Cloud Services Architecture

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Distinguished MEF Fellow

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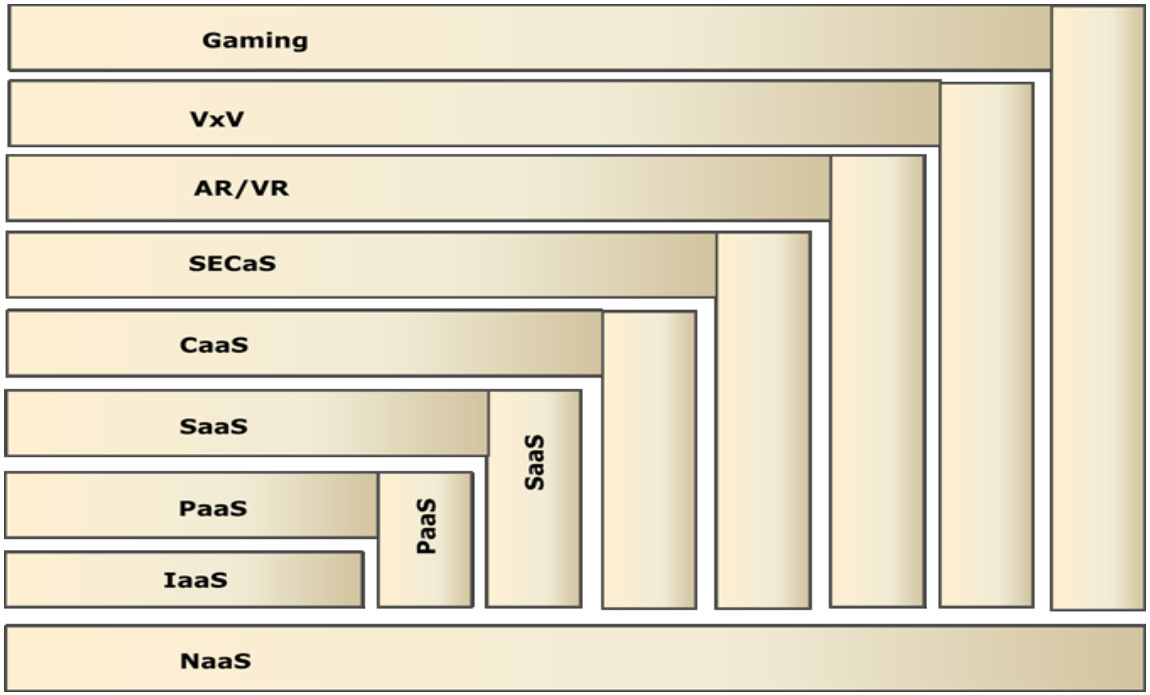
Cloud Services



Characteristics of Cloud Services*

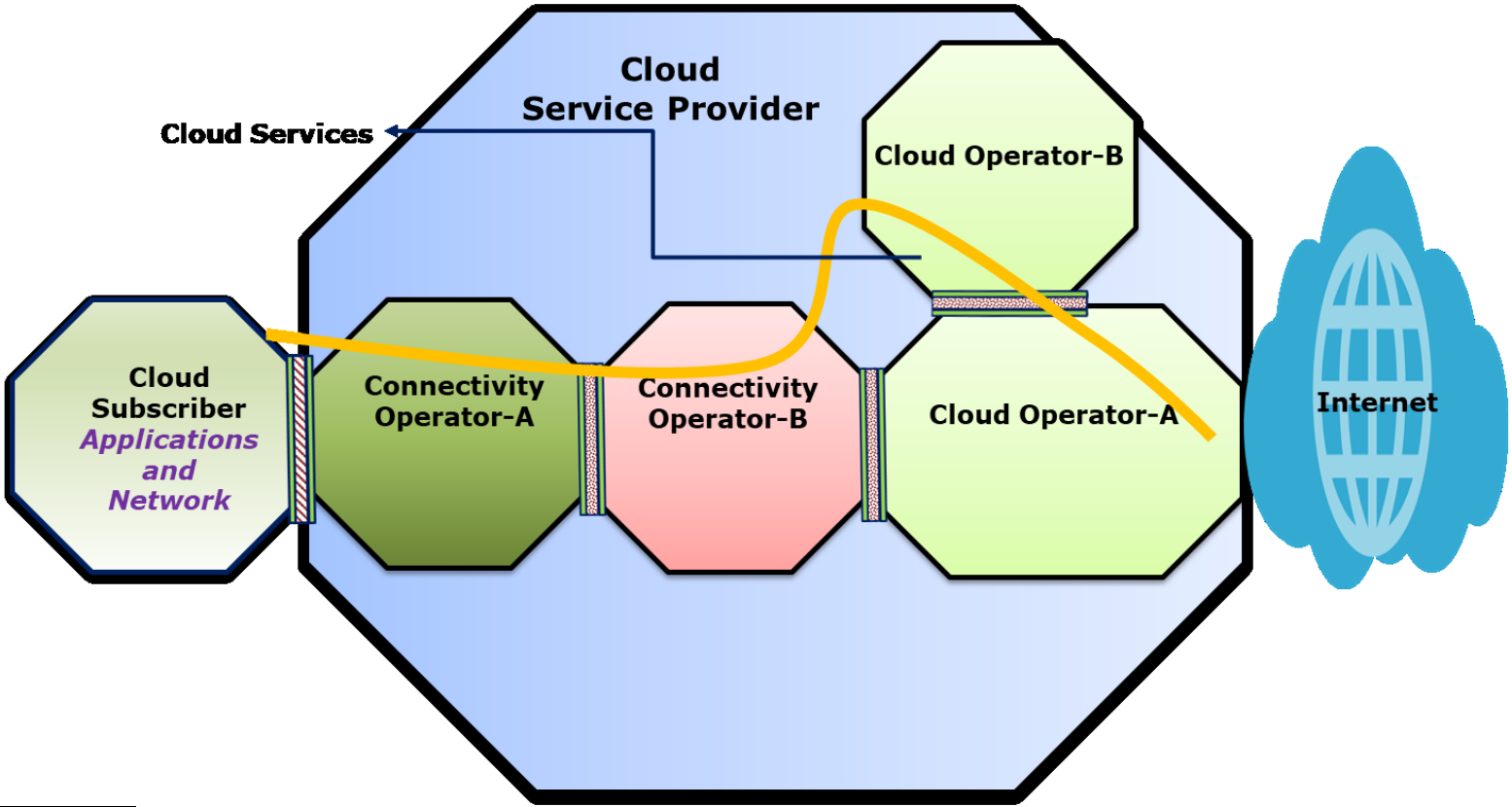
- Combining connectivity and applications with compute, storage and networking resources;
- Consisting of network functions implemented using just non-virtualized components (e.g., PNFs) or both virtualized components (e.g., VNFs) and non-virtualized components (e.g., PNFs);
- Consisting of applications 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*

