



Building NFV Solutions with OpenStack and Cisco ACI



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Agenda

- *Brief Introduction to Cisco ACI*
- *Introduction and benefits to run OpenStack and ACI Integration.*
- *NFV features of ACI Neutron Plugin.*
- *High performance HW Load Balancing to OpenStack VNFs through BGP ECMP.*
- *Deployment of service chaining using Neutron SFC API.*

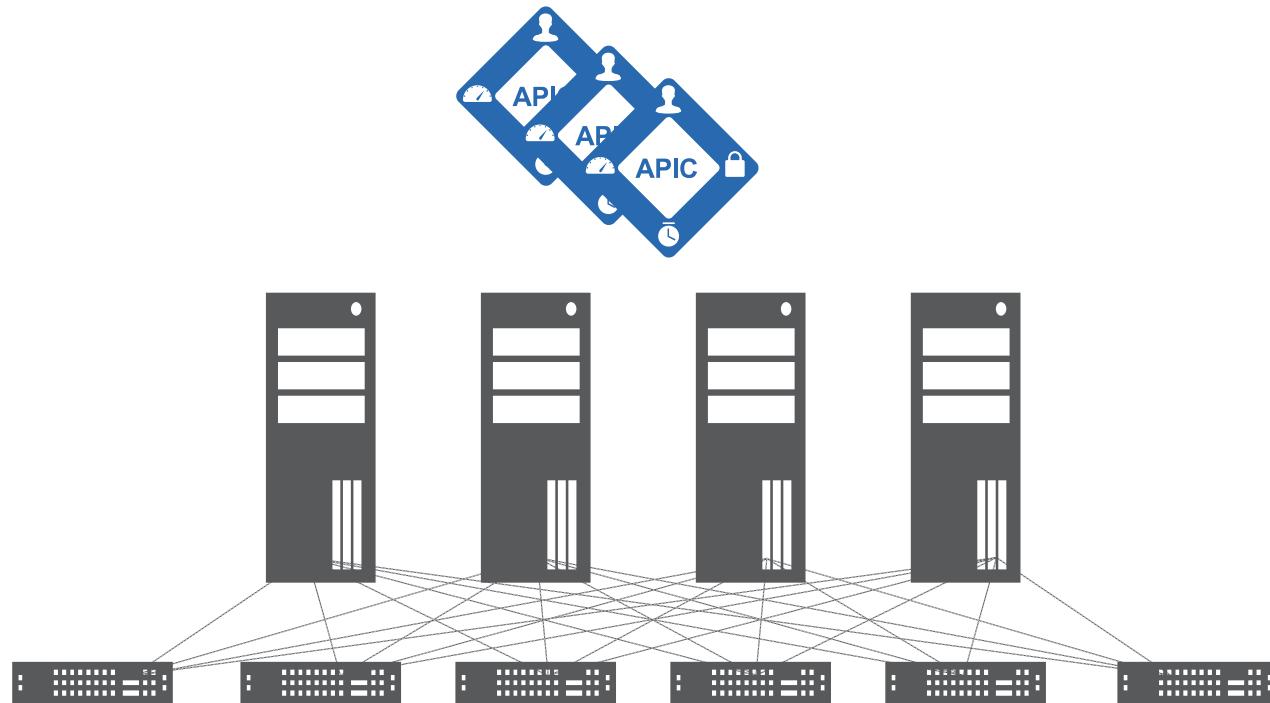


What is Cisco ACI?



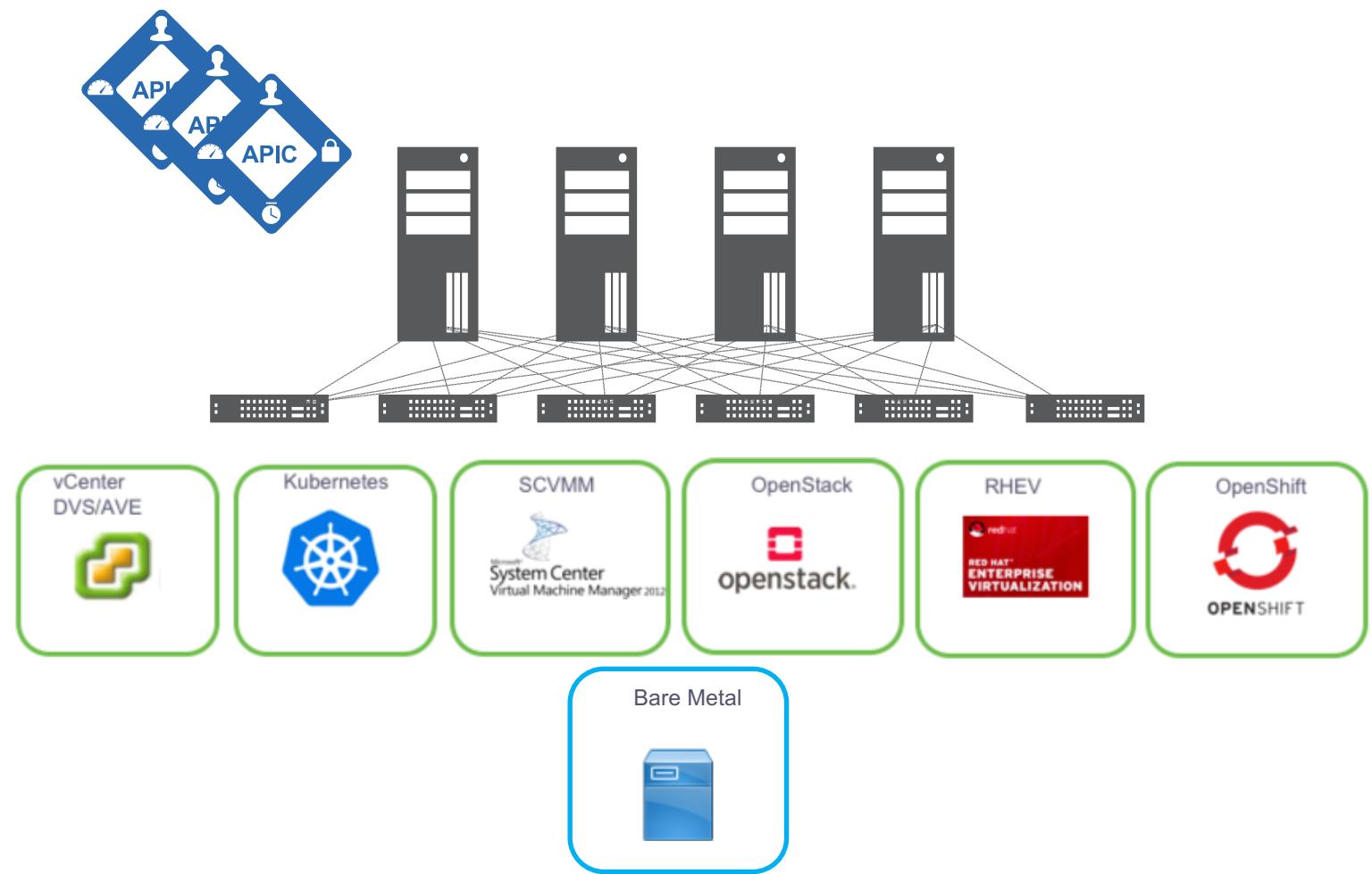
Cisco SDN Solution:

