

Cloud Native based Edge/Cloud Platform Integration via ICN Blueprint Family

Goal: Is to have end-to-end Cloud native platform

R5 Release Overview

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Agenda

- What is ICN ?
- Cloud Native Platform Needs
- Integrated Platform– ICN (Integrated Cloud Native) platform
- ICN roadmap

What is ICN ?

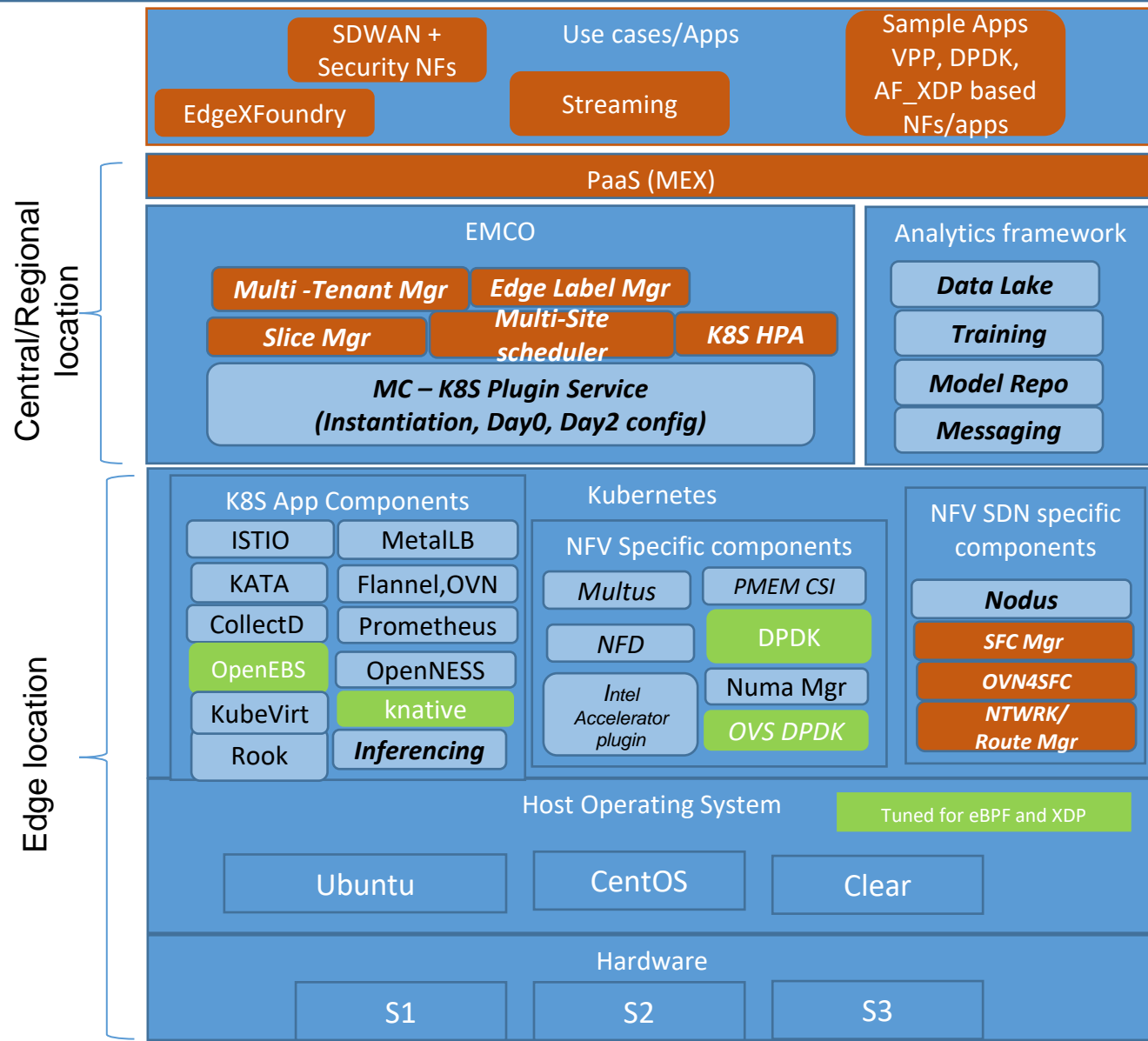
- A reference architecture/integration initiative targeting edge computing use cases
- Approved (incubation phase) as a 'blueprint' family within the Akraino project (LF)
- ICN Family has two blueprints
 - Multi-server Integrated Cloud Native NFV/App stack
 - Private LTE/5G
- Lead ICN use case is SD-EWAN, Distributed Cloud Manager, Distributed Analytics as a Service; IOT framework - EdgeXFoundry, Video CDN & Streaming to follow
- ICN Family has 16 Partners:
 - Verizon, VMWare, Dell, Orange, Airbus, T-Mobile US, Juniper Networks, Cloudlyte – Tata Communications, MobileEdgeX, Aarna Networks...
- Intel-optimized ingredients include OpenNESS, EdgeX, SRIOV, QAT, CSI/Optane, K8s HPA, etc.
- Highly dependent on Intel's upstream enabling

ICN

Infrastructure Orchestration Architecture



ICN Stack

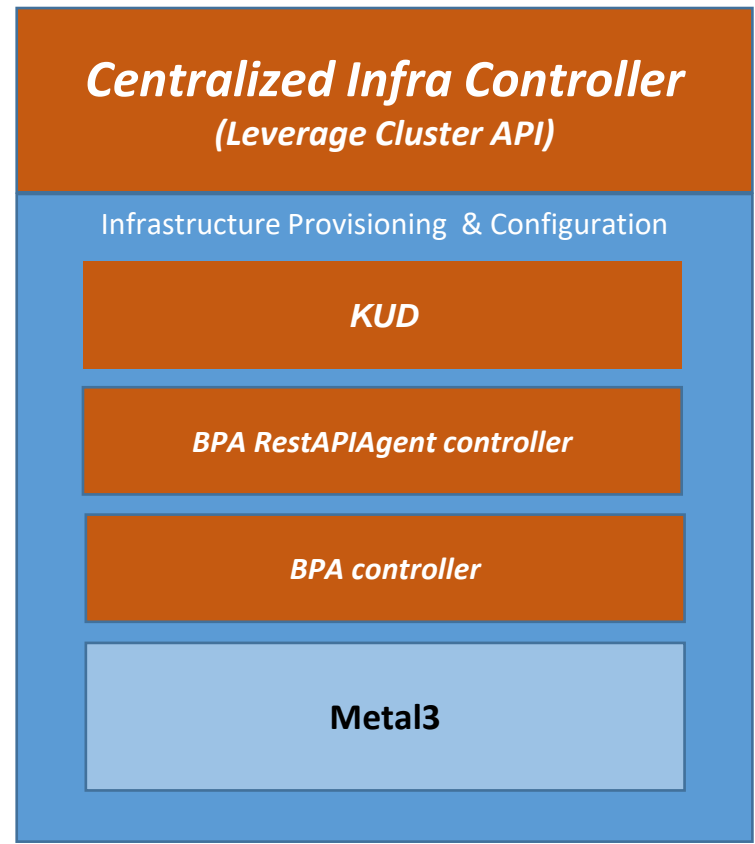


Upstream communities: ONAP, OPNFV, Many CNCF projects, EdgeXFoundry, FD.IO, DPDK, Linux, Openstack Ironic, OVS, Many ASF projects, OpenNESS, Intel Open Source

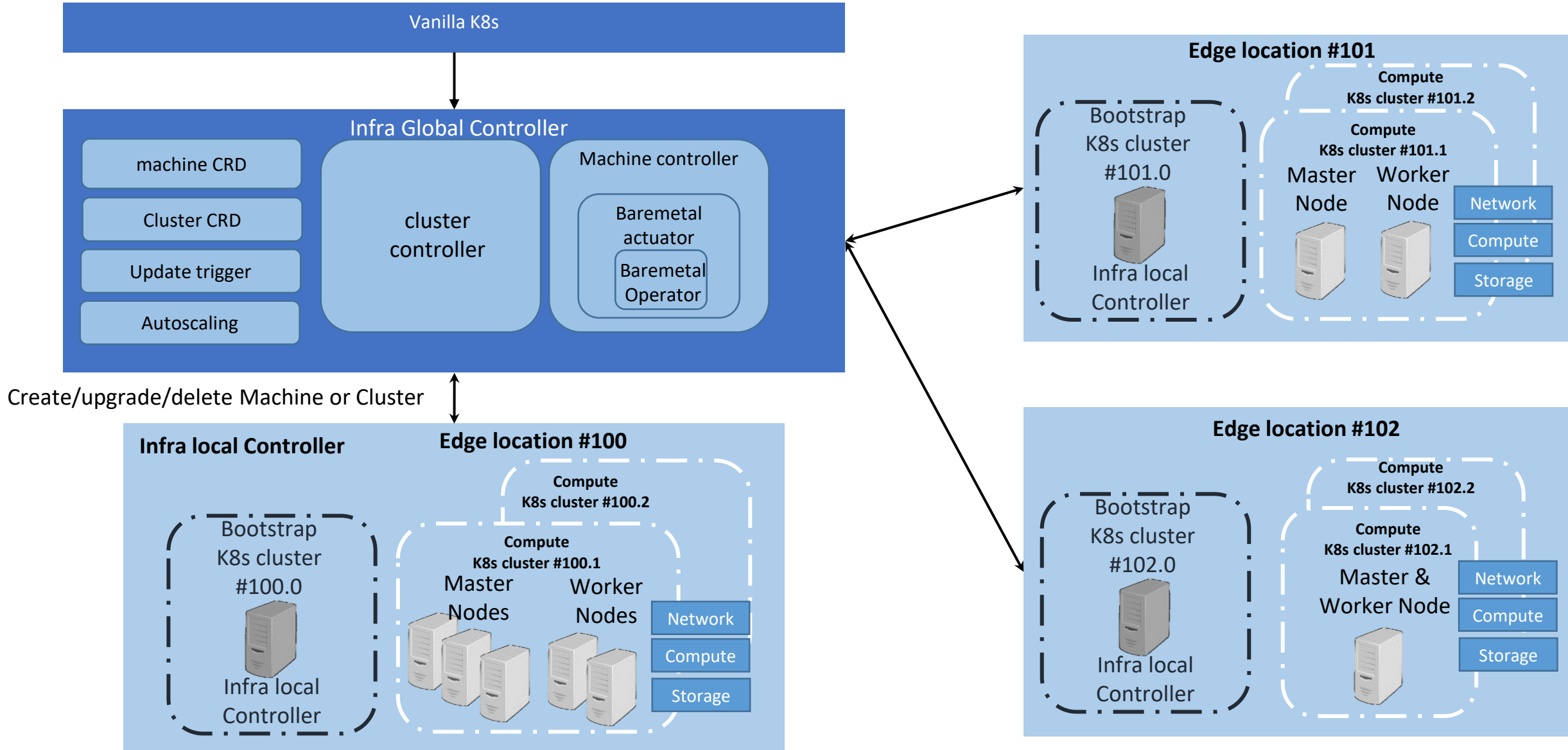
Existing Open source, Major enhancement, work with upstream