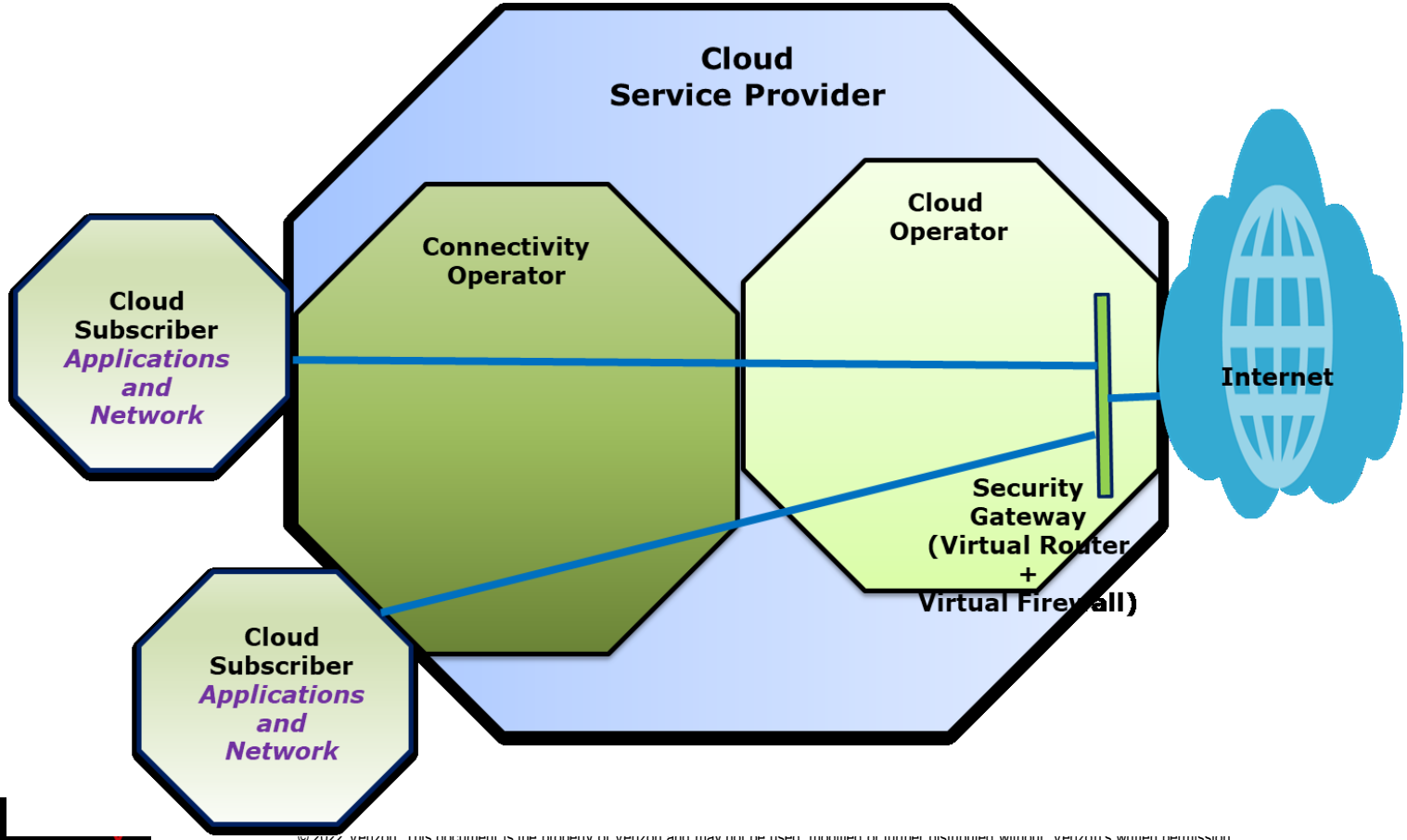
**M. Toy, "Elastic Metro Ethernet and Elastic Cloud Services", Procedia Computer Science, June 2021.*

