

MEF

Cloud Services Architecture

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Verizon

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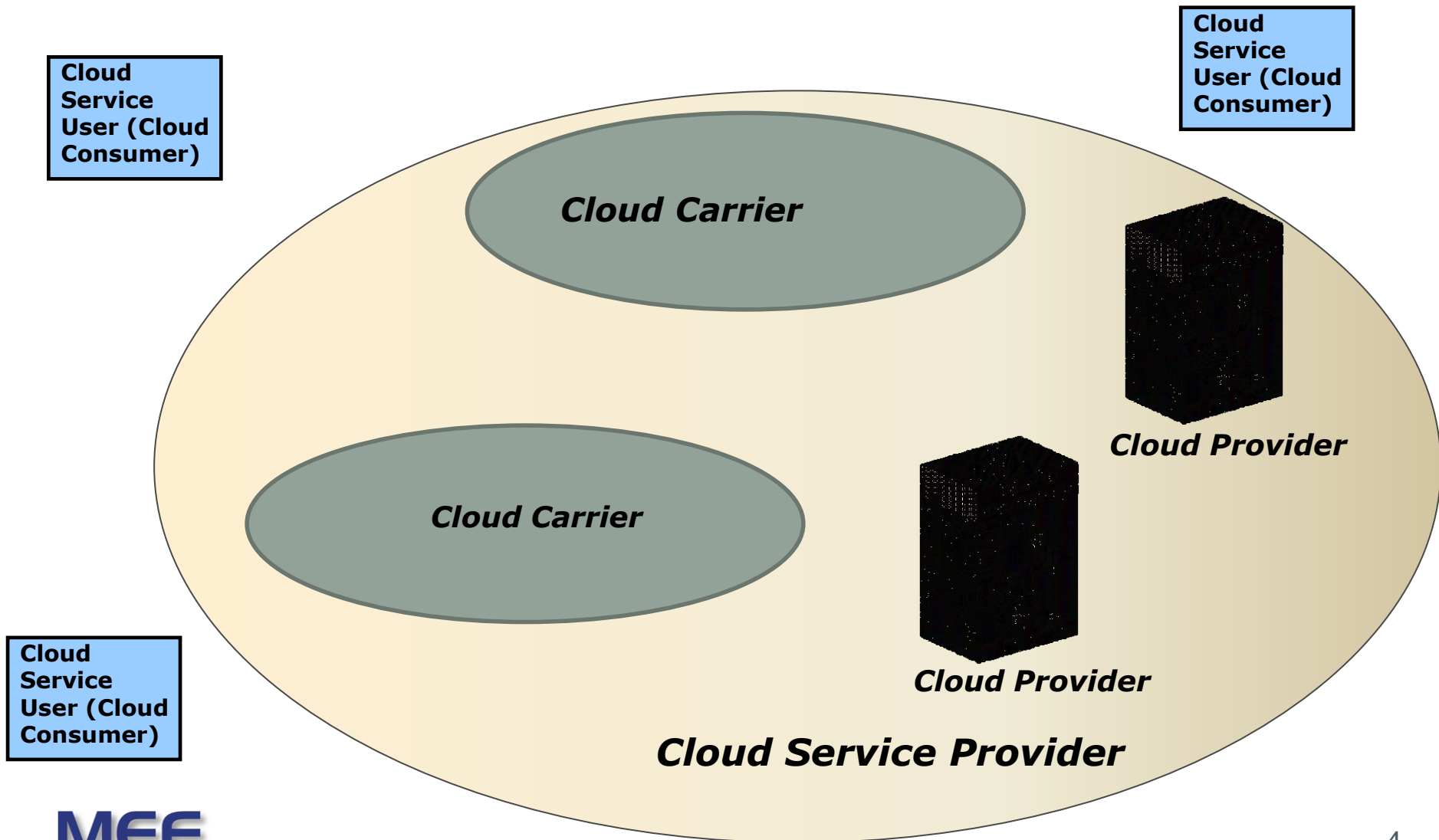
Outline

- ***Cloud Service Actors***
- ***Cloud Service Architectures***
- ***Cloud Service User Interface (cSUI)***
- ***Cloud Service Interface (cSI)***
- ***Cloud Carrier Cloud Provider interface (cCcPI)***
- ***Cloud Service Provider Cloud Service Provider interface (cSPcSPI)***
- ***Exchange GW Examples***
- ***Cloud Service Connections and Connection Termination Points***
- ***Cloud Services***
- ***OAM for Cloud Services***
- ***Mapping Between ETSI NFV and OCC Constructs***
- ***Management Architecture for Cloud Services***

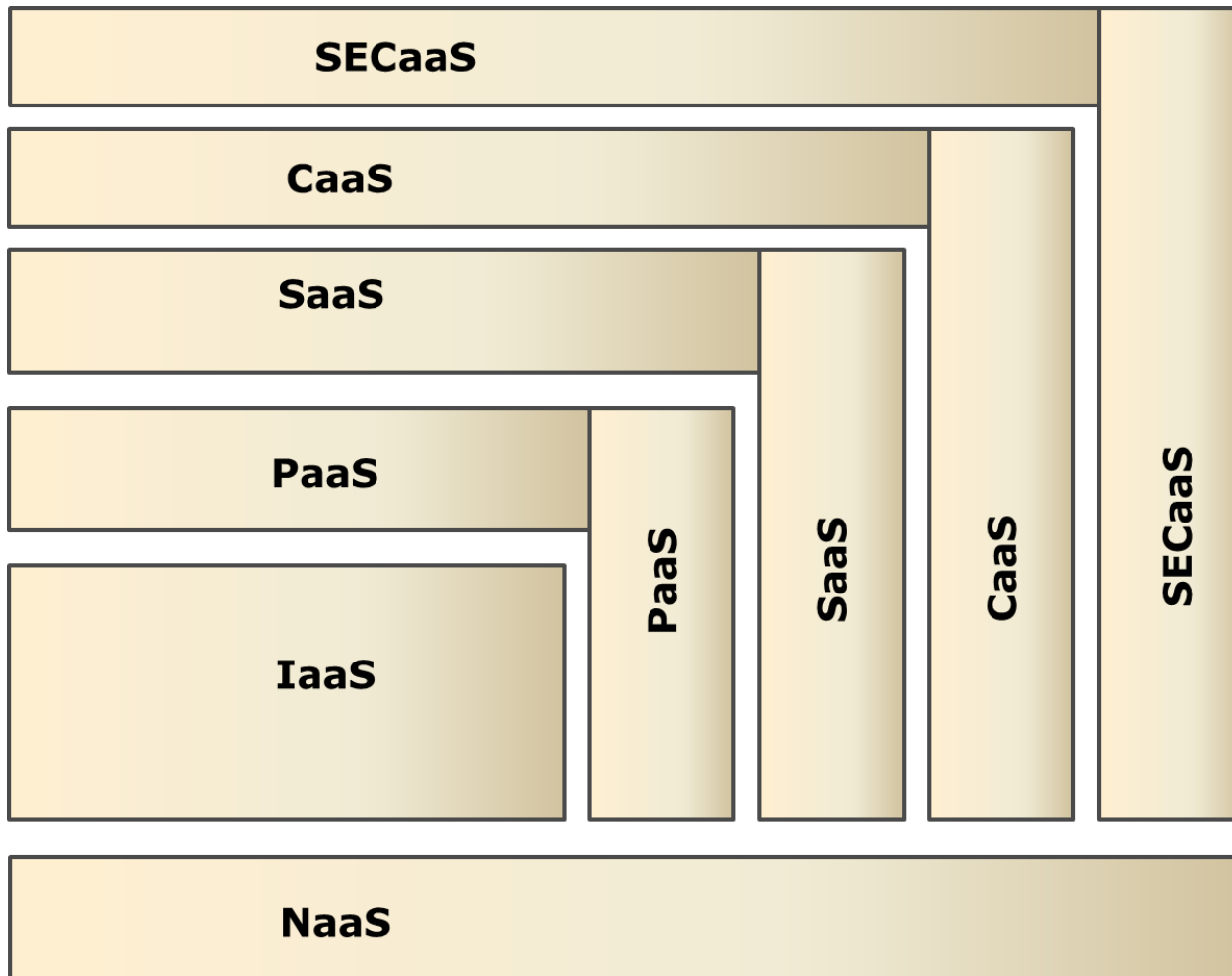
Reference Architecture

- ***Cloud Services provided over a Cloud Service Connection (cSC)***
- ***cSC is a logical entity that may ride over overlay, virtual and physical entities that are provided by single or multiple operator (s)***
- ***Cloud Service is an end-to-end concept that can include cloud application entities, cSC and associated cloud resources, as well as just the cloud application or just the cloud connection.***
- ***User interface can be L1-2, L1-3, L1-4. L1-5, L1-6, or L1-L7***
- ***Service PDU can be Ethernet frame, IP packet, MPLS packet, application PDU***

