Reference Platform Design for Edge Cloud

-- OPNFV Edge Cloud Project


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Service Requirement for Edge

With the emergence of 5G, lots of services with requirement of low latency and high bandwidth appears, leading to huge demand for edge cloud

Service for Edge:
- User plane services: SAE-GW, UPF
- Low Latency Services: VR, automatic driving
- High Throughput services: AR, Video surveillance
- Services with huge requirement for multicast: IPTV
- High Speed Mobile Services: UAV
Where is Edge Cloud

Number of Servers per DC

<table>
<thead>
<tr>
<th>Distance From UE</th>
<th>Access-level DC</th>
<th>County-level DC</th>
<th>Municipal-level DC</th>
<th>National/District-level DC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1km</td>
<td>0</td>
<td>3000</td>
<td>300</td>
<td>100,000</td>
</tr>
<tr>
<td>10km</td>
<td>34</td>
<td>150-300us</td>
<td>1-2ms</td>
<td>1-2ms</td>
</tr>
<tr>
<td>50km</td>
<td>60</td>
<td>500-1500km</td>
<td>15-20ms</td>
<td>40-80ms</td>
</tr>
<tr>
<td>200-300km</td>
<td>200-300km</td>
<td>2000-3000km</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3000-5000km</td>
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<td>2000-3000km</td>
<td></td>
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</tr>
</tbody>
</table>

Facility: Enough central offices fully distributed at the edge locations

Edge Facility: Enough central offices fully distributed at the edge locations

Distance From UE:
- 1km: 10us
- 10km: 50us
- 50km: 150-300us
- 200-300km: 200-300km
- 500-1500km: 500-1500km
- 2000-3000km: 2000-3000km

UE 1km 10us 50us 200-300km 500-1500km 2000-3000km
Latency and Bandwidth

*Bandwidth* and *Latency* are the main constrains to decide the deployment location of edge services.

**Basic policy:**

- Service E2E delay demand > E2E delay = radio access + transmission + GW + VM
- Service bandwidth demand < Transmission bandwidth
- **Telco Edge cloud can provide high enough bandwidth and low enough latency**

<table>
<thead>
<tr>
<th>DC Level</th>
<th>Access</th>
<th>County</th>
<th>City</th>
</tr>
</thead>
<tbody>
<tr>
<td>E2E delay</td>
<td>Around 2ms</td>
<td>Less than 2.5ms</td>
<td>Around 4ms</td>
</tr>
<tr>
<td>Transmission bandwidth</td>
<td>50G</td>
<td>100G</td>
<td>200G</td>
</tr>
</tbody>
</table>

All calculations are based on 5G technology.
Lots of communities have setup projects or WGs to focus on edge usecase
OPNFV Projects

Each project focuses on a certain study point. Edge requirements are not fully covered. Need a new edge-focused project to combine them and cover those uncovered requirements for edge. 

https://etherpad.opnfv.org/p/tsc_edge_cloud
Edge Cloud Project in OPNFV

**Purpose for this project:**
- Focusing on the NFV Platform integration for Telco Edge cloud.
- Platform for edge, which is homogeneous with core in orchestration, so that unified orchestration and operation mechanism can be used.
- Better trimmed platform to meet the specific need for edge services.

**What we can do:**
- **Requirement Analysis**
  - Analyze and conclude the requirement from multiple services (MEC, CRAN, vCPE, vOLT, vCDN, etc.)
  - Translate requirement of edge into deployment requirements including NFV/SDN component requirement (NFVO, VNFM, VIM, Hypervisor, VSW, HW, etc.)
- **Reference platform design**
  - Define and release a limited number of OPNFV scenarios for edge cloud taking consideration of the analyzed requirements.
- **Upstream collaboration**
  - Collaborate with related communities (ONAP, OpenStack Akraino etc.) for requirement analysis and scenario design.
  - Output detailed requirements for components to relevant project/s.
- **Testing strategy**
Features for Edge

Different from core, edge cloud, especially edge cloud located in access and county levels, are highly distributed. Space and power are quite limited in edge cloud, leading to constraints on devices of edge cloud.

Light weight control

- Taking consideration of limited space and power, there could be a dozen to less than a hundred nodes in one edge, where it is unnecessary to deploy Orchestrator and VNFM.
- VIM and SDN should be deployed in a light weight manner, especially in CO with very hash environment (say less than 10 nodes a stack).

Remote provisioning

- Edge cloud is rather distributed, while the operation environment is considerably hash. Remote provisioning is necessary.
- Only hardware maintenance in Access and County level edge, with virtual resource operator sitting at the city level edge for overall virtual resource maintenance.
- A unified Orchestrator together with OSS/BSS, EMS, and VNFM are used in regional level to support overall service orchestration and maintenance.
- Multi region OpenStack could be considered as one of the solution.

Resource Heterogeneity

- With various applications running on edge, heterogeneous resources, including VM, containers, and bare-metal could co-exist in edge.
- Edge cloud should be capable of managing the heterogeneous resource pool.
- MANO workflow should take these different resources into consideration.