**M. Toy, "OCC Reference Architecture", December 2014.*

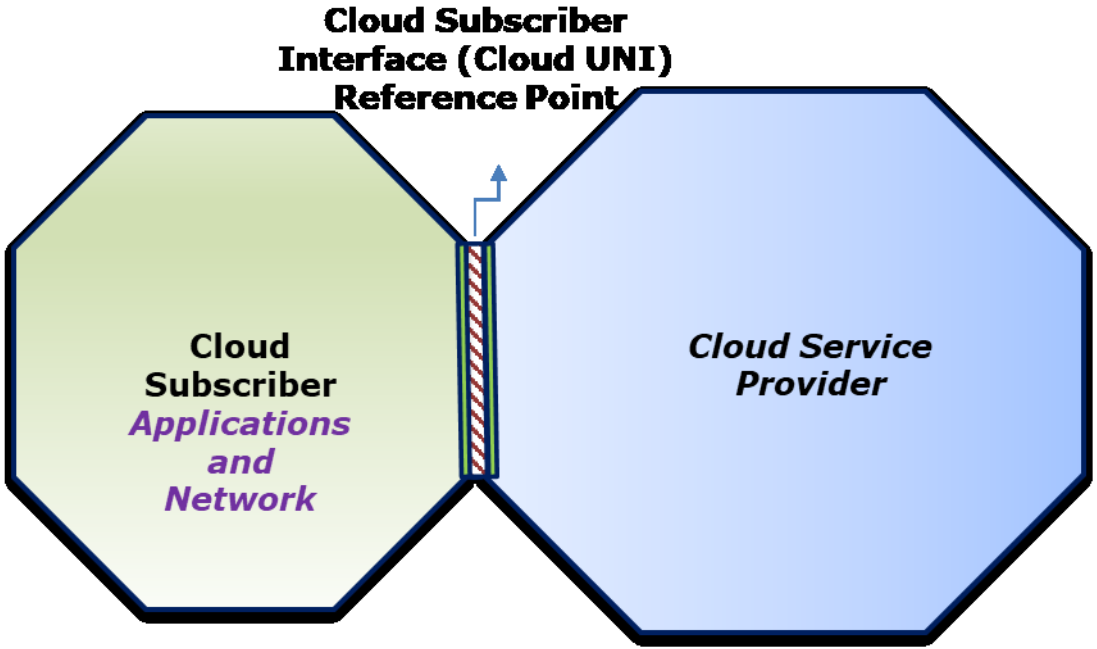
Cloud Services provided by Cloud Providers