Open source projects with ICN Enhancement

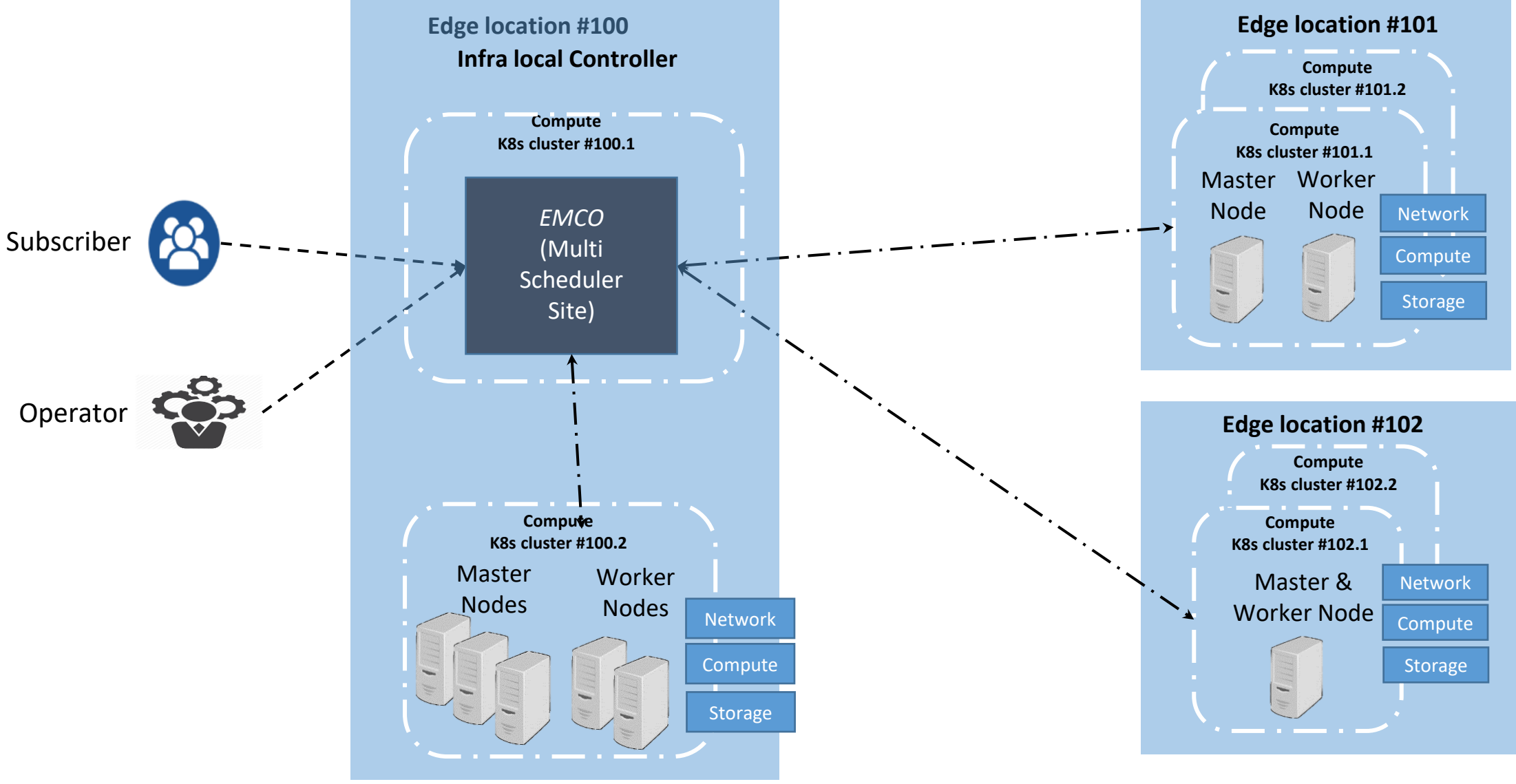
Open source projects in ICN roadmap for the inclusion



ICN Infrastructure – Bird's eye view

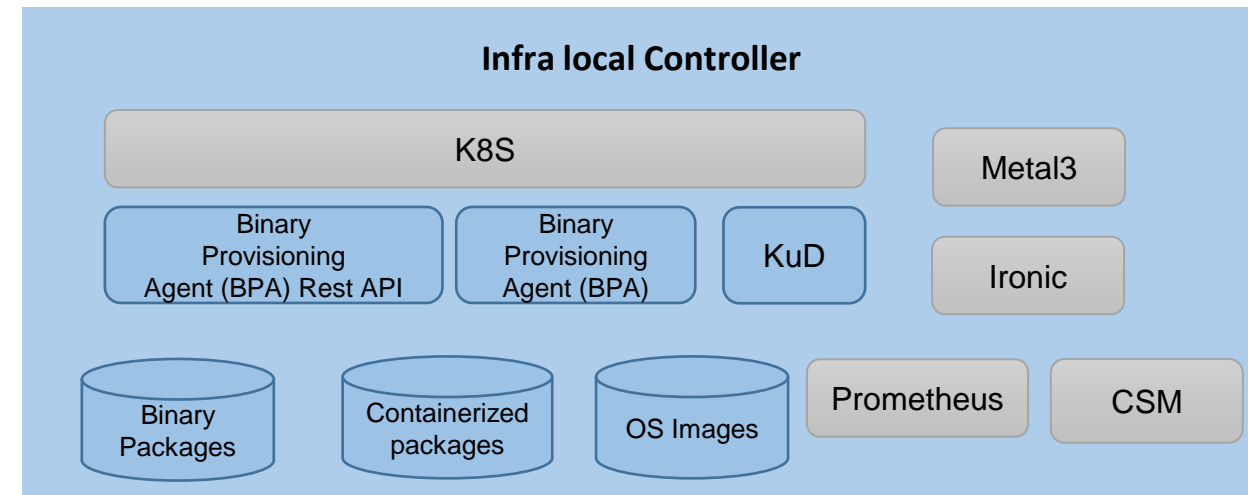
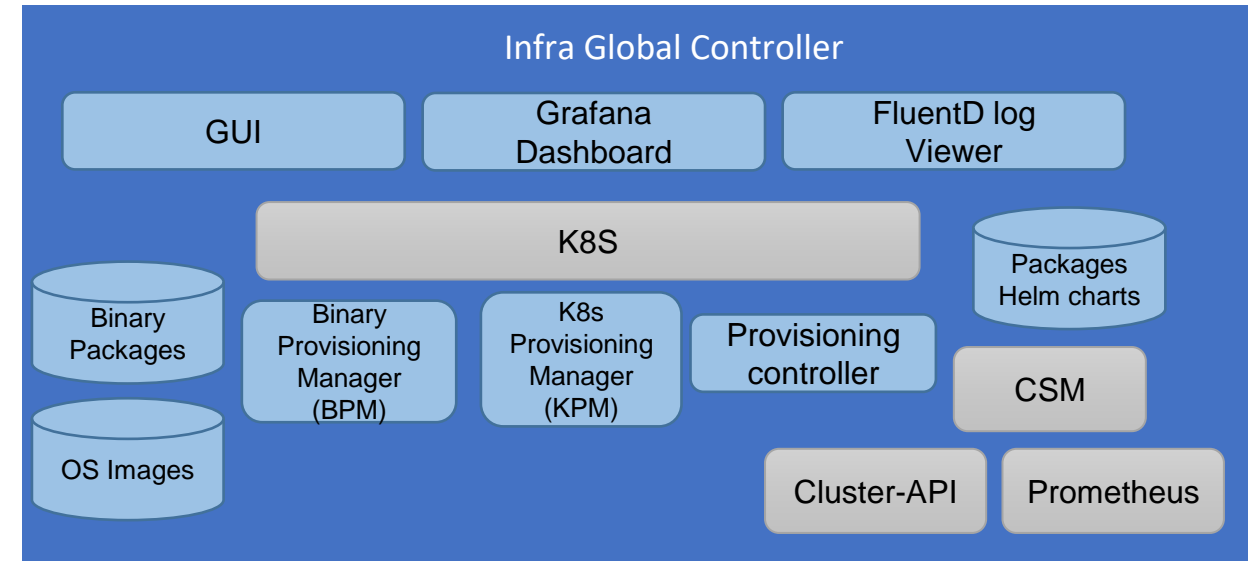


