

CNTT Edge - RA01 (OpenStack) Architecture - Scenario

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- CNTT Hybrid Multi-Cloud Architecture (includes Edge)
- CNTT Edge Architecture

Topic Areas:

(RM Chapter 3 new section on Edge Computing w/o OpenStack specifics)

Edge deployment scenarios

Cloud Infrastructure (CI) deployment environment for different edge deployments:

Controlled: Indoors, Protected, and Restricted environments. Data Centers, Central Offices, Indoor venues. Operational benefits for installation and maintenance, and reduced need for hardening/ruggedized.

Exposed: Outdoors, Exposed, Harsh and Unprotected environments. Expensive rugged equipment

Cloud Infrastructure (CI) hardware type for different edge deployments:

Commodity/Standard: COTS, standard hardware designs and form factors. Deployed only in Controlled environments. Reduced operational complexity.

Custom/Specialised: non-standard hardware designs including specialised components, ruggedised for harsh environments and different form factors. Deployed in Controlled and/or Exposed environments. Operationally complex environment.

Cloud Infrastructure (CI) hardware specifications for different edge deployments:

CNTT Basic: General Purpose CPU; Standard Design.

CNTT Network Intensive: CNTT Basic + high speed user plane (low latency, high throughput); Standard Design.

CNTT Network Intensive+ : CNTT Network Intensive + optional hardware acceleration (compared with software acceleration can result in lower power use and smaller physical size); possible Custom Design.

CNTT Network Intensive++ : CNTT Network Intensive + required hardware acceleration; Custom Design.

Server capabilities for different edge deployments and the OpenStack services that run on these servers; the OpenStack services are containerised to save resources, intrinsic availability and autoscaling:

Control nodes host the OpenStack control plane components (subset of [Cloud Controller Services](#)), and needs certain capabilities:

OpenStack services: Identity (keystone), Image (glance), Placement, Compute (nova), Networking (neutron) with ML2 plug-in

Message Queue, Database server

Network Interfaces: management, provider and overlay

Compute nodes host a subset of the [Compute Node Services](#):

Hypervisor

OpenStack Compute nova-compute (creating/deleting instances)

OpenStack Networking neutron-l2-agent, VXLAN, metadata agent, and any dependencies

Network Interfaces: management, provider and overlay

Local Ephemeral Storage

Storage Nodes host the cinder-volume service. Storage nodes are optional and required only for some specific Edge deployments that need large persistent storage:

Block storage cinder-volume

Storage devices specific cinder volume drivers

Cloud partitioning: Host Aggregates, Availability Zones

[OpenStack Edge Reference Architecture](#) provides more depth and details

Edge Deployments:

- Small footprint edge device: only networking agents
- Single server: deploy multiple (one or more) Compute nodes
- Single server: single Controller and multiple (one or more) Compute nodes
- HA at edge (at least 2 edge servers): Multiple Controller and multiple Compute nodes

SDN Networking support on Edge

(RM Potential Ch 2 as a specialised workload type)

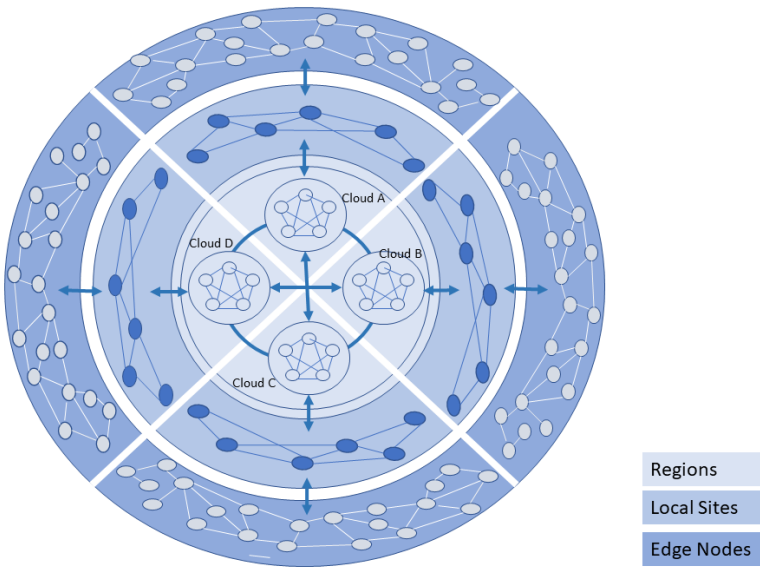
Network Function as a Service (NFaaS)

Higher level services such as Network Functions (includes composition of Network Functions to form higher level services) offered on Telco and other clouds (HCP, specialised, etc.). While here the discussion is about NFaaS, this is equally applicable to anything as a service (XaaS)

- NFaaS offered on one or more Cloud Services (Telco, HCP, others) including at the Edge
 - Network integration and Service Chaining
 - Security Considerations including delegated User Authentication & Authorization
 - Commercial arrangements including User Management

(RM Ch03 as a sub-section of Introduction)