Nexus 9000 + APIC controller = Cisco ACI



Network Policy across multiple Domains

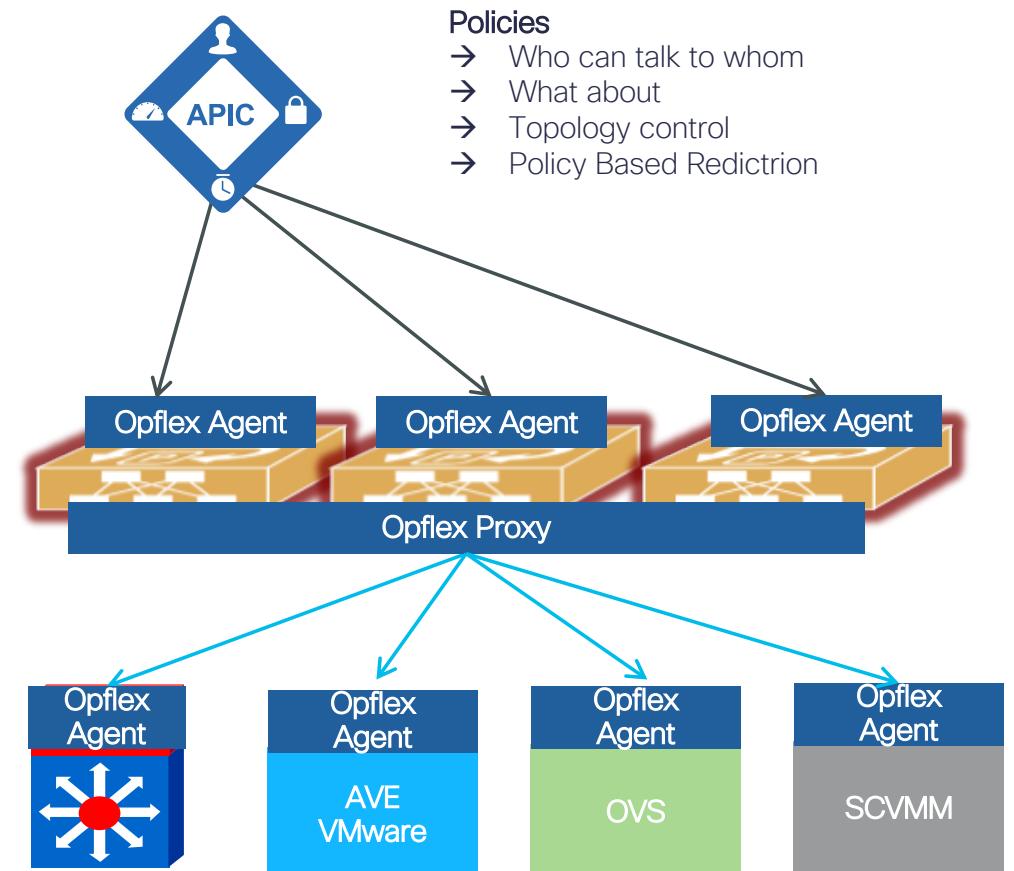
One network policy framework that can be extended across multiple domains: physical servers, multiple VMM and containers