ICN Infrastructure within Infra local controller

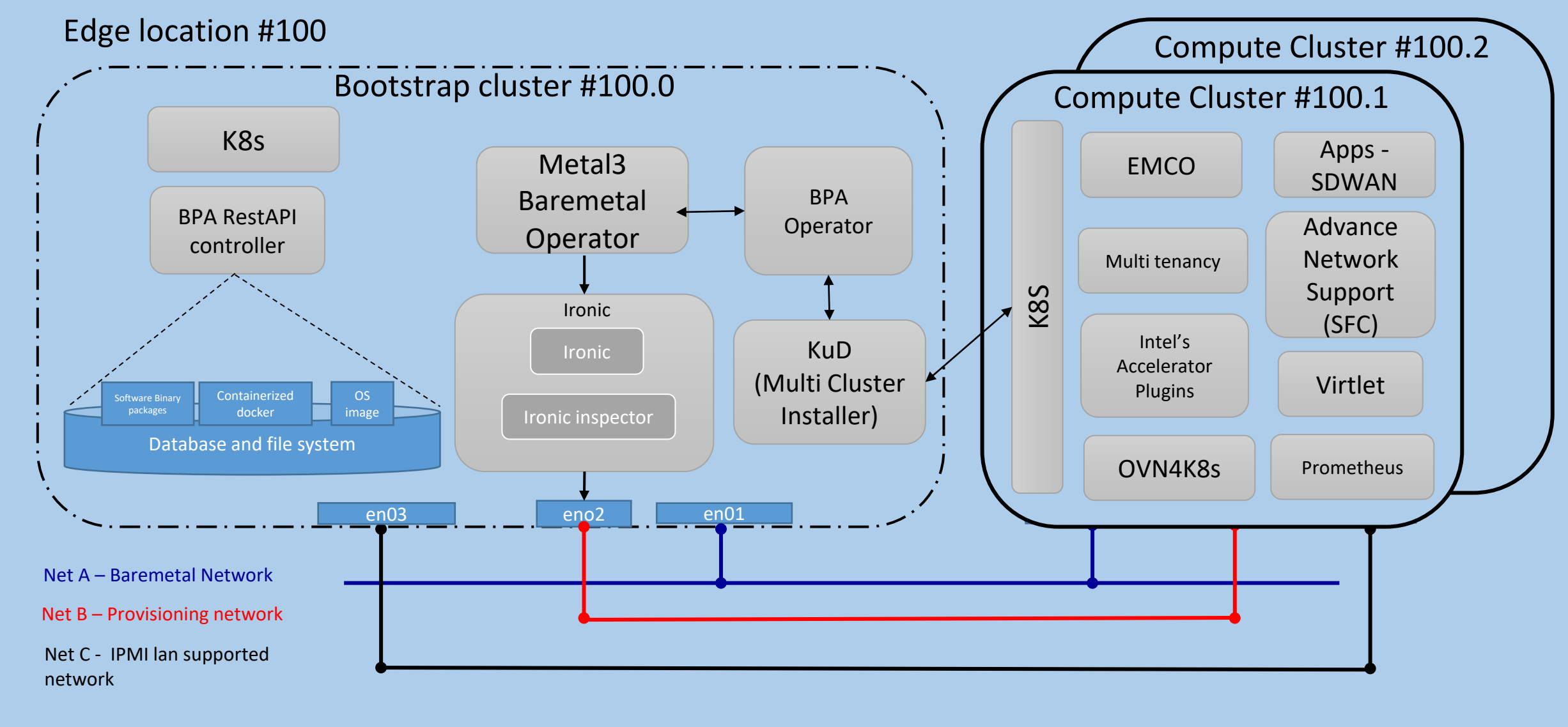


ICN Blocks and Modules

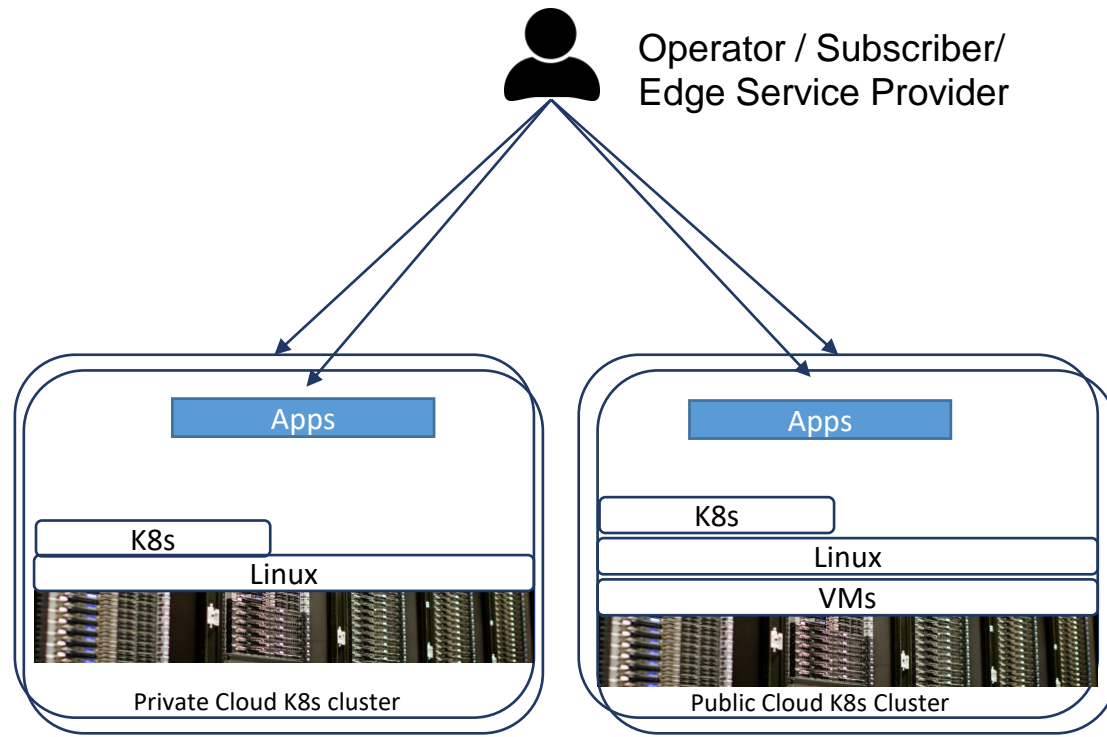
- › Infra global controller
 - › Centralized Software Provisioning and configuration system
 - › Provides one single-pane-of-glass for administrating the edge locations with respect to infrastructure
 - › A reference architecture/integration initiative targeting edge computing use cases
- › Infra local controller
 - › Expected to run on each bootstrap machine/jump servers
 - › It has it own K8s cluster to bring up the edge compute cluster, where the workload are running
 - › Simple to bring up as USB bootable disk or as KVM/QEMU virtual machine image
 - › Can run without infra global controller as a separate entity to bring up the Compute cluster.



ICN Infrastructure– Infra local controller



Traditional Cloud Native frameworks For Enterprise applications



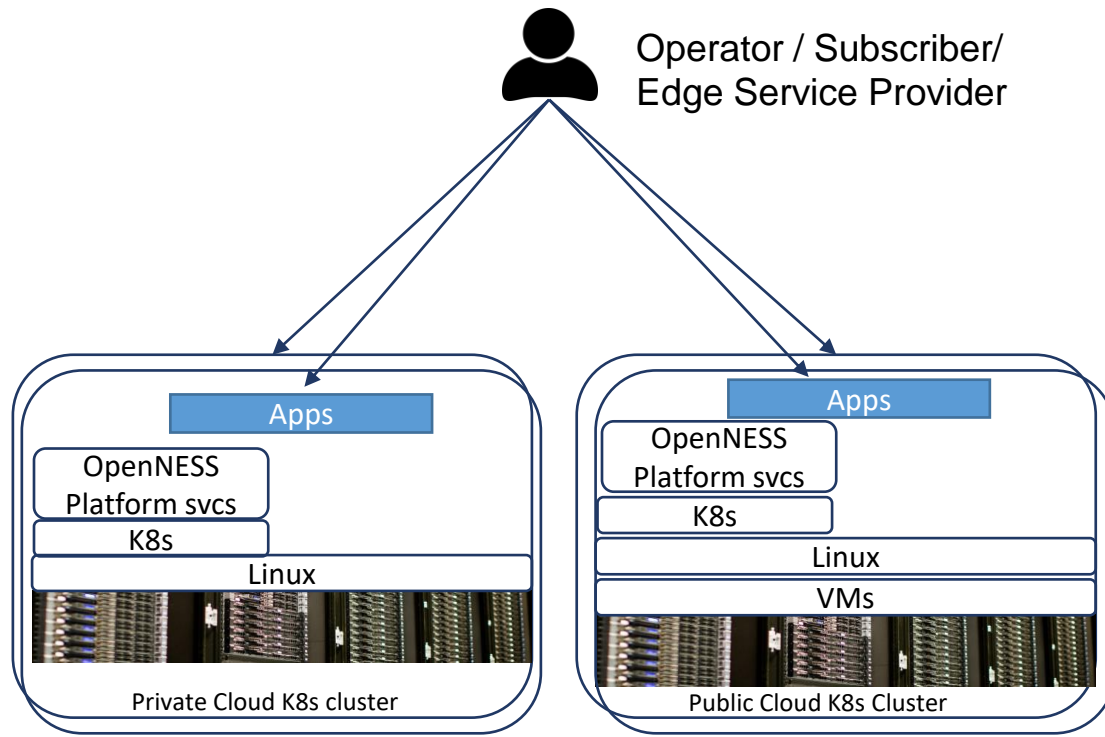
Traditionally

- Number of K8s clusters are small
- K8s Cluster installation/upgrades are mostly done independently in each location.
- Deployment of applications on K8s clusters is also done independently.
- K8s clusters are used for normal applications
- Network and security functions are deployed outside of K8s clusters as physical appliances or virtual appliances

