Edge Automation – Potential Strategies for Deploying ONAP at Edge

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Aug 2018
Our Proposal

• Edge group to consider additional scope in ONAP for Edge Application Management – as per MEC guidelines

• ONAP deployment to suit edge automation scenarios

• MVP closely following the standards to enable interoperability.
Reference Implementation of MEC Architecture

• Step 1. MVP “Orchestration Level”:
  - MEAO
  - Ref Points: Mm1, Mv1

• Step 2. “Management Level”:
  - MEMPM-V
  - ME Platform LCM
  - ME App LCM
  - Ref Points: Mm2, Mm3*, Mv2, Mm6

• Step 3. “Platform and Applications”:
  - ME Platform
  - ME Application
  - Ref Points: Mm5, Mp1, Mp2, Mv3, Nf-Vn

• Step 4. “External Interfaces”
  - CFS Portal
  - UE Application
  - User App LCM Proxy
  - Ref Points: Mx1, Mx2, Mm8, Mm9

• Step 5. “Network Edge”:
  - Ref Point: Mp3
Potential ONAP Edge Deployment Scenarios

MVP1 – current candidate
MVP2 – new proposal candidate

Central and Edge ONAP – not mean physical location of ONAP instance, but responsibility.
Focus of this presentation

Edge Infrastructure Service LCM

Edge System Level Management as per MEC

Workload (MEC App as per MEC)

Edge Host Level capabilities as per MEC

Application image

Application introduced by Application Provider and deployed on Network Service Provider infrastructure
About MEC Use Cases in General

• 3 kind of Use Cases:
  - Consumer-oriented services (AR, VR, Cognitive Assistance…)
  - Operator and third party services (device location tracking, big data, security, safety)
  - Network performance and QoE improvements (performance, video optimization…)

• MEC does not care about in what MEC Application do in Use Case.
  - MEC just fulfill requirements of MEC Application (Mobility, Compute resources…).
  - Like MANO does not care what VFN do (vCPE, vEPC, vFW…), but care about LCM
  - MEC Application requirements - still evolving.
Use Case: Application computation off-loading (Example 1)

- MEC host executes compute-intensive functionalities with high performance instead of mobile devices.
- Business value of such applications is:
  - graphical rendering (high-speed browser, artificial reality, 3D game, etc.),
  - intermediate data-processing (sensor data cleansing, video analysing, etc.)
  - value-added services (translation, log analytics, etc.).
- This is most simple Use Case is good for ONAP Dublin deployment showcase.
  - Need to demonstrate LCM on dummy MEC Application.
  - Include all basic MEC Management components (SL/HL) and reference points.
  - No need to support Mobility and integration with 5G RAN for Radio Interface.
  - No need to demonstrate Slicing and integration with 5G Core.

Reference ETSI GS MEC 002 V2.2.0 (2018-08) A.23
MEC and 5G Interworking

**MEC integration with 5G**

- MEC Host’s DP is mapped to UPF in 5G
- MEC Host’s CP is mapped to AF in 5G

**ETSI MEC - 5GCoreConnect Feature**: [link]

**ETSI MEC – Use case for MEC deployment in 5G**: [link]
Typical Management Functionalities at Edge for various NFV based Use Cases (General) – Reference ETSI MEC

**System Level Management**
- Edge Orchestrator
  - Inventory Management
  - Catalog Management
  - Application Placement and LCM Triggering
- NFVO

**Host Level Management**
- Platform Manager (MEPM-V)
  - Platform Element Mgmnt
  - Assurance (Host Level)
- Platform LCM
- App LCM

Available Functions in ONAP, but need adaptation for MEC.

Scope of ONAP MVP.
Can be aggregate for multiple Edges

Optionally placed at System Level as well

Scope of VNF vendor and infrastructure Provider
Functional Responsibility of Central and Edge Management System

- **Central Management and Orchestration**
  - End to End Service Management
  - Service Design and Distribution
  - OSS/BSS Integration
  - User Application LCM Proxy Function (assumption)
  - CSMF, NSMF Functionality for Slicing

- **Edge Domain Orchestration**
  - Domain Level Orchestration
  - MEAO and NFVO functionality as per MEC
  - Maintains domain level catalog and inventory
  - Domain level Control loop
  - NSSMF Functionality for Slicing

- **Akraino NFV & Application Orchestration**
  - Edge Application Platform Management
  - Element and NF Management
  - Network Control (SDN)

- **Akraino Edge Platform**
  - Infrastructure Management (VIM, PIM)

- **Akraino - Edge IaaS**

- **Akraino Stack**

- **SP Central Management and Orchestration**

- **SP Edge System Level Management (Edge Domain Orchestration)**

- **Edge Host Level Management**

- **Edge Infrastructure**

- **Partner Edge Domain Orchestrator (non-ONAP)**

- **Partner Edge PaaS**

- **Partner Edge IaaS**

- **MEF Legato or Interlude (TMF 641, 640, 638, 633), Proxy for MEC Mm2, Mm9, MEC MM1**

