Edge Cloud and Multi-Access Edge Compute
CKN Session – Data Centre

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Edge Computing: Many Perspectives !!!

Centralized DCs / Clouds

- SP Edge Cloud
- IOT Edge Cloud
- Ent Edge Cloud
- Public Cloud Providers @Edge

Cloud Services Edge

- IoT Edge
- Enterprise Edge

Edge on the Devices

SP Multi-access Edge
Edge Cloud and Multi-Access Edge Computing

Edge computing aims to increase the customer experience through ultra-reliable low-latency services, increases in transport network efficiency, enabling CDN and offload capabilities and creating the foundation for 5G, and O-RAN networks.

In this session we will address:

• The Drivers and Requirements for Edge Computing in Service Provider Infrastructure
• The Cisco Solution to build the Edge Cloud and support Distributed Workload Deployments
Drivers & Requirements
Telco Cloud and Edge Computing

(Distributed) Telco Cloud
Virtualized Telecom infrastructure, that is distributed from Central Data Centers to Far Edge with a consistent management framework, to run any telco apps and services with agile operations.

Edge Cloud or Edge Computing
Distributed computing paradigm that brings computation and data storage closer to the location where it is needed, to improve response times and save bandwidth.

Multi-Access Edge Computing (MEC)
Run-time and hosting environment which provides a set of middleware services and API for applications to run at the edge of the Service Provider networks.

Mainly based on ETSI NFV + Open Source...

Defined by ETSI MEC ISG
Edge Computing and MEC is to improve Customer Experience

**Bandwidth Optimization**
- Content delivery (downstream)
- Surveillance, connected mobility, IoT, edge analytics
- Live event coverage, in-band advertising, AR/VR

**Latency**
- Mass customization
- Live event coverage, in-band advertising, AR/VR
- Virtual and augmented reality

**Proximity**
- Data reduction (upstream)
- Peer-to-peer communication
- Local reliability and survivability

**Edge connectivity and multi-cloud**
- Video, software downloads/updates
- Localization
- Industrial automation
- Surveillance, connected mobility, IoT, edge analytics
- Video, software downloads/updates
- Industrial automation

Enabled by the network edge

Augmented with a “middle-mile”

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Telco cloud is expanding toward the Edge

Access
- Radio head
- vRAN

Edge
- vRAN CU/DU
- 5G User Plane
- 5G Control Plane
- MEC hosting
- Edge CDN
- Video
- Cloud Gaming
- SD-WAN/VPN
- IMS, Policy, OTT Caches
- OTT Edge DC
- Edge DC
- Far Edge DC
- Central DC
- Internet CDN/Video
- Internet / Public Cloud

Core + Cloud
- CPF
- OTT Edge DC
- Edge CDN
- Video
- Cloud Gaming
- SD-WAN/VPN
- IMS, Policy, OTT Caches

# Locations
- 10,000’s
- 1,000’s
- 100’s
- 10’s
- few

Round Trip Delay
- 150μs
- <10–20ms
- <20–50ms

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Software Defined 5G
Open vRAN & Edge Computing Architecture

Zero Touch, End-to-End Automation with NSO, ESC

IPv6 based 5G Ready Transport Network for Backhaul

~3000 Edge DCs
- vCU
- vDU
- CVIM
- Nexus

~50 Regional DCs
- MEC App
- UPF
- CVIM
- ACI

2 Central DCs
- vIMS
- vEPC
- CVIM
- ACI

Distributed and Common Carrier-Grade Telco Cloud
Software Defined Programmable Infrastructure

Open, Decomposed, and Virtualized RAN

Edge Computing for Enhanced Experience

New Business Models Including B2B Monetization

End-to-end Closed-Loop Automation

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Critical Requirements for Operators Edge Deployments

- Security
- Ability to operationalize and manage the cloud
- Low cost of deployment
- A tech/ops partner to enable the deployment
- Full-stack turn-key tech solution
- Subsidised cost of deployment
- Cross-SP federated edge cloud model

Source: Analysys Mason, 2020
Cisco Telco Cloud Stack for Edge Computing – Architectural Pillars

Operating Model
Service and Infrastructure Lifecycle Management, Automation & Assurance
Tools, processes and skillsets.

