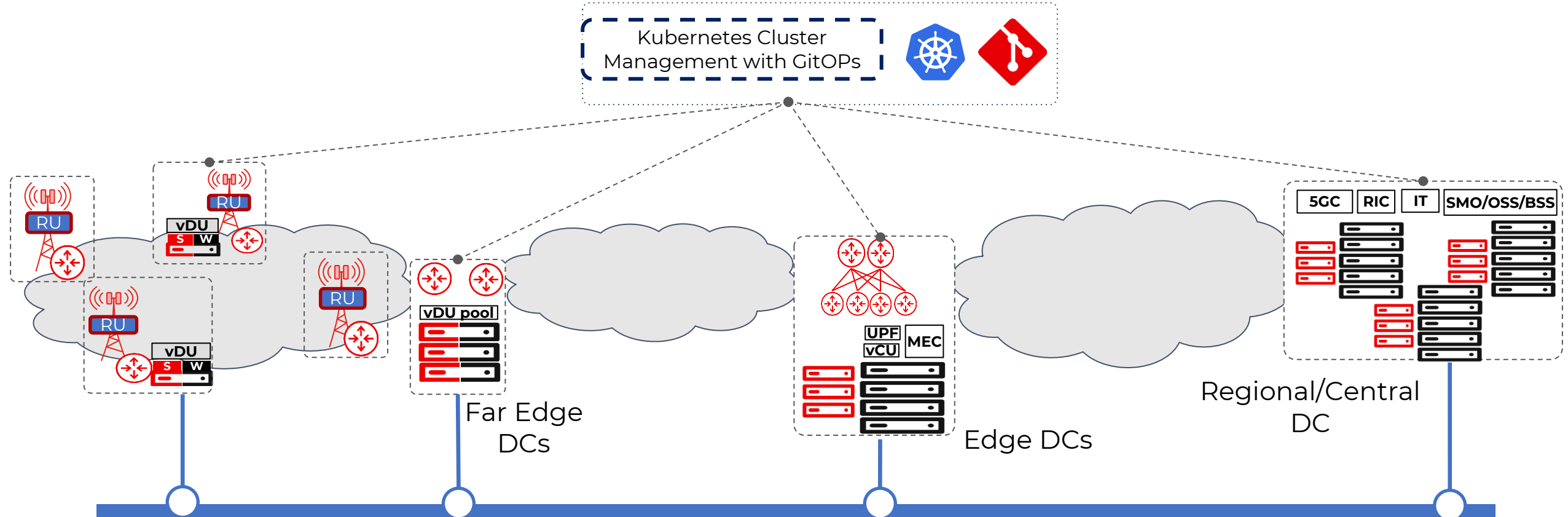
Lesson Summary: GitOps is a useful scaling tool for Open RAN as well as rest of the operator's mobile network

MEC: MultiAccess Edge Compute
UPF: User Plane Function
5GC – 5G Core
RIC: RAN intelligent Controller

SMO: Service Orchestration and Management
OSS: Operations Support Systems
BSS: Business Support Systems

Lesson 5: Concurrency does not equate to Scale

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Concurrency vs Scale

- Scale is the total number of sites that can be deployed and managed
- Concurrency is the number of operations that be performed simultaneously on the network
- Concurrency is key to ongoing O-RAN components' LCM
  - 10's of thousands of CaaS and/or RAN workloads' LCM is needed in one maintenance window
- A hierarchical approach management can provide both concurrency and scale
- Each region can scale independently, but also provides high concurrency
- Region can be county, city, state, or multi-state
- Multiple "Regional Hubs" can be deployed within a geographical regional for additional concurrency

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Hierarchical Open RAN Management