- **ETSI Or-Vnf, Ve-Vnfm-em, Ve-Vnfm-vnfProxy for MEC Mm2, Mm3**

- **ETSI Vi-Vnfm, Proxy for Or-Vi**

- **3GPP 5G Naf (Optional)**

- **CP Connectivity**

- **DP Connectivity**

- **CP Connectivity**

- **DP Connectivity**

- **MEC Mp3, 3GPP 5G Naf (Optional)**

- **MEC Mp3, ETSI 5G Naf (Optional)**

- **3GPP 5G Naf (Optional)**

- **ETSI Vi-Vnfm, Proxy for Or-Vi**

- **ONAP Scope**
Applications can be classified at a high level as follows:

- Near Real Time Data Plane Applications: Deployed in the DP and resides in the Edge Cloud infra near to other NFs – e.g. Video Cache, IoT etc
- Near Real Time Control Plane Applications: Deployed in the close proximity of the host level management functions, managed by the Edge Platform – e.g. Traffic steering rules update
- Non-Real Time Data Plane Applications: Deployed in public cloud and traffic is steered to them by local cloud proxy applications
- Non-Real Time Management Applications: Deployed in the close proximity of the system level management functions – e.g. Fault and Performance Aggregation per host, Closed control loop
- Non-Real Time Operational Applications: Deployed in the close proximity of the End to End/ Central Orchestration, typically used for end to end monitoring at NOC, SOC – e.g. Fault and Performance Aggregation across systems, SLA Monitoring
ONAP Functional Mapping to MEC Functions: Typically for Data Plane Applications
ONAP Functional Mapping to MEC Functions: Typically for Monitoring Applications

- **ONAP External APIs**
  - Design-Time (SDC)
    - VNF Onboarding
    - Service/VF/PNF Design
    - DCAE Design Studio
  - User LCM Proxy
  - Workflow Designer
  - Controller Design Studio
  - Catalog

- **External Systems**
  - Network Function Layer
    - Hypervisor/OS Layer
      - Hypervisor
      - OpenStack
      - Commercial VIM
      - K8s
      - Public Cloud
  - Private Cloud
  - MPLS
  - Private Edge Cloud
  - IP

- **MSB/DMAAP**
  - Multi-VIM/Cloud Infrastructure Adaptation Layer
  - SDN-C
  - Application Controller (APPC)
  - Virtual Function Controller (VF-C)
  - Additional services: A&AI/ESR, AAF, OOF, Logging, MUSIC, Others

- **RUN-TIME**
  - Policy Framework
  - Service Orchestration Project
  - MEAO + NFVO + MEPM Engine (Holmes)

- **ONAP Operations Manager**

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**Integration/Container Images**

- ONAP CLI
- U-UI
- ONAP Portal

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**VNF Requirements**

- **Utilities**
  - AAF
  - OOF
  - Logging
  - MUSIC
  - Others

**VNF Validation Program**

- **Monitoring (Utilities)**
  - Benchmark/Container Images

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**ONAP**

- **THE LINUX FOUNDATION**
An MVP View for ONAP at Edge and Central

SDC (Application Package, VNF Package, NS Package)

- VNFD
- NSD

**Orchestration (MEAO, NFVO for MVP1)**
- RT Catalog
- WF Engine
- Adaptors

**A&AI**
- Full Deployment

**Policy FW**
- PAP
- PIP
- PDP

**DCAE**
- Full Deployment

**Common Services (DMaaP, MSB, OOF)**

- Extended processing, analytics at Central, Metrics aggregation at Central, Controller for deploying DCAE MS from Central

**External API**
- Optional Proxy connection with OSS/BSS (Mm1)

**ONAP Central (End to End Scope)**
- Long term storage at central site based on pull model from Central
- PAP, PIP at Central
- PDP at Edge
- Common Controller SDK with essential MS or Light weight CM. Can function as MEPM

**ONAP Project Impact**
- Common Services (DMaaP, MSB)
- Outlet API
- Orchestrator (MEAO, NFVO for MVP 2)
- Catalog
- WF Engine
- Specific Adaptor

**A&AI**
- Inventory API
- Inventory Query
- Inventory Graph

**DCAE**
- Pub/Sub
- Holmes
- Collector

**External API**
- Extended processing, analytics at Central, Metrics aggregation at Central, Controller for deploying DCAE MS from Central

**ONAP Edge (System Level Management, Domain Orchestration)**
- Distribution of NSD, VNFD, AppD
- MVP 1: E2E, NS, Infra, App LCM
- MVP 2: Only E2E Service LCM

- Edge service
- Orchestration (Especially Central to Domain or Partner)

