Introducing Containers Platform

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4G to 5G: System Evolution and Deployment Options

4G

- Centralized Architectures
- VNF orchestration w. SDN/MANO

5G

- RAN/Core/Apps move to Edge
- Microservices foundation
- CNF E2E orchestration
- Multi Access

Deployment Options: SA & NSA

1) Standalone LTE, EPC connected - Legacy
2) Standalone NR, NGCN connected
3) Non-Standards/LTE assisted, EPC connected
4) Non-Standards/LTE assisted, EPC connected
5) Non-Standards/NR assisted, EPC connected
6) Non-Standards/NR assisted, EPC connected

...
5G Service-Based Architecture (SBA)

- Required Cloud Native based platform
- Micro service principles: Stateless services, Canary Releases/Blue-Green, Self-Discovery
- Control plane functions communicate via NFR using HTTP (but SCTP is possible)
- PaaS services: DB, LB, API GW, Service Mesh, Mon, Application CI/CD
## PaaS and Infra Solutions for 5G SBA

<table>
<thead>
<tr>
<th>Service Name</th>
<th>Required</th>
<th>SBA Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>Container as a Service / Cluster Manager</td>
<td>Yes</td>
<td>ALL</td>
</tr>
<tr>
<td>DBaaS</td>
<td>Yes</td>
<td>ALL</td>
</tr>
<tr>
<td>LBaaS (HTTP)</td>
<td>Yes</td>
<td>Control Plane / Service Based Interface</td>
</tr>
<tr>
<td>API Gateway</td>
<td>Yes</td>
<td>NEF</td>
</tr>
<tr>
<td>Service Discovery / Registry</td>
<td>Yes</td>
<td>ALL</td>
</tr>
<tr>
<td>Authentication Service</td>
<td>Yes</td>
<td>ALL</td>
</tr>
<tr>
<td>Monitoring</td>
<td>Yes</td>
<td>ALL</td>
</tr>
<tr>
<td>Application CI/CD &amp; DevOps</td>
<td>Yes</td>
<td>ALL</td>
</tr>
<tr>
<td>Openstack</td>
<td>Yes, but will be replaced by K8S in the future (kubevirt, virtlet).</td>
<td>Those which require support for stable features not provided by K8S.</td>
</tr>
<tr>
<td>K8S</td>
<td>Yes</td>
<td>NUMA/SR-IOV Evolving towards production grade</td>
</tr>
<tr>
<td>CEPH Cloud Storage (Cloud Infra)</td>
<td>Optional</td>
<td>ALL</td>
</tr>
</tbody>
</table>
Cloud Native Platform for NFV Solutions

Developer Support
- CI/CD
- Developer Portal
- SDK

Multi Cloud Platform Services (M-PaaS)
- DB
- Mon
- LB
- API GW
- Analytics
- Function
- Mesh
- AI
- Rule Engine
- IoT
- Tracing

Platform Foundation (Container Based)
- Container Orchestration & Mgmt.
- Container Runtime

Ops Tools
- Monitoring
  - Perf
  - Alerts
- Life-cycle Mgr
  - Provisioning
  - Configuration
  - Maintenance

OpenStack
- Core
- ORS PaaS
- SDS

Cloud Native Interoperability
- OpenStack – Kubernetes Interoperability
- Ready for various service operation models
- Based on open source frameworks and standards
Hybrid VIM – NFVI and NFCI

Current (VM Based)
- VNFs
- ONAP Orchestrator
- OpenStack or VMware
- Bare Metal
- Azure or Rackspace

On-Going Future (Hybrid VIM)
- VNFs
- CNFs
- ONAP Orchestrator
- OpenStack
- Kubernetes
- Bare Metal
- Any Cloud

Global Orchestrator (ONAP)

Cloud Management System
- NFVO
- VNF
- VIM

Current (VM Based)

Global Orchestrator (ONAP)

Cloud Management System
- NFVO
- VNF
- VIM

On-Going Future (Hybrid VIM)