OpFlex - A flexible, extensible policy protocol

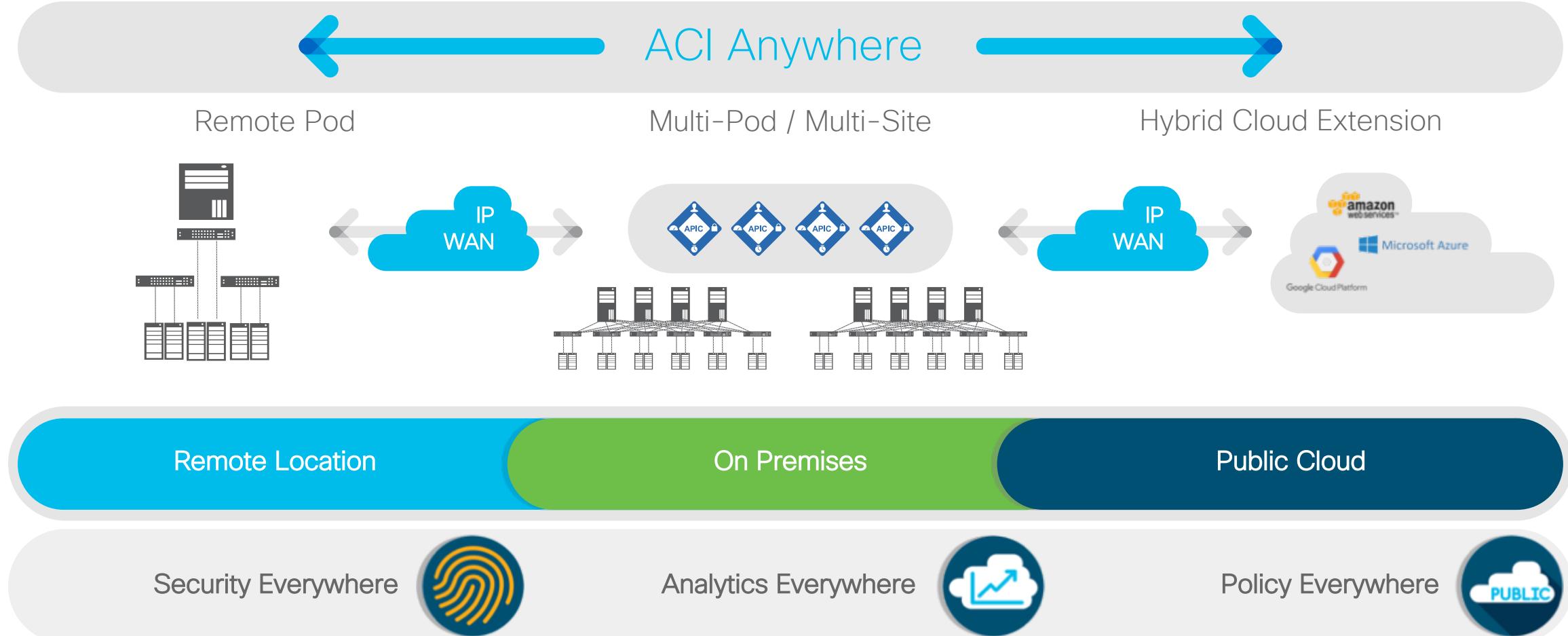
OpFlex is an open source extensible policy resolution protocol designed for declarative control of datacenter infrastructure.

1. Abstract policies rather than device-specific configuration
2. Flexible, extensible definition of using XML / JSON
3. Support for any device – vSwitch, physical switch, network services, servers, etc.



ACI Anywhere - Vision

Any Workload, Any Location, Any Cloud



Why Cisco ACI and OpenStack?



OpenStack Challenges

Non distributed
L3 services

No underlay
visibility

Performance

Complexity of
troubleshooting

Why Cisco ACI and OpenStack?



Distributed, Scalable
Virtual Networking



Hardware-Accelerated
Performance



Integrated Overlay and
Underlay



Operations and
Telemetry

4 key advantages to remember



Why Cisco ACI and OpenStack?



Distributed, Scalable
Virtual Networking



Hardware-Accelerated
Performance

- Full Neutron Node datapath replace
- Fully distributed Layer 2, anycast gateway, DHCP, and metadata
- Distributed NAT and floating IP address



Integrated Overlay and
Underlay



Operations and
Telemetry

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Why Cisco ACI and OpenStack?



Distributed, Scalable
Virtual Networking



Hardware-Accelerated
Performance



Integrated Overlay and
Underlay



Operations and
Telemetry

- Fully managed underlay network through Cisco® APIC
- Capability to connect physical servers and multiple hypervisors to overlay networks



Why Cisco ACI and OpenStack?