Today K8s Clusters are not meant for Network functions and Telcos. Need for Telco grade platform.
Let us see the needs

Need: High performance applications

Low latency, Deterministic performance & high throughput



High performance applications requirement

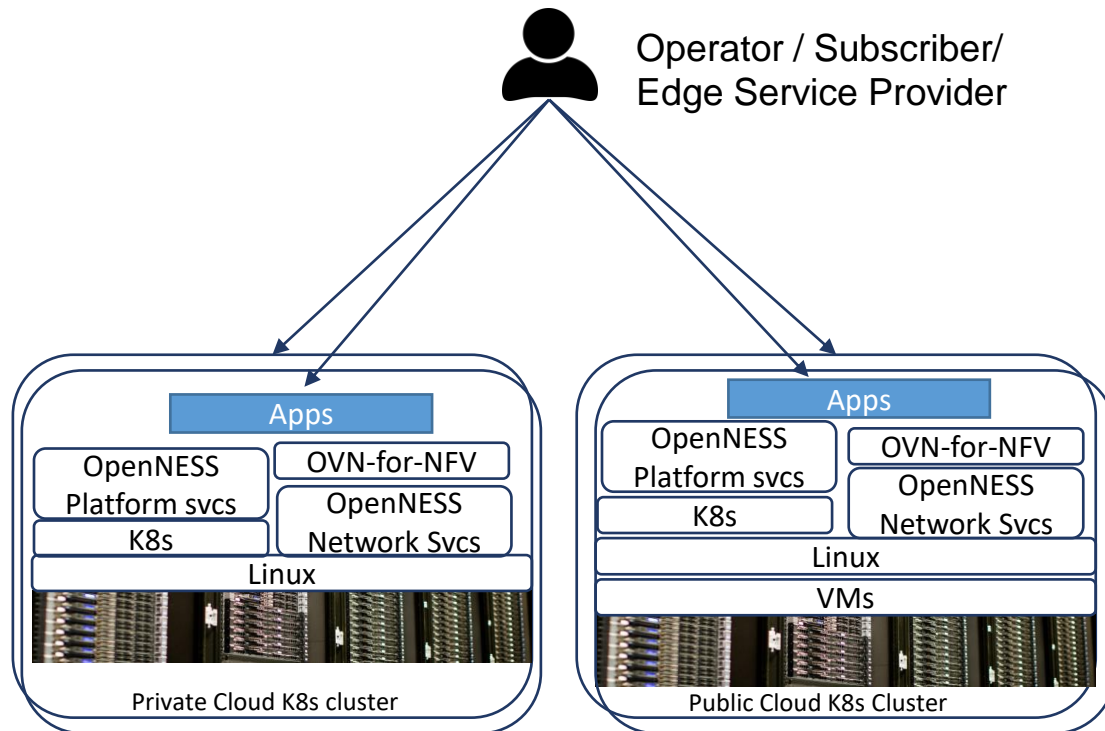
- *Dedicate cores*
- *Core affinity*
- *L3 Cache allocation*
- *NUMA aware placement*
- *Dedicating Memory bandwidth*

Intel ICN solution

- OpenNESS platform micro-services
 - CMK for core affinity/dedication.
 - Topology manager for NUMA aware placement
 - KPI aware scheduling
 - RDT configuration

Need: Cloud Native network functions

Resource constrained Edges, Data plane NF (such as UPF, firewall, RAN) support
Separate Management Interface



Network function requirements

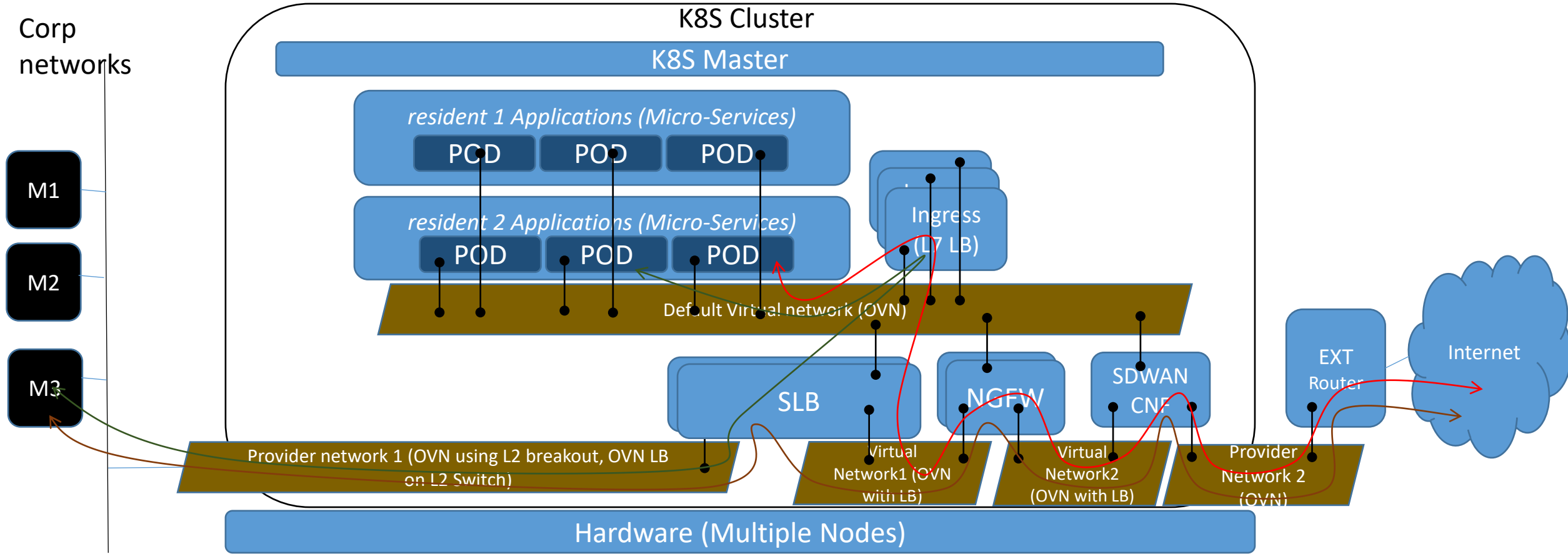
- *SRIOV-NIC support*
- *Multiple CNIs*
- *Multiple virtual networks*
- *Provider network support*
- *Service function chaining*
- *Some cases, attaching GPU and FPGA based accelerators.*
- *Platform feature exposure*

Intel ICN solution:

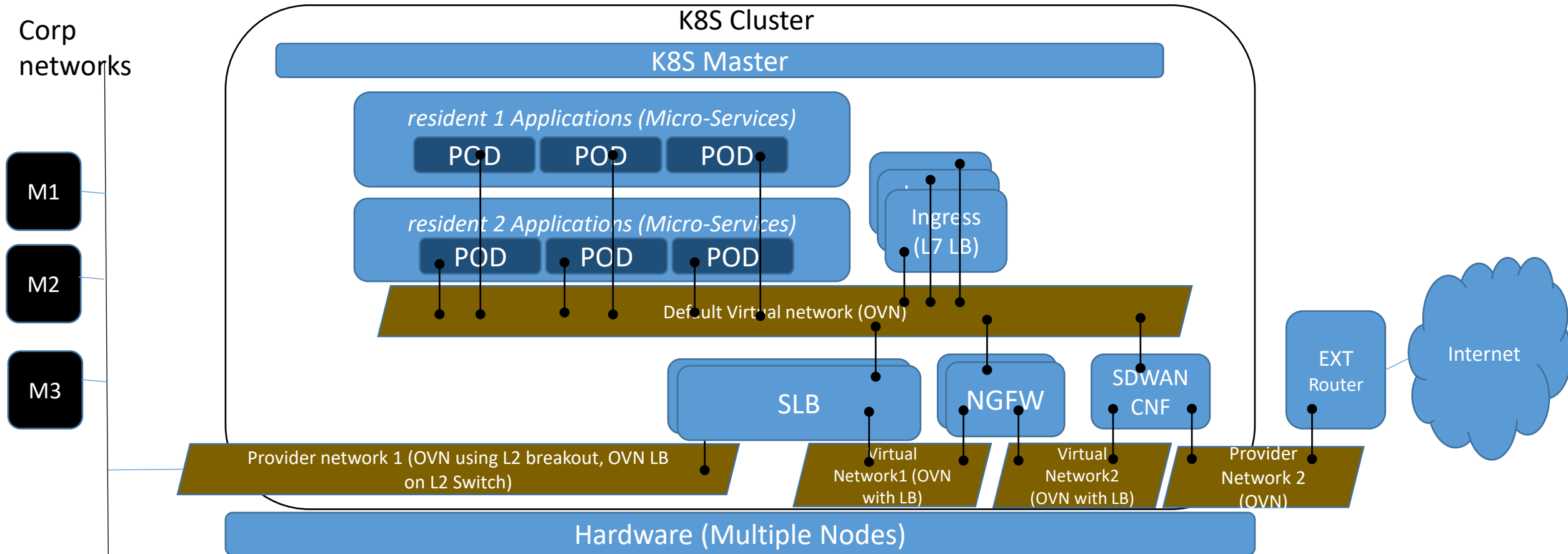
- **OpenNESS Network Services**
 - SRIOV-NIC device plugin/CNI
 - FPGA Device service.
 - Multus for Multiple CNI support
 - NFD
- **OVN-for-K8s-NFV Network Controller:**
 - For Multiple virtual networks, Provider networks & Service function chaining