- Long term storage at central site based on pull model from Central
- PAP, PIP at Central
- PDP at Edge
- Extended processing, analytics at Central, Metrics aggregation at Central, Controller for deploying DCAE MS from Central

**Optional Proxy connection with OSS/BSS (Mm1)**
- Extended processing, analytics at Central, Metrics aggregation at Central, Controller for deploying DCAE MS from Central

- Optional Proxy connection with OSS/BSS (Mm1)
- Common Controller SDK with essential MS or Light weight CM. Can function as MEPM
Central and Edge ONAP API Scope (MVP2)

SP OSS/BSS
- Service Order Management (TMF)
- Service Catalog Management (TMF)
- Service Inventory Management (TMF)

Central ONAP
- Platform Configuration, Fault, PM (MEC Mm1)
- UE Application Request (ETSI MEC Mm9)
- Application LCM (ETSI MEC Mm1)

Edge System Level ONAP (Domain Orchestration)
- ETSI MANO (Or-Vnfm)
- Platform Configuration, Fault, PM (MEC Mm1)
- ETSI MANO (Or-Vi)

Edge Host Level Management
- ETSI MEC Mp3

Product Order Management (MEF SONATA)

Partner OSS/BSS
- Network Slice Management (ETSI)
- Service Activation Management (TMF), MEF Interlude

Central ONAP
- Network Slice Subnet Management (ETSI)
- MEF Interlude (Optional, Not defined by ETSI yet)

Partner Central Orchestrator
- Network Slice Management (TMF), MEF Interlude
- Service Activation Management (TMF), MEF Interlude

Partner Edge System Level Management
- Application lifecycle, Rules Mgmnt, MEC Services Monitoring (MEC Mm3)

Partner Edge Host Level Management
- ETSI MEC Mp3
## ONAP Central vs Edge System Level Functionality Split (MVP2)

### ONAP Central

<table>
<thead>
<tr>
<th>Component</th>
<th>Capability</th>
</tr>
</thead>
<tbody>
<tr>
<td>SDC</td>
<td>End to end service design, Service distribution to Central and Edge ONAP System Level</td>
</tr>
<tr>
<td>External API</td>
<td>Proxy the connection to OSS/BSS to enable MM2, Coordinate communication with</td>
</tr>
<tr>
<td>SO</td>
<td>Optional – Infrastructure Service for ONAP Edge, Onboarding and LCM for System level monitoring applications (Mainly DCAE Apps)</td>
</tr>
<tr>
<td>DCAE</td>
<td>Host applications that aggregate monitoring data and carry out analytics from multiple Edge System level management functions.</td>
</tr>
<tr>
<td>A&amp;AI</td>
<td>Edge System level Inventory reconciliation</td>
</tr>
<tr>
<td>VID</td>
<td>Infrastructure Service Instantiation</td>
</tr>
<tr>
<td>CLAMP</td>
<td>Closed loop configuration, deployment for Edge System level infrastructure services</td>
</tr>
<tr>
<td>Policy</td>
<td>For managing CL Policy</td>
</tr>
<tr>
<td>Generic Controller</td>
<td>Can Function like MEPM in MVP 1 scenario</td>
</tr>
</tbody>
</table>

### ONAP Edge System Level

<table>
<thead>
<tr>
<th>Component</th>
<th>Capability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Runtime Catalog</td>
<td>Maintains application and VNF packages those are distributed by SDC from Central</td>
</tr>
<tr>
<td>SO/VFC</td>
<td>Application and NS Lifecycle, Edge Platform LCM, Role of MEAO + NFVO</td>
</tr>
<tr>
<td>DCAE</td>
<td>Host applications that aggregate monitoring data from multiple host level management systems and carry out analytics for CL</td>
</tr>
<tr>
<td>A&amp;AI</td>
<td>Edge Host level inventory reconciliation</td>
</tr>
<tr>
<td>Generic Controller</td>
<td>For VNF and Application LCM, Application Traffic Steering. Can take the role of Platform Manager</td>
</tr>
<tr>
<td>Policy</td>
<td>For managing the CL Policy</td>
</tr>
<tr>
<td>Ext-API</td>
<td>For enabling the MEC System level NBI</td>
</tr>
<tr>
<td>CLAMP</td>
<td>Optional – For onboarding/instantiation the Control loop applications</td>
</tr>
</tbody>
</table>

### ONAP Edge Host Level

<table>
<thead>
<tr>
<th>Component</th>
<th>Capability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generic Controller</td>
<td>Persona for Edge Platform Management, especially for provisioning the application and connectivity rules</td>
</tr>
</tbody>
</table>

Note: Further study required to come up with specific changes
Operational Scenario: Sequence Diagram for Application Onboarding

- Designer User
- Operation User
- ONAP Central

- SDC
- Central ONAP RT
- UUI (Optional)