Distributed, Scalable
Virtual Networking



Hardware-Accelerated
Performance



Integrated Overlay and
Underlay

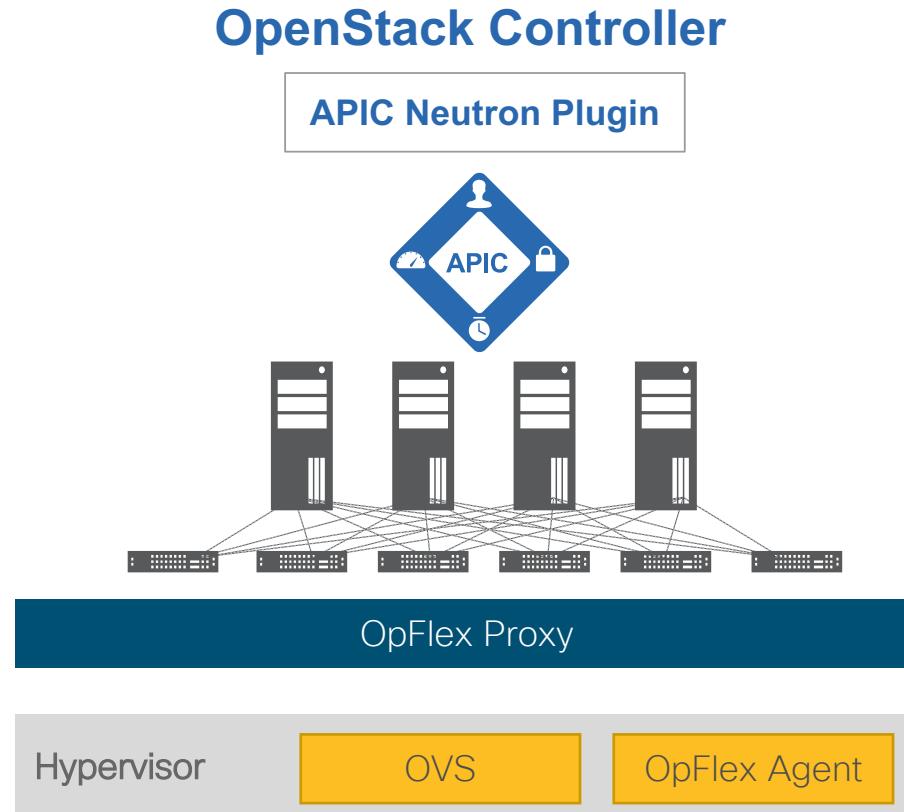


Operations and
Telemetry

- Troubleshooting across physical and virtual environments
- Health scores and capacity planning per tenant network

ACI Neutron Plugin – With OpFlex Support

Full Policy Based Network Automation Extended to the Hypervisor



OpFlex for OVS

- Open Source OpFlex agent extends ACI into the host
- OpFlex Proxy exposes new open API in ACI fabric

OpenStack Feature Highlights

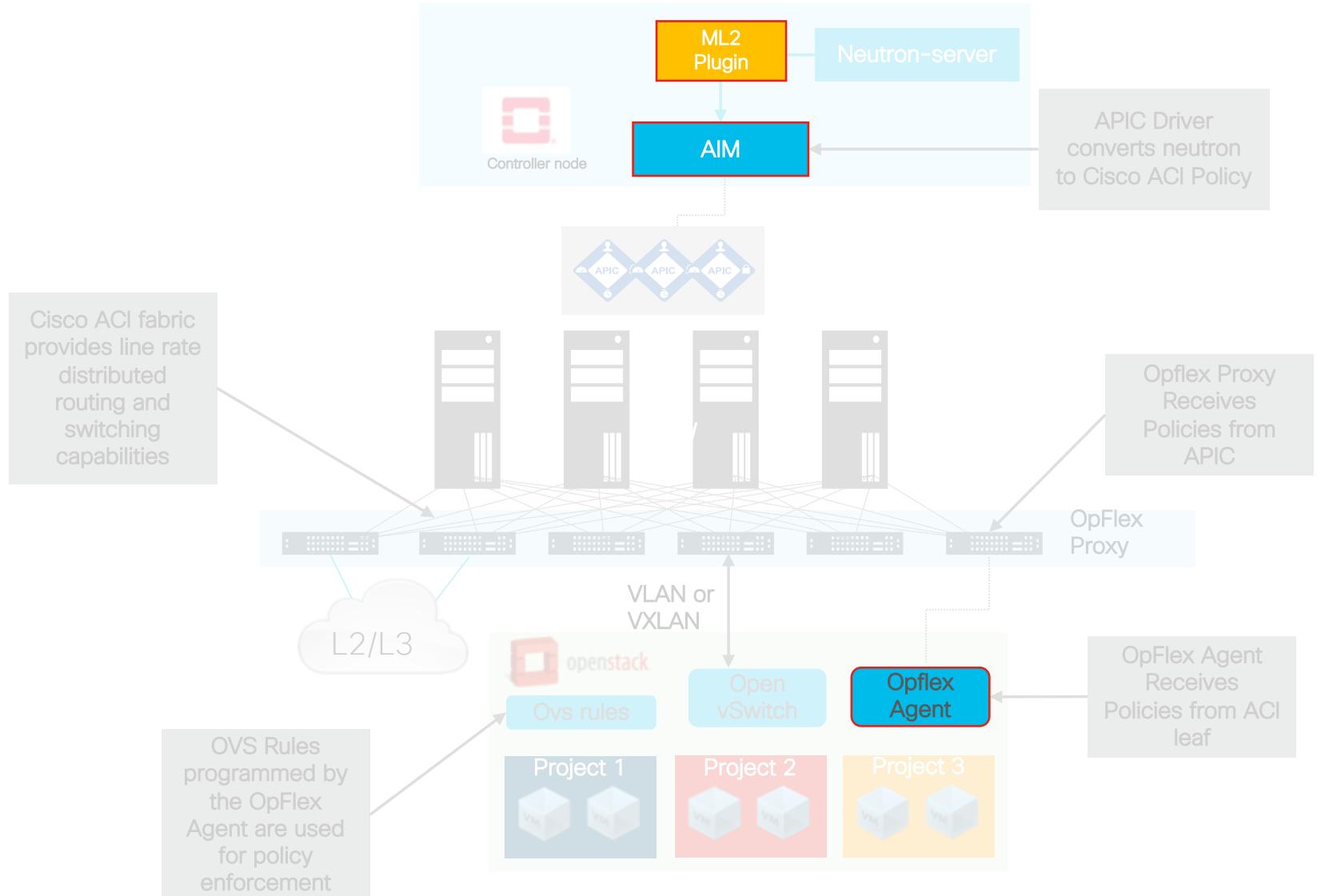
- Fully distributed Neutron network functions, including NAT
- Integrated, centrally managed overlay and underlay fabric
- Operational visibility integrating OpenStack, Linux, and APIC
- Choice of virtual network (standard Neutron ML2) or Group-based Policy driven networking