How does NFV based deployment with Cloud Native network functions look like ? (Taking SDWAN with security NFs as an example)

[View in Slide show](#)



NFV based deployment with Cloud Native network functions requirements



Feature Reqmts	Dynamic virtual Networks	Provider networks	Multiple interfaces	Network function chaining	Network function load balancing
Implementation Consideration	No changes to NFs	No changes to Apps	Configuration via operators	OVN based SRIOV Overlays	Smart NIC friendly & AF_XDP for packet processing NFs

OVN4NFV: <https://gerrit.opnfv.org/gerrit/admin/repos/ovn4nfv-k8s-plugin>

Need: Geo-Distributed Application (Such as 5GRAN, 5GC) Life Cycle management For geo-distributed applications across multiple K8s clusters



Operator / Subscriber

Deploy & Manage Apps - EMCO

Onboard

Deploy

Visibility



Edge Service Provider

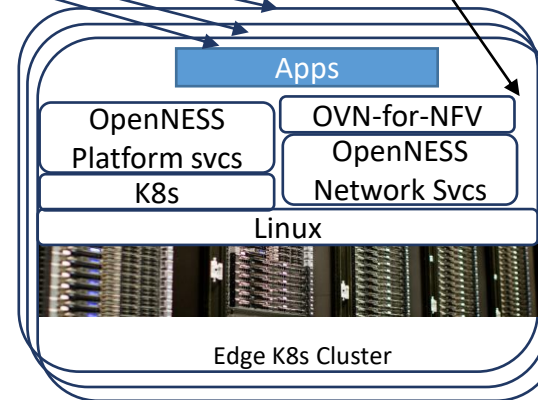
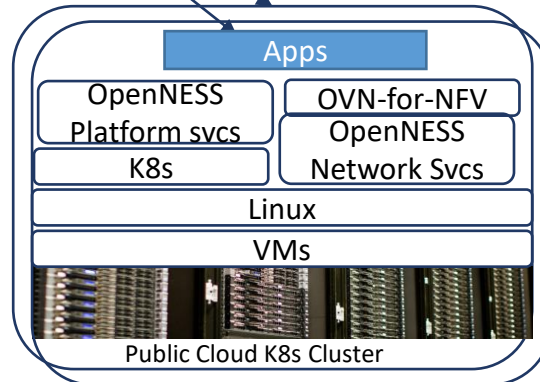
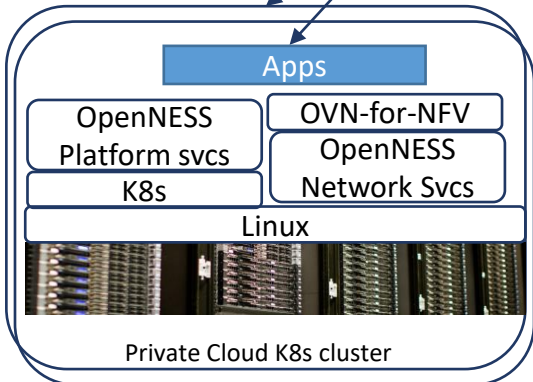
Infrastructure
Orchestrator

Distributed Application
deployment and visibility

- Simplify
- Geo distribution

Intel ICN solution:

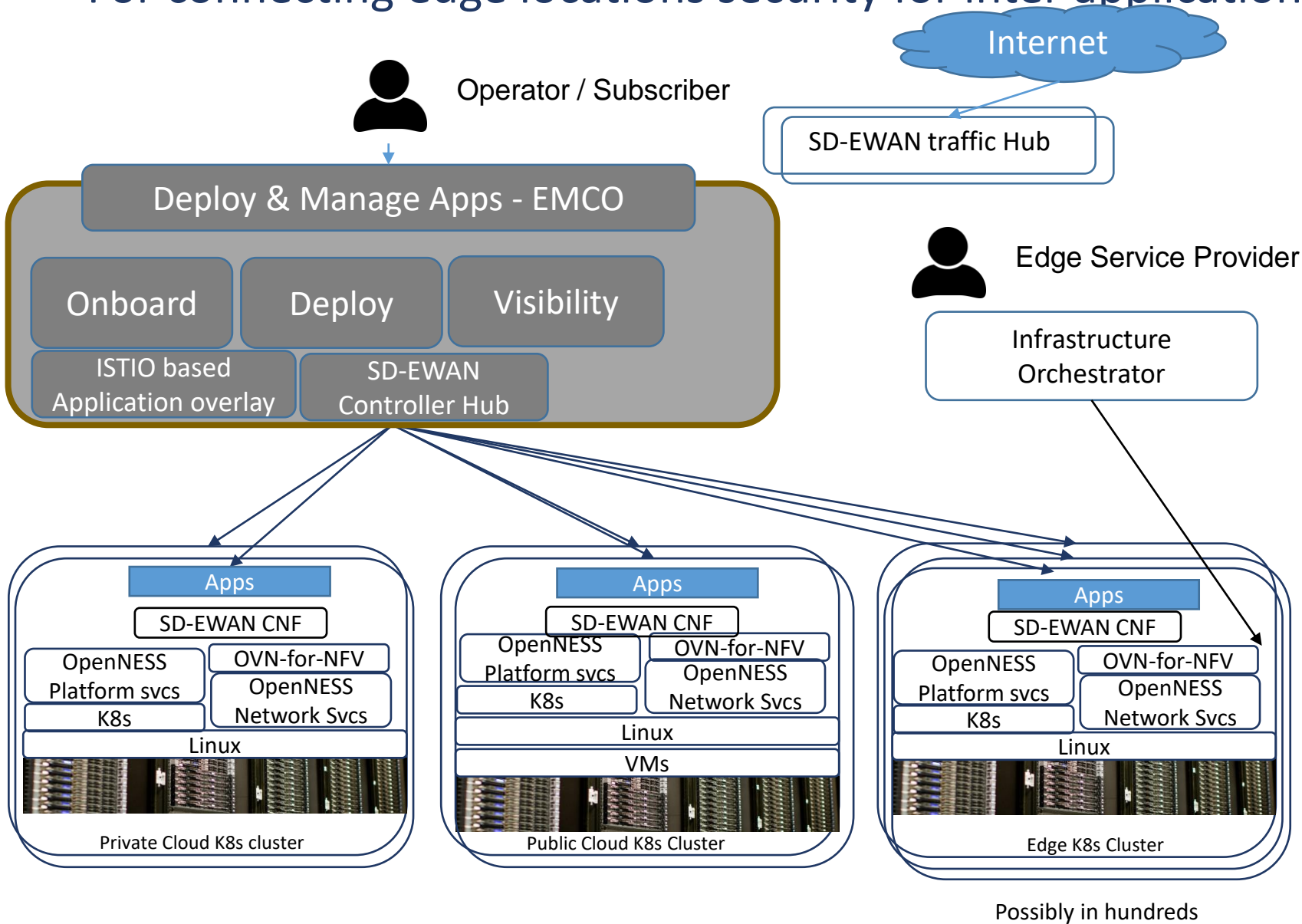
- EMCO
 - Onboarding of composite applications
 - Deployment intent
 - Configure ISTIO and security of edges automatically
 - Comprehensive visibility across clusters



