Edge Cloud Discussion
Service Requirement for Edge

**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

![Service Requirement Diagram]
Use Case 1: Enterprise Private Network

- **Related Technology**
  - Edge DC deployment
  - Local Traffic Offloading
  - Distinguish Local Network Access

- **Target**
  - Inform local private network service
  - Reduce the access latency
Usecase 2: CDN deployment

- Without edge cloud
  - Waste more transmission bandwidth
  - Increase Core Network workload

- With edge cloud
  - Reduce the access latency
  - Reduce the resource consumption in transmission
Use case 3: Live Sporting Event

- Target
  - More comfortable user experience

- MEC
  - Processed at local application servers
  - Video back to end users with service distribution
Use case 4: Scenic Area with AR/VR

- Disadvantage & Problem
  - Lack of innovation
  - Few items for sightseeing
  - Flow charge is too expensive

- Target
  - Reduce the charge with providing the scenic area more economic larger package
  - Enrich the experience of travelers
Usecase 5: Real time data backhaul of Unmanned Aerial Vehicle (UAV)

<table>
<thead>
<tr>
<th>分辨率</th>
<th>帧率</th>
<th>码率</th>
<th>带宽</th>
</tr>
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<tbody>
<tr>
<td>4K</td>
<td>120FPS</td>
<td>20~40Mbps</td>
<td>&gt;50Mbps</td>
</tr>
</tbody>
</table>

- **Disadvantage & Problem**
  - Using UAV’s local storage
  - Long backhaul route
  - Bandwidth demand

- **Using MEC**
  - Use the venue's prepared storage or some others
  - Shorten backhaul route
  - Reduce workload of both core network and backhaul network
Usecase 6: V2X service

- Application Scenario:
  - Driverless
  - Intelligent parking
  - Intelligent traffic and weather reminding
  - Communication between cars
  - V2N V2X V2I V2V V2P

- Difficulties:
  - Very strictly low latency for driverless scenario
## Network Structure of China Mobile

![Network Structure Diagram]

### Distance From UE
- **1km**: 10us
- **10km**: 50us
- **50km**: 150-300us
- **200-300km**: 1-2ms
- **500-1500km**: 15-20ms
- **2000-3000km**: 40-80ms

### Number of Servers per TIC

<table>
<thead>
<tr>
<th>Year</th>
<th>Access-Level DC</th>
<th>County-Level DC</th>
<th>Municipal-Level DC</th>
<th>Provincial-Level DC</th>
<th>National/District-Level DC</th>
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</table>
Features of Edge TIC is quite different from core TIC, especially county-level and Access-levy edge TIC.

Features of Edge TIC:

- **Limited space and power resource**
- **Lightweight management**
  - Small scale of edge TIC nodes (less then 10 in AP)
  - No need to fully install management component
- **Unattended**
  - Remote & scattered location of edge TIC nodes
  - Remote orchestration & management are needed
- **Resource Heterogeneity**
  - Various services: MEC, CDN, 5G-UPF
  - Various infrastructure: VM, container, bare metal
- **Acceleration**
  - Low-delay, high-bandwidth services
  - FPGA, GPU, TPU
Open Questions for Edge (1/2)

• **Hardware:**
  - Do we need a specific design of hardware for edge?
  - Central offices for operations varies a lot. For central offices in AP, specifically designed hardware should be necessary due to limited space and power resources

• **OpenStack:**
  - Light weight OpenStack is important for Edge
  - Remote provisioning (cell, Multi-region, or remote compute). For each solution, lots of detailed questions will be raised for integration.

• **SDN**
  - Do we need SDN at Edge?
  - Light weight SDN controller should be necessary for edge
  - How should SDN work with OpenStack in edge, when OpenStack may in a remote mode
Open Questions for Edge(2/2)

• Network
  • Does Edge still need spine-leaf?

• Storage
  • Do we need distributed storage or disk array necessary for edge? Or we just use local disk

• Container
  • Heterogeneous resources at edge, including VM, container and bare metal
  • How should we manage these resources? Using OpenStack or K8S or both?

• Acceleration
  • Lots of acceleration requirements for service at edge, including GPU, FPGA, smart NIC
  • A unified API for all different acceleration resources is necessary so that we can still have the agility feature for virtualization

• Provisioning and operation
  • Remote provisioning is a must for edge, therefore reliability and disaster recovery is important
Progress in Upstreams

• ETSI MEC ISG
  • Requirement analysis
  • Framework design
  • Deployment of MEC in NFV
  • (http://www.etsi.org/deliver/etsi_gr/MEC/001_099/017/01.01.01_60/gr_MEC017v010101p.pdf)

• OpenStack
  • FEMDC SIG https://wiki.openstack.org/wiki/Fog_Edge_Massively_Distributed_Clouds
  • Tricircle: https://wiki.openstack.org/wiki/Tricircle_before_splitting#Massive_distributed_edge_cloud
  • Cyborg: https://wiki.openstack.org/wiki/Cyborg

• Akraino:
  • code designed for carrier-scale edge computing applications running in virtual machines and containers
  • Code release in 2018Q2
  • https://www.akraino.org/

• ONAP
• K8S
• ODL
• ONOS
• Ceph
Edge cloud proposal for OPNFV

• **Purpose for this project:**
  • Focusing on the NFV Platform integration for Edge cloud.
  • Make sure we can have a platform for edge, which can stay homogeneous with core, 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.)
    • Reflect the service requirements into allocation and detail requirement for edge
    • Reflect detail requirement of edge into component requirement (NFVO, VNFM, VIM, Hypervisor, VSW, HW, etc.)
  • Upstream integration
    • Engaged in upstreams
    • Transfer detailed requirement of component to upstreams
    • Promote the work in upstream, and integrate them back into OPNFV releases
    • Focusing on integration issues for edge scenario (e.g. how OpenStack should work with SDN controller in remote compute scenario?)
  • Several release scenarios for Edge
  • Specific testing for Edge
NFV Platform for Edge

**Solution 1: Remote Hypervisor**  
(VxLAN Gateway is necessary)

- Local edge TIC
- VIM
- SDN ctrl
- SDN GW
- VNF
- Regional/access edge TIC
- SDN GW (TBD)

**Advantage:**
- For regional/access TIC, it is not so important to manage the resource
- Multi areas can share the resource

**Disadvantage:**
- Two layer network, low latency
- SDN GW is TBD

**Solution 2: Multi-Region**

- One Regional edge TIC
- Horizon
- Keystone
- VIM
- nova
- neutron
- VNF
- Regional/access edge TIC
- SDN ctrl
- SDN GW

**Advantage:**
- Unified keystone for certification. Tenants management and resource overview can be done in the regional or local TIC.
- Not strict to the network and latency. IP network is OK.

**Disadvantage:**
- Regional/access edges will be deployed with unnecessary VIM part.
- Resource share is impossible
Edge Deployment strategy (2/2)

Solution 3: Cell

Advantage:
• Extend the resource pool to 2000+ or even more
• Not so strict to the network and latency. IP network is OK.
• Have some successful cases in IT industry.

Disadvantage:
• Regional/access edges will be deployed with unnecessary VIM part.
• Migration is impossible
• Solution 3 Can not meet the demand of lightweight edge TIC

Solution 4: Light weight OpenStack

Advantage:
• With light weight OpenStack services in 1-2 vCPU
• Other CPU resources could be shared with VNFs

Disadvantage:
• Impossible for physical separation of management network and service network
• Performance of light weight OpenStack need to reexamined.