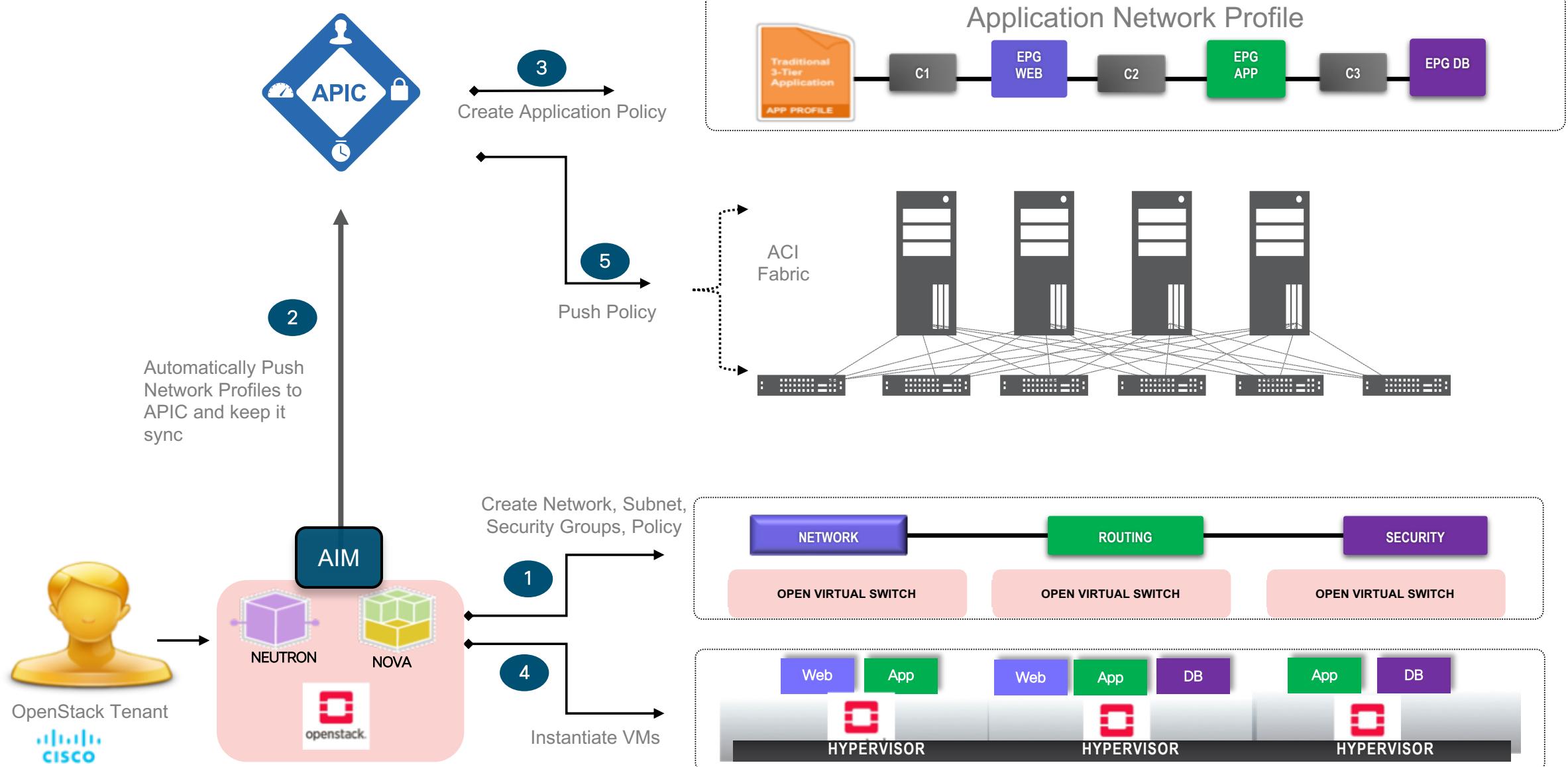
ACI Neutron Plugin Main Components

Main Components are:

