Cloud Services Architecture

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Characteristics of Cloud Services*

- Combining connectivity and applications with compute, storage and networking resources;
- Consisting of network functions implemented using just non-virtualized components (e.g., PNFs) or both virtualized components (e.g., VNFs) and non-virtualized components (e.g., PNFs);
- Consisting of applications implemented using virtualized components such as VMs, Containers, and CNFs/VNFs;
- Consisting of connections provided by one or more Cloud Operator(s) and Connectivity Operator(s);
- Ability for the Cloud Subscriber to modify the Cloud Service dynamically within pre-agreed limits;
- Supporting dynamic scalability of resources;
- Supporting service monitoring and usage-tracking by Cloud Subscribers;
- Collaboration among Connectivity and Cloud Operators in providing resources;
- Supporting various high availability options from physical layer to application layer; and
- Supporting “pay as you use” (i.e. usage based billing).

*MEF 68 “Cloud Services Architecture”, June 2021
Cloud Services provided by Cloud Providers

Cloud Services

Cloud Service Provider

Cloud Operator-A

Cloud Operator-B

Connectivity Operator-A

Connectivity Operator-B

Cloud Subscriber

Applications and Network

Internet

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Cloud Service Example
Cloud ENNI

Connectivity Operator

Cloud Operator

Cloud Operator–Operator Interface (Cloud ENNI) Reference Point
Cloud ENNI

Cloud Operator A

Cloud Operator B

Cloud ENNI
Cloud UNI and Cloud ENNI

- L7-Application Layer
- L6-Presentation Layer
- L5-Session Layer
- L4-Transport Layer
- L3-Network Layer
- L2-Data Link Layer
- L1-Physical Layer

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Connection and Connection EPs

Cloud Subscriber

Applications and Network

Cloud Service Provider

Cloud VC

Cloud UNI

Cloud VC EP

Cloud Application
Connection and Connection EPs (cont.)
Cloud Application Interface

L7-Application Layer
L6-Presentation Layer
L5-Session Layer
L4-Transport Layer
L3-Network Layer
L2-Data Link Layer

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AI/ML
Cloud UNI, ENNI and Application Interface Examples

Cloud Service Provider

Cloud Subscriber

Connectivity Operator (Operator-A)

Operator Cloud VC_A

Cloud Operator (Operator-B)

Operator Cloud VC_B

Cloud UNI

Cloud ENNI

Cloud Application

Operator Cloud VC EP

Cloud Application

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Cloud UNI, ENNI, and Application Interface Examples (cont.)
Cloud UNI Attributes

- UNI Id, Tenant ID, NaaS ID
- Physical Interface: Ethernet, DOCSIS, EPON, GPON, WDM, SONET/SDH, OTN
- MTU
- Connection Multiplexing
- Maximum Number of Connection End Points
- L2 Configuration Attributes, PPP, ....
- L2 SOAM Attributes
- MPLS UNI Attributes [MPLS PVC User-to-Network Interface]
- IPv4 address, IPv6 address
- IP VPN
- L4 attributes
- L5 attributes
- L6 attributes
- L7 attributes
- Interface Level Security
- Operational State, Administrative State
Cloud Application Interface Attributes

- Cloud Application Interface ID, VM ID, List of NaaS IDs
- Interface Protection
- VM/Container Flavor: vCPU, Memory, Disk, Ephemeral Disk for temporary storage
- VM/Container Protection
- MTU
- Connection Multiplexing
- Maximum Number of Connection Termination Points
- VM/Container Portability
- L2 Configuration Attributes, PPP, ...
- L2 SOAM Attributes
- IPv4 address, IPv6 address
- IP VPN
- L4 attributes
- L5 attributes
- L6 attributes
- L7 attributes
- Interface Level Security
  - Operational State
  - Administrative State
Some of vFW Attributes

- **License**
- **VM/Container Flavor:** vCPU, Memory, Disk, Ephemeral Disk for temporary storage
- **Bandwidth**
- **MTU**
- **Addressing mode (static, DHCP), VLAN ID**
- **DNS, NTP**
- **vNIC Name, vNIC Port Number**
- **Affinity-VM/Container or Anti-Affinity-VM/Container**
- **Type of Operation:** Transparent, NAT/Route
- **Intrusion detection, virus detection, web access blocking, anti-spam, botnets, ...**
Some of vR Attributes

• License
• Single tenant, multiple tenants, router IDs
• Routing tables and Interfaces that belong to these routing tables
• Routing table groups
• Static Routing
• Loopback Address
• Multicast, Broadcast, Anycast
• Routing protocol and option configurations
• Per-packet load balancing (equal cost multipath routing)
• Autonomous system numbers
• Autonomous system confederation members for BGP
• ICMP, Bidirectional Forwarding Detection (BFD), BFD Authentication
• Dynamic Routing: RIP (export filters), OSPF (ospf area, vlinks, import filters, authentication type)
• Dynamic Host Configuration Protocol (DHCP) Relay
Cloud VC End Points

- Traffic Management
- Fault Management
- Performance Management
- Protection
- Security
- Examples
  - Cloud UNI ID, Cloud VC ID, Cloud VC EP ID
  - Subnet Address
  - LSP Label
  - DSCP/EXP Mapping
  - Bandwidth Profile
  - Frame/packet counts
  - L2/L3 SOAM Attributes (e.g., MEG Level)
  - Packet encryption
  - Connection Authentication
  - Data confidentiality/privacy
  - Operational & Administrative States
Cloud VC

- Service Level Objectives (SLO)
- Fault Management
- Performance Management
- Protection
- Billing
- Examples
  - MTU
  - Type
  - Connection Start Time
  - Connection Duration
  - Connection Period
  - Redundancy
  - Frame/packet counts
  - Operational State & Administrative State
  - Usage-based billing (e.g., transactional billing)
OAM for Cloud Services

- Quoting, Ordering and Inventory
- Provisioning-Rapid provisioning, resource changing, automated OS reload, remote reboot, etc.
- Performance Management-Periodic measurements, TCA, etc.
- Fault Management-Discovering and monitoring virtual resources, scheduled maintenance, upgrade events, etc.
- Service Availability-Monthly Uptime of four 9s or five 9s
- Unavailable-No external connectivity, Zero read/write I/O, etc.
- Billing-Fixed, Usage Based, etc.
- Testing-Verification of attributes of each interface, connections, cloud services
Thank you.