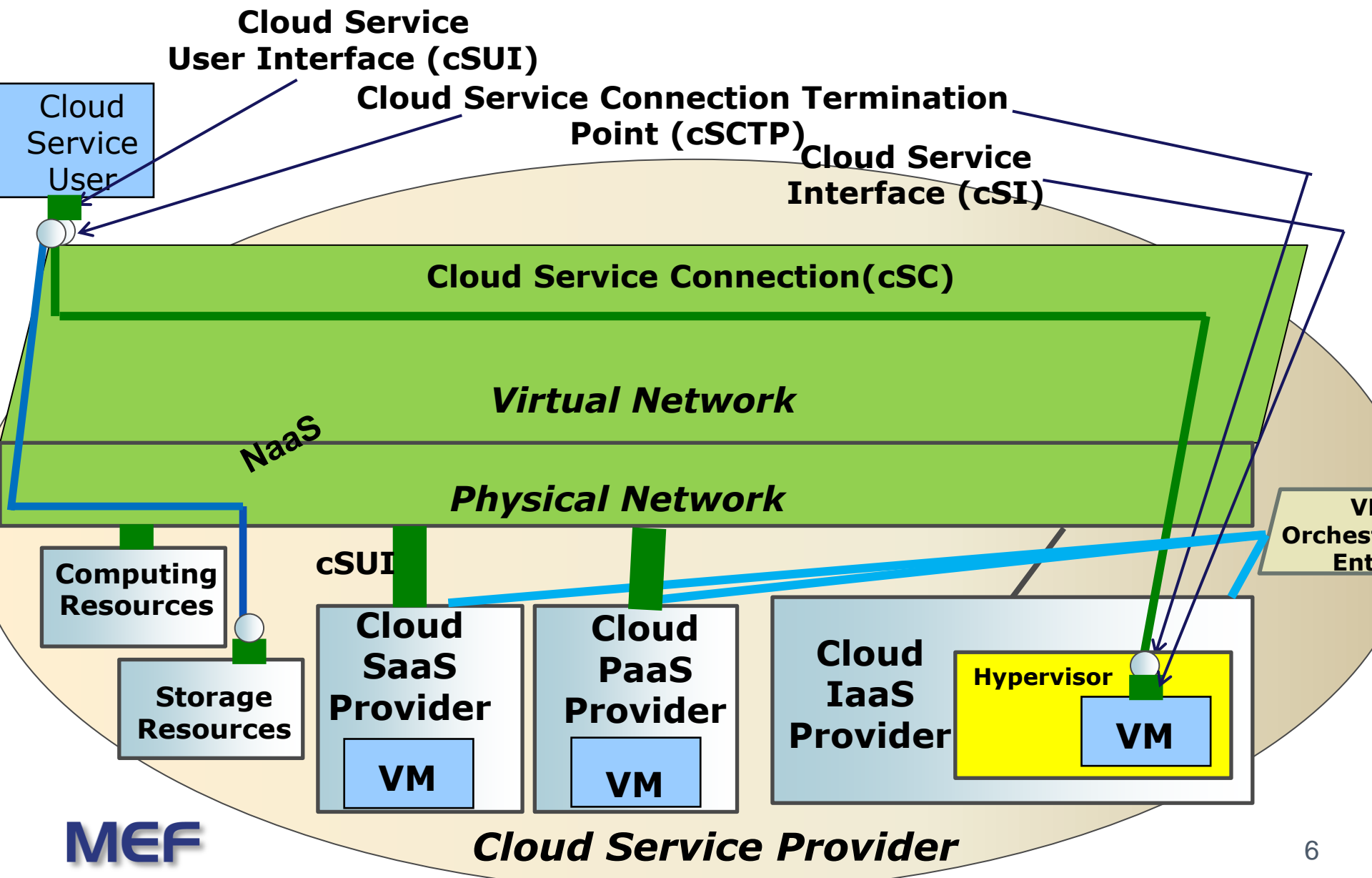
Cloud Service Actors



Cloud Services

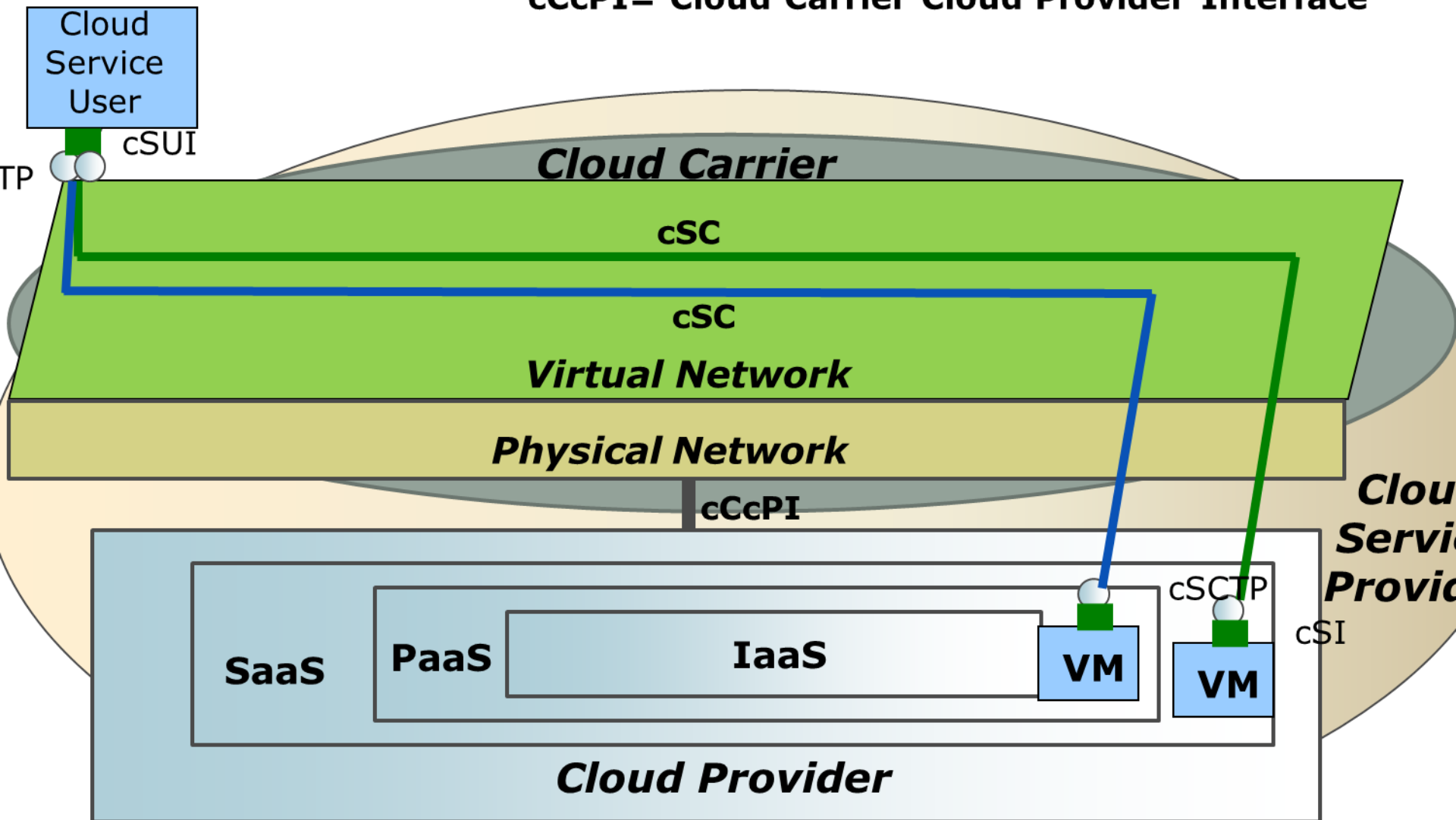


Architecture for Cloud Services by one Operator

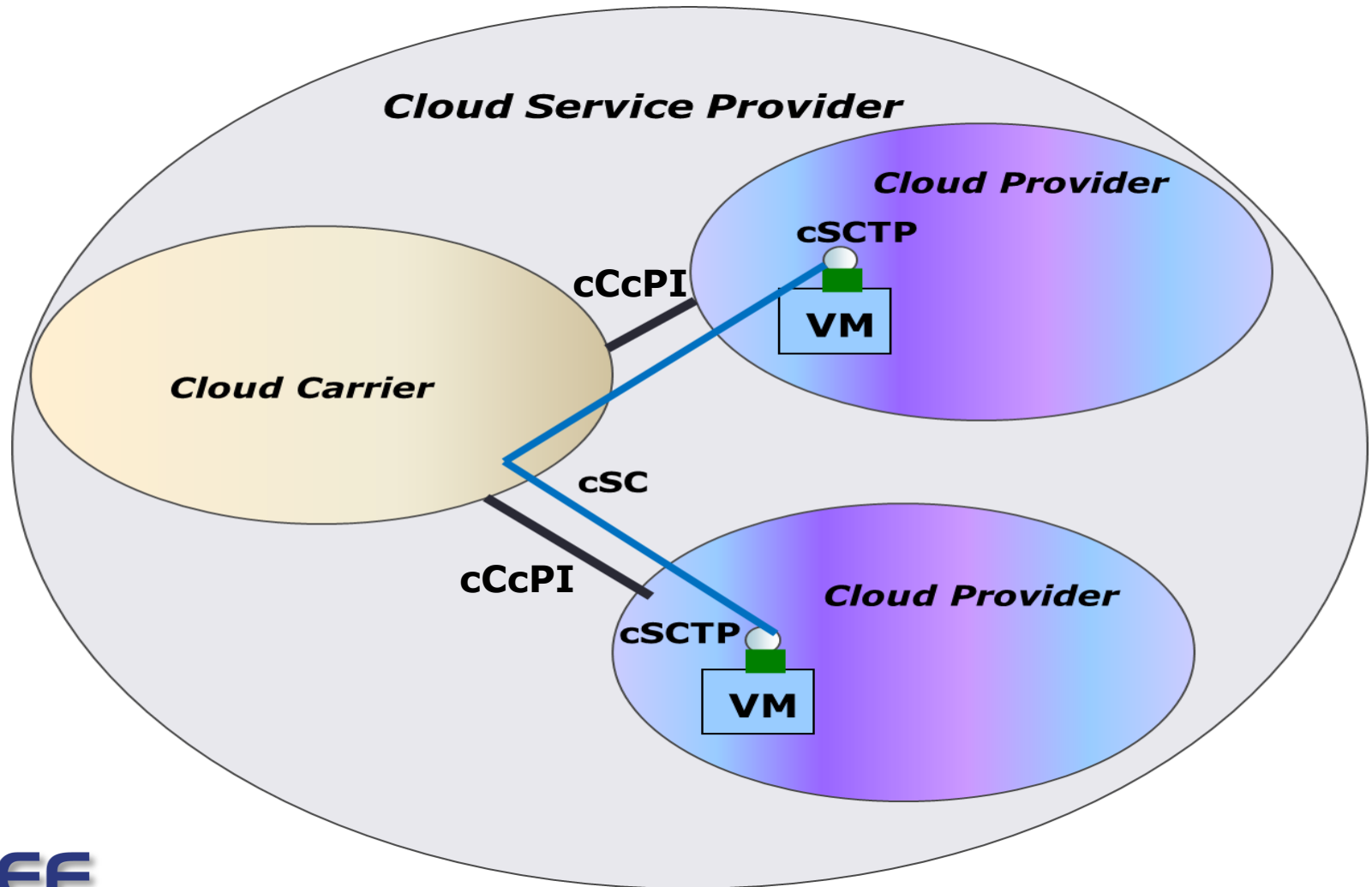


Architecture for Cloud Services by Two Operators

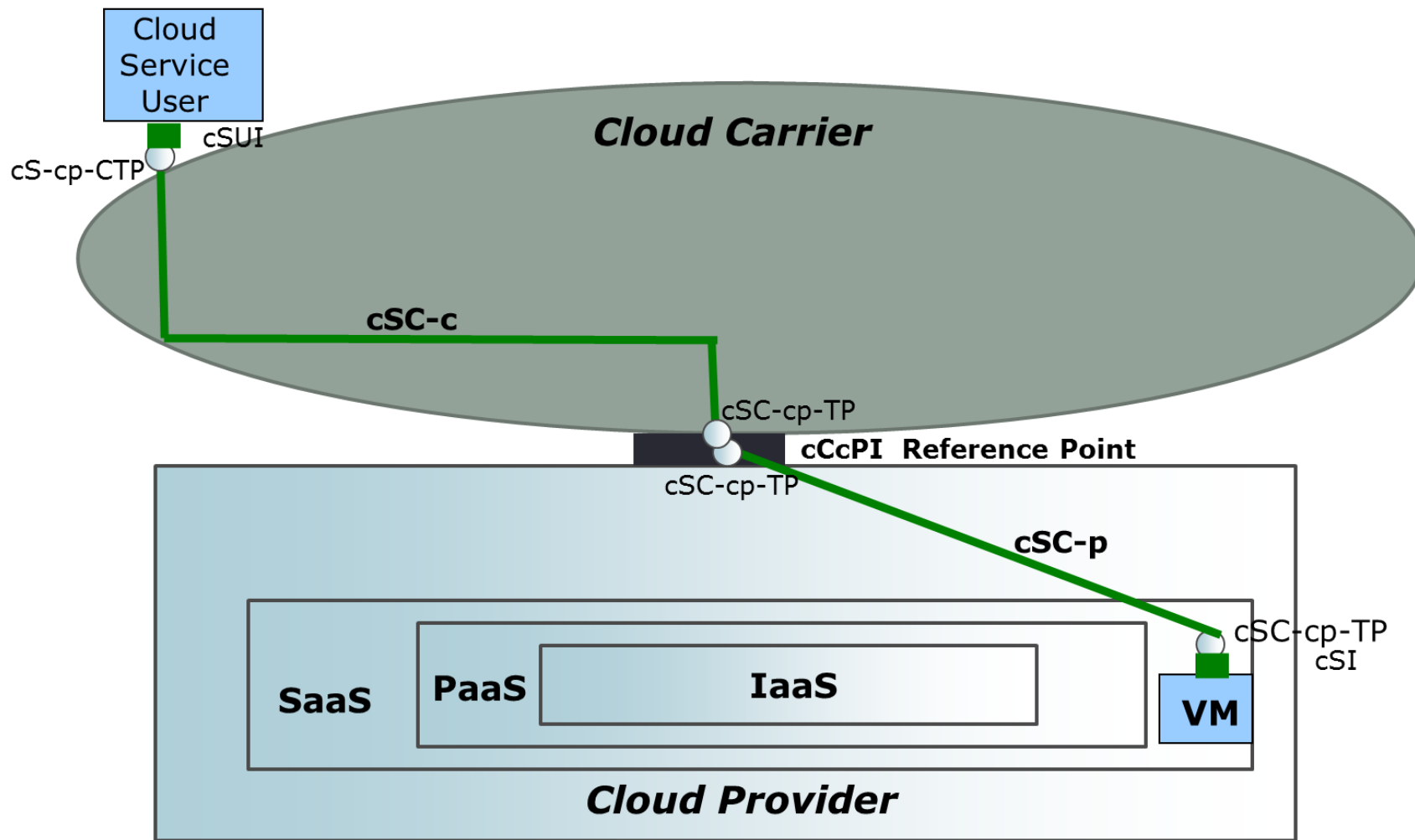
cCcPI= Cloud Carrier Cloud Provider Interface