- AIM
- ACI ML2 Plugin
- Opflex Agent



The AIM Daemon at work: the workflow



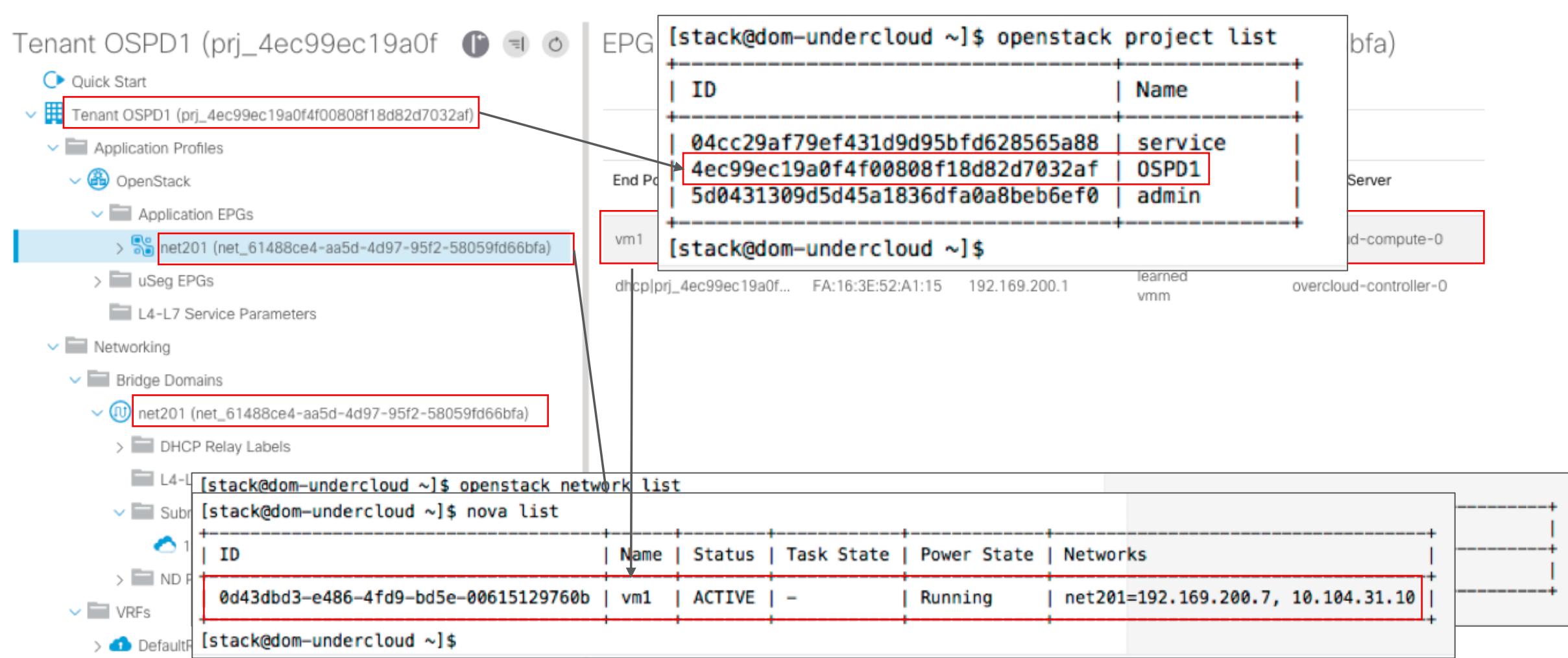
OpenStack Neutron to APIC Objects Mapping

- With the ML2 Standard Neutron model, the following mapping happens.
- All the operations are done on OpenStack through Horizon, CLI or Heat

Neutron Object	APIC Object
Project	Tenant
Network	EPG + BD
Subnet	Subnet
Router	Contract
Security Group + Rule	ACI Host Protection Profiles



ACI Tenant Creation with ML2 model

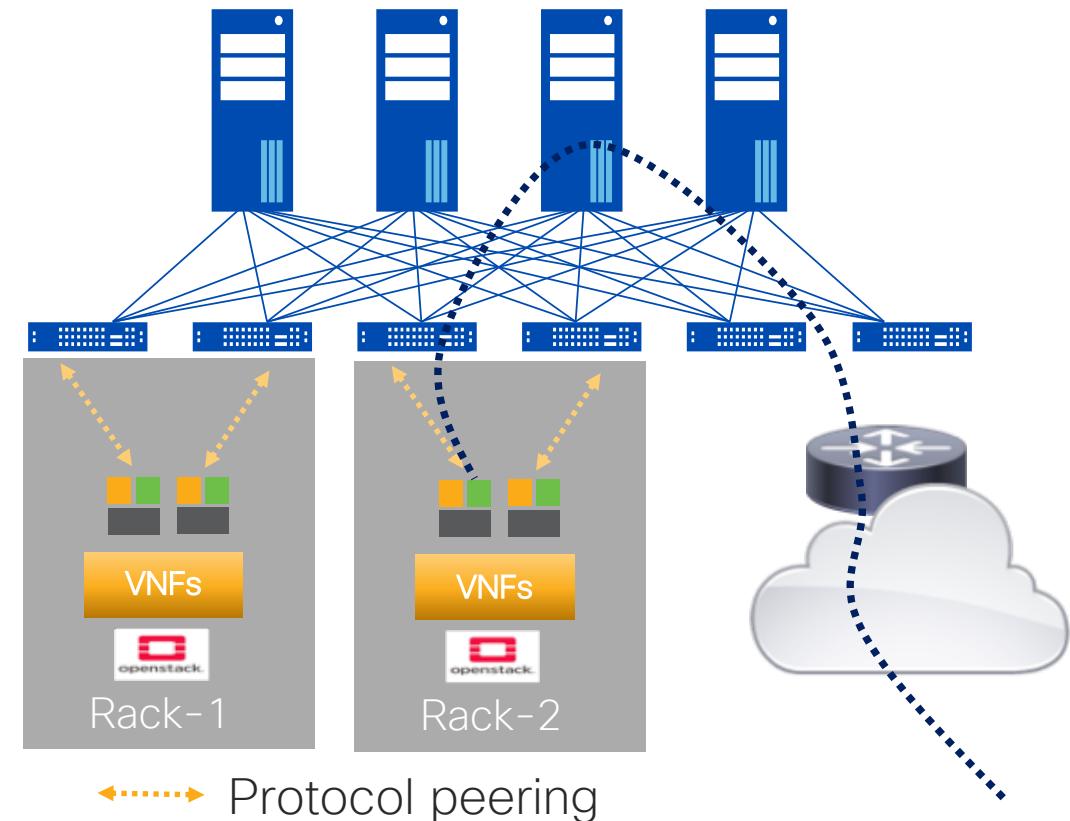


NFV Features of ACI Neutron Plugin



Challenges of VNFs

- Configuration of dynamic routing protocol between fabric switch and VNF
- Support for dynamic VNF deployed in distributed fashion
- Traffic distribution among VNF
 - Wider ECMP than normally seen with physical appliance
 - Ensure evenly traffic distribution among VNF
- Optimal performance with VNF



How ACI can help solve NFV challenges

- ACI Plugin Supports Neutron Trunk Ports.
- Neutron SVI for dynamic BGP peering to VNFs.
- ACI Plugin Supports Neutron SFC with traffic redirection to VNF.
- Support for OVS-DPDK and SR-IOV.



