End2End NFV & Application Stack
With Kubernetes & ONAP4K8S
(Support for VNFs and CNFs along with applications)

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Agenda

• Background:
• Needs of E2E stack
• Cloud native end-to-end NFV stack – One opinionated stack
  • And corresponding Open source projects
• Q&A
An App consisting of four Micro-services
μS1 talks to μS2, μS2 to μS3 and μS3 to μS4
μS1” is user facing service
“μS1”, “μS2” are expected to be there together
“μS2” is stateful and hence need to talk to each other

Figure x: Centralized computing to distributed computing
Edge/Site transformation
(to single resource orchestrator for all types)

Two different resource orchestrators
Compute nodes are divided

- K8S for VNFs, CNFs, Micro-Services and functions
Enterprise Edge with SDWAN scenario

Central Orchestration, Analytics and Closed loop control

AR/VR Services
Media Analytics
MEC Services
Training
MEC Services
AR/VR Services

Security VNF
WAN Opt CNF SDWAN VNF
Operator slice

Advanced network services (e.g. DLP)
Network Edge
Cloud
Advanced network services (e.g. DLP)
Network Edge

ISP A
ISP X
ISP B
ISP Y

Tunnel
CoSP / Internet

Subscriber Edge1

Network Edge

Advanced network services (e.g. DLP)

AR/VR Services
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ISPs:
- ISP A
- ISP B
- ISP X
- ISP Y
- CoSP / Internet
- Subscriber Edge1
- AR/VR Services
- Media Analytics
- MEC Services
- Training
- Advanced network services (e.g. DLP)

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Needs of E2E Stack
Coexistence of Network functions & Apps
(Typical K8S deployment scenario)
Coexistence of Network functions & Apps (Apps + Network functions – SDWAN as an example)

Support for multiple networks and provider networks – Advanced networking support as known to the Openstack population
Coexistence of Network functions & Apps
(Traffic flow)

Traffic Steering across multiple network functions
Multi K8S Cluster Orchestration

Deployment Intent
An App consisting of four Micro-services
μs1 talks to μs2, μs2 to μs3 and μs3 to μs4
μs1” is user facing service and need to respond within 20Micro-seconds
“μs1”, “μs2” are expected to be there together
“μs3”, “μs4” don’t have any latency requirements

Why MC Orchestration
• Geo replication
• Geo Distribution

New Edges locations -> No manual intervention

Not only for orchestrating for apps, but also VNFs/CNFs.
MC Traffic Orchestrator for L7/HTTP services:

User facing Geo-replicated services:
- GSLB (K8S aware DNS Server)

Service coupling across Micro-services (E-W traffic) of different sites:
- Programming ISTIO egress/ingress
- Auto NAT (in cases sites having overlapping addresses + sites having limited public IP addresses)
MC Traffic Orchestrator for L3-L4 functions:

- **IPAM Mgr**: To ensure that each site is assigned with unique IP subnet (to avoid overlapping addresses to Micro-services/functions).
- **Secure GENEVE tunnels across sites**
- **Provider networks**
- **Auto Port forwarding (SNAT & DNAT) configuration** (for overlapping cluster IPs)
Multi-Cluster tenant (Zones)

Logical zone across physical locations
- Should be simple
- Look for dynamic edges
- Auto extend the zone.
Fixing Larger attack surface

Considerations:
• Edges are insecure
• E-W traffic over WAN

Attack surfaces
1. Inter Micro service comm
2. Cyber attacks on apps.
3. Key/Secret security
4. Code and Model IP security
5. Software tampering
6. SSD/HDDs

Security Orchestration
1. CA Service
2. Key Distribution
3. Attestation
4. Configure ISTIO
   users/permissions dynamically
5. Configure OAuth2 dynamically
Multi K8S Cluster App Visibility & Monitoring