Cloud Services Between Cloud Providers

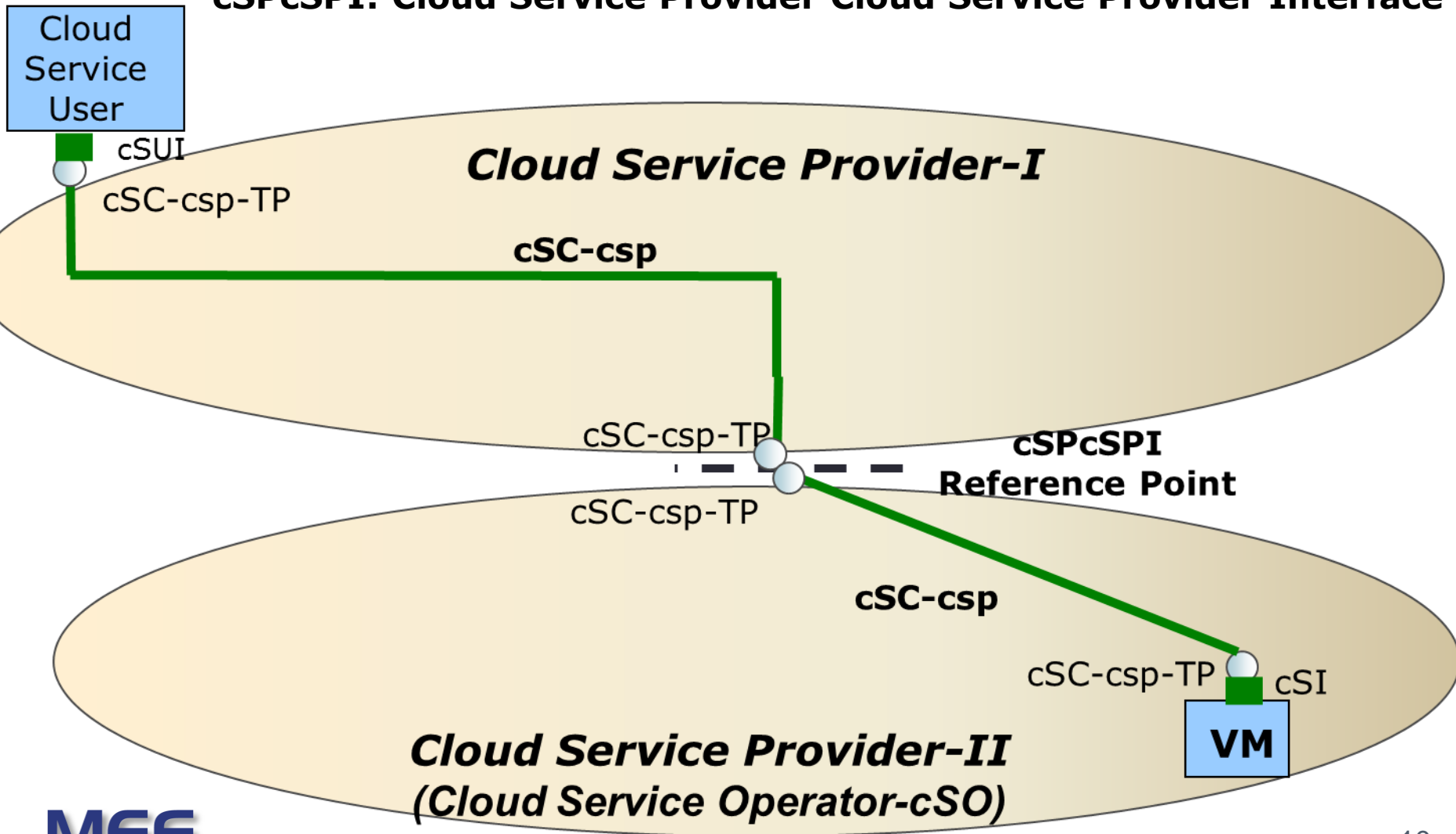


Segments of Connection Crossing cC and cP

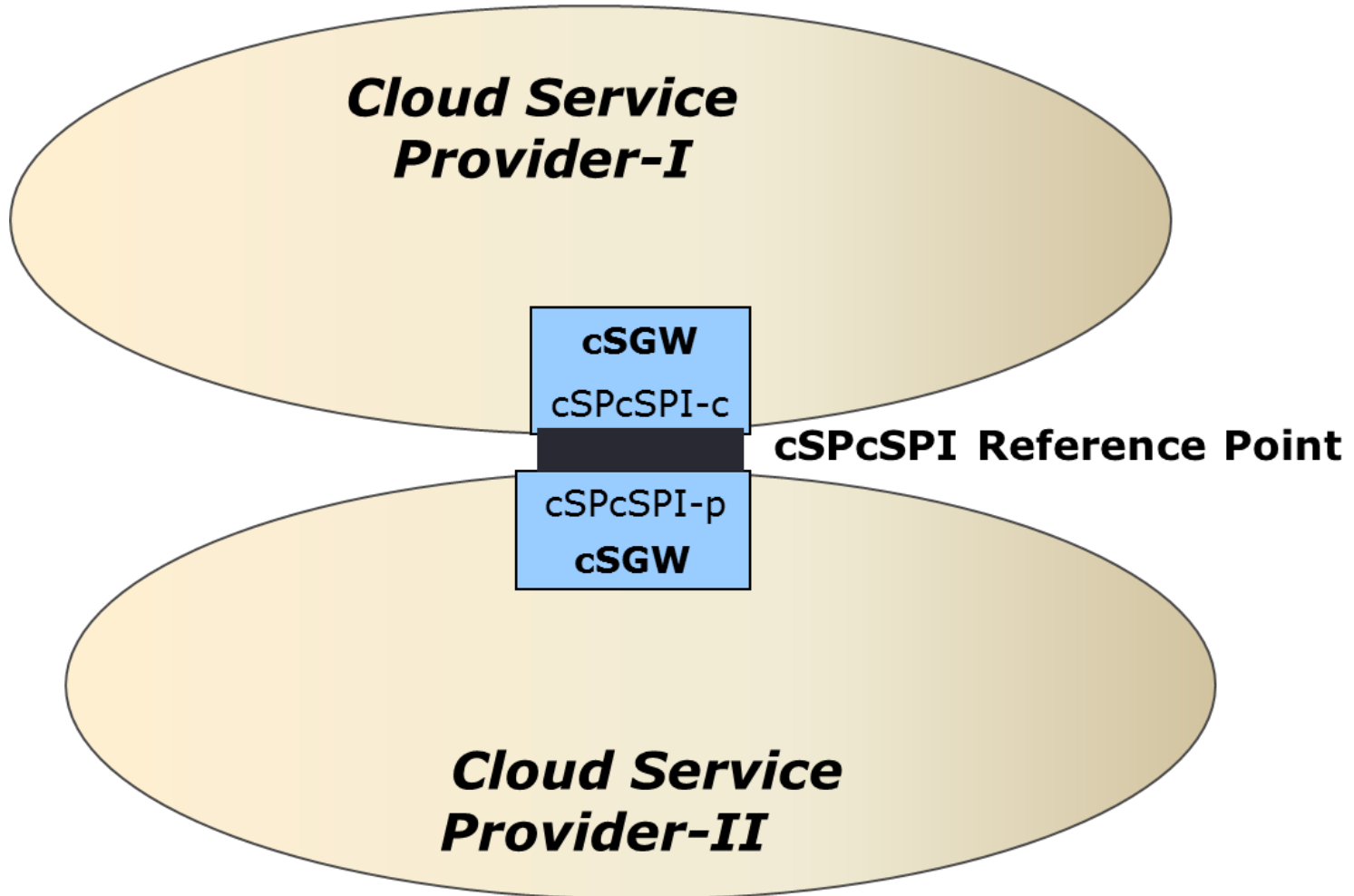


Cloud Services by Two cSPs

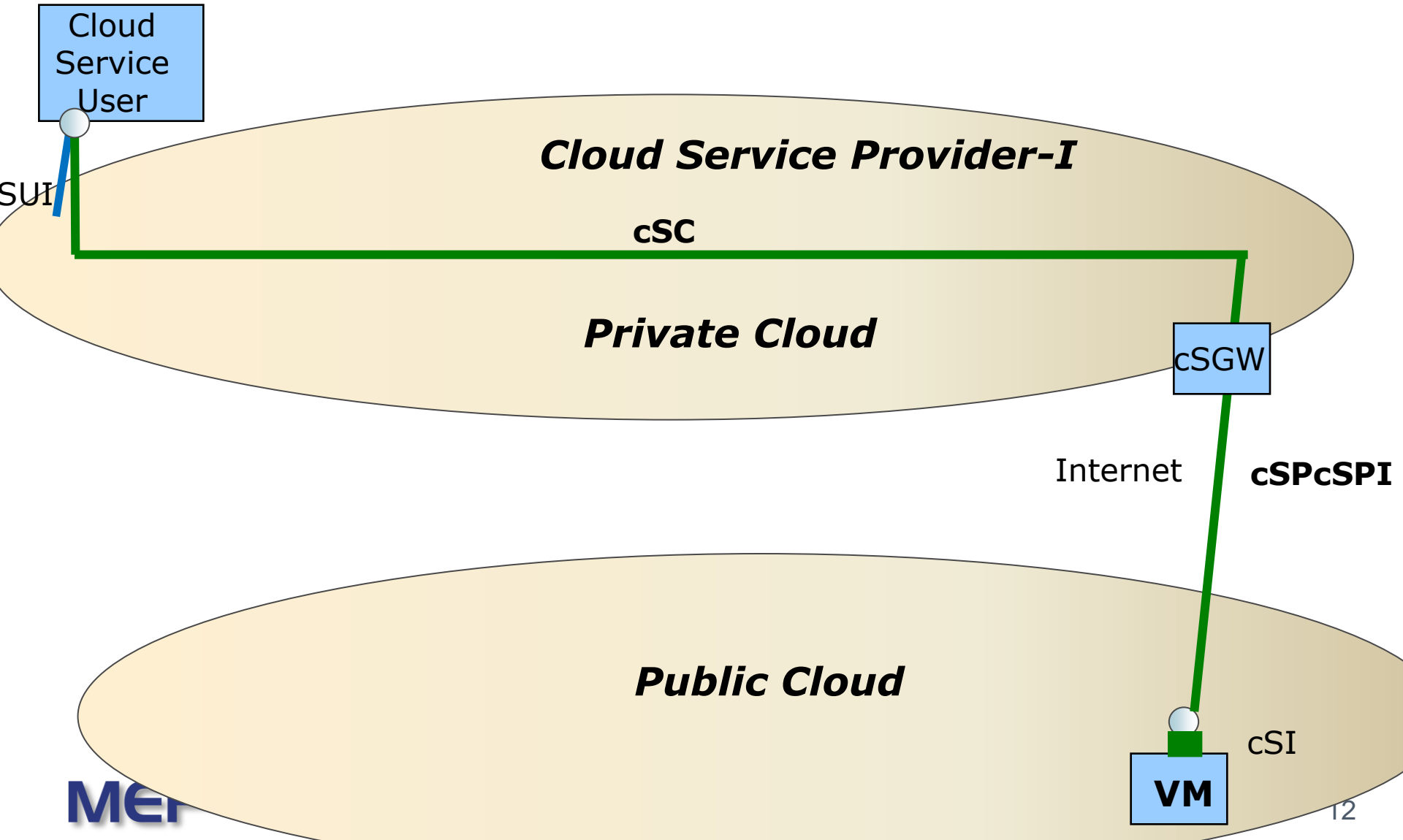
cSPcSPI: Cloud Service Provider Cloud Service Provider Interface



cSGW



Private Cloud-Public Cloud



Exchange GW Examples with LSO

LSO Enabled Cloud Inter-Connectivity Gateway and Cloud Provider Exchange Services

Andy Mayer, Mehmet Toy, Pascal Menezes, Abel Tong

A collaborative effort of the MEF, OCC, and ONF

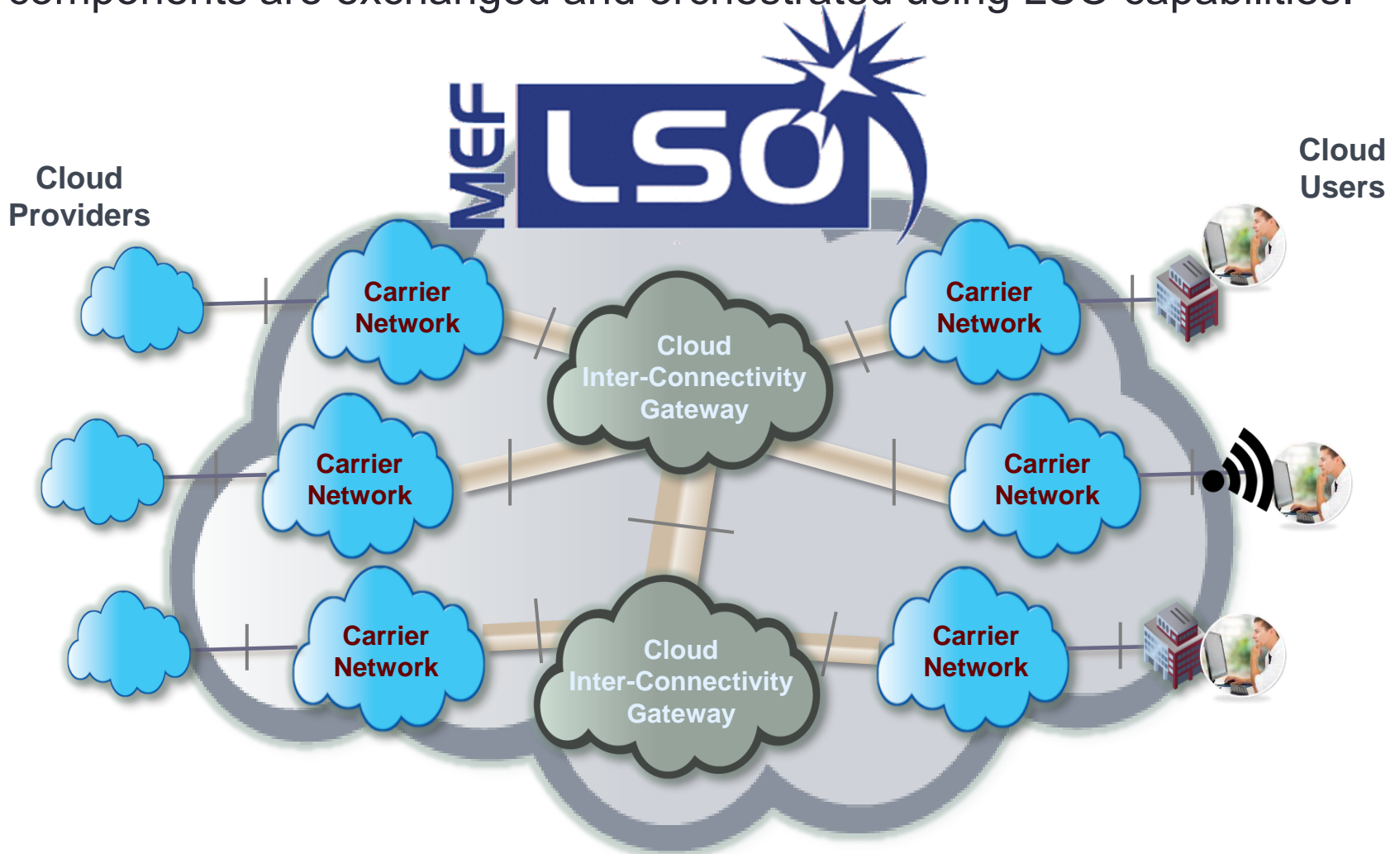
DRAFT: September 10, 2015

LSO Enabled Cloud Inter-Connectivity Gateway & Cloud Provider Exchange Services

- Cloud Users need a way to access across a single interface to the Cloud Carrier many Cloud Services provided by potentially multiple Cloud Providers.
- Cloud Providers need a way to instantiate, manage, and control both cloud application specific functions as well as connectivity within the Cloud Carrier for the services they provide to their users.
- Cloud Providers may need to have traffic from multiple customers aggregated within the Cloud Carrier.
- Cloud Providers also need to manage and control dynamic inter-connectivity with other Cloud Providers.
- The Cloud Carrier may be interconnected to potentially multiple Cloud Providers supporting Cloud Services for users.

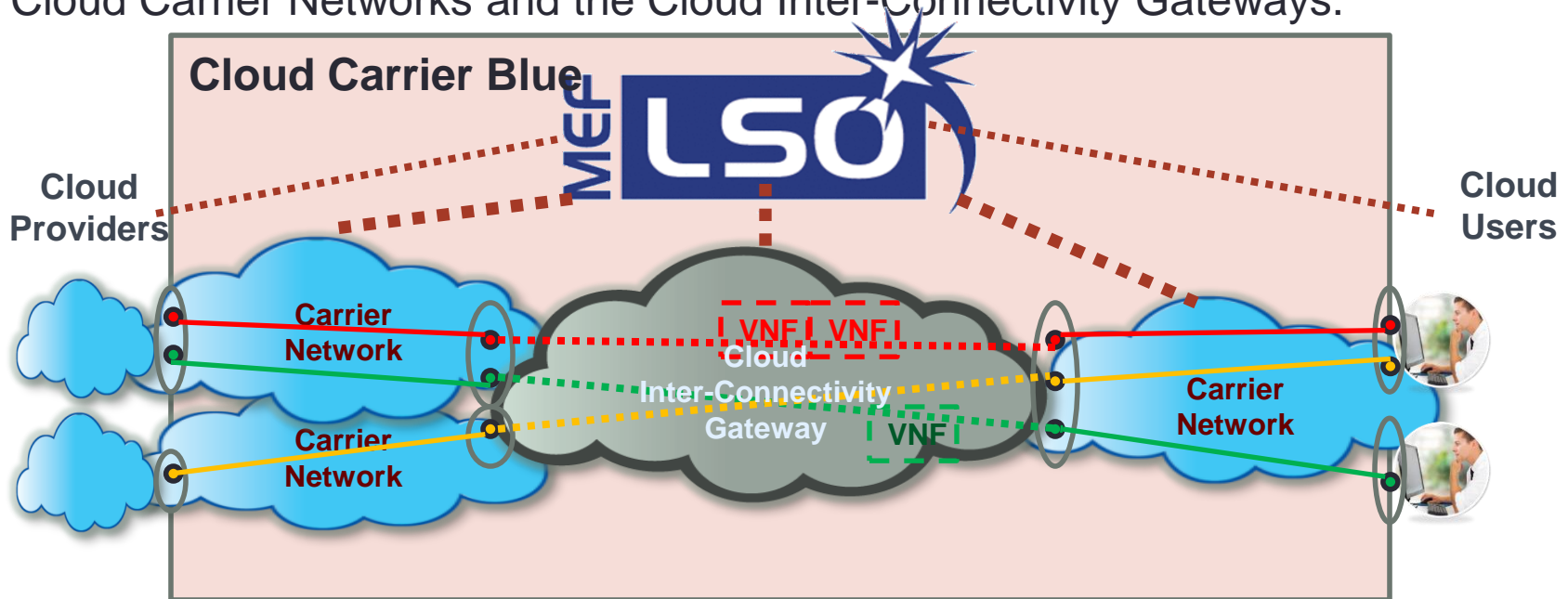
Cloud Inter-Connectivity Gateway

“Gateway among Cloud Carrier Networks where cloud inter-connectivity services formed of software defined, virtualized and non-virtualized components are exchanged and orchestrated using LSO capabilities.”