Possibly in hundreds

Need: Secure Overlay

For connecting edge locations security for inter application traffic

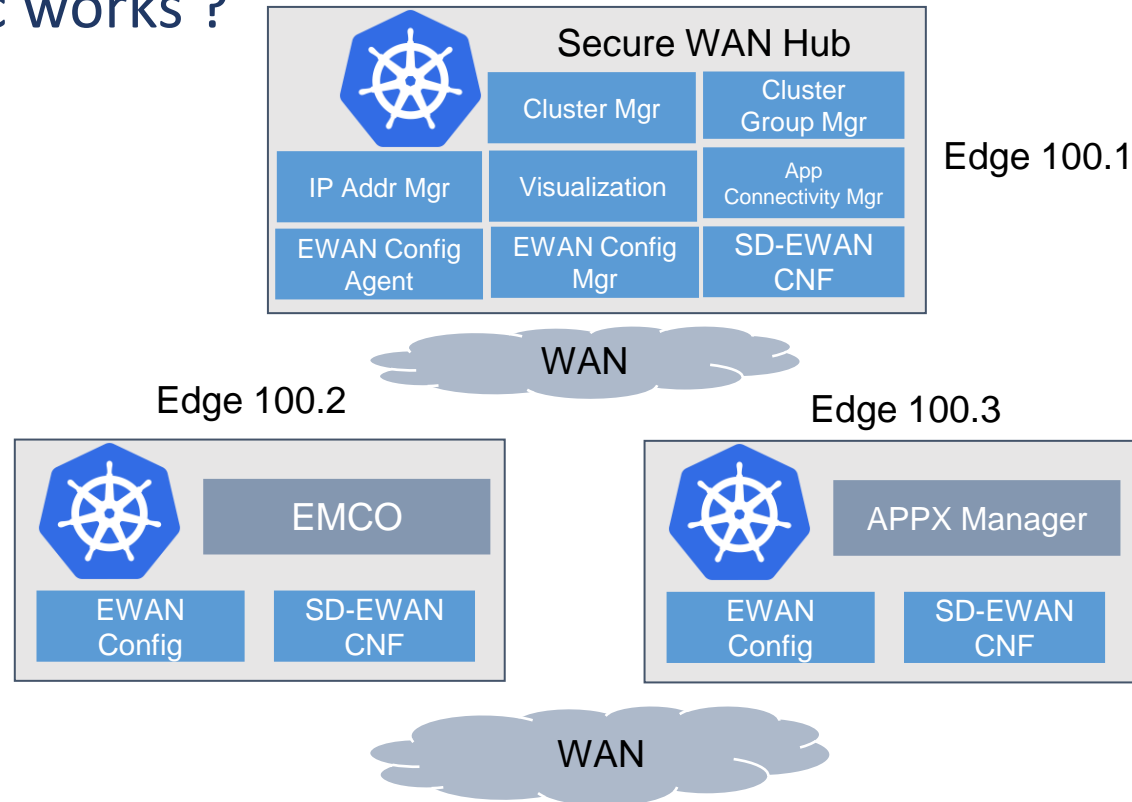


Unique Edge challenges (No public IP, Less bandwidth links, Prone to DDOS attacks) and the need for overlay

Intel ICN solution:

- SD-EWAN
 - OpenWrt based
 - CNF
 - Cloud native configuration
 - Traffic Hub for traffic sanitization
 - Controller Hub to create security and WAN policies dynamically
 - FW+NAT+DPI+IPSEC+SLB
- ISTIO/Envoy based Application overlay
 - Automation of ISTIO (Ingress, egress & SC) across edges for microservice connectivity

How the Secure Overlay For connecting edge locations security for inter application traffic works ?



SD-EWAN

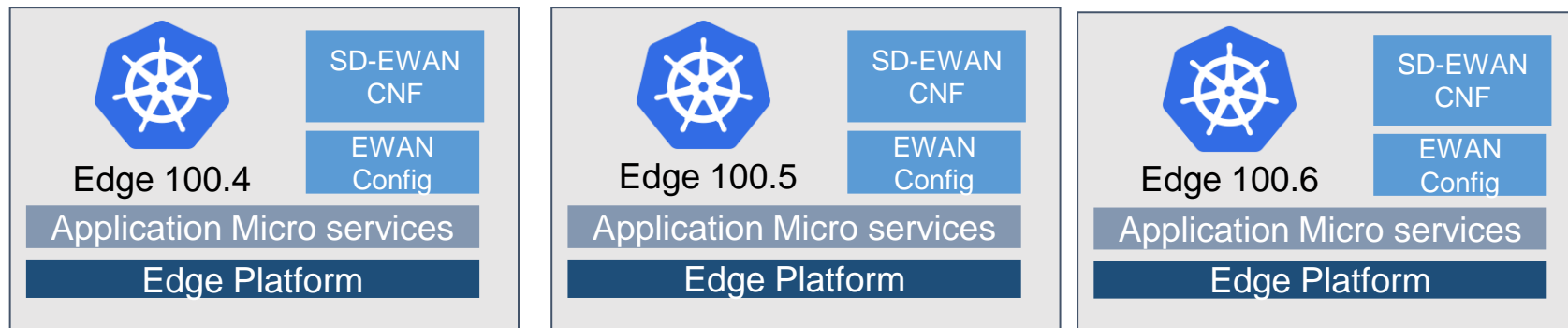
- Open WRT based SE-DWAN CNFS
- Cloud Native based SD-EWAN controller and IPsec controller
- Zero touch automation
- Solution to all Edge Challenges identified
- Centralization controller for configuration
- Traffic Hub for sanitization

Advantages

- No changes to application Micro services and configuring Edges
- Supporting both green field and brownfield requirements
- Work with third party SD-WAN VNFs (future roadmap)

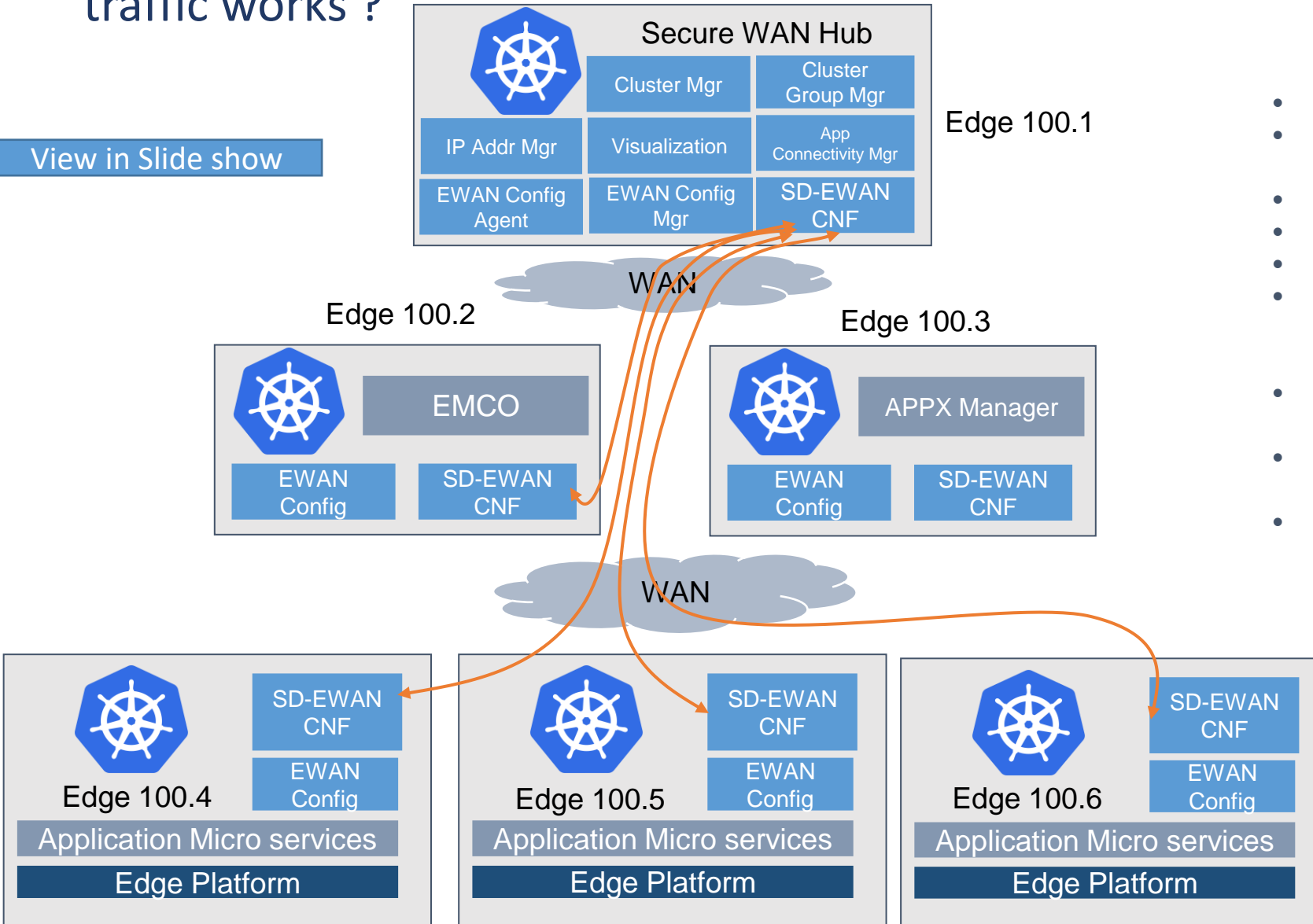
Refer

Repo: <https://gerrit.akraino.org/r/admin/repos/icon/sdwan>



How the Secure Overlay For connecting edge locations security for inter application traffic works ?