Onboard Application Package, VNF Package, Design

End to End Service Package

Distribute Package

End to End Control Loop Service Package for Central DCAE

Application Package Distribution

MVP1 Scenario

MVP2 Scenario

Control Loop Service Package (optional)

Onboard Application Package (ETSI MEC 10 Part 2)

Distribute NS Package (Existing SO API)

Get SDC Catalog Items

Optional : Onboard Application Package

Optional : Distribute NS Package

Refer also to [this](https://example.com) ETSI GR Issue 6

Additional Feature Requirement in ONAP (Ext-API or SO)
Operational Scenario: Edge Platform Instantiation – MVP 1

Assumptions:

- VNFM for Edge applications and Edge Platform is supported by Central ONAP or external to ONAP.
- Application LCM is responsibility of Central ONAP.
- Platform Manager consolidates the metrics, events from platform and passes on the aggregated metrics to ONAP Central.
- Edge Platform is instantiated as Infra service component.
- Central ONAP Generic Controller acts like a Platform Manager for multiple Edge hosts.

A Common flows
Operational Scenario: Edge Platform Instantiation – MVP 2
Case 1: Platform Instantiation controlled by Central ONAP

- **VID/Ext-API**
- **SO**
- **OOF**
- **A&AI**

**Central ONAP**

1. Create Edge Infra Service instance in inventory
2. Decompose
3. Create Edge Infra Service in ONAP of SPPartner (Ref: CCVPN use case)
4. Response with Service Instance Id
5. Create SPPartner Resource Instance

**Edge ONAP**

1. Create Edge Infra Service
2. Response with Service Instance Id
3. Decompose
4. Refer to previous slide

**Response with Service Instance Id**
Operational Scenario: Edge Platform Instantiation – MVP 2
Case 2: Platform Instantiation controlled by Edge ONAP

- Create Edge Infra Service instance in inventory
  - Decompose
  - Homing/Optimization
- Create Edge Platform VNF Inventory Instance
  - Assign Edge Platform VNF network resources
- Create VF Module Inventory Instance (Platform & Platform Manager)
  - Assign network resources for VF Module
- Instantiate workload (for Platform Manager and Platform)

Edge ONAP

VID/Ext-API  SO  OOF  A&AI  Generic Controller  Multi-Cloud
Operational Scenario: Sequence Diagram for Application Instantiation: MVP 1

1. OSS/BSS
   - Instantiate Application Request
   - Not Supported Currently

2. Ext-API
   - Instantiate Application Request
   - Not Supported Currently

3. SO
   - Create Application Instance in Inventory
   - Allocate network resources for Application
   - Instantiate workload
   - Activate
   - Update Inventory

4. A&AI
   - Currently Not Supported
   - Create Application Instance in Inventory

5. Platform Manager (Generic Controller)
   - Update Inventory

6. Multi-Cloud
   - Via VIM
   - Application
   - Components in ONAP Central

Reference: ETSI GS MEC 010-2 V1.1.1 (2017-07)
Operational Scenario: Sequence Diagram for Application Instantiation: MVP 2

End User Device → MEC User Application LCM Proxy

Query Application List

Create Application Context

Reference ETSI GS MEC 016 V1.1.1 (2017-09)

 Instantiate Application Request (via OSS)

Ext-API → SO → A&AI → Platform Manager (Generic Controller) → Multi-Cloud

Instantiate Application Request → Create Application Instance in Inventory → Allocate network resources for Application → Instantiate workload → Activate → Update Inventory → Via VIM → Configuration Request → Application

ONAP Edge Level

NOT SUPPORTED CURRENTLY
Summary – What we are suggesting?

- MEC recommends separation of System Level and Host Level Management
- Enable MEC functional capabilities in ONAP components – Especially System Level Management and Host Level Management Selectively depending on the deployment model
- Enhance ONAP scope to handle Application LCM Orchestration
  - Different Categories of Applications
  - Modelling constructs to support Application Descriptors
  - License Management of Applications
  - Application onboarding and instantiation workflows
  - End user dynamic application instantiation capability
  - Enable Capabilities as per 3GPP 5G AF for application traffic steering
Next Steps

- Wiki pages detailing (target: Dublin)
  - Study on the impact of Application Orchestration on ONAP
  - Study on aligning ONAP with MEC Architecture

- A use case proposal for edge application orchestration through ONAP (target: Dublin)

- Study on the Control loop scenarios for Edge Deployment of Non Real-time management applications at Edge
Thanks
## Modelling Impact – AppD Support

### VNFD attribute vs AppD attribute

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### VNFD attribute vs AppD attribute (cont.)

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Reference: **ETSI GR MEC 017 V1.1.1 (2018-02)**

**VNFD as per** ETSI GS NFV-IFA 011, **AppD as per** ETSI GS MEC 010-2

Additional attributes to support AppD