Cloud Infrastructure
Edge Deployment Models: HW & VIM
Performances for Telco VNF
Multi-Cloud: VM, Container, BMaaS

Network Services
Seamless WAN+DC Interworking
Centralized & Dist. (Network & Compute)
Consistent Policy and Automation
Hybrid Cloud (Edge, Public, Private Cloud)

Security
Secure Development Process
Network/Application Visibility
Predictive Threat Analytics
Automated Detection and Response
Compliance, Forensic
Cisco Telco Cloud Stack for Edge Computing
Cisco Telco Cloud Stack & VIM at glance

VNF - Cisco fixed & Mobile + 100’s of 3rd Party On-boarded VNF

Pure upstream opensource components

Lifecycle Management

O&M / Monitoring

Security

Neutron, OVS / VPP & intel SRIOV NIC

Cisco Virtual Infrastructure Manager

Cisco UCS Server

Cisco Nexus 9K Fabric

Cisco ACI SDN

Open, Standard, Reliable
Ease VNF on-boarding

Optimized operations
LCM, CVIM-Mon, Network insights

High performance
Optimized settings, ACI+SRIOV
CVIM Edge stack deployment models

Nano-POD  Far-Edge 1000’s

CVIM Edge POD  Edge x 100’s

CVIM Micro POD  Edge/Regional 10’s

CVIM Full POD  Regional/Central few

Full featured Openstack deployment at each layer
Far Edge optimized stack: Edge POD

- Edge optimized: Openstack “zero” core overhead
- VRAN ready: supports specialized FPGA NICs, GPU
- VRAN ready: Real-time kernel for time sensitive VNFs like vRAN vDU
Enhance with new hardware & software

Enhance with Bare-metal & Containers

TOR Switches

Server

Servers

Servers

Servers

TOR Switches

Management Node

Control Nodes

Storage Nodes

Compute Nodes

Virtual Network Functions / Applications

Inception

Cloud definition

Input validation

Mgmt Node Orchestration

Validation

Bare-metal deployment

Operating system setup

Storage setup

Openstack orchestration

Test app deployment

Firmware upgrade

Software Reconfigure

Software patch

Software upgrade

Add hardware

Replace hardware

Monitoring/Alerting

Logging

Enhance with Bare-metal & Containers

Enhance with new hardware & software

CVIM: Deploy → Operate → Evolve
Cisco UCS Edge optimized (UCS C240-SD)

Optimized Design for Edge Deployment

- 600mm ETSI Rack
- Central Management
- NEBS Compliant

Hardware accelerators for vRAN & MEC workloads

- GPU & FPGA
- 6x PCIE NIC
- Full NVME storage
Cloud-Based Systems Management as-a-Service

Centralized Management
- Global Policies

Intuitive experience

Enhanced Support

Proactive Guidance

Secure and Extensible

SaaS or Connected Appliance

Comprehensive Automation
- Single Pane of Glass

SaaS Simplicity

Actionable Intelligence
ACI Architecture for 5G and Edge Computing

Automation with Consistent Policy

Remote Leaf/Edge DC

MPLS/SR

ACI On-Premises

Cloud ACI

Edge / Remote DC

Regional/Central Location

Public or Private Cloud

Security

Network Insight

Proactive Support

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ACI Remote leaf – lean Edge & central SDN

Stretches an ACI Fabric across the WAN (up to 1000’s when combined with MSO)
ACI Segment Routing for E2E slicing

- Seamless integration to WAN services (local WAN breakout, L3VPN/EVPN enterprise interworking)
- Interwork with MPLS-SR / ODN to trigger traffic engineering policies based on application profile
  - Low latency service slice (eg URLLC service type)
  - Secure (eg encrypted links, high availability, data sovereignty)
Hybrid Cloud MEC use case
Scope of Orchestration and Automation
For both Infrastructure and Service Lifecycle Management

**Day 0**
- Infra/Site/POD Onboarding
- VNF Onboarding
- VNF Instantiation

**Day 1**
- Network Provisioning
- DC Provisioning
- Cloud Provisioning
- VNF and Service Provisioning
- Licensing
- Service Activation

**Day 2-N**
- Auto Healing
- Auto Healing with Restoration
- App/VNF Patching
- Minor Cloud / infra update
- Major Cloud / infra upgrade
- Composite upgrade (infra + VNF)
- Auto Scale out
- Dynamic Re-Provisioning
- Security management
- Licensing management
- Rollback (for many things)

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Mostly Operations Focused
Distributed Telco Cloud Orchestration: Cisco NSO