View in Slide show



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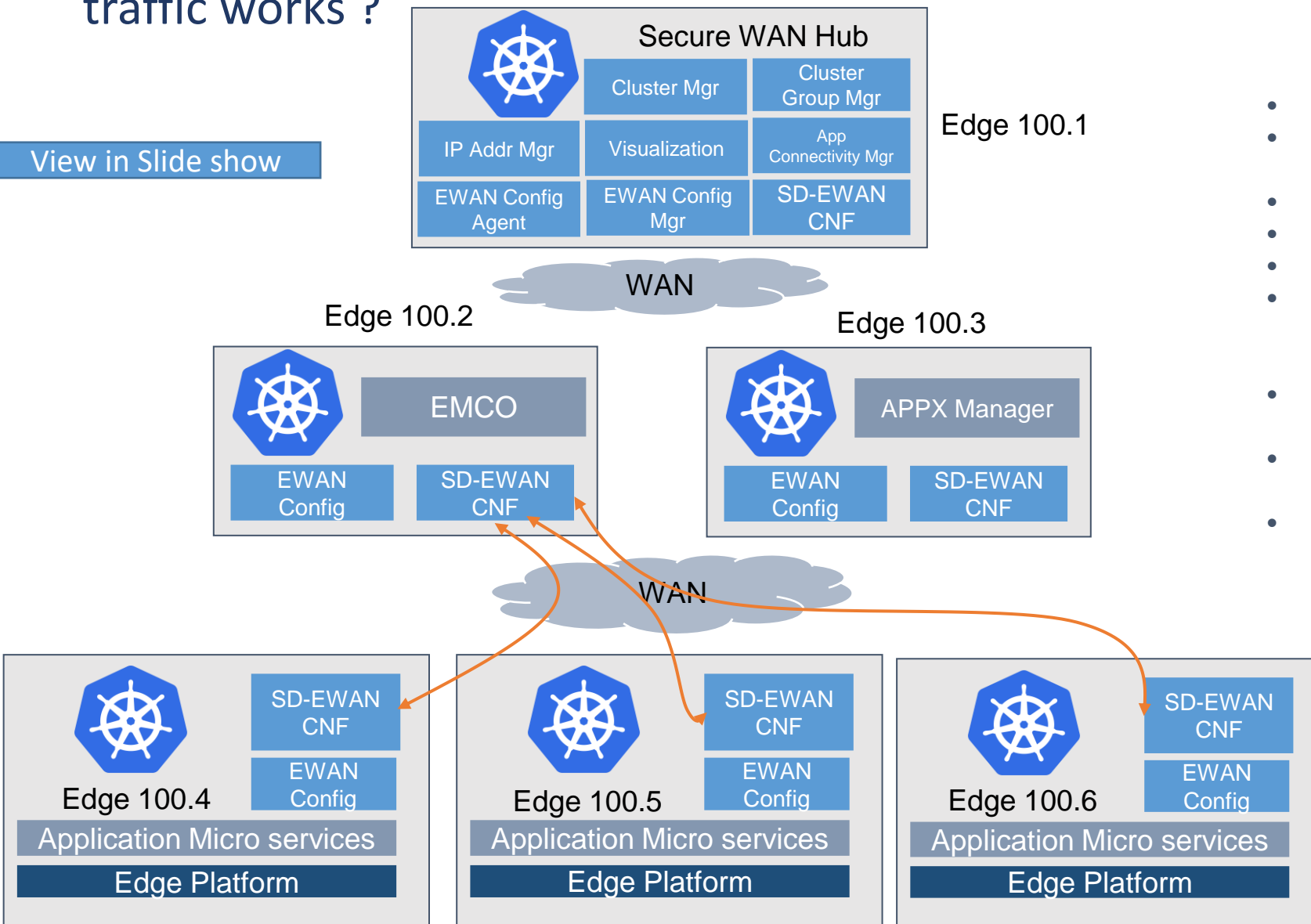
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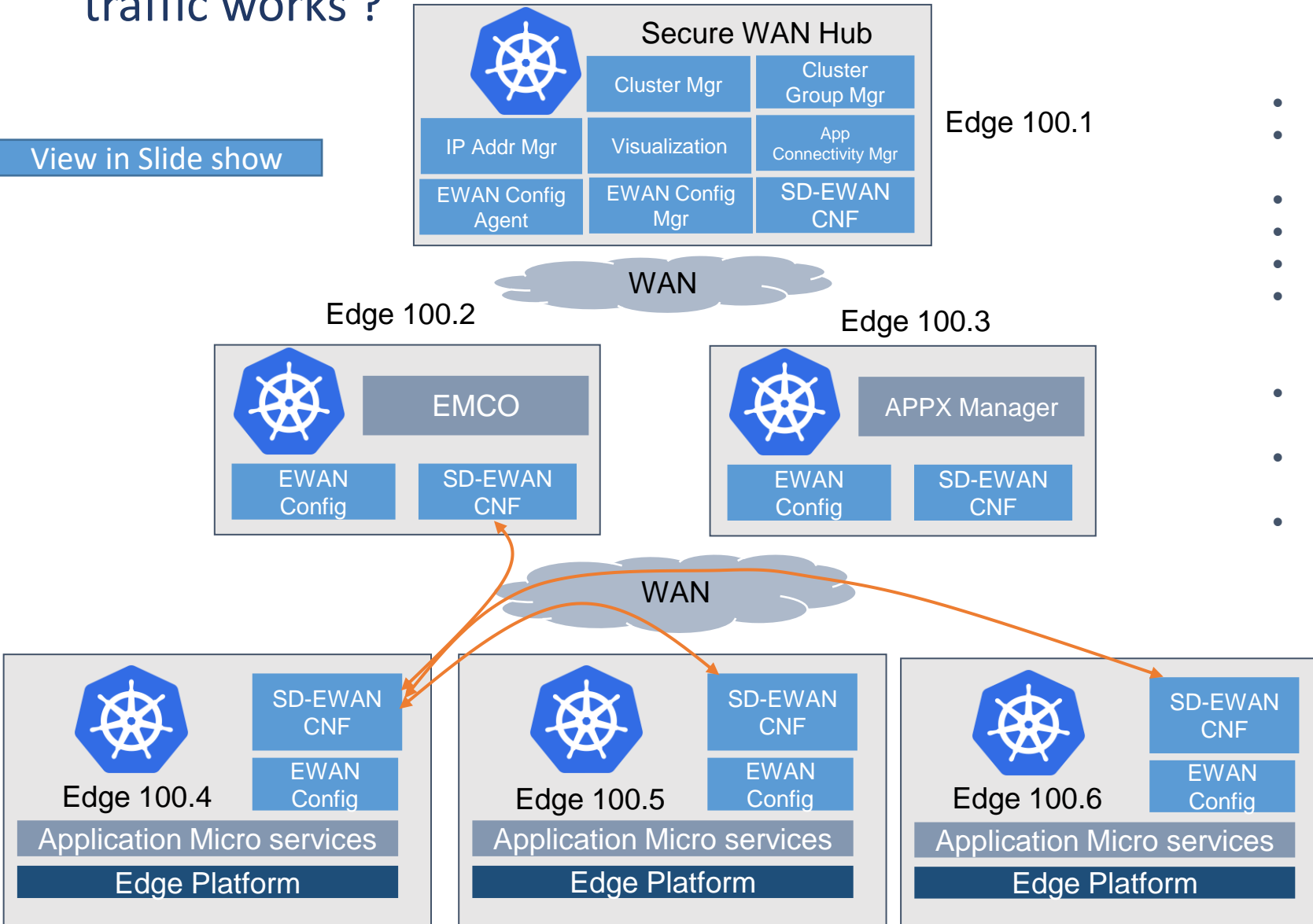
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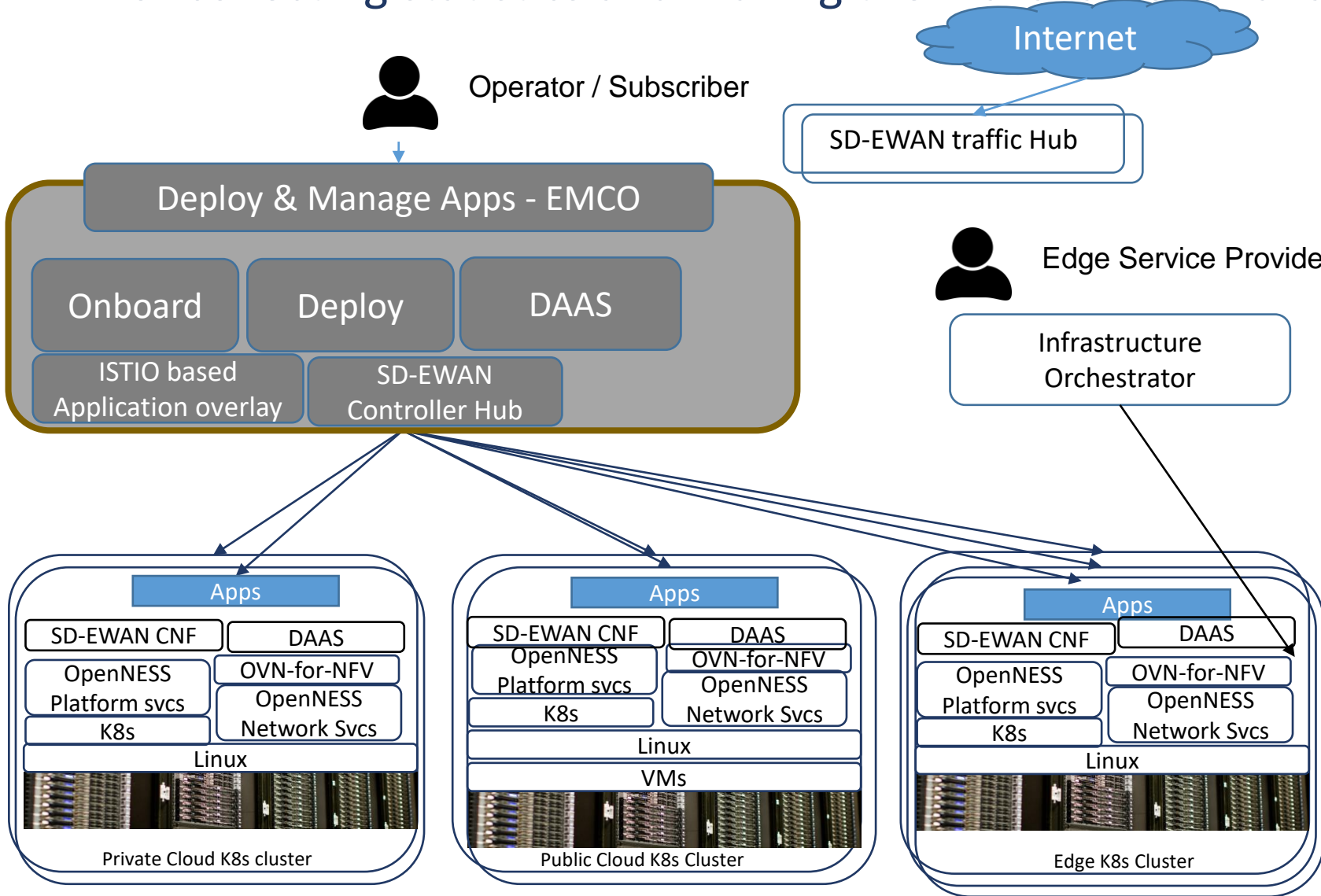
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Need: Analytics