National/Central DC

Multicluster Global Kubernetes Cluster Management

ACM Regional Hub Cluster # n

Regional Kubernetes Cluster Management

Regional DCs

Regional Kubernetes Cluster Management

Cell site and Far Edge DC for DU

Cell site and Far Edge DC for DU

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Lesson 6: Don't forget xHaul Readiness
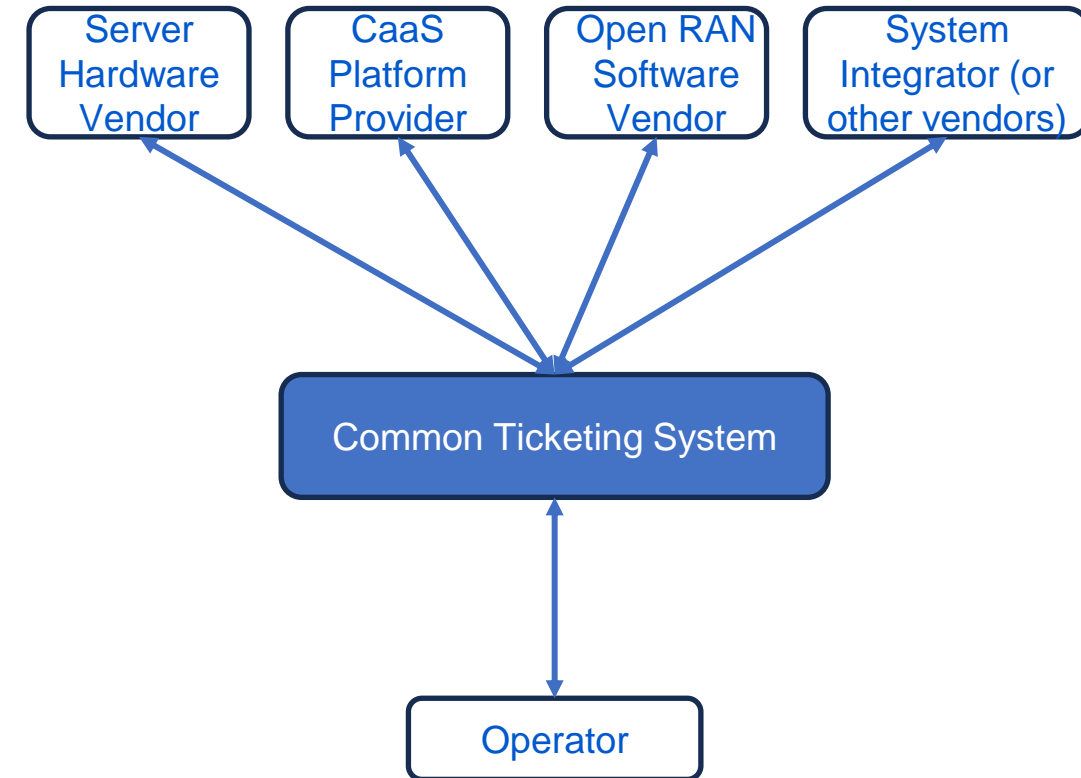
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Is your network ready for Open RAN?

- Open RAN requires network readiness beyond RAN CNF and Kubernetes

- Legacy backhaul is now divided into Fronthaul, Midhaul and Backhaul – collectively called xHaul

- Far Edge and Near Edge Sites Data Centers are now sprinkled across your entire network

- There are strict requirements for every xHaul domain

- Latency between RAN components dictate distance between Cell Sites, Far Edge DC, Edge DC and Regional/National DCs

- Real Estate, power, cooling and adequate fiber infrastructure is critical for these new RAN sites hosting Cloud Platform

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Lesson 7: Common Ticketing System

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Common Ticketing System

- Fast and efficient communication is key to problem solving

- Open RAN, with multi-vendor ecosystem, can benefit from a common problem ticketing system

- Telco must have the ability to open ticket across vendors that provides:
  - Single common ticket ID
  - Real time update across multiple vendors
  - Ability to edit/modify/view shared notes

- May require some setup work, but very helpful in problem solving and troubleshooting during operations

Server Hardware Vendor

CaaS Platform Provider

Open RAN Software Vendor

System Integrator (or other vendors)