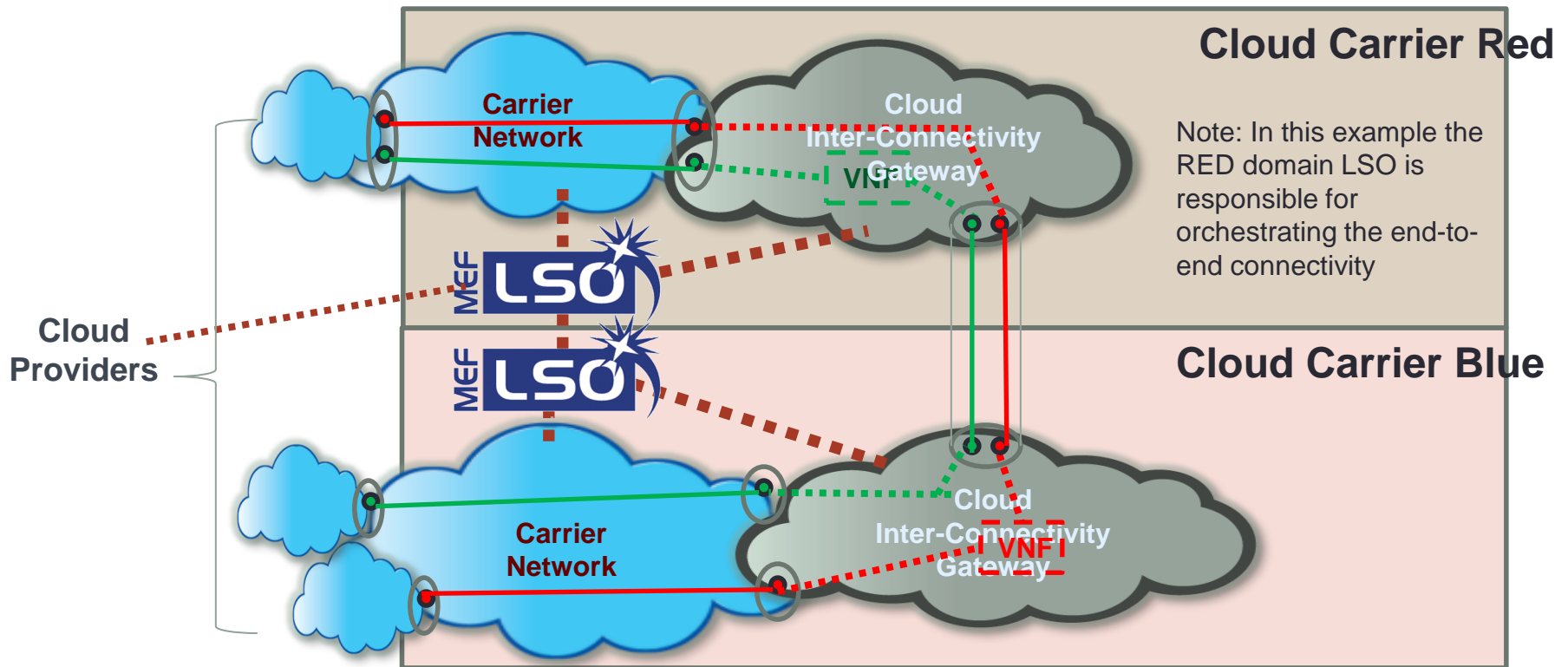
Cloud Service Inter-Connectivity

- Cloud Inter-Connectivity Gateway provides inter-connectivity from Cloud User to one or more Cloud Providers
- At the Cloud Inter-Connectivity Gateway , Cloud Service Connections originating from the Cloud User are forwarded to the appropriate Cloud Provider based on dynamic rules (based on layer characteristics, metrics, etc.)
- The Cloud Inter-Connectivity Gateway also allows the Cloud Provider to insert and instantiate specific VNFs (if used) within the service chain of the Cloud Service Connections (note: VNFs may also be used within the Cloud Carrier domains)
- LSO orchestrates the connectivity and supporting network functions across Cloud Carrier Networks and the Cloud Inter-Connectivity Gateways.

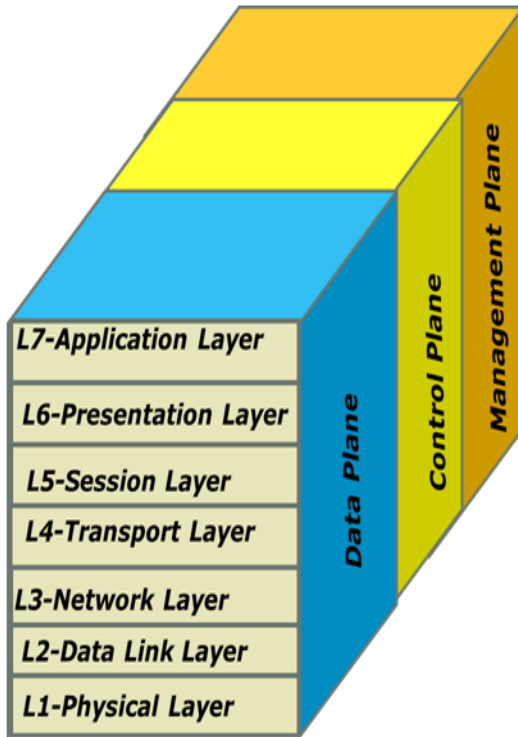


Cloud Provider Exchange

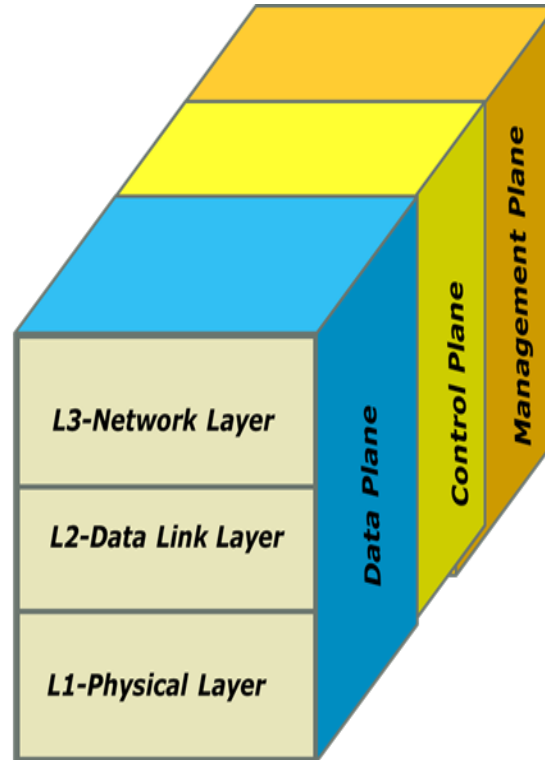
- Cloud Inter-Connectivity Gateway provides inter-connectivity from one Cloud Provider to another Cloud Provider.
- At the Cloud Inter-Connectivity Gateway, Cloud Service Connections originating from one Cloud Provider are forwarded to the appropriate Cloud Provider based on dynamic rules (based on layer characteristics, metrics, etc.)
- The Cloud Inter-Connectivity Gateway also allows the insertion of specific VNFs (if used) within the service chain of the Cloud Service Connections
- LSO orchestrates the connectivity and supporting network functions across Cloud Carrier Networks and the Cloud Inter-Connectivity Gateways.