For collecting statistics and making them available for analysis & closed loops



- Local collection agents
- Local inferencing and closed loop
- Centralized metrics collection
- Training
- Model Reps
- Policy based Analytics
- Rule Synchronizer

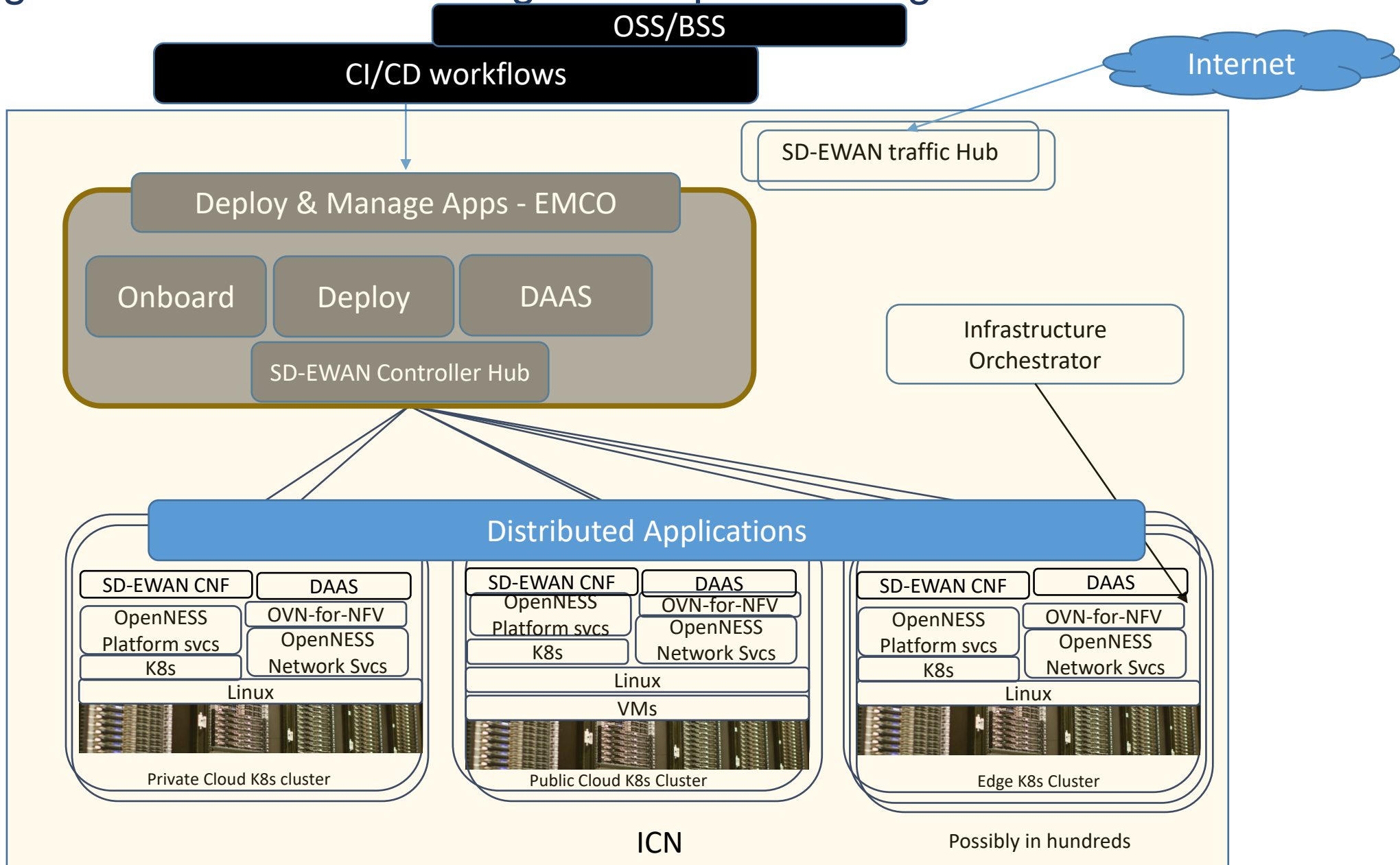
Intel ICN solution:

- Distributed AI Analytics
 - CollectD, Prometheus
 - Grafana
 - M3DB for central collection
 - Spark & TF for training
 - Kafka for distribution
 - Minio for storage
- Flexibility to deploy various pieces at various locations.

Possibly in hundreds

MICN

Integrated Platform combining all components together



ICN Recipe

Intel led LFN / LFE Efforts

Multi Edge/Cloud Orchestrator
– **EMCO**
(IA Aware)

Cloud Native Edge WAN
function
SD-EWAN (IA Optimized)

OVN based CNI : **OVN-for-K8s-NFV**
(IA friendly)

Infrastructure Orchestration :
BPA
(IA enablement)

Distributed AI Analytics Stack : **DAAS**
(IA optimized)

OpenNESS toolkit

5G UPF, AF, NEF
(IA Optimized)

MEC type service
discovery
(IA Optimized)

Topology, CPU Manager,
NFD
(IA aware)

OpenVINO
(IA Optimized)

IA platform device plugins
(SRIOV-NIC, QAT, FPGA)

CNIs (Multus, SRIOV-
NIC, OVS-DPDK)

Cloud Native industry Open Source projects

K8s

ISTIO

Prometheus

Virtlet/
Kubevirt

Collect
D

Envoy

Ceph/
Rook

FluentD

- **ICN is an excellent starting point for Cloud native Telco grade PaaS**
- **Far better than a generic baseline**
- **But with modular extensions and services that can be built upon in Telco , Enterprise and IOT uses cases**
- **ICN is complete End2End platform – All SW and HW necessary for Edge Service Providers and Telcos that require deployment of CNFs, VNFs, CNAs and all working together.**

Integration
Validation
Platforms
w/ XEON-SP, OS
Use cases (uCPE, 5G
RAN, 5GC, AI, Vision,
IoT)

ICN BPs
Integrated Cloud Native
Edge SW platforms for
Enterprises, IoT and Telco
markets

Refer

ICN: <https://gerrit.akraino.org/r/admin/repos/icn>
 EMCO: <https://gerrit.onap.org/r/admin/repos/multicloud/k8s>
 OVN4NFV: <https://gerrit.opnfv.org/gerrit/admin/repos/ovn4nfv-k8s-plugin>
 SD-EWAN: <https://gerrit.akraino.org/r/admin/repos/icn/sdwan>
 DAAS: <https://gerrit.akraino.org/r/admin/repos/icn/daaas>

Openness: <https://github.com/openness/specs/blob/master/doc/architecture.md>

Features in ICN R5 Release

- SDEWAN and IPsec controller, SDEWAN HUB
 - More Flexibility and more controllers for Mwan3, Firewall, SNAT/DNAT and IPsec
- Logical Cloud in edge location by EMCO
 - Multi – tenancy provider through service orchestration
- ICN Customer Readiness
 - ICN
 - User configuration for Network interfaces
 - Reduction in network requirement for Ironic in Baremetal
 - EMCO as the infrastructure deployer for KUD
 - All Kubernetes addons will be deployed through EMCO
 - Nodus
 - Multus
 - Kubevirt
 - NFD(Node Feature Discovery)
 - SRIOV Device plugins
 - QAT Device Plugins
 - Topology Managers
- Nodus as Network plugin in Kubespray & Service Function Chaining (SFC) using Nodus in ICN
 - Service Function chaining in Nodus primary network
 - Support Multiple network Service Function chaining as well

Upcoming features in ICN R6 Release

- ICN Storage
 - OpenEBS cStore, JIVA
 - Mayastor - Intel IA acceleration with SDPK
- ICN Customer Readiness
 - ClusterAPI support in ICN R6
 - EMCO as the Infrastructure deployer for the Infra local controller
- Nodus
 - Network Policy with OVN ACLs
 - Kube-proxy is replaced with OVN Load Balancer controller for higher performance
 - IPV6 support in Nodus
- More device plugin integration to meet high performance workloads based on GPU, FGPA
- SDEWAN and IPsec controller, SDEWAN HUB
 - SDEWAN Overlay controller
 - Optimization with Intel IA accelerators (QAT, AES-NI)
 - Intel SGX(Software Guar Extensions)

Call for Action

- Try it yourself !!
 - <https://wiki.akraino.org/display/AK/ICN+Installation+Guide>
- What to be a ICN contributor – Please sign up here with LF ID !!
 - <https://wiki.akraino.org/x/BAi3>
- Missing Features or bug ? – create an issue here !!
 - <https://jira.akraino.org/projects/ICN/issues>
- Talk to us regarding your Edge use cases in Akraino ICN slack
 - Invite yourself - <https://akraino-icn-admin.herokuapp.com/>

Q&A