Hybrid Multi-Cloud Enabled Edge Architecture



(PG: In the above diagram, replace "Local" with "Metro")

- The Telco Operator may own and/or have partnerships and network connections to utilize multiple Clouds
 - for network services, IT workloads, external subscribers
 - On Prem Private
 - Open source; Operator or Vendor deployed and managed | OpenStack or Kubernetes based
 - Vendor developed; Operator or Vendor deployed and managed | Examples: Azure on Prem, VMWare, Packet, Nokia, Ericsson, etc.
 - On Prem Public: Commercial Cloud service hosted at Operator location but for both Operator and Public use | Example: AWS Wavelength
 - Outsourced Private: hosting outsourced; hosting can be at a Commercial Cloud Service | Examples: Equinix, AWS, etc.
 - (Outsourced) Public: Commercial Cloud Service | Examples: AWS, Azure, VMWare, etc.
 - Multiple different Clouds can be co-located in the same physical location and may share some of the physical infrastructure (for example, racks)

Type	System Developer	System Maintenance	System Operated & Managed by	Location where Deployed	Primary Resource Consumption Models

Private (Internal Users)	Open Source	Self/Vendor	Self/Vendor	On Prem	Reserved, Dedicated
Private	Vendor HCP	Self/Vendor	Self/Vendor	On Prem	Reserved, Dedicated
Public	Vendor HCP	Self/Vendor	Self/Vendor	On Prem	Reserved, On Demand
Private	HCP	Vendor	Vendor	Vendor Locations	Reserved, Dedicated
Public (All Users)	HCP	Vendor	Vendor	Vendor Locations	On Demand, Reserved

- Each Telco Cloud consists of multiple interconnected Regions
- A Telco Cloud Region may connect to multiple regions of another Telco Cloud (large capacity networks)
- A Telco Cloud also consists of interconnected local sites (multiple possible scenarios)
- A Telco Cloud's local site may connect to multiple Regions within that Telco Cloud or another Telco Cloud
- A Telco Cloud also consists of a large number of interconnected edge nodes
- Edge nodes may be impermanent
- A Telco Cloud's Edge node may connect to multiple local sites within that Telco Cloud or another Telco Cloud; an Edge node may rarely connect to an Telco Cloud Region

(RM Ch03 the new Edge Section)

Comparison of Edge terms from various Open Source Efforts

	Characteristics											Other	
CNTT Term?	Compute	Storage	Networking	RTT*	Security	Scalability	Elasticity	Resiliency	Preferred Workload Architecture	Upgrades		OpenStack	OPNFV Edge
Regional Data Center (DC)	1000's	10's EB	>100 Gbps	~100 ms	Highly Secure	Horizontal and unlimited scaling	Rapid spin up and down	Infrastructure architected for resiliency	Microservices based	HW Refresh: ?		Central Data Center	
Fixed	Standardised	Standardised	Standardised					Redundancy for FT and HA	Stateless	Firmware: When required			
	>1 CPU	HDD and NVMe							Hosted on Containers	Platform SW: CD			
	>20 cores /CPU	Permanence											
Metro Data Centers	10's to 100's	100's PB	> 100 Gbps	~10 ms	Highly Secure	Horizontal but limited scaling	Rapid spin up and down	Infrastructure architected for some level of resiliency	Microservices based	HW Refresh: ?		Edge Site	Large Edge
Fixed	Standardised	Standardised	Standardised					Redundancy for limited FT and HA	Stateless	Firmware: When required			
	>1 CPU	NVMe on PCIe							Hosted on Containers	Platform SW: CD			
	>20 cores /CPU	Permanence											
Edge	10's	100 TB	50 Gbps	~5 ms	Low Level of Trust	Horizontal but highly constrained scaling, if any	Rapid spin up (when possible) and down	Applications designed for resiliency against infra failures	Microservices based	HW Refresh: ?		Far Edge Site	Medium Edge
Fixed / Mobile	Some Variability	Standardised	Standardised					No or highly limited redundancy	Stateless	Firmware: When required			
	>=1 CPU	NVMe on PCIe							Hosted on Containers	Platform SW: CD			
	>10 cores /CPU	Permanence / Ephemeral											
Mini-/Micro-Edge	1's	10's GB	10 Gbps	<2 ms	Untrusted	Limited Vertical Scaling (resizing)	Constrained	Applications designed for resiliency against infra failures	Microservices based or monolithic	HW Refresh: ?		Fog Computing (Mostly deprecated terminology)	Small Edge
Mobile / Fixed	High Variability	NVMe	Connectivity not Guaranteed	Located in network proximity of EUD /IoT				No or highly limited redundancy	Stateless or Stateful	Firmware: ?		Extreme Edge	
	Harsh Environments	Ephemeral							Hosted on Containers or VMs	Platform SW: ?		Far Edge	
	1 CPU	Caching							Subject to QoS, adaptive to resource availability, viz. reduce resource consumption as they saturate				
	>2 cores/CPU												

*RTT: Round Trip Times
EUD: End User Devices
IoT: Internet of Things

Glossary

- [State of the Edge](#)