Neutron SVI Support

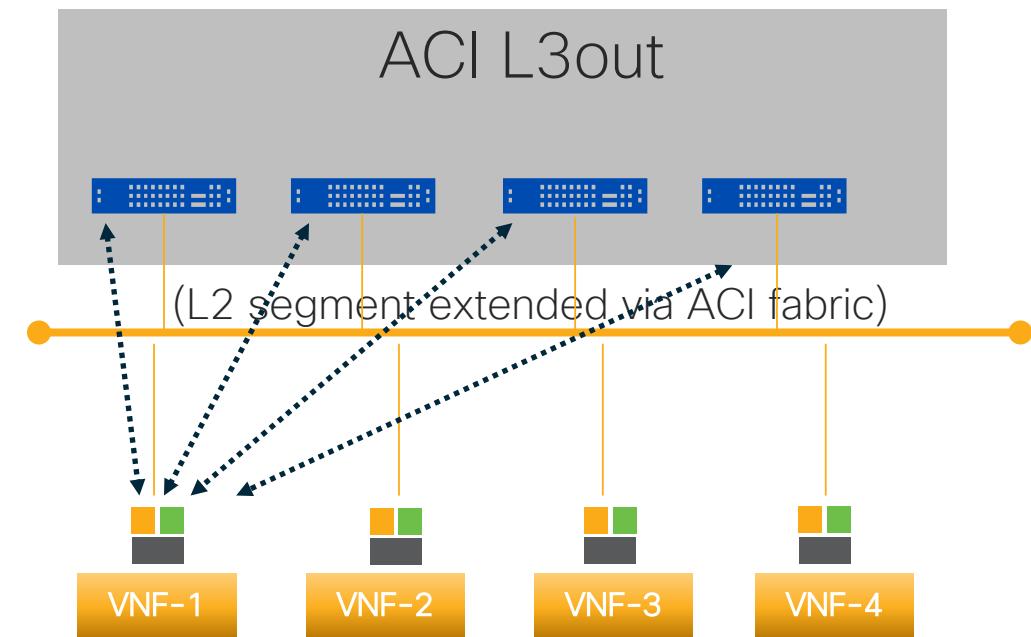


What is Neutron SVI feature

- ACI plugin for OpenStack enables distributed route peering between the switches and OpenStack VNFs:
 - Based on the creation or destruction of VNFs, Neutron SVI feature dynamically and automatically create and destroy SVI on the underlay and enables line rate routing capabilities and up to 64-way ECMP to the VNFs.

ACI with VNFs capabilities

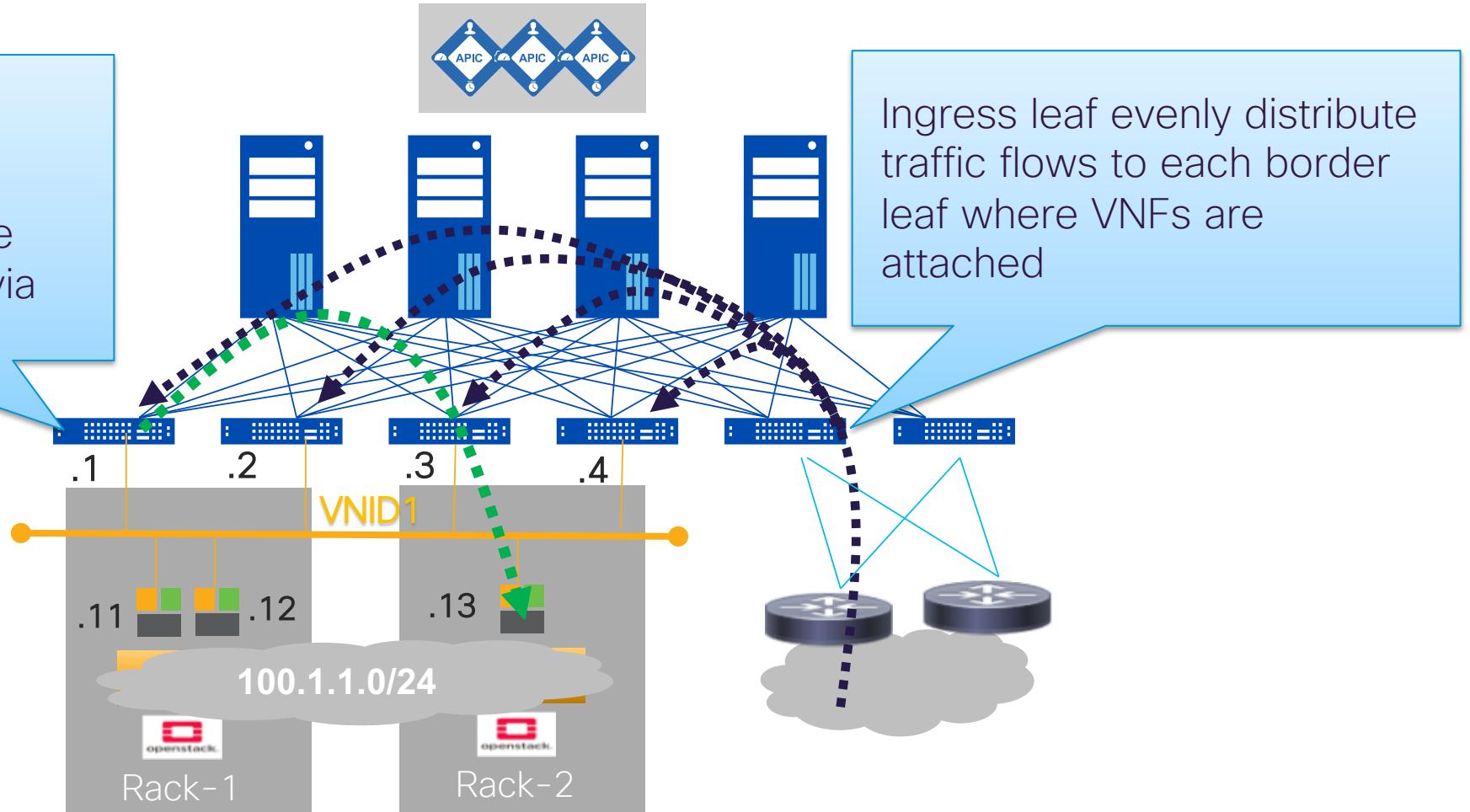
- Supports up to 6 pairs of switches under same L3out
- Supports VNFs across distributed sites (MultiPod)
- Supports automatic BGP peering over fabric for encapsulated control traffic
- Supports bonding with VPC
- Support BFD for fast VM failure detection