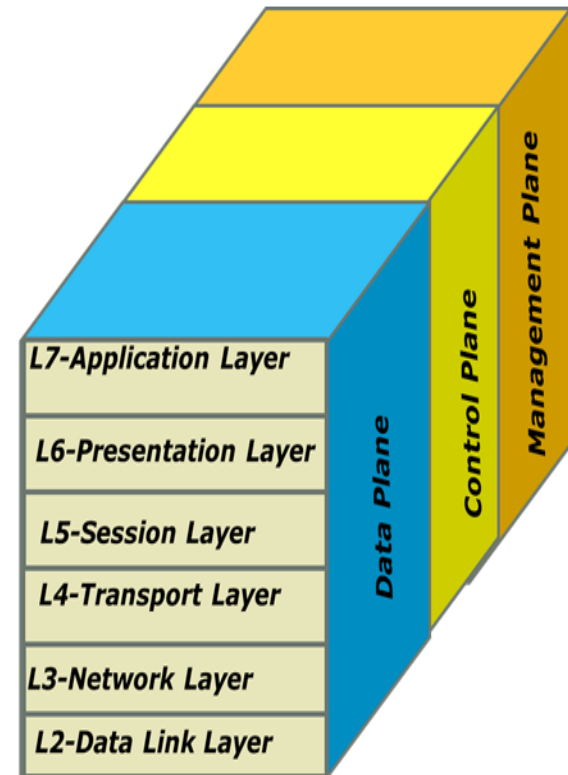
Interfaces



cSUI

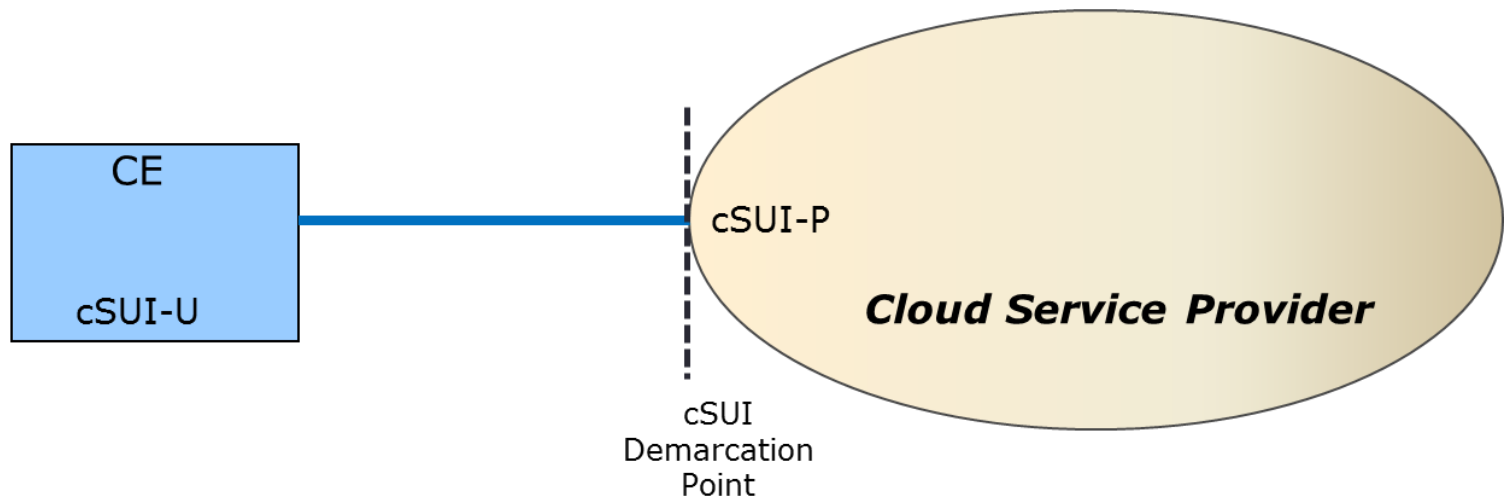


cSPcSPI
Or
cCcPI



cSI

cSUI



cSUI Attributes

Attributes

Dynamic Attributes

Traffic Management

Fault Management

Performance Management

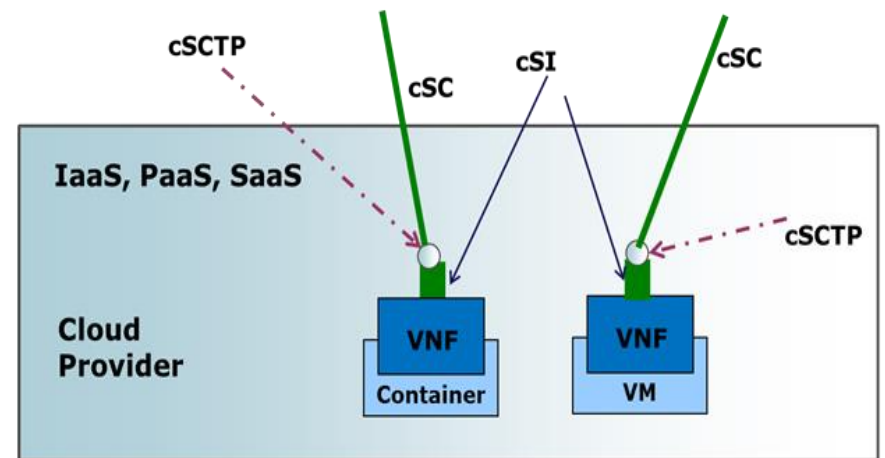
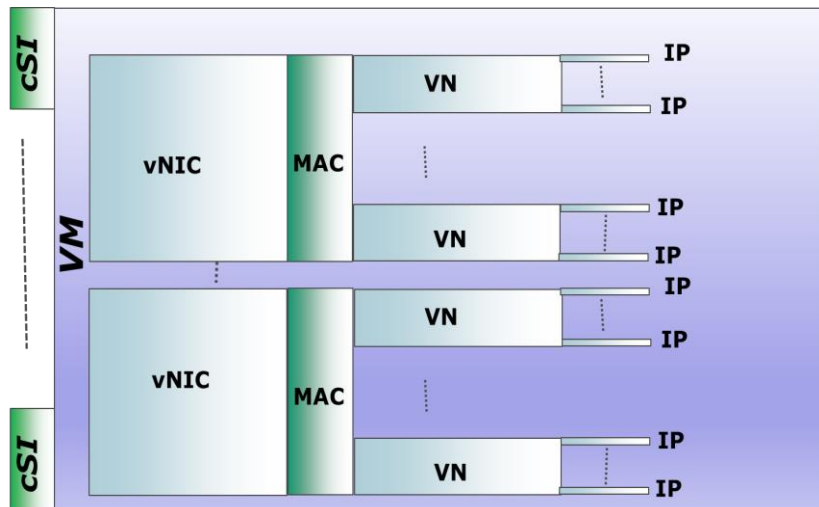
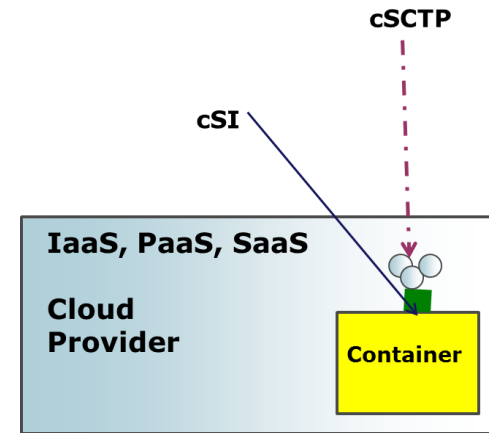
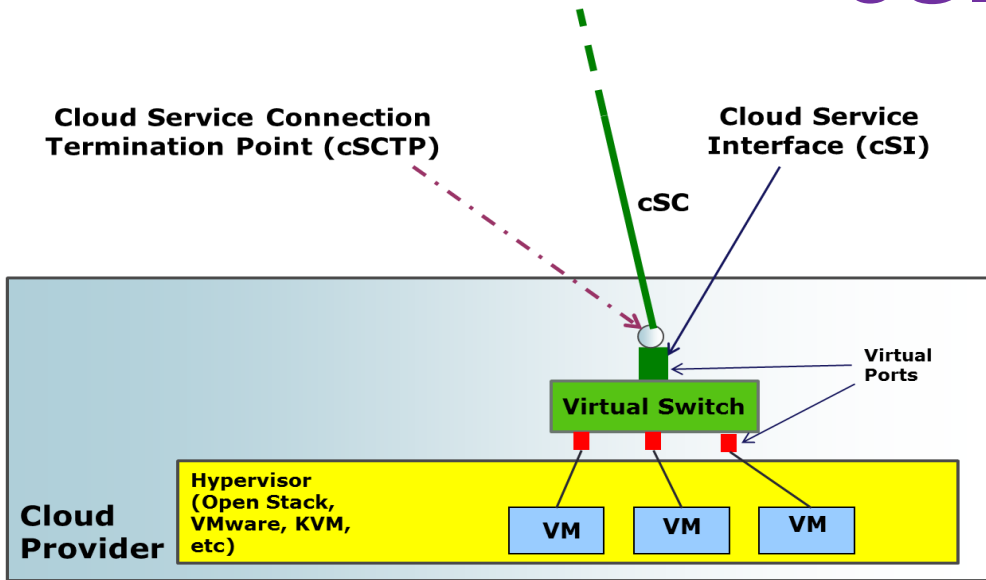
Security

Billing

cSUI Attributes

- ***cSUI Id, Tenant ID***
- ***NaaS Id***
- ***Physical Interface: Ethernet, DOCSIS, EPON, GPON, WDM, SONET/SDH, OTN***
- ***MTU***
- ***Connection Multiplexing***
- ***Maximum Number of Connection Termination Points***
- ***L2 Configuration Attributes [MEF10.3-MEF UNI], PPP, PPTP,***
- ***L2 SOAM Attributes [MEF30.1 and 30.2]***
- ***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***
- ***Service Level Security***
- ***Operational State***
- ***Administrative State***

cSI



cSI Attributes

Attributes

Dynamic Attributes

Traffic Management

Fault Management

Performance Management

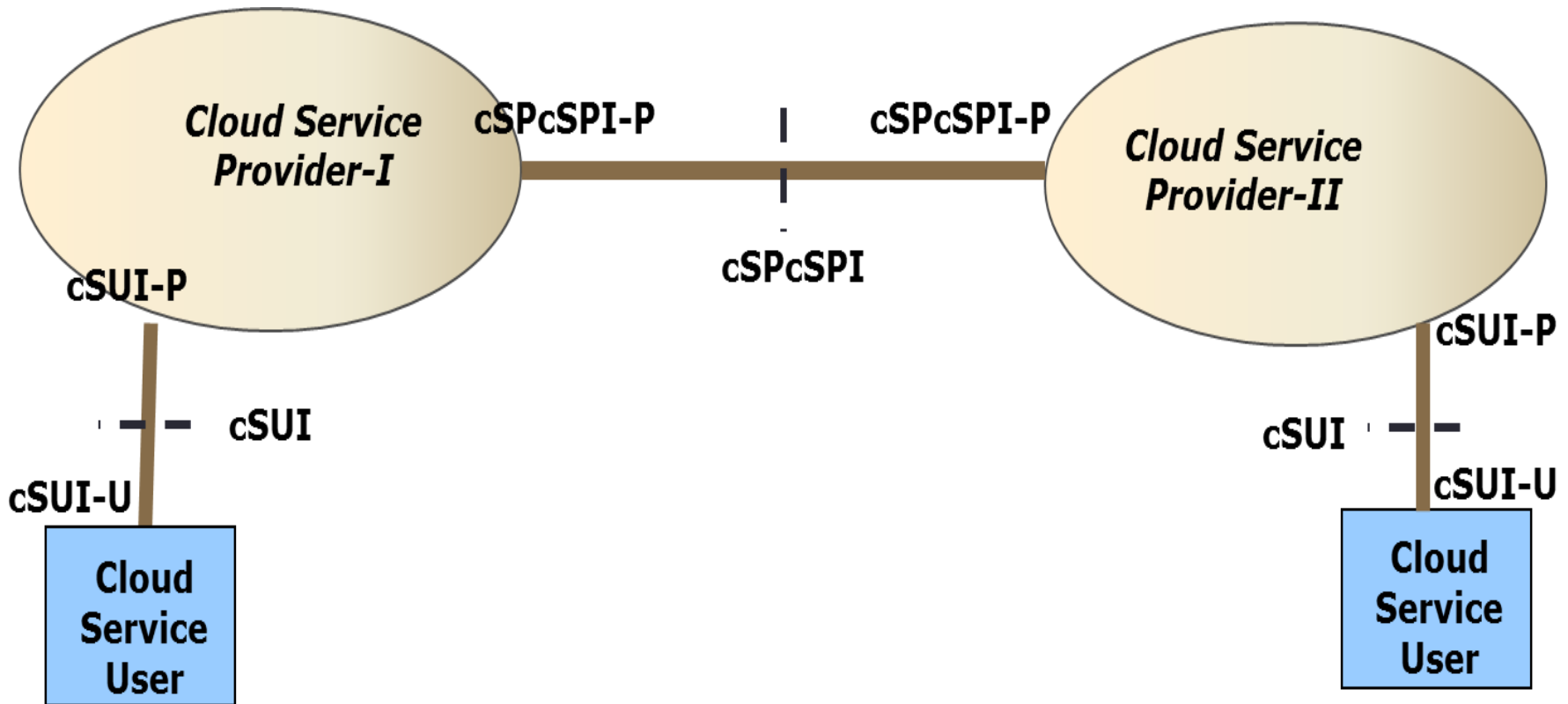
Security

Billing

cSI Attributes

- ***cSI Id, VM ID***
- ***List of NaaS Ids***
- ***Interface Protection***
- ***VM Protection***
- ***MTU***
- ***Connection Multiplexing***
- ***Maximum Number of Connection Termination Points***
- ***VM Portability***
- ***L2 Configuration Attributes [MEF10.3-MEF UNI], PPP, PPTP,***
- ***L2 SOAM Attributes [MEF30.1 and 30.2]***
- ***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***
- ***Service Level Security***
- ***Operational State***
- ***Administrative State***

cSPcSPI



cSPcSPI Attributes

Attributes

Dynamic Attributes

Traffic Management

Fault Management

Performance Management

Link Protection

Security

Billing

cSPcSPI Attributes (cont.)

cSPcSPI attributes
cSPcSPI Id
Names of cSPs interfacing each other
Physical Interface
L2 Ethernet[4]
DOCSIS if supported [5,6]
EPON if supported[7,8]
GPON if supported[9]
WDM if supported[10,11]
SONET/SDH if supported [12,13]
Optical Transport Network (OTN) [78]
MTU
Connection Multiplexing
Maximum number of Connection Termination Points (or End Points)
L2 Ethernet configuration attributes[20,22]
MEF ENNI Service attributes in Table 2 of MEF 26.1 [22]
MEF ENNI L2CP Service Attributes for Access EPL in Table 17 of MEF 45 [69]
MEF ENNI L2CP Service Attributes for UTA in Table 20 of MEF 45 [69]
MEF ENNI L2CP Service Attributes for vNID Case A in Table 25 of MEF 45 [69]
MEF ENNI L2CP Service Attributes for vNID Case B in Table 28 of MEF 45 [69]

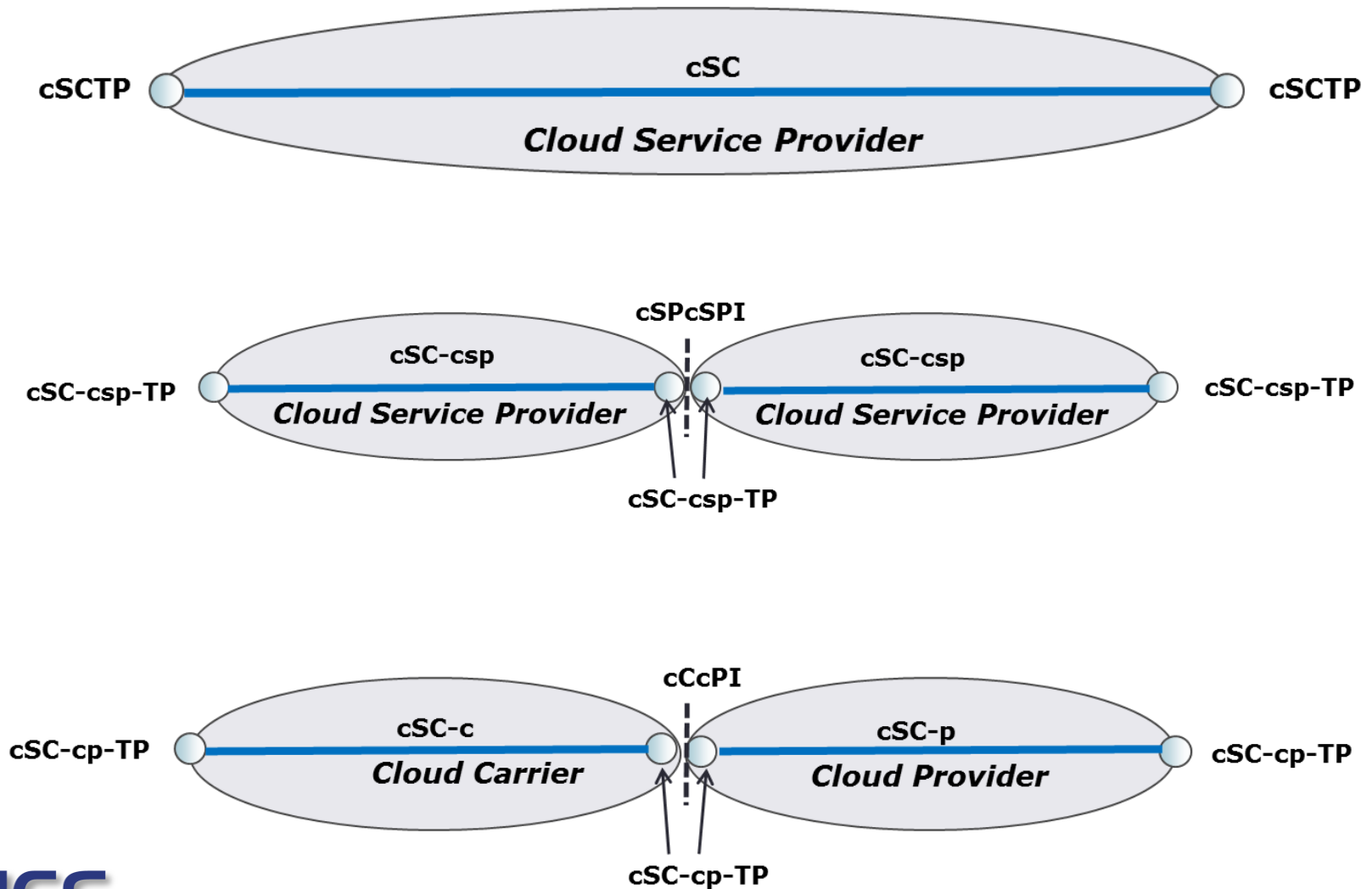
cSPcSPI Attributes (cont.)

cSPcSPI attributes
L2 Ethernet SOAM attributes [25]
Maintenance Entity Group (MEG) Id
Maintenance End Point (MEP) Id
MEP Level
Maintenance Intermediate Point (MIP) Id
LAG MEG
LAG Link MEG
Operator MEG
Other L2 Protocols such as Point-to-Point Protocol (PPP) and Point-to-Point Tunneling Protocol (PPTP) if supported
L3 attributes if L3 protocol such as IP and MPLS are supported
MPLS UNI attributes [49] if MPLS is supported
Fast Reroute [71,62]
NAT
IPv4 Subnet Address
IPv6 Subnet Address
DSCP Marking
IPv4 VPN [31]
IPv6 VPN [32]

cSPcSPI Attributes (Cont.)

cSPcSPI attributes
Security between cSPs (if supported)
ACL
Packet encryption
Connection Authentication
Service Level Security
Billing

Connections and Connection Termination Po



Cloud Service Connection Termination Point (or End Point) (cSCTP)