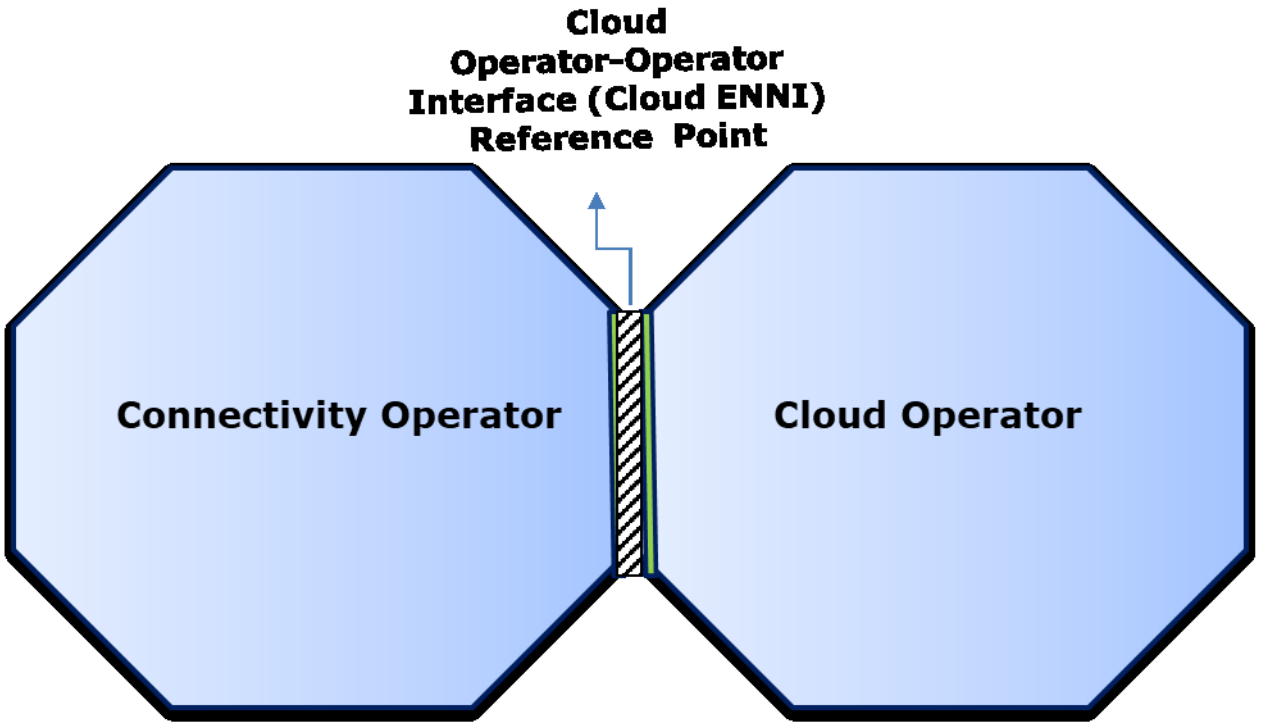
Cloud Service Example



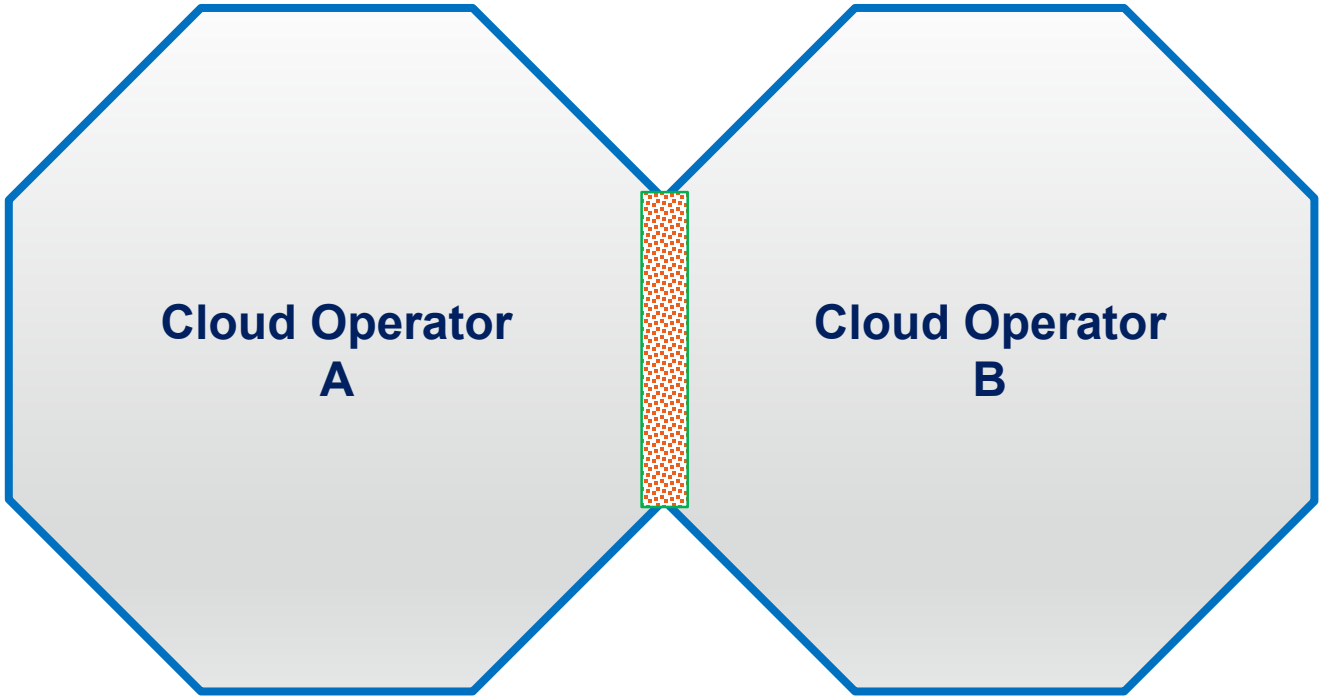
Cloud UNI



Cloud ENNI

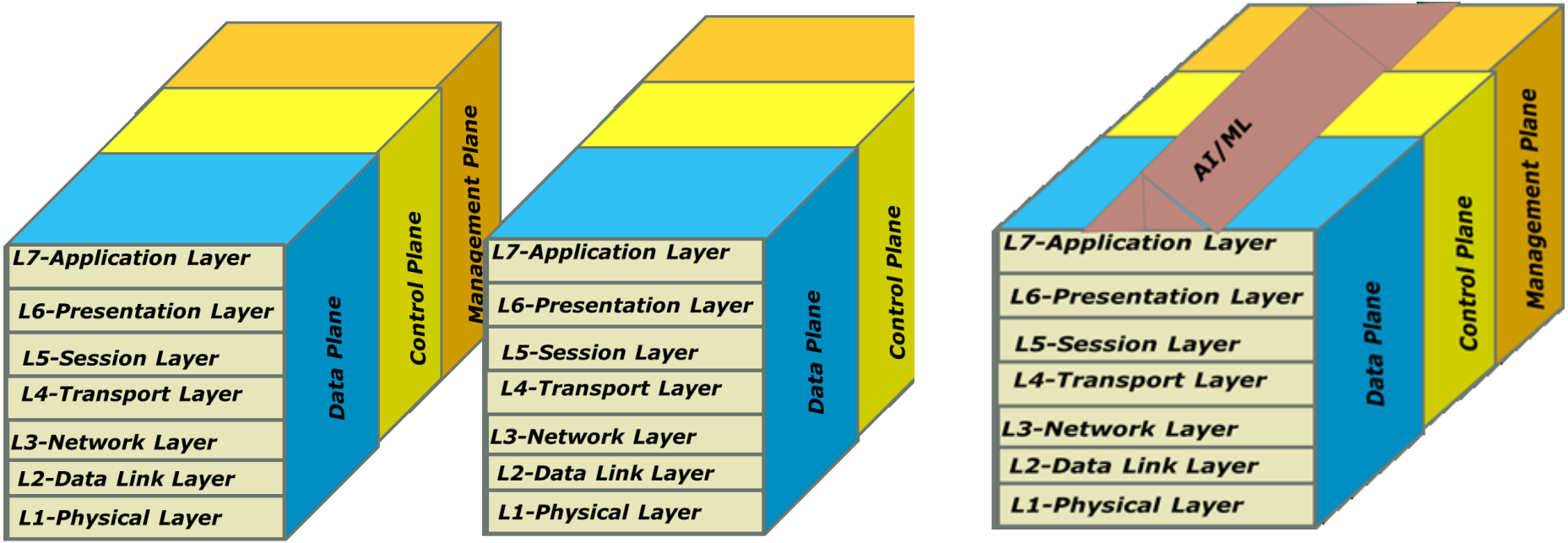