Common Ticketing System

Operator

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Lesson 8: Plan for failure, not success
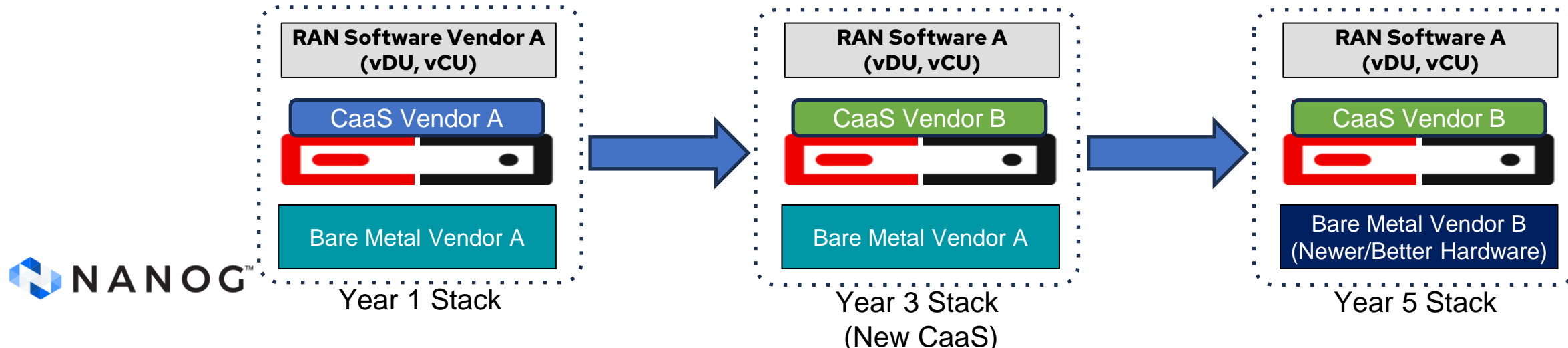

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Plan for Failure

- Planning for success is easy, Open Ran must be planned for failure

- You must plan to: Fail often, Fail fast, and Recover quickly

- Individual component failure should not impact "system" functionality

- Not a new concept, but renewed focus needs careful planning for Open RAN

- Robustness of Technology partner, Testing, Automation, GitOps pipelines, scale and concurrency (lessons 2, 3, 5, and 6) play a critical role here

- Often times, simple quick re-deployment may provide in-time recovery

- Intelligent remediation provides business continuity while RCA should be done offline with the logs gathered

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Final Lesson:
You've got the power!!!

You've Got the Power

- Open RAN can seem to be a daunting undertaking

- If done right, however, it gives immense freedom, flexibility and power of choice to operators

- Open RAN stack is a collection of build-it-yourself components: Hardware, Cloud Software, RAN CNF

- Each component is independent, yet integrated in the solution

- Every component is replaceable – no vendor lock in !!!

- This is an incredible paradigm shift, which is a reality *today*!

RAN Software Vendor A (vDU, vCU)	**RAN Software A (vDU, vCU)**	**RAN Software A (vDU, vCU)**
CaaS Vendor A	CaaS Vendor B	CaaS Vendor B
Bare Metal Vendor A	Bare Metal Vendor A	Bare Metal Vendor B (Newer/Better Hardware)
Year 1 Stack	Year 3 Stack (New CaaS)	Year 5 Stack

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Navigating Open RAN: Summary

- Lesson 1: Choose your technology providers wisely

- Lesson 2: SI's role is critical, but operator cannot be hands-off

- Lesson 3: Test, Retest, and Test Again

- Lesson 4: Scale is critical, GitOps automation is key to scale Open RAN

- Lesson 5: Concurrency and scale are different

- Lesson 6: Is your network ready for Backhaul to xHaul Transformation

- Lesson 7: Common ticketing systems smooths out communications

- Lesson 8: Plan for failure, not success

- Lesson 9: You've got the power

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Thank You!

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