Monitoring
- Active probing
- Passive monitoring
  - Metrics (From Prometheus)
  - Logs (from Fluentd)
  - Tracing (from Jaeger)
End 2 End Stack
Full Stack – Akraino ICN

- **Multi Cluster Orchestration**
  - MC workload Orchestrator (ONAP4K8S)
  - Kubernetes

- **Site level Orchestration**
  - MC Traffic & Security Orchestrator (ONAP4K8S)
  - QoS based Admission control

- **Edge Value added services**
  - MC Zone Orchestrator (ONAP4K8S)
  - Augment K8S for all deployment types

- **Platform Services**
  - Distributed Security & Vault
  - Distributed Data & Analytics platform
  - Monitoring Platform (fluentd, Elasticsearch, Kibana)
  - NFD
  - OVN4K8S

- **Virtualization & Container Run time**
  - Optimized Service mesh ISTIO/Envoy
  - Virtualization of
    - Local accelerators
    - Remote Accelerators

- **Operating system**
  - Docker
  - Virtlet/Kubevirt
  - Kata
  - Multus
  - Kilo + wireguard
  - Flannel/Calico
  - Ubuntu
  - CentOS
  - Clear

- **Hardware platform**
  - SmartNIC
  - Inline Crypto Acceleration
  - Autonomous Media Acceleration
  - Elastic Power Management

- **Infrastructure Orchestration**
  - (Metal3, Ironic, BPA)
# Full Stack – Akraino ICN (Another view)

## Value Added Services
- SDWAN + Security NFs
- EdgeXFoundry

## PaaS (MEX)
- Traffic Orch
- Security Orchestration
- K8S HPA
- Zone Mgr
- Workload Orchestrator
- MC – K8S Plugin Service (Instantiation, Day0, Day2 config)

## Analytics framework
- Data Lake
- Training
- Model Repo
- Messaging

## K8S App Components
- ISTIO
- gVisor
- kata
- CollectD
- Vertlet, Kubevirt
- Ceph/ Rook
- Logging

## Kubernetes
- NFV Specific components
  - Multus
  - SRIOVNIC
  - NFD
  - QAT
  - Inferencing
  - OpenNESS
  - knative
  - OpenVINO
- Host Operating System
  - Ubuntu (start with this)
  - RH
  - Clear

## Infrastructure Provisioning & Configuration
- Ironic with Metal3 for bare-metal provisioning

**Centralized Infra Controller**
(Leverage Cluster API + Workflow manager such as Argo/Tekton)

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**Infrastructure Provisioning & Configuration**
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**Main contributions in**
- Wiki.onap.org
- Wiki.akraino.org
- Wiki.opnfv.org
- And multiple CNCF projects

**Bold & Italic – Intel led initiatives**
## Your contributions are welcome

(Meeting invites and Git links)

<table>
<thead>
<tr>
<th>Project</th>
<th>Description</th>
<th>Links</th>
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|                  |                                                                             | Zoom: [https://zoom.us/j/961993336](https://zoom.us/j/961993336), 6:00AM PT every Thursday
|                  |                                                                             | Git: [https://github.com/onap/multicloud-k8s](https://github.com/onap/multicloud-k8s) |
| OPNFV/OVN4K8SNFV | OVN for data plane & provider networks and SFC                               | Meeting link: [https://wiki.opnfv.org/pages/viewpage.action?spaceKey=OV&title=Meeting+Agenda](https://wiki.opnfv.org/pages/viewpage.action?spaceKey=OV&title=Meeting+Agenda)
|                  |                                                                             | Git: [https://github.com/opnfv/ovn4nfv-k8s-plugin](https://github.com/opnfv/ovn4nfv-k8s-plugin) |
|                  |                                                                             | Zoom: [https://zoom.us/j/981389370](https://zoom.us/j/981389370) 7:00AM PT every Wednesday
|                  |                                                                             | Git: [https://gerrit.akraino.org/r/icn](https://gerrit.akraino.org/r/icn) |
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