Attributes

Dynamic Attributes

Traffic Management

Fault Management

Performance Management

Protection

Security

cSCTP Attributes (cont.)

cSCTP attributes
cSCTP Id
cSUI Ids and cSI Ids
cSC Id
Overlay Network Attributes
L2 Ethernet attributes
MEF EVC per UNI Service attributes in Table 5 of MEF 6.2 [70]
MEF EVC per UNI Service attributes for EPL Service in Table 8 of MEF 6.2 [70]
MEF EVC per UNI Service attributes for EVPL Service in Table 11 of MEF 6.2 [70]
MEF EVC per UNI Service attributes for EP-LAN Service in Table 14 of MEF 6.2 [70]
MEF EVC per UNI Service attributes for EVP-LAN Service in Table 18 of MEF 6.2 [70]
MEF EVC per UNI Service attributes for EP-Tree Service in Table 20 of MEF 6.2 [70]
MEF EVC per UNI Service attributes for EVP-Tree Service in Table 23 of MEF 6.2 [70]
MEF EPL Option 2 L2CP Processing Requirements in Table 8 of MEF 45 [69]
MEF EPL Option 2 L2CP Processing Recommendations in Table 9 of MEF 45[69]
Protection (via redundant cSCTP on a different physical port of the same CE or different CE at cSUI, and on a different VM at cSI)
L2 Ethernet SOAM attributes [25]
Maintenance Entity Group (MEG) Id
Maintenance End Point (MEP) Id
MEP Level

cSCTP Attributes (cont.)

cSCTP attributes
L3 attributes if interface is L3
IPv4 Subnet Address
IPv6 Subnet Address
DSCP Mapping
Bandwidth Profile
Protection (via redundant cSCTP on a different port of the same CE or different CE providing the cSUI, and on a different VM of the application entity providing cSI)
LSP Label
EXP Mapping
Operational State
Administrative State
cSCTP Level Security
Packet encryption
Connection Authentication
Data confidentiality/privacy
Service Level Security

Cloud Service Connection (cSC)

Attributes

Dynamic Attributes

SLOs

Fault Management

Performance Management

Protection

Billing

cSC Attributes (cont.)

cSC attributes	
cSC Id	
List of associated cSCTP Ids	
Overlay Network Attributes	VNI ID
Type	Point-to-Point
	Point-to-Multipoint
	Multipoint-to-Multipoint
Protection	1:1 or 1+1
L2 Ethernet connection attributes [71,47]	
MEF EVC Service attributes in Table 6 of MEF 6.2 [70]	
MEF EVC Service attributes of EPL in Table 9 of MEF 6.2 [70]	
MEF EVC Service attributes of EVPL in Table 12 of MEF 6.2 [70]	
MEF EVC Service attributes of EP-LAN in Table 15 of MEF 6.2 [70]	
MEF EVC Service attributes of EVP-LAN in Table 18 of MEF 6.2 [70]	
MEF EVC Service attributes of EP-Tree in Table 21 of MEF 6.2 [70]	
MEF EVC Service attributes of EVP-Tree in Table 24 of MEF 6.2 [70]	
MEF EVC Performance attributes and Parameters per CoS in Table 25 of MEF 6.2 [70]	

cSC Attributes (cont.)

cSC attributes	
L3 connection attributes (if supported)	Service Level Objectives (SLOs)
	MTU
	Type
Connection Start Time	
Connection Start Interval (Start Interval parameter to indicate the acceptable interval after the Start Time during which the service attribute modifications can be made.) [80]	
Connection Duration	
Connection Period	
Operational State	
Administrative State	
Billing Options	Monthly, Hourly

Cloud Carrier-Provider Connection Termination Point (cSC-cp-TP)

Attributes

Dynamic Attributes

Traffic Management

Fault Management

Performance Management

Protection

Security

Cloud Service Provider Connection (cSC-csp)

Attributes

Dynamic Attributes

SLOs

Fault Management

Performance Management

Protection

Billing

Cloud Provider Connection (cSC-P)

Attributes

Dynamic Attributes

SLOs

Fault Management

Performance Management

Protection

Billing

Cloud Carrier Connection (cSC-C)

Attributes

Dynamic Attributes

SLOs

Fault Management

Performance Management

Protection

Billing

Cloud Services

- ***NaaS (SD-WAN, MEF Services, Load Balancing, ELB, Domain Registration Service, Managed DNS, Network Appliances, IPv4/v6 Capable Dual Stack, Elastic IP Services, Overlay Network Services,..)***
- ***IaaS (Storage Services, Databases, Disaster Recovery, Cloud Computing (Bare Metal Servers, High Performance Computing, Virtual Servers, ...))***
- ***SECaaS (Managed access, NaaS security, Traffic Cleaning, etc.)***
- ***PaaS (Managed application platform, scalable and high performing network, etc.)***
- ***SaaS (On-demand Software Installation, Licensing, CDN, Email)***
- ***CaaS (Virtual PBX, Voice and Video Conferencing, etc.)***

NaaS Service Types

- **SD-WAN**
- **EPL, EVPL, EP-LAN, EVP-LAN, EP-Tree, EVP-Tree: On-demand with SLOs**
- **On-Demand Load Balancing: Local, global, or high availability LB**
- **Elastic Load Balancing**
- **Domain Registration Service**
- **Managed DNS**
- **Network Appliances (Firewalls, Routers, ...)**
- **IPv4 and IPv6 Capable Dual Stack**
- **Outbound Public Bandwidth**
- **Inbound Public Bandwidth**
- **Private Network Bandwidth**
- **Private and Public Port**
- **Elastic IP Addresses**
- **Overlay Network Services: PBB/PBT, L3VPN, VXLAN**
- **Security**

Cloud Service Common Attributes

Cloud Services	
Resource	Virtual
	Physical
Network (i.e. NaaS)	Service Name
	Bandwidth
	Scheduled
	Shared
	Dedicated
	On-Demand
	Duration of Resource
	IPv4/IPv6 Address, VLAN and MAC Filtering
	NAT
	Firewall
	User Authentication
	Encryption
	Dynamic Scalability
Billing	

CS Common Attributes (cont.)

Cloud Services	
Infrastructure (i.e. IaaS)	Service Name _____
	CPU
	Memory
	Hard Disk Space
	Dedicated
	Shared
	Scheduled
	On-Demand
	Duration of Resource
	Operating Systems
	User Authentication
	Encryption
	Data Security
	Dynamic Scalability
	NaaS attributes
Billing	

CS Common Attributes (cont.)

Cloud Services	
Platform (i.e. PaaS)	Service Name _____
	CPU
	Memory
	Hard Disk Space
	Dedicated
	Shared
	Scheduled
	On-Demand
	Duration of Resource
	Operating Systems
	User Authentication
	Encryption
	Dynamic Scalability
	Data Security
	NaaS attributes
Billing	

CS Common Attributes (cont.)

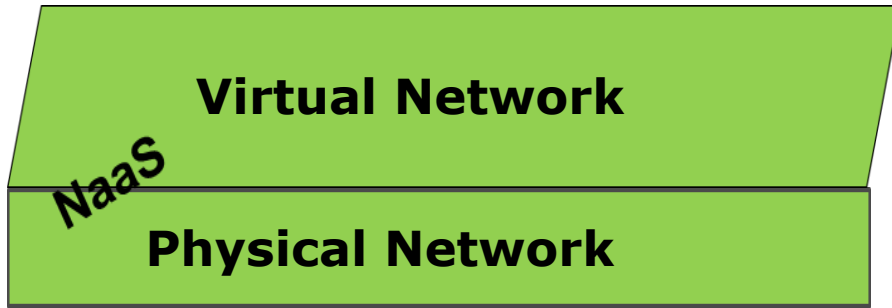
Cloud Services	
Software Service (SaaS)	Service Name _____
	Licensing
	On-demand Software Installation
	NaaS Attributes
Communications (i.e. CaaS)	Service Name
	Number of users
	Licensed
	Unlicensed
	SLAs
	Service Type
	Data Security
	Authentication Realm
	NaaS attributes
Billing	
Security (i.e. SECaaS)	Security Service Type
	Security function
	Billing

OAM for Cloud Services

- **Service Availability-Monthly Uptime of four 9s or five 9s**
 - **Unavailable-No external connectivity, Zero read/write I/O, etc.**
- **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.**
- **Billing-Fixed, Usage Based, etc.**
- **Testing-Verification of attributes of each interface, connections, cloud services**

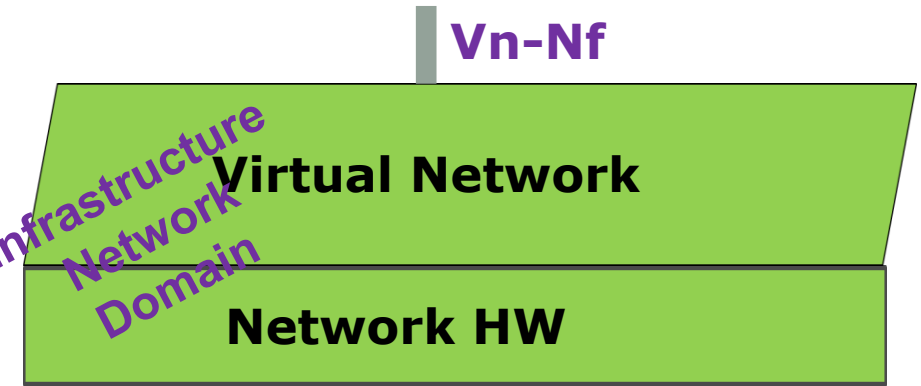
OCC/MEF vs ETSI NFV Architectures

OCC/MEF Architecture



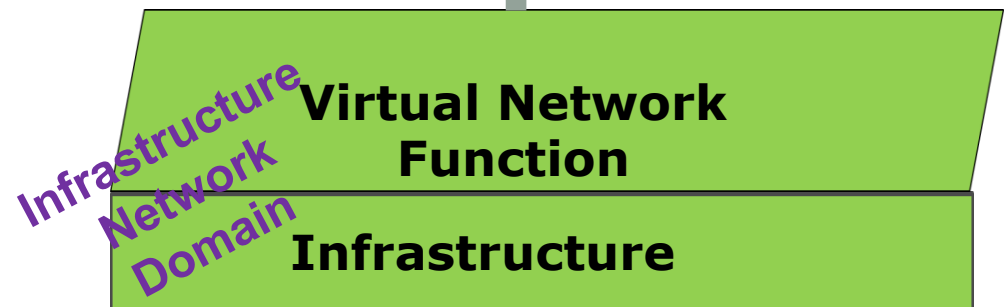
cCcPI
Or
cSUI
Or
cSPcSPI

VNF Architecture

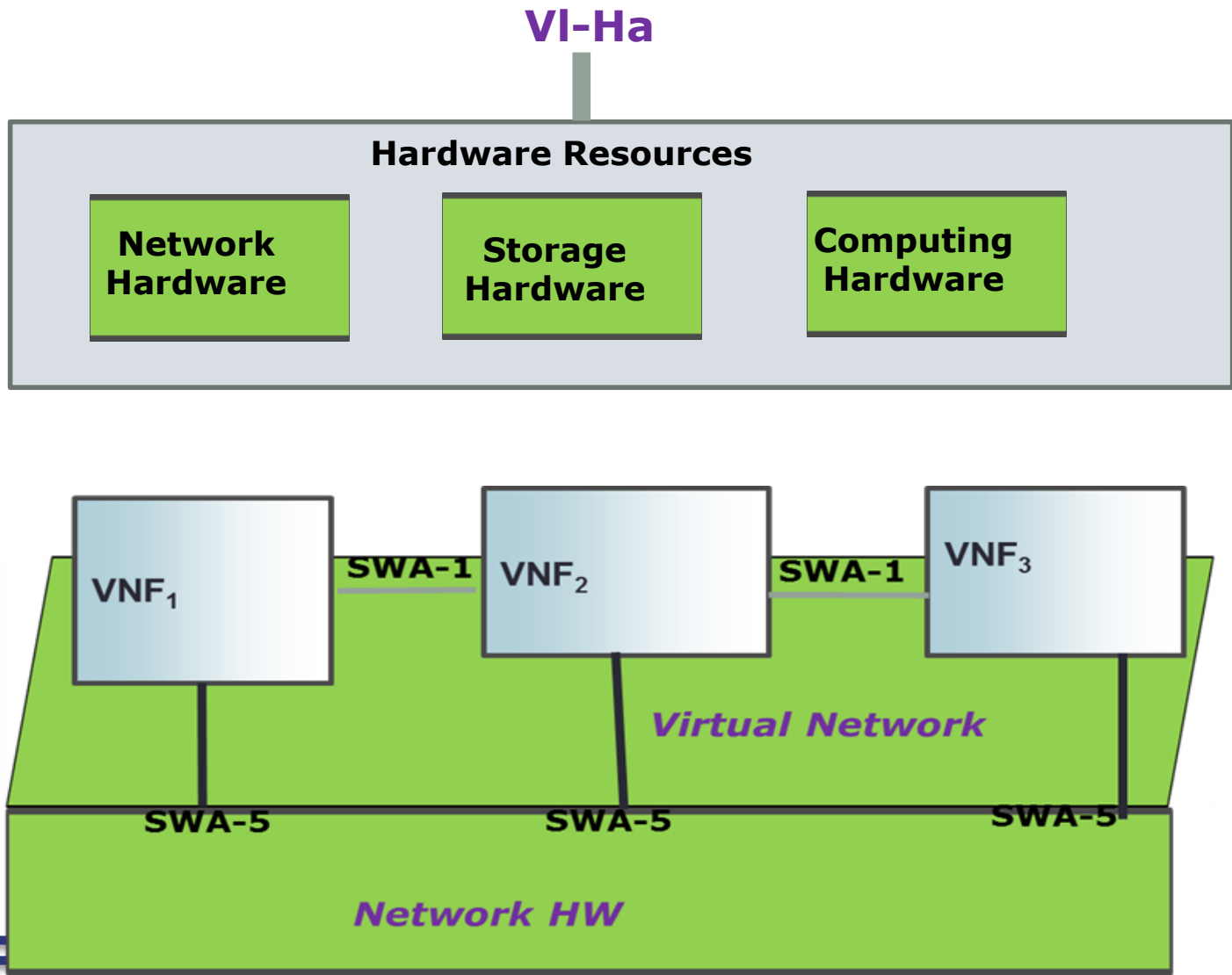


(Vn-Nf)/VN interface supporting E-Line or E-LAN

or
Vn-Nf



ETSI NFV Bare Metal Server and VNF Interface



VM Interfaces

OCC/MEF Architecture

cSI



VNF Architecture

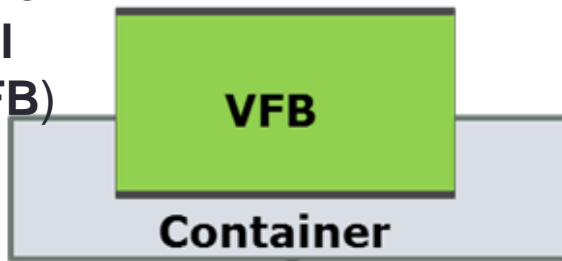
(Vn-Nf)/VM

Or

Vn-Nf-VM



Virtualization
Functional
Block (VFB)