Cloud ENNI

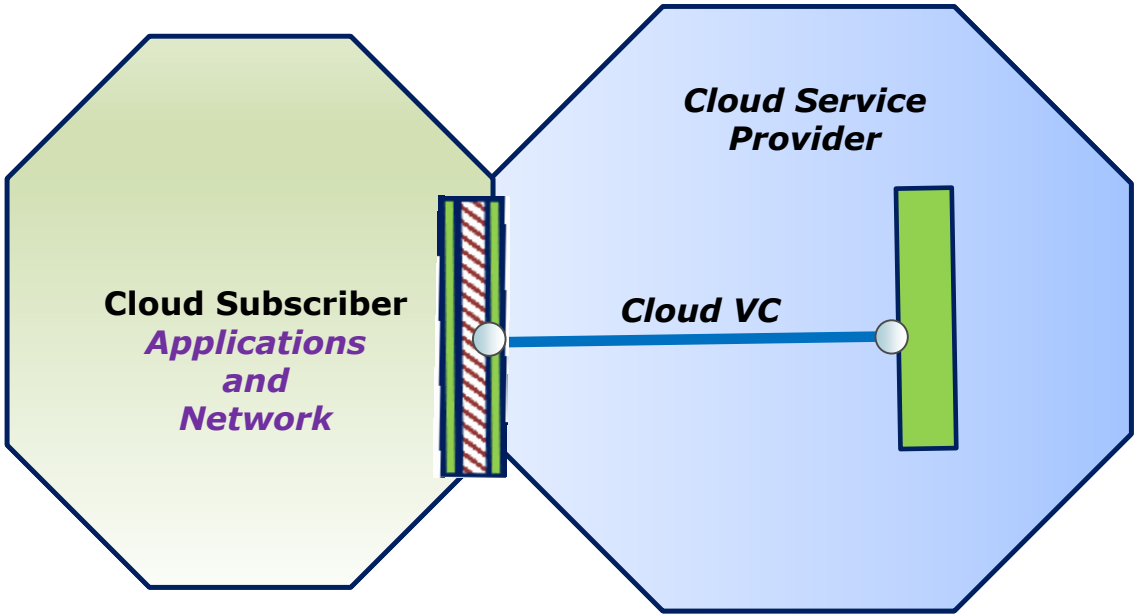


Cloud ENNI

Cloud UNI and Cloud ENNI



Connection and Connection EPs

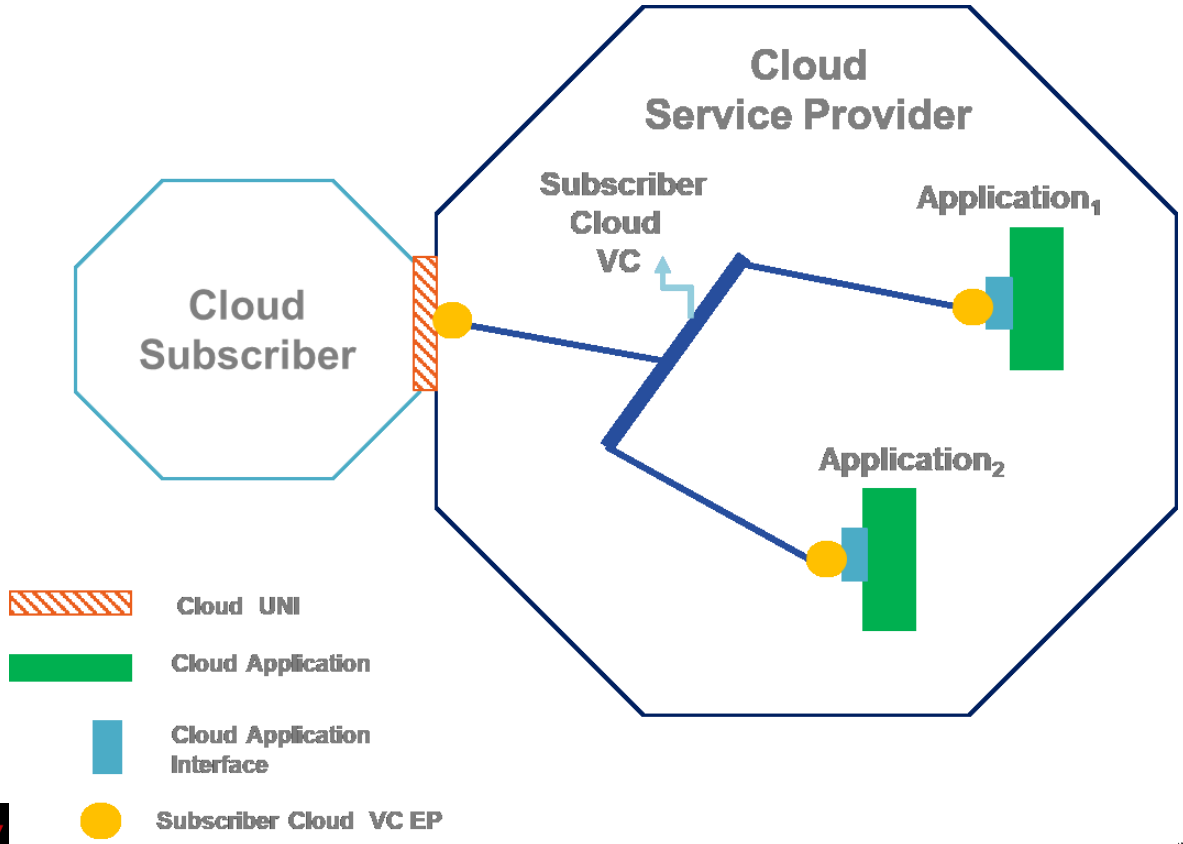


