Orchestration and Management for Edge Application with ONAP

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Agenda

- Akraino Edge Stack
- ONAP – VNF/CNF Orchestrator
- StarlingX – Infrastructure as a Service
- Close Control Loop for Network Automation
- Hardware Platform Awareness
- vCPE as an example
What is Akraino?
Everything about Edge – Akraino is the Edge Stack

- Development of Edge Applications
  - Develop Edge applications and create an app/VNF/CNF ecosystem

- Development of Edge Middleware and API
  - Development of Edge API, Middleware, SDKs
  - Cross Platform Interoperability (3rd party clouds)

- Fully Integrated Open Edge Stack
  - Fully integrated, working Edge blueprints
  - Edge Stack Life Cycle – CI/CD & Tooling
  - Upstream collaboration
What is ONAP?

“The ONAP project was formed in March 2017 in response to a rising need for a common platform for telecommunication, cable and cloud operators – and their solution providers – to deliver differentiated network services on demand, profitably and competitively, while leveraging existing investments.”

- 2+ years of Deployment Maturity at AT&T.
- Comprehensive: Design + Orchestration + Control + Policy + Analytics.
- Model-based design enabling self-serve capabilities for instantiation and closed loop automation.

- Open TOSCA model.
- Most Advanced Open Source Process & tool chain.
- Architected for ease of VNF insertion (SDK).
Introduction to ONAP

- ONAP is a platform to **orchestrate** the lifecycle of VNFs/CNFs in an SDN.

- ONAP is a composition of several (10+) **applications**.

- ONAP is divided in 2 main functional areas: design & run-time.

FCAPS: Fault, Configuration, Accounting, Performance, and Security
ONAP Architecture

Design-time
- Resource Onboarding
- Service & Product Design
- Policy Creation & Validation
- Change Management Design
- Design Test & Certification

VNF SDK

CLAMP

Run-time
- Dashboard OA&M (VID)
- Policy Framework
- DCAE Correlation Engine (Holmes)
- Service Orchestration Project
- A&AI/ESR
- Multi-VIM/Cloud Infrastructure Adaptation Layer
- SDN-C (L0-L3 Controller)
- Application Controller (APPC) (L4-L7)
- Virtual Function Controller (VF-C)

MSB/DMAAP

ONAP External APIs
- ONAP CLI
- U-UI
- ONAP Portal

ONAP External APIs
- OSS/BSS
- External Gateway

VNF Requirements Modeling Program
- ONAP Portal
- ONAP External APIs

ONAP Operations Manager
- Common Services
- AAF
- OOF
- Logging
- MUSIC
- Others

ONAP Operations Manager
- Integration
- VNF Requirements Program

ONAP Operations Manager
- Network Function Layer
- Hypervisor/OS Layer
- VNFs
- PNFs

Network Function Layer
- OpenStack
- Commercial VIM
- K8S
- Public Cloud

Hypervisor/OS Layer
- Private edge Cloud
- MPLS
- Private DC Cloud
- IP
- Public Cloud

Others
ONAP Design Time - Onboarding

- Upload descriptive model of the virtual function (Heat, TOSCA)
- Validate, assign, license, certify virtual function
- Create catalog entry, assign data/metadata
- Distribute for instantiation
ONAP Run Time

- Instantiate virtual functions.
- Lifecycle: start/stop/reset/scale up/scale down/configure…
- Monitoring metrics.
- Control loops.
What is StarlingX?

- New, top-level OpenStack* Foundation pilot project
- Software stack providing high performance, low latency, and high availability for Edge Cloud applications
- Aligned with the OpenStack Foundation Edge Working Group and the Linux Foundation Akraino Edge Stack
- Its R1 was released on Oct. 24, 2018.

Growing community
- Inviting users, operators and developers to try out the software and participate in the community
## StarlingX Architecture

### OpenStack Components
- Cinder
- Ironic
- Magnum
- Horizon
- Swift-API
- Murano
- Nova
- Keystone
- Neutron
- Glance
- Heat
- Telemetry

### New StarlingX Services
- Configuration Management
- Fault Management
- Host Management
- Service Management
- Software Management

### Some of the Open Source Building Blocks Used by StarlingX
- Kubernetes
- Ceph
- Collectd
- libvirt
- QEMU
- Open vSwitch
- DPDK
- SR-IOV

### Linux
Networking Automation:
Design->Create->Collect->Analyze->Detect->Publish->Respond
ONAP Control Loop – Design Time

- The core/main ONAP components involved in control loop are: DCAE, CLAMP, Policy, VF-C and SDC.
- A Control Loop does several functions:
  - Collect data about VNFs/CNFs or VNF/CNF infrastructure
  - Compute analytics based on collected data
  - For open loop, send message to ticketing system for human intervention
  - For closed loop, execute one of many actions to remediate the network condition
  - For closed loop, detect that a network condition has been corrected through our actions
ONAP Control Loop Run-time

• Choose/create micro services sequence that makes the Control Loop
  • Binding to a VNF/CNF in a Service
  • Choose from pre-existing sequence
  • Build a brand new sequence