Hardware/software acceleration

- Low latency, high bandwidth, large computing service requires various acceleration technology, including DPDK, SR-IOV, GPU, Smart NIC, FPGA and etc.
- OpenStack should fully expose these acceleration capabilities.
- Unified API is necessary to fully decouple the VNF services with acceleration resources.
Edge Cloud Architecture

Distributed edge clouds bear various applications, resulting in a quite heterogeneous architecture

- Common server & customized server
- VM & container & Bare metal
- VNF & PNF

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Multi region and light weight OpenStack are the main solutions for edge cloud

**Core cloud**
- **Scale**: >100
- With fully deployment of MANO
- Cloud resources are managed with one or several OpenStack cloud

**City Level Cloud**
- **Scale**: local 20-200 nodes, remote 200-300 nodes
- Only OpenStack deployed, no Orchestrator/VNFM/EMS
- Remotely managing County and access level OpenStack with shared Keystone and Horizon

**County/access level cloud**
- **Scale**: 20-100 nodes
- Remotely controlled by city level OpenStack

**County/access/Customer premises level cloud**
- **Scale**: <20 nodes
- Light weight OpenStack with few virtual resources
Upstream Collaboration

- **OpenStack**
  - Close collaboration with EC WG
  - Hybrid VIM
  - Containerization
  - Acceleration
  - Hybrid VIM
  - Light Weight

- **K8S**
  - Hybrid VIM
  - Containerization

- **ONAP**
  - Close collaboration with edge automation project
  - ONAP+K8S+OpenStack
  - Remote Provisioning

- **ODL/ONOS**
  - Light Weight SDN

- **Akraino**
  - Telco Edge Reference Platform
  - Edge requirements

- **ETSI MEC**

Requirement will go to upstream through close collaboration with upstream related WG/projects

Continuous integration of upstream to deliver typical scenarios for edge

**OPNFV Edge Cloud Project**
- Integration
- Testing

**Edge Reference Platform**
OPNFV Projects Cooperation

- **AUTO**: ONAP+K8S+OpenStack
- **Container4NFV**: ONAP + Remote VIM
- **Clover**: Edge hybrid VIM
- **CRAN**: Requirement as an edge service: e.g. hardware acceleration

Uncovered requirements: SDN, light weight management component

**Test cases**

- Functest/Yardstick
- Pharos

**Integration**

- Edge Cloud Project
- Test together with XCI and other installers
- Testing

**Edge hardware spec**

- Edge Reference Platform
Progress and Plan for OPNFV G release

- First discussed during 2018 ONS-North America
  https://etherpad.opnfv.org/p/edge_cloud_discussion_in_ONS2018
- Project on-boarding: Apr.24
- OPNFV G release plan
  - Requirement analysis for edge cloud
  - Architecture design for edge cloud
  - Release scenario: ONAP orchestration of K8S & OpenStack (collaborate with AUTO)
- Project wiki page: https://wiki.opnfv.org/spaces/viewspace.action?key=EC
- Project meeting minutes:
  https://wiki.opnfv.org/pages/viewpage.action?spaceKey=EC&title=Edge+Cloud+Project+Meeting
Progress and Plan for OPNFV G release

Current work at hand

- Pharos spec for edge
  - Should we work out specific pharos pod for edge?
  - Two spec for edge pod
    - General pod: 3 controller, 2 compute, 1 jump server
    - Slim edge: 4 nodes, 3 nodes with light weight controlling service distributed and LB. Save the rest resources to compute; 1 node for compute
  - Define multi-cloud scenario template

- Requirement and Architecture design
  - https://etherpad.opnfv.org/p/edge_cloud_requirements
  - Waiting for building gerrit commit and start contribute
Progress and Plan for OPNFV G release

• Code base for edge: ONAP+OpenStack+K8S
  – Need detailed discussion with AUTO team for the code base
  – What is the architecture of AUTO release, whether it fit into the requirement for edge

• OpenStack component testing
  – Collaborate with OpenStack EC WG
  – Build testing and integration environment, joint testing with OpenStack projects
OPNFV Edge Work Force

- **Edge Taskforce Objectives**
  - Report back to TSC with recommendations on an OPNFV Edge Cloud Strategy (At this stage report out is informal – TSC will ask for any progress / updates in weekly meetings)
  - Survey related projects in OPNFV and understand overlaps and synergies
  - Understand if there are gaps with existing or proposed activities to determine need for additional Edge projects or activities in OPNFV
  - Make recommendations on collaboration across OPNFV Edge activities
  - Make recommendations for collaboration with other Open-source communities
    - [https://etherpad.opnfv.org/p/tsc_edge_cloud](https://etherpad.opnfv.org/p/tsc_edge_cloud)

- **Progress for OPNFV Projects**
  - [https://etherpad.opnfv.org/p/tsc_edge_cloud_project_questions](https://etherpad.opnfv.org/p/tsc_edge_cloud_project_questions)
  - [https://etherpad.opnfv.org/p/tsc_edge_cloud_opnfv_activities](https://etherpad.opnfv.org/p/tsc_edge_cloud_opnfv_activities)

- **Progress for Upstreams**
  - [https://etherpad.opnfv.org/p/tsc_edge_cloud_upstream_communities](https://etherpad.opnfv.org/p/tsc_edge_cloud_upstream_communities)

- **Comments and Next Steps**
  - [https://wiki.opnfv.org/display/meetings/Edge+Cloud](https://wiki.opnfv.org/display/meetings/Edge+Cloud)
Thank You!
You are very welcome to join us.