Cloud UNI

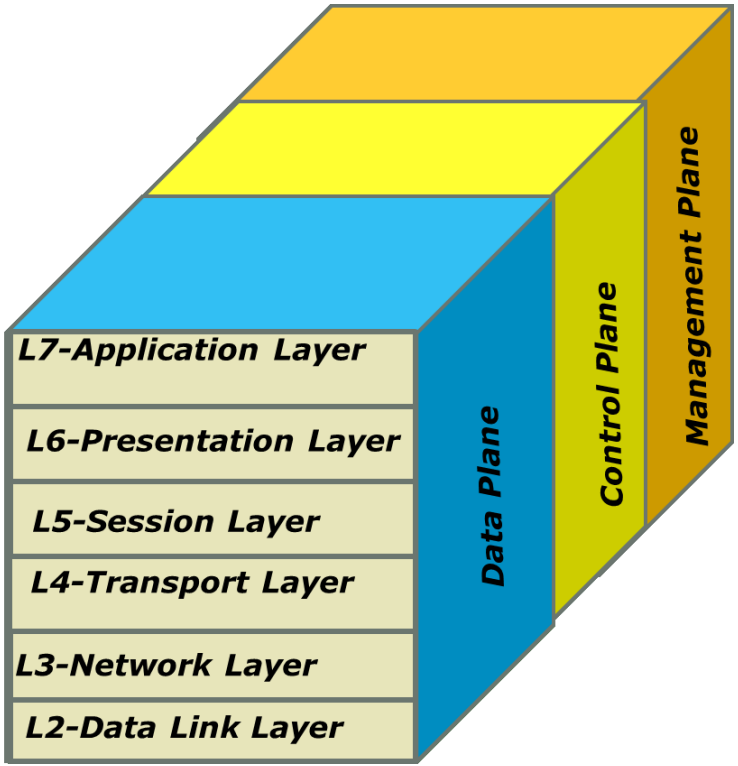
Cloud VC EP

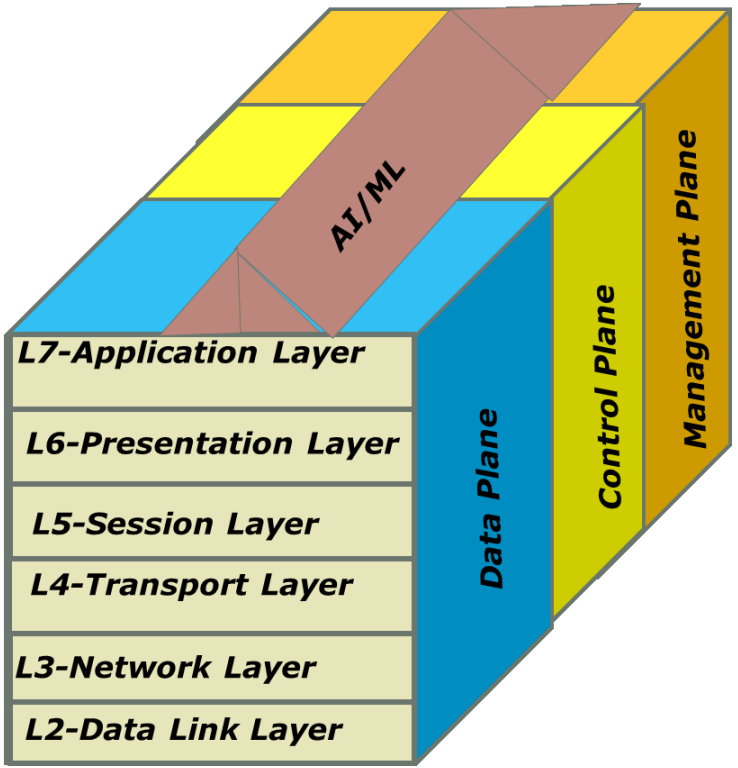
Cloud Application

Connection and Connection EPs (cont.)

