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

We did some survey on detailed requirements of following typical edge services:

- CDN, SAE-GW, enterprise vCPE, 5G-UP, MEC, CRAN, 5G-CU, sCPE

Investigated requirement aspects include:

- Time delay, bandwidth, storage, computing server, virtualization layer, acceleration devices
Service Deployment Location

In which DC to deploy service:

- Service E2E delay demand > E2E delay = radio access + transmission + GW + VM
- Service bandwidth demand < Transmission bandwidth

<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.
Constrains that are taken into consideration:

1. Delay: service E2E delay demand > E2E delay
2. Bandwidth: service BW demand < Transmission BW
3. Tradition + compromised consideration of service type, resource, management, security etc.
4. Service's requirement on location

<table>
<thead>
<tr>
<th>Service</th>
<th>CDN</th>
<th>enterprise vCPE</th>
<th>SAE-GW</th>
<th>5G-UP</th>
<th>sCPE</th>
<th>MECP</th>
<th>CRAN-CU</th>
<th>MECP</th>
</tr>
</thead>
<tbody>
<tr>
<td>E2E delay</td>
<td>10ms</td>
<td>50ms</td>
<td>10ms</td>
<td>10ms</td>
<td>10ms</td>
<td>eMBB&lt;10ms</td>
<td>3ms</td>
<td>uRLLC≤3ms</td>
</tr>
<tr>
<td>requirement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bandwidth</td>
<td>≤150GB</td>
<td>&lt;50GB</td>
<td>≤50GB</td>
<td>≥300GB</td>
<td>20GB</td>
<td>20GB</td>
<td>≥300GB</td>
<td>&lt;10GB</td>
</tr>
<tr>
<td>requirement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

City: Delay=4ms, BW=200GB  
County: Delay<2.5ms, BW=100GB  
Access: Delay=2ms, BW=50GB
## Service Requirements on Infrastructure

<table>
<thead>
<tr>
<th>Service</th>
<th>CDN</th>
<th>enterprise vCPE</th>
<th>SAE-GW</th>
<th>5G-UP</th>
<th>sCPE</th>
<th>MECP</th>
<th>CRAN-CU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceleration</td>
<td>SR-IoV/DPDK</td>
<td>SR-IoV</td>
<td>SR-IoV</td>
<td>SR-IoV, Smart NIC</td>
<td>SR-IoV</td>
<td>SR-IoV, Smart NIC</td>
<td>QAT, FPGA</td>
</tr>
<tr>
<td>Storage magnitude</td>
<td>K TB</td>
<td>&lt;200GB</td>
<td>≤500GB</td>
<td>TB</td>
<td>TB</td>
<td>100GB</td>
<td>Local disk</td>
</tr>
<tr>
<td>Container</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>Need in the future</td>
<td>Need</td>
<td>Need</td>
<td>/</td>
</tr>
<tr>
<td>Computing server #</td>
<td>&lt; 50</td>
<td>1</td>
<td>&lt; 50</td>
<td>&gt;50</td>
<td>&lt; 20</td>
<td>Depend on applications</td>
<td>&lt;50</td>
</tr>
<tr>
<td>Storage server #</td>
<td>≥100</td>
<td>Few</td>
<td>Few</td>
<td>Few</td>
<td>Few</td>
<td>Few</td>
<td>Few</td>
</tr>
</tbody>
</table>

### Summary

**City-level DC:**
- Number of servers: a few hundred
- **Acceleration devices:** SR-IoV, Smart NIC
- **Container:** not needed for now, but suggested to be deployed in the future
- Distributed storage: needed

**County-level DC:**
- Number of servers: a few dozen
- **Acceleration devices:** SR-IoV, Smart NIC, FPGA etc.
- **Container:** needed
- Small demand on storage server, relative large demand on computing server

All data of a service are based on a typical scenario for that service.
Edge Requirement – Infrastructure

Hardware: acceleration resources including SR-IoV, SNIC, FPGA…

- Resource to be virtualized
- OpenStack to manage acceleration devices and virtualized acceleration resources
- NFVO, VNFM to manage the lifecycle of acceleration resource
- Unified API for hypervisor to shield the difference of HW and to use resources from different provider

Virtualization layer: container

- Three types: only container, container+VM?, container in VM
- O & M: cooperate with hybrid VIM on remote lifecycle management of both container and VM e.g. VNF launch, start, stop, scale, recover, status monitor and etc.
- VIM: OpenStack cooperate with K8S on managing VM & container lifecycle (images, configuration, scheduling, deployment, resume, migration and shutdown)
## DC Conditions

<table>
<thead>
<tr>
<th>DC Level</th>
<th>Access</th>
<th>County</th>
<th>City</th>
</tr>
</thead>
<tbody>
<tr>
<td>Server #</td>
<td>1 ~ 20</td>
<td>20 ~ 60</td>
<td>≥200</td>
</tr>
<tr>
<td>DC Area ($m^2$)</td>
<td>Several to dozens</td>
<td>Dozens to few hundreds</td>
<td>Hundreds</td>
</tr>
<tr>
<td>Power (KW)</td>
<td>A few KW</td>
<td>Less than 20KW</td>
<td>&gt; 20KW</td>
</tr>
</tbody>
</table>

**Access-level DC:** 1 or 2 racks, server number less than 10, most resources occupied by service

→ not enough resource to fully install control component

**County-level DC:** 20~60 servers, no operator

→ need control node and remote control

**DC physical facility conditions:** limited space, power, cooling system, building structure

→ need edge customized server which is lighter in weight, smaller in size and cost fewer power
Edge Requirement – Management

OpenStack:
- **Light weight OpenStack**: Super small edge cloud sites with few nodes, limited resource for control component
- **Remote OpenStack**: medium-size edge cloud sites, no O&M ability
- **No operator for county-level, access-level DC**
  - City-level OpenStack provides remote provisioning, remote upgrade, remote monitor, remote lifecycle management
- **Shared resource pool**: share projects and users among sites, use remote-attached volume, migration between sites
- **Network**: maintain reliable network between upper-level site and lower-level sites

SDN:
- **Remote SDN controller**
- **Light weight SDN controller**

https://wiki.openstack.org/wiki/OpenStack_Edge_Discussions_Dublin_PTG#Requirements
Summary

Requirements:
1. Hardware: acceleration, customized hardware
2. Virtualization layer: container, K8S
3. OpenStack: remote OpenStack, light weight OpenStack
4. SDN: remote SDN controller, light weight SDN controller

What’s next:
More detailed requirements should be addressed.
Thank You!