Model-driven, end-to-end service lifecycle and customer experience focused

Seamless integration with northbound tooling

Loosely-coupled and modular architecture leveraging open APIs and standard protocols

Orchestration across multi-domain and multi-layer for network-wide, centralized policy and services

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Example of Day 0 Lifecycle Management
Not only CVIM POD, but Zero Touch Provisioning of an entire Edge Data Center

Outcome – 250+ edge data centers got deployed in ~20 days, 20 Edge DC on a single day was achieved!
ETSI MANO Standard Compliance
NSO, ESC and CVIM and 3rd Parties

- SOL001 used for all VNFDs (Cisco & 3rd Party)
- SOL003 used for VNF lifecycle management

**OSS/BSS/Business Process Automation**
- Single API-based entry point for VNF lifecycle
- Model-driven APIs for multi-vendor service agility

**NSO-NFVO**

**ETSI SOL003**
- VNF Lifecycle Management Interface

**Cisco ESC (VNFM)**

**Cisco VIM**
- Cisco VNFS
- 3rd Party VNFS

**3rd Party EMS**

**3rd Party VNFM**
- 3rd Party VNFS

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Layered Orchestration Architecture to Support vRAN and MEC

Central DCs

A-A ESCs

Edge / Far Edge DC - 1000’s

VNFs - 10,000’s
Security Challenges in an Edge Computing Environment

The true pain point is policy lifecycle management

Appliances / VMs in Central DCs

Vs.

Micro-services in Public Cloud

How do I generate the policy?
How do I maintain the policy?

Micro-services in Edge DCs

Micro-services in Enterprise Private Cloud

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Edge Computing Security Enhance with AI/ML

- NFVI & DCN Hardening, Segmentation, RBAC, Key Management
- Workload Protection & Policy Enforcement (Application Layer)
- Enhanced Visibility & Threat Detection (Networking Layer)

Tetration

Stealthwatch

CVIM, ACI

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Network level Security Analytics with Stealthwatch

- **Contextual network-wide visibility**: Agentless, using existing network and cloud infrastructure, even in encrypted traffic.
- **Predictive threat analytics**: Combination of behavioral modeling, machine learning and global threat intelligence from Talos.
- **Automated Detection and Response**: High-fidelity alerts prioritized by threat severity with ability to conduct forensic analysis.

Stealthwatch

- Network Telemetry
- Network Telemetry
- Cloud Telemetry

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- **Edge DCs**
- **Central DCs**
- **Public Cloud**

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Application level Security in a Multi-Cloud Environment with Tetration
Summary & Take-aways
Edge Cloud – Architectural Pillars

Operating Model
NSO, ESC
CVIM-MON, DC Network Insight, Intersight

Cloud Infrastructure
CVIM
UCS Edge

Network Services
ACI/Nexus9K
Segment Routing

Security
Stealthwatch
Tetration
## Cisco Telco Cloud Stack Benefits for Edge Computing

<table>
<thead>
<tr>
<th>Pre-Integrated, yet Open</th>
<th>Faster TTM &amp; reduced risk in deployment, Open to any 3rd Party MEC Platform and Applications / VNFs</th>
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</thead>
<tbody>
<tr>
<td>Optimized for 5G &amp; Edge</td>
<td>VIM and SDN footprint minimized for Edge (CVIM Micropod, Edgepod, Nanopod, ACI Remote Leaf, no SDN host overlay...), vRAN Support</td>
</tr>
<tr>
<td>Best of Breed</td>
<td>Every component is best of breed in its category (NSO, CVIM, UCS &amp; ACI...), composable architecture for multiple deployment models</td>
</tr>
<tr>
<td>Security</td>
<td>Multi-Cloud Security scaling to Edge Business needs (Stealthwatch Security Analytics, Tetration Workload Protection, NFVI Hardening...)</td>
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<tr>
<td>Evolved Operating Model</td>
<td>Full Life Cycle Management of the Infrastructure and VNF with Zero Touch Provisioning (Day0, Day1 and DayN operations)</td>
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![Diagram showing Far-Edge, Edge, Core, and Cloud with a timeline concept]
Continue the Journey

https://www.analysysmason.com/research/content/white-papers/edge-computing-strategies-rma16/

Cisco Edge Computing

Cisco Virtualized Infrastructure Manager

Cisco Application Centric Infrastructure

Cisco Network Services Orchestrator

Cisco SecureX