Container
Interface



Host Functional
Block (HFB)

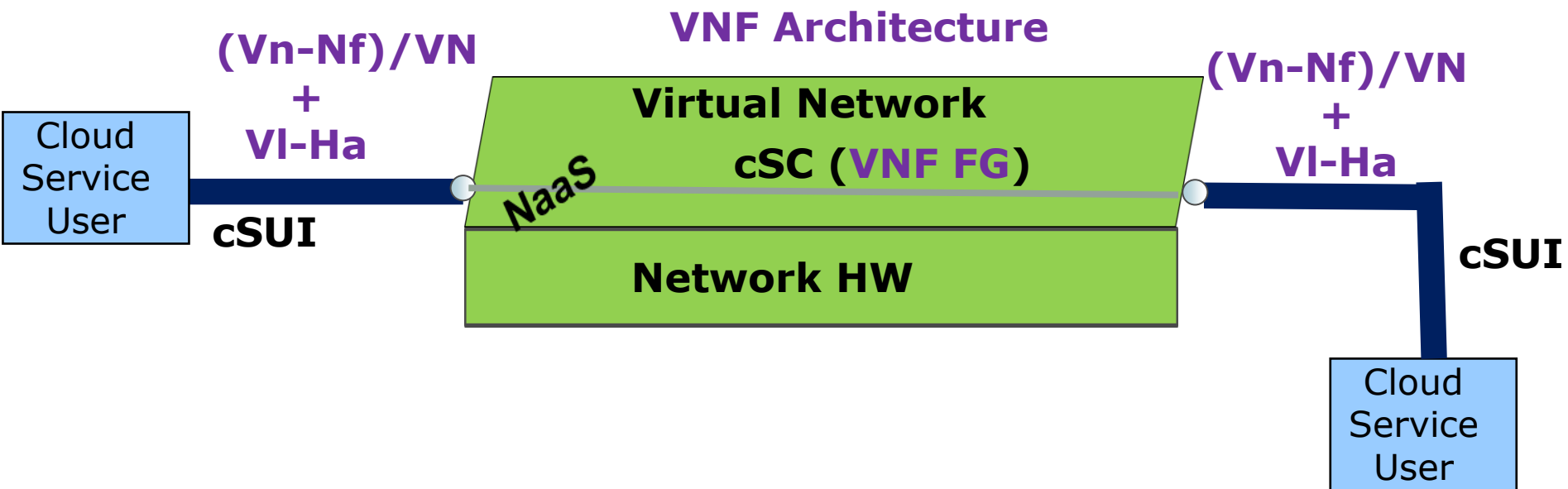
Infrastructure
Interface



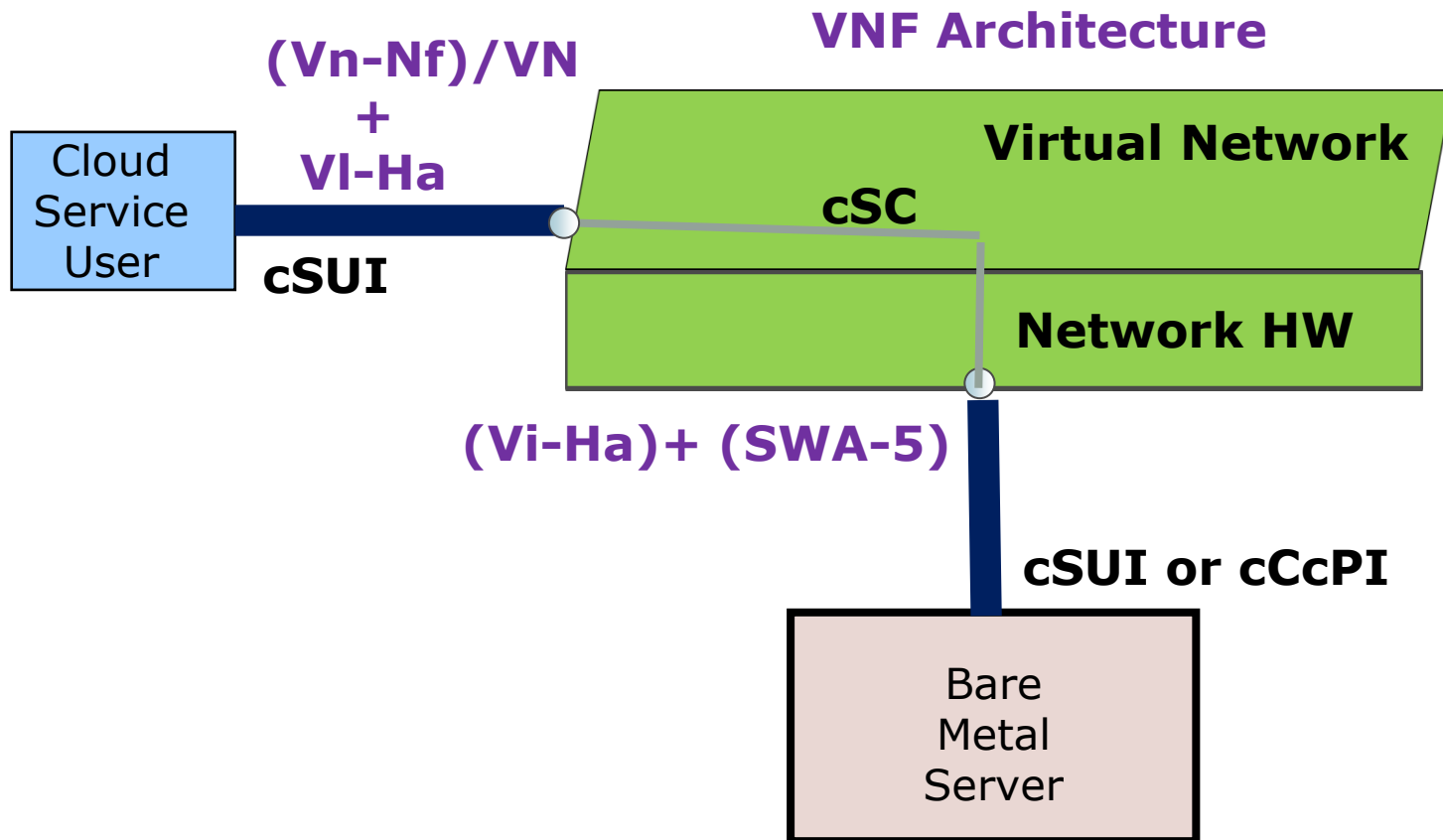
Mapping of OCC/MEF and NFV Interfaces

Architectural Construct	ETSI NFV Construct	OCC Construct
User Interface	(VI-Ha)+(Vn-Nf)/VN	cSUI
VM Interface	(Vn-Nf)/VM	cSI
Container Interface	Container Interface	cSI
SWA-1	Software Architecture-1	cSI
Cloud Carrier-Cloud Provider Interface		cCcPI
Cloud Service Provider-Cloud Service Provider Interface		cSPcSPI
Connection between Users or between a User and VM or between VMs	VNF Forwarding Graph	cSC
Connection Termination Point		cSCTP