Cloud Management System
- NFVO
- VNF
- VIM

NFVI: Network Function Virtualized Infra.
NFCI : Network Function Containerized Infra.
Hybrid VIM

- Supporting 3 type of clusters (VM, Container in VM, Container on BM)
- Unified management of Container clusters – Container in VM and Container on BM
- SDN based connectivity between VM cluster and Container cluster
- Openstack integrated networking (Neutron – Kuryr)
## Diversity

<table>
<thead>
<tr>
<th>Feature</th>
<th>HAProxy</th>
<th>Netflix</th>
<th>Zuul</th>
<th>Java</th>
<th>C</th>
<th>NGINX</th>
<th>etcd</th>
<th>Netflix Eureka</th>
<th>Consul</th>
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<tbody>
<tr>
<td>Service Discovery</td>
<td>✓</td>
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<tr>
<td>Load Balancing</td>
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<tr>
<td>Traffic Shifting</td>
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<tr>
<td>Rate Limiting</td>
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<td>Circuit Breaking</td>
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</tr>
<tr>
<td>Timeouts, Retries</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
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<td>✓</td>
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</tr>
</tbody>
</table>
Service Mesh - Istio

• Open source service mesh control framework

• Provides:
  - Connectivity
  - Control
  - Monitoring
  - Security
  - Discovery

• Uses Envoy as proxy server (sidecar)

• Integration with:
  - Prometheus – metrics
  - Jaeger – distributed tracing
Istio monitoring – Grafana dashboard

- **Incoming Requests by Source And Response Code**
- **Incoming Success Rate (non-0x0 responses) By Source**
- **Incoming Request Duration by Source**
- **Incoming Request Size By Source**
- **Response Size By Source**
- **Bytes Received from Incoming TCP Connection**
- **Bytes Sent to Incoming TCP Connection**
Istio tracing – Jaeger dashboard
Canary Releases – CNF CI/CD

• Spinnaker Platform
• 5G Core CNF’s
  - HTTP based protocol
  - Samsung Cloud Native Platform integration
Clearwater - Sample CNF

- Clearwater sample vIMS application deployed on Samsung Cloud Native Platform
- Sensing ISTIO Service Mesh
- Gained much lessons learnt
  - Istio is not fully transparent for applications
  - Limited set of supported protocols
  - Introduces latency overhead
  - Bigger resource consumption
Cloud Native Solutions and ONAP Integration

Design-Time
- VNF Validation
- Service Design & Creation (SDC)
  - Service/xNF Design
  - xNF Onboarding
  - Workflow Designer
  - Controller Design Studio
  - DCAE Design Studio
  - Catalog

Run-Time
- Closed Loop Automation (CLAMP)
- Policy Framework
- Service Orchestration (SO)
- Active & Available Inventory (AAI)
- External APIs
- CLI
- Interfaces
- Microservice Bus (MSB) / Message & Data Routers (DMaaP)
  - Correlation Engine (Holmes)
  - Data Collection Analytics & Events (DCAE)
  - Infrastructure Adaptation (Multi-VIM/Cloud)

Manage ONAP
- O&M Dashboard (VID)
- Use-Case UI
- External System Register (ESR)
- ONAP Operations Manager (OOM)

Shared Services
- AuthN/AuthZ (AAF)
- Optimization (OOF)
- Logging
- Audit (POMBA)
- Multi-Site State (MUSIC)
- & Others ...

Cloud Native Platform

Development & Deployment Env.
- APP CI/CD
- Helm Chart Repository
- CI/CD

- Installer/LCM
- Container Image Builder(Kolla)
- Customized Container Image Repository
- Customized Openstack Repository
- Docker rpm Repository
- RDO rpm Repository
- RHEL rpm Repository

IaaS + PaaS
- VNF
- VNF
- CNF
- CNF
- Helm
- Heat
- Ansible

VM / Containers Virtualization
- Containerized Openstack Services
- OwC (K8S)
- CEPH Storage
- Bare Metal & OS