• Generate model file (YAML and cloudify blueprint) to be distributed to run-time part of control loop (DCAE/CLAMP)
ONAP Control Loop Run-time

- Configuring the Control Loop
  - Driven by the VNF/CNF (list of alarms,…)
  - Configuring micro services parameters values (configuration policies)
  - Configuring the action to be taken (operational policy)
- Trigger Deployment of the Control Loop
  - Trigger API exposed by DCAE
- Lifecycle Management of the Control Loop
  - Stopping/restarting/updating configurations
  - Monitoring (status of the Control Loop)
ONAP Control Loop Run-Time

Closed Loop Flow’s

- **Analytics Micro service x:** “TCA”, “Holmes”, …

**DMaaP**

**Collector (VES, SNMP, …)**

**Docker/CDAP**

**Analytics Micro service 1**

**Docker/CDAP**

**Analytics Micro service n**

**Docker/CDAP**

**DMaaP**

**Drools Policy**

**DMaaP/REST**

**Action Execution**

**App-C**

**SO**
ONAP HPA Path:
Policy – OOF – VFC – MultiCloud
HPA for Performance Purpose

• HPA = Hardware Platform Awareness
  • Describes a set of hardware features across orchestration and control domain software stacks
  • Targets “smarter” hardware platform capability consumption
• Two key focus areas…
  • Detecting hardware platform capabilities
  • Configuring hardware platform capabilities
• HPA requirements specification is part of the ETSI NFV Virtual Network Function Descriptor (VNFD)
1. VFC sends out homing request to OOF(OSDF) containing resource info
2. OOF(OSDF) pulls all the related homing constraints from Policy
3. OOF(HAS) check AAI database to pull region(flavor) information
4. OOF(HAS) communicate with Multi-cloud to check cloud capacity (vims which fulfill the requirements)
5. OOF(OSDF) returns homing allocation solution to VFC
Edge Use Case:
Can ONAP work with StarlingX under Akraino?
Let’s try out vCPE!
The NERG specification splits the residential gateway into two distinct components: Bridged Residential Gateway (BRG) and Virtual Gateway (vG).

**At Home**

LAN

BRG

Logical Subscriber Link (LSL)

**Edge/Cloud Network**

vG

WAN

Network functions and services, such as DHCP, NAT, ...

Relatively simple L2 switching device
Edge Use Case - vCPE

Functions provided traditionally by RG are distributed between:
- On-site device (Bridged Residential Gateway — BRG)
- Edge/Cloud-based component (Virtual Gateway — vG)
Virtual customer premises equipment (vCPE) is a way to deliver network services such as routing, firewall security and virtual private network connectivity to enterprises by using software rather than dedicated hardware devices.
Edge Use Case - vCPE

• From:
  - NAT –
  - FW –
  - Media
  - Server –
  - AAA - ....

• To:
  - Simple GW
  - Cheap
  - Provider agnostic
  - vAAA –
  - vFW –
  - vDLNA - etc
Edge Use Case: vCPE

- **DCAE (Collector)**
- **DMaaP**
- **SDNC**

**ONAP OAM Neutron Network**

- **vDHCP**
  - Dynamic Host Config Protocol

- **vAAA**
  - Authorization, Authentication, Accounting

- **vDNS + vPDHCP**

**BRG Emulator 1 (VPP)**

**BRG Emulator 2 (VPP)**

**vBNG (VPP)**

**vG MUX (VPP)**

**vG1 (VPP)**

**vG2 (VPP)**

**Home Network 1**

**Home Network 2**

**CPE Public Neutron Network**

**Web Server**
Environment at China Mobile Lab

WindRiver

Controller-0

Controller-1

Compute0

Compute1

Compute2

OAM Network

Management Network

Data Network

StarlingX

Controller-0

Controller-1

Compute0

Compute1

Compute2

Management Network

Data Network
Engineering and Testing Status

- ONAP Casablanca (R3) is about to be released in the middle of Nov.
  - HPA support is added.
  - SR-IOV support as one of HPAs is just added.
  - PoC to onboard vCPE with ONAP, StarlingX and SR-IOV is implemented and tested at local.
- Integration testing is ongoing at China Mobile ONAP Lab now.
  - Another PoC is being demonstrated.
- StarlingX R1 is released in Oct.
- vCPE build from the source: see also [https://wiki.onap.org/display/DW/ONAP+vCPE+VPP-based+VNF+Installation+and+Usage+Information](https://wiki.onap.org/display/DW/ONAP+vCPE+VPP-based+VNF+Installation+and+Usage+Information)
FlexRAN* onboarding with StarlingX and ONAP
See Demo at Intel Booth Now

- **FlexRAN** is a reference implementation for Cloud enabled wireless access Virtual Network Functions

- **DEMO**: StarlingX enables Mobile Edge Computing (MEC) wireless workloads on Intel® Xeon® scalable processors using Intel® AVX 512 and DPDK*.

*Other brands and logo
Thank you !