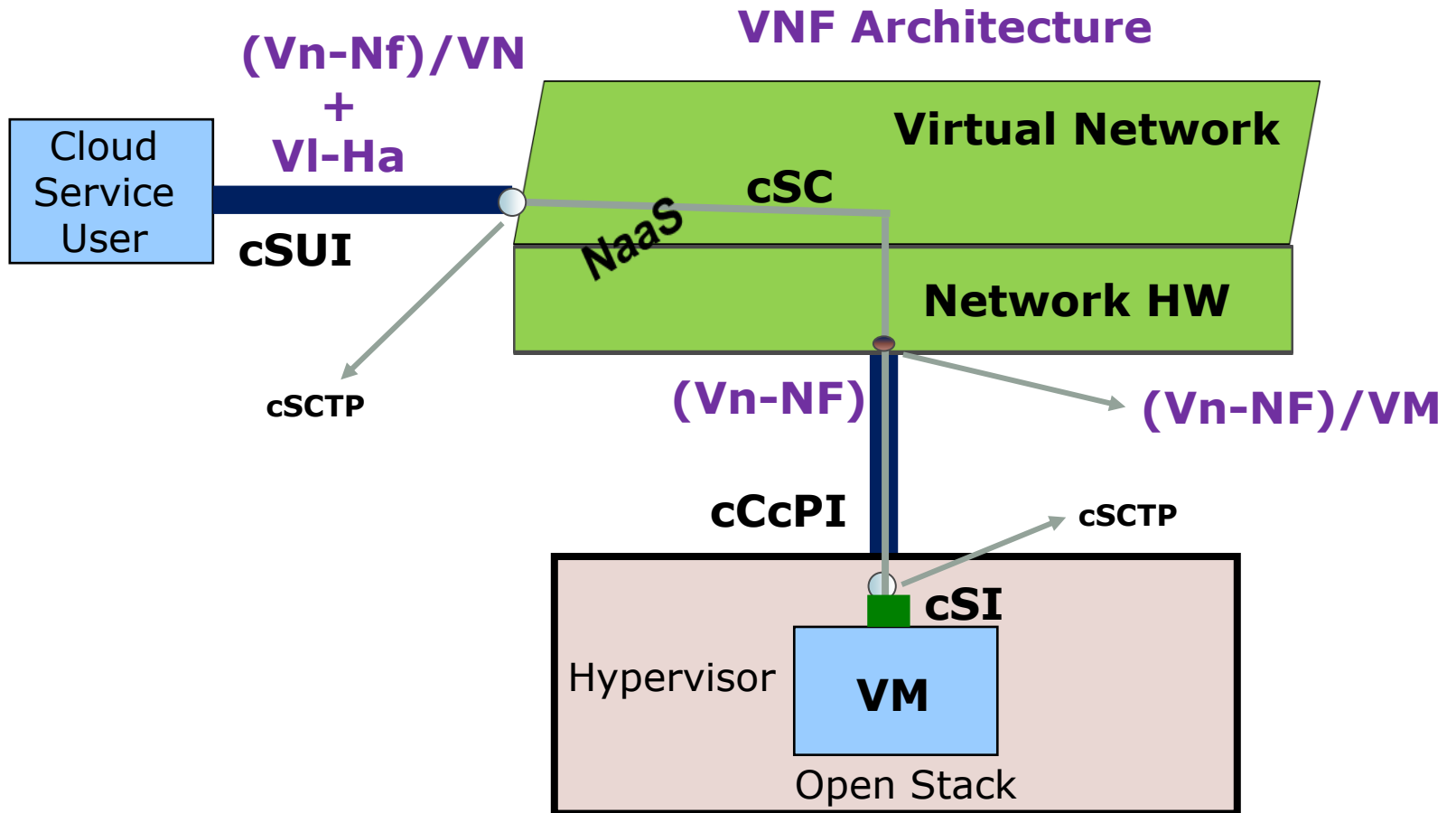
NaaS with NFV Interfaces



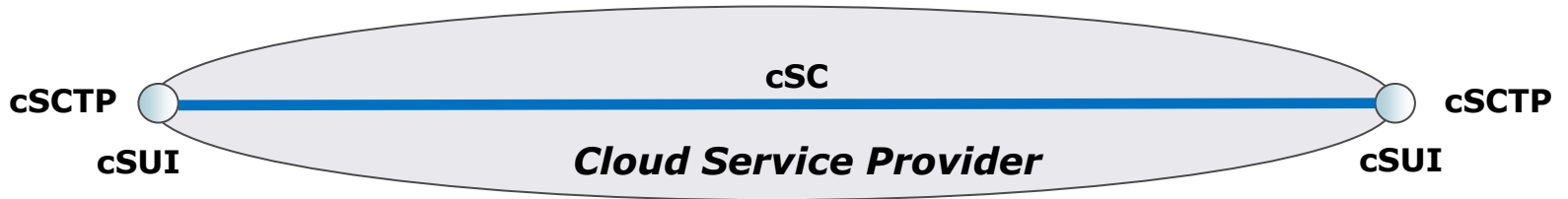
NaaS with Bare Metal Server Interface



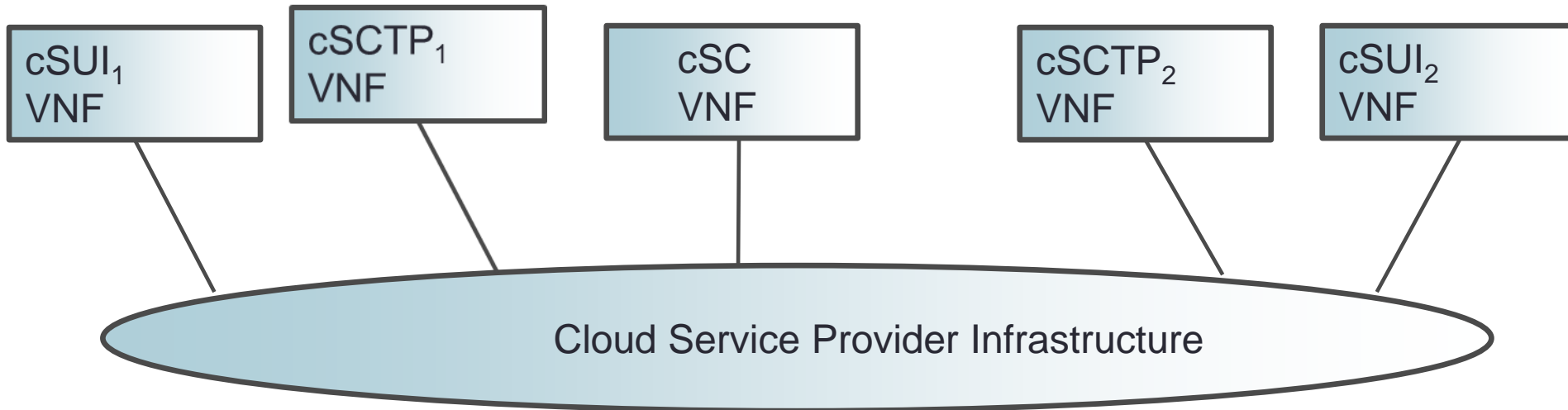
VM Interface



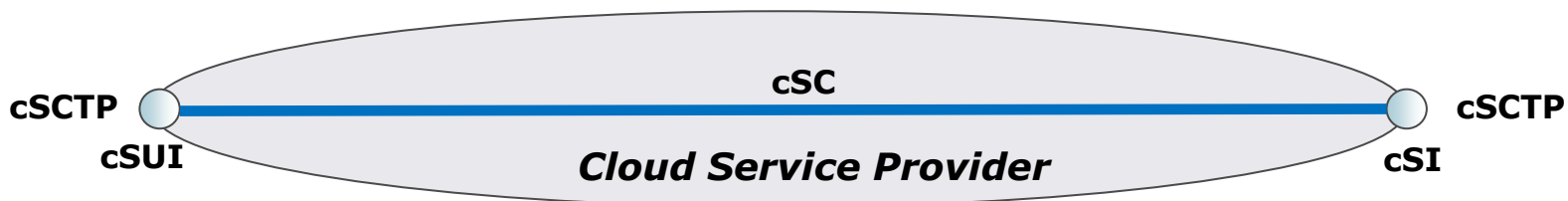
Virtualized cSC between Two cSUIs



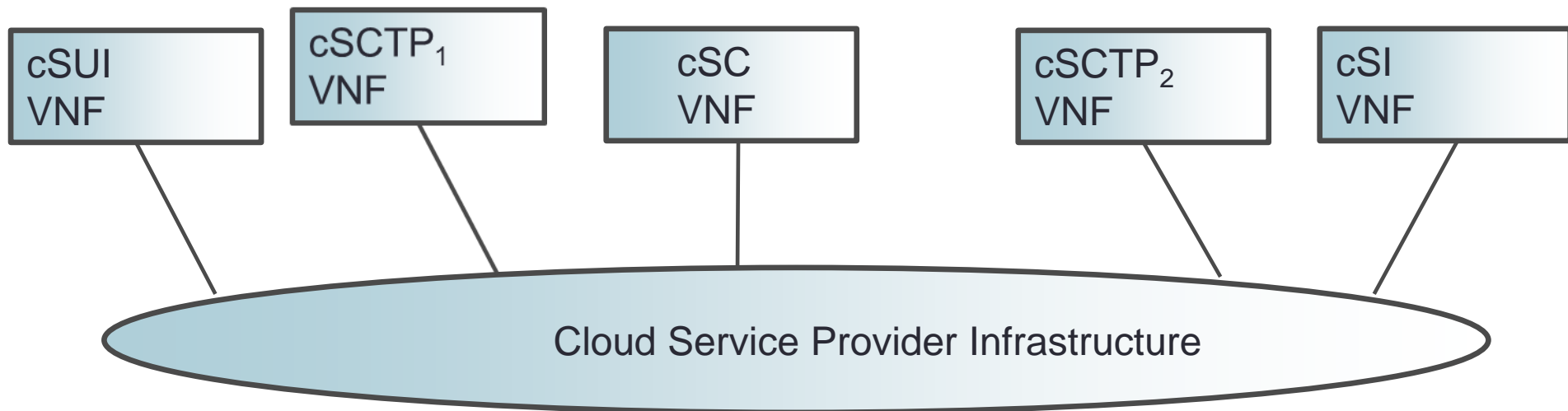
Virtualized Implementation



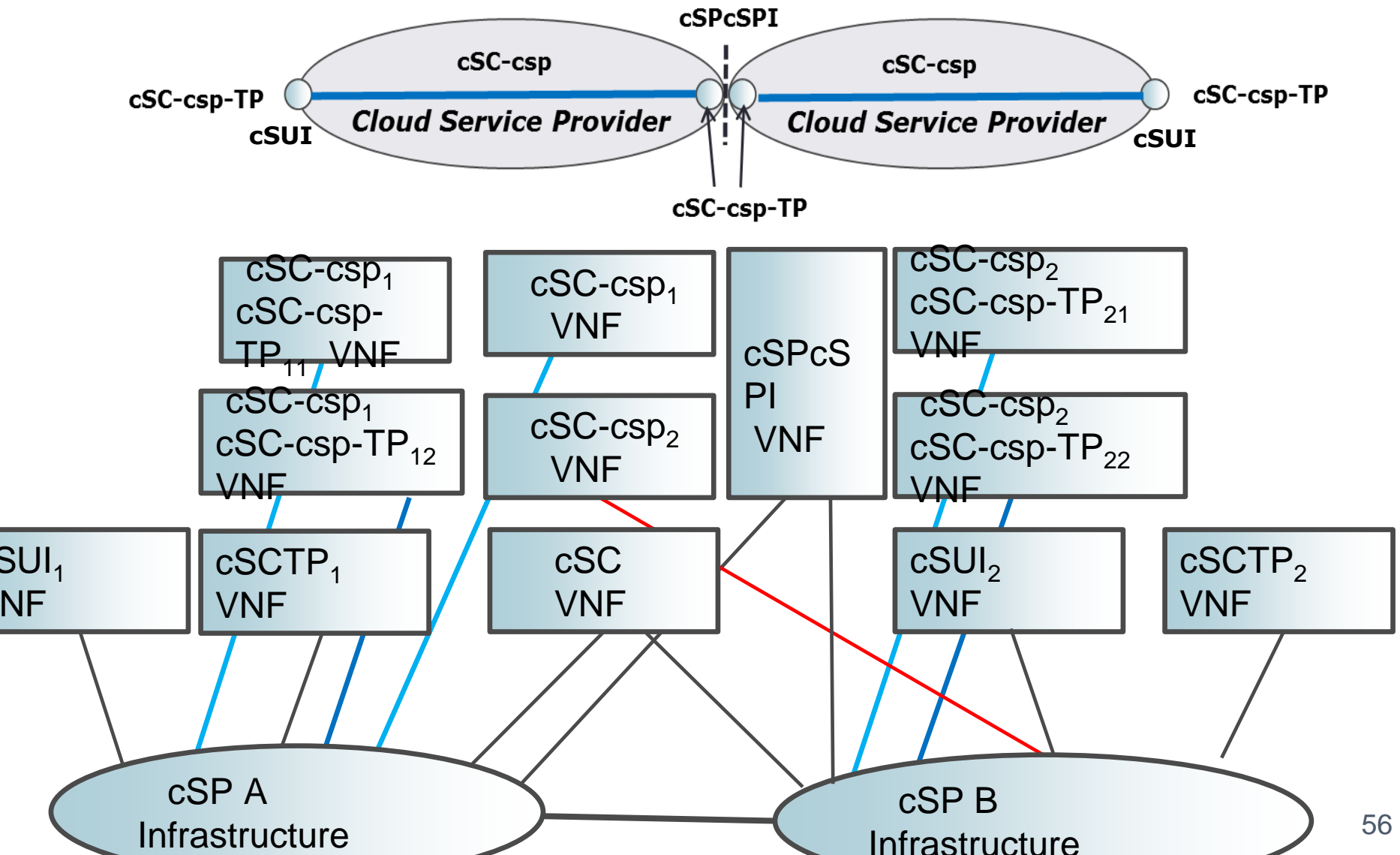
Virtualized cSC between cSUI and cSI



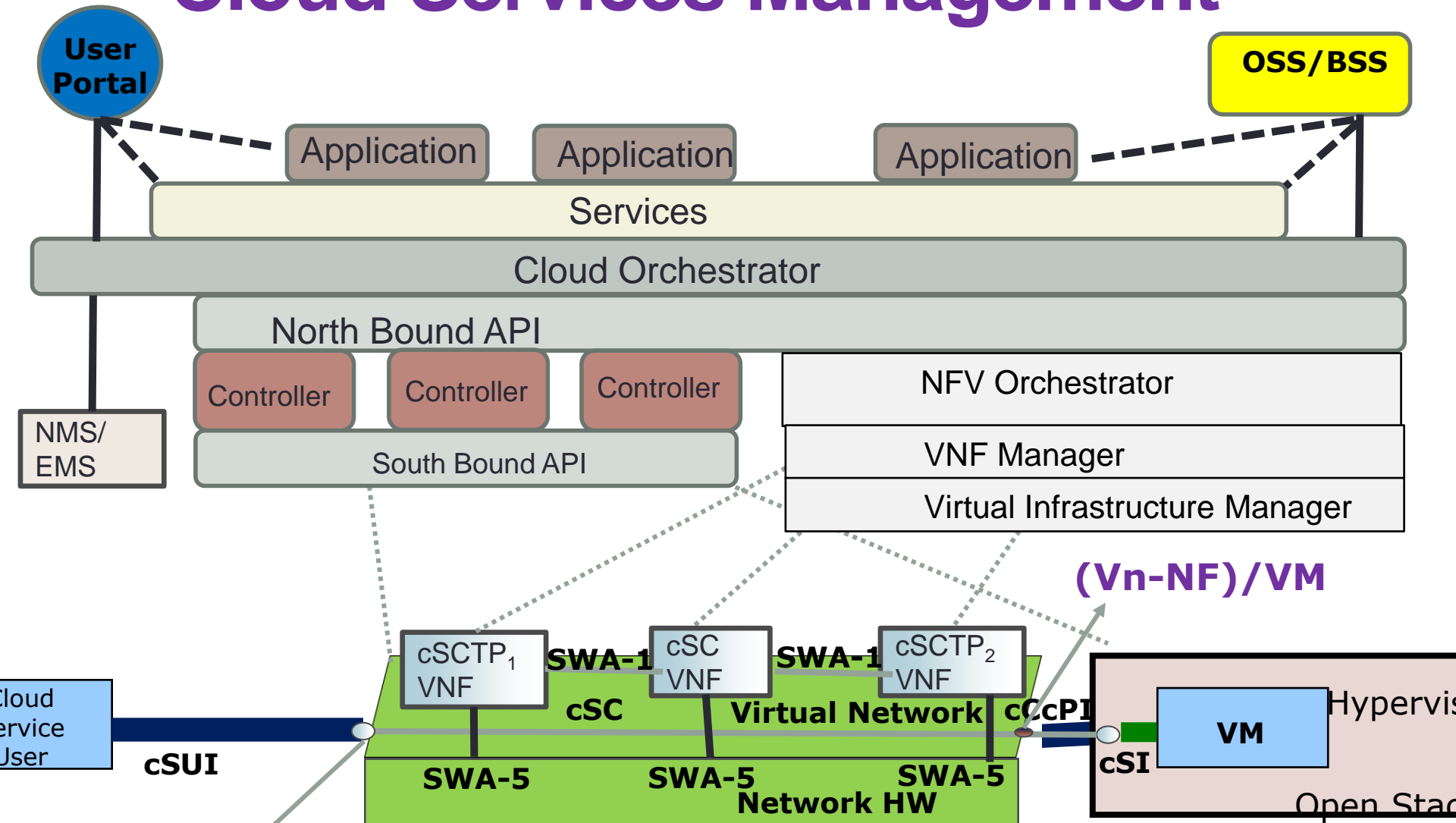
Virtualized Implementation



Virtualized cSC Crossing Two cSPs

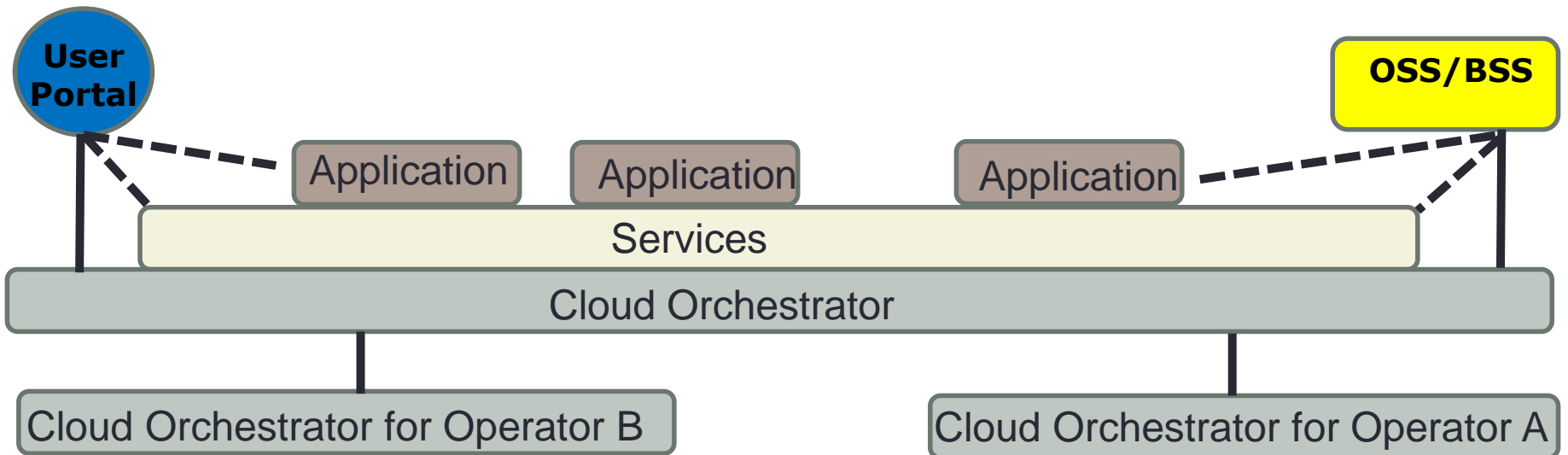


Cloud Services Management



(Vn-Nf)/VN + Vi-Ha

Cloud Services Management with Multiple Operators



Thank You!
