Multi-server Integrated Cloud Native NFV/App stack
ICN Blueprint Family
Goal: Is to have end-to-end Cloud native platform

R4 Overview
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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
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

Operator / Subscriber/ Edge Service Provider

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)
NFV based deployment with Cloud Native network functions requirements

- **K8S Cluster**
  - **K8S Master**
  - **resident 1 Applications (Micro-Services)**
    - PCD
    - POD
    - POD
  - **resident 2 Applications (Micro-Services)**
    - POD
    - POD
    - POD
  - **Default Virtual network (OVN)**
  - **Provider network 1 (OVN using L2 breakout, OVN LB on L2 Switch)**
  - **Provider network 2 (OVN)**
  - **Virtual Network1 (OVN with LB)**
  - **Virtual Network2 (OVN with LB)**
  - **SLB**
  - **NGFW**
  - **SDWAN CNF**
  - **Ingress (L7 LB)**

- **Corp networks**
  - M1
  - M2
  - M3

- **Hardware (Multiple Nodes)**
  - **Internet**
  - **EXT Router**

- **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: Support for Large number of Edges
Simplify cluster life cycle management

Large number of Edge Cluster
- Install, upgrade/patch and terminate are complex operations

Intel ICN solution
- Infrastructure orchestration (infra-local-controller) based on ClusterAPI, Metal3 and Ironic.

ICN Infra local controllers: https://gerrit.akraino.org/r/admin/repos/icn
Need: Geo-Distributed Application (Such as 5GRAN, 5GC) Life Cycle management
For geo-distributed applications across multiple K8s clusters

- 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
How does the geo-distributed applications across multiple K8s clusters with logical cloud features in EMCO

- User creation
- Logical cloud creation based on cluster-labels
- Istio control plane per logical cloud
- Instance creation with respect to logical cloud
- Isolate microservice with respect to logical cloud and users

EMCO: https://gerrit.onap.org/r/admin/repos/multicloud/k8s
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/ecn/sdwan](https://gerrit.akraino.org/r/admin/repos/ecn/sdwan)

**View in Slide show**

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**Application Micro services**
- Edge Platform

**Secure WAN Hub**
- Cluster Mgr
- Cluster Group Mgr
- App Connectivity Mgr
- EWAN Config
- EWAN Mgr
- SD-EWAN CNF
- IP Addr Mgr
- Visualization

**Edge 100.1**

**Edge 100.2**

**Edge 100.3**

**Edge 100.4**

**Edge 100.5**

**Edge 100.6**
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Repo: https://gerrit.akraino.org/r/admin/repos/in/sdwan
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Refer

Repo: https://gerrit.akraino.org/r/admin/repos/ecn/sdwan
Need: Analytics
For collecting statistics and making them available for analysis & closed loops

Deploy & Manage Apps - EMCO

Onboard  Deploy  DAAS

ISTIO based Application overlay  SD-EWAN Controller Hub

Apps
SD-EWAN CNF  DAAS
OpenNESS Platform svcs  OVN-for-NFV
K8s  OpenNESS Network Svcs
Linux
Private Cloud K8s cluster

Apps
SD-EWAN CNF  DAAS
OpenNESS Platform svcs  OVN-for-NFV
K8s  OpenNESS Network Svcs
Linux  VMs
Public Cloud K8s Cluster

Apps
SD-EWAN CNF  DAAS
OpenNESS Platform svcs  OVN-for-NFV
K8s  OpenNESS Network Svcs
Linux
Edge K8s Cluster
Possibly in hundreds

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.
MICN
Integrated Platform combining all components together

OSS/BSS
CI/CD workflows

Deploy & Manage Apps - EMCO
Onboard
Deploy
DAAS
SD-EWAN Controller Hub

Distributed Applications
SD-EWAN CNF
DAAS
OpenNESS Platform svc
K8s
OVPN-for-NFV
OpenNESS Platform svc
K8s
Linux
VMs
Private Cloud K8s cluster
Public Cloud K8s Cluster

SD-EWAN traffic Hub
Infrastructure Orchestrator

Possibly in hundreds

Internet
**ICN Recipe**

- **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.**

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

Refer

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

Upcoming features in ICN R4 Release

- SDEWAN and IPSec controller, SDEWAN HUB
  - More Flexibility and more controllers for MWAN3, Firewall, SNAT/DNAT and IPSec
- Optimization with Intel IA accelerators (QAT, AES-NI)
- Logical Cloud in edge location by EMCO
  - Multi-tenancy provider through service orchestration
- ICN Customer Readiness – Ansible operator for KUD
- OVN4NFV as Network plugin in Kubespray & Service Function Chaining (SFC) using OVN4NFV in ICN
- More device plugin integration to meet high performance workloads based on GPU, FPGA
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