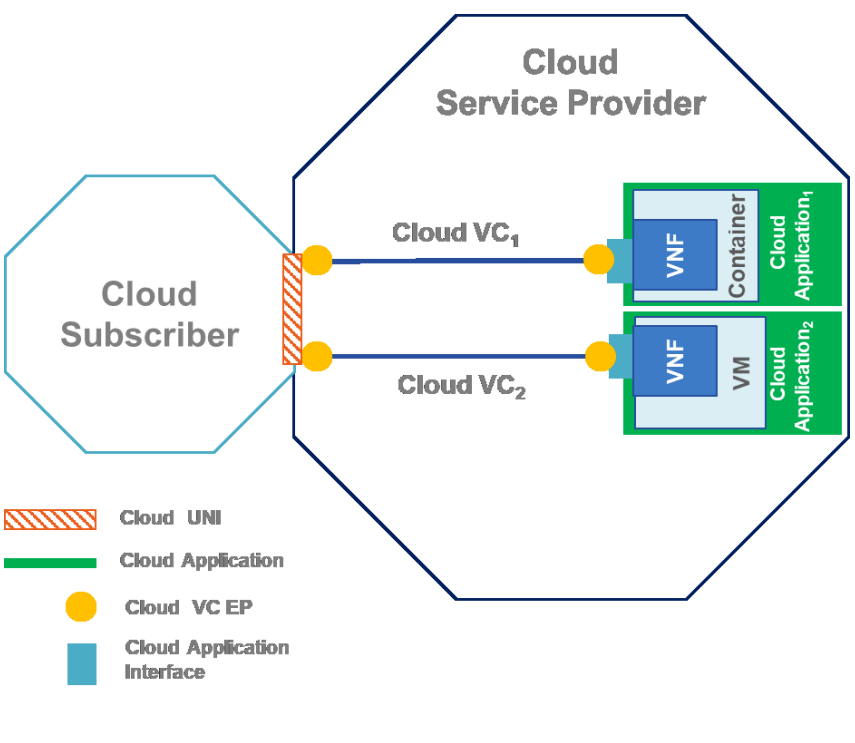


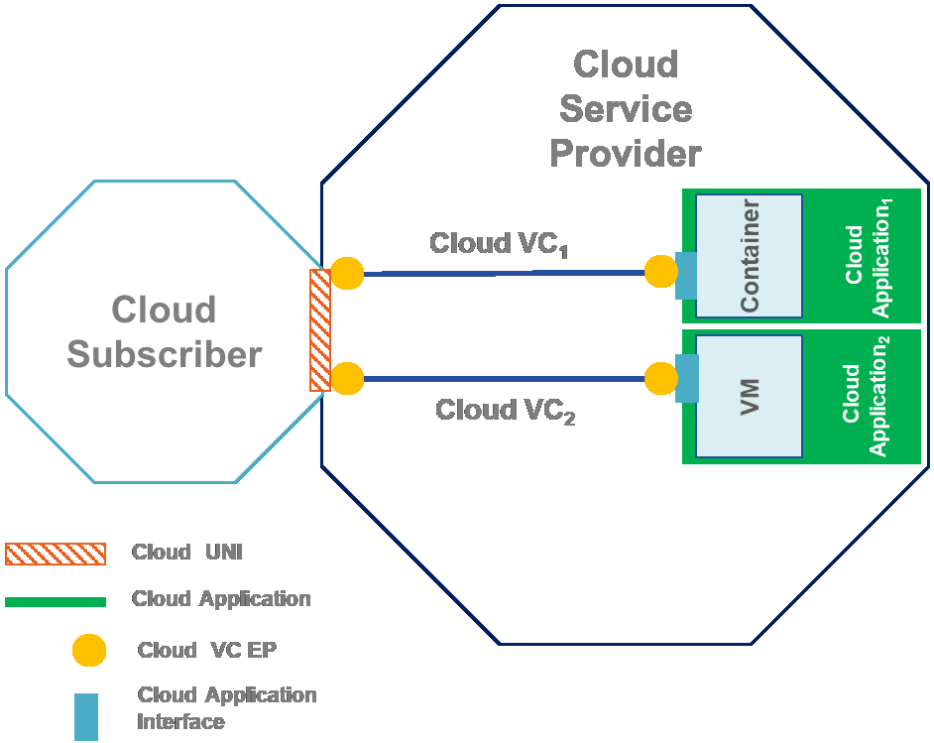
Cloud Application Interface



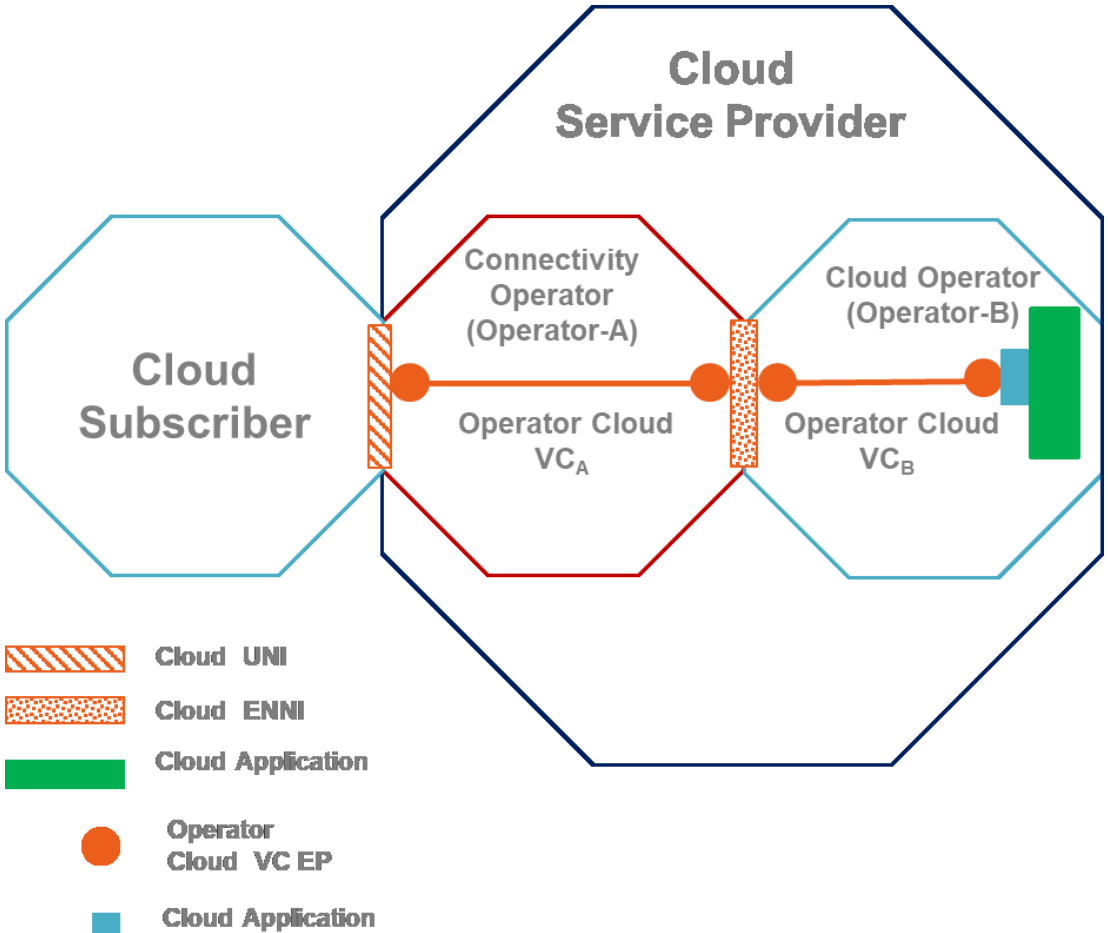


Cloud Application Interface Examples

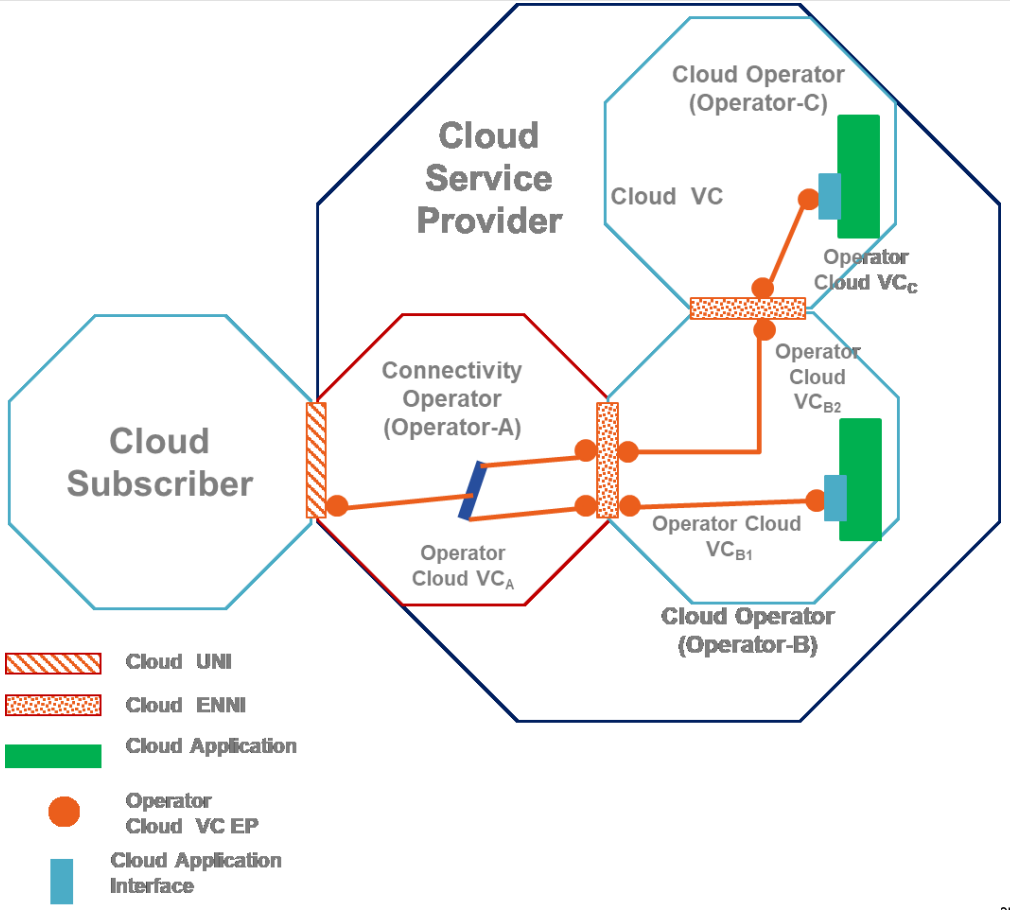




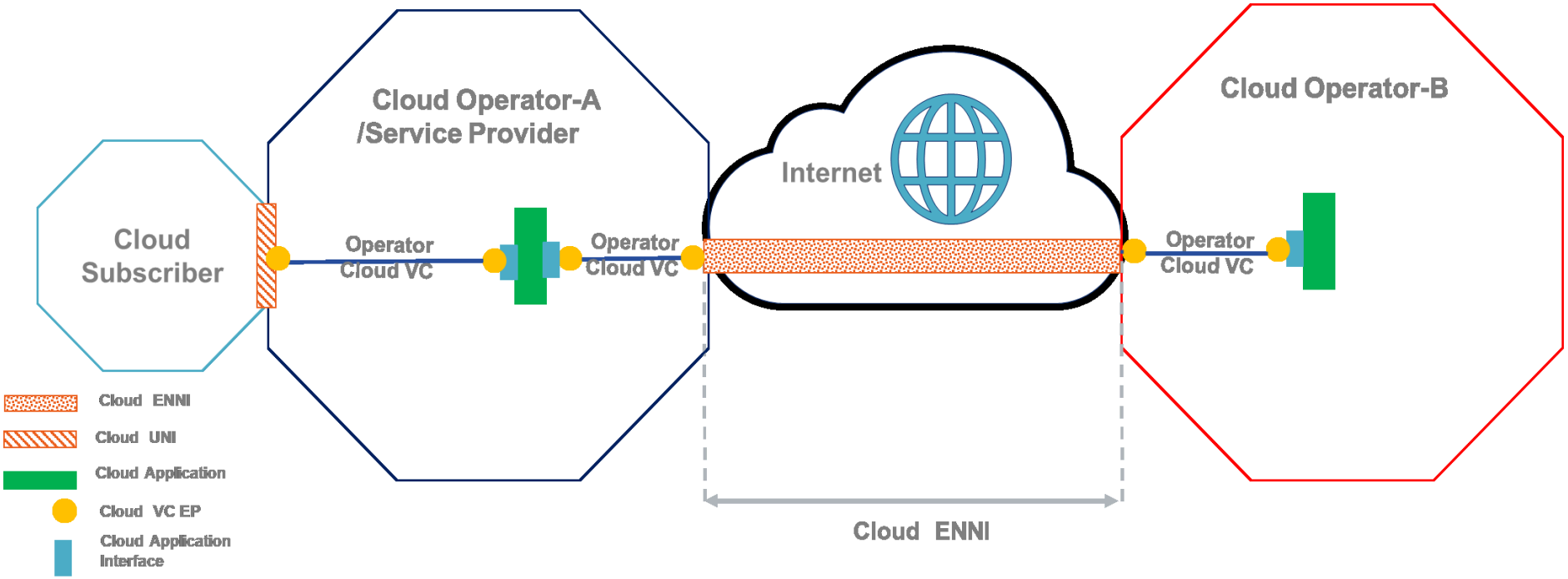
Cloud UNI, ENNI and Application Interface Examples



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



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.

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