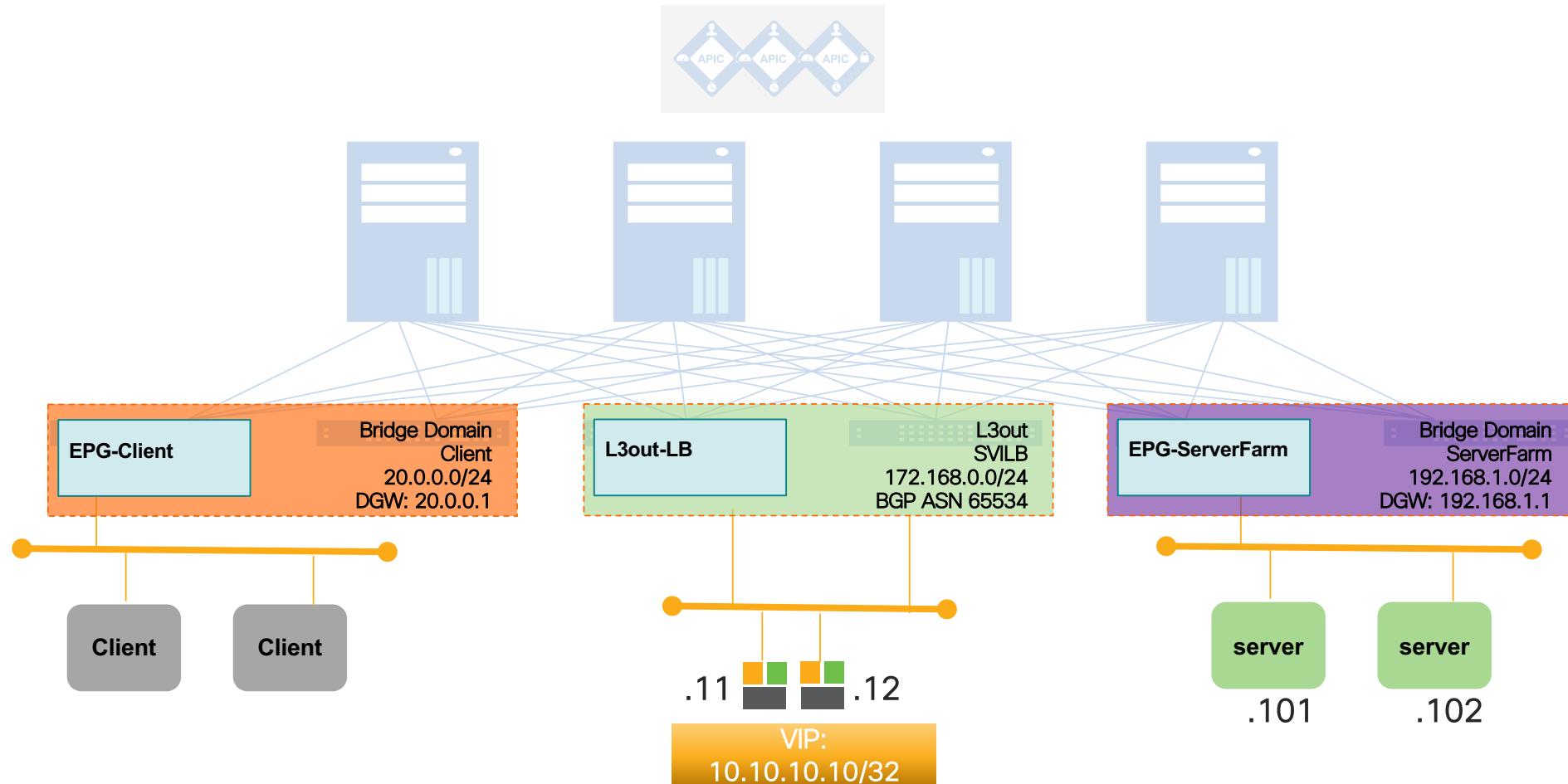
Distribute traffic evenly to VNFs

Each VNF within the cluster receives equal amount of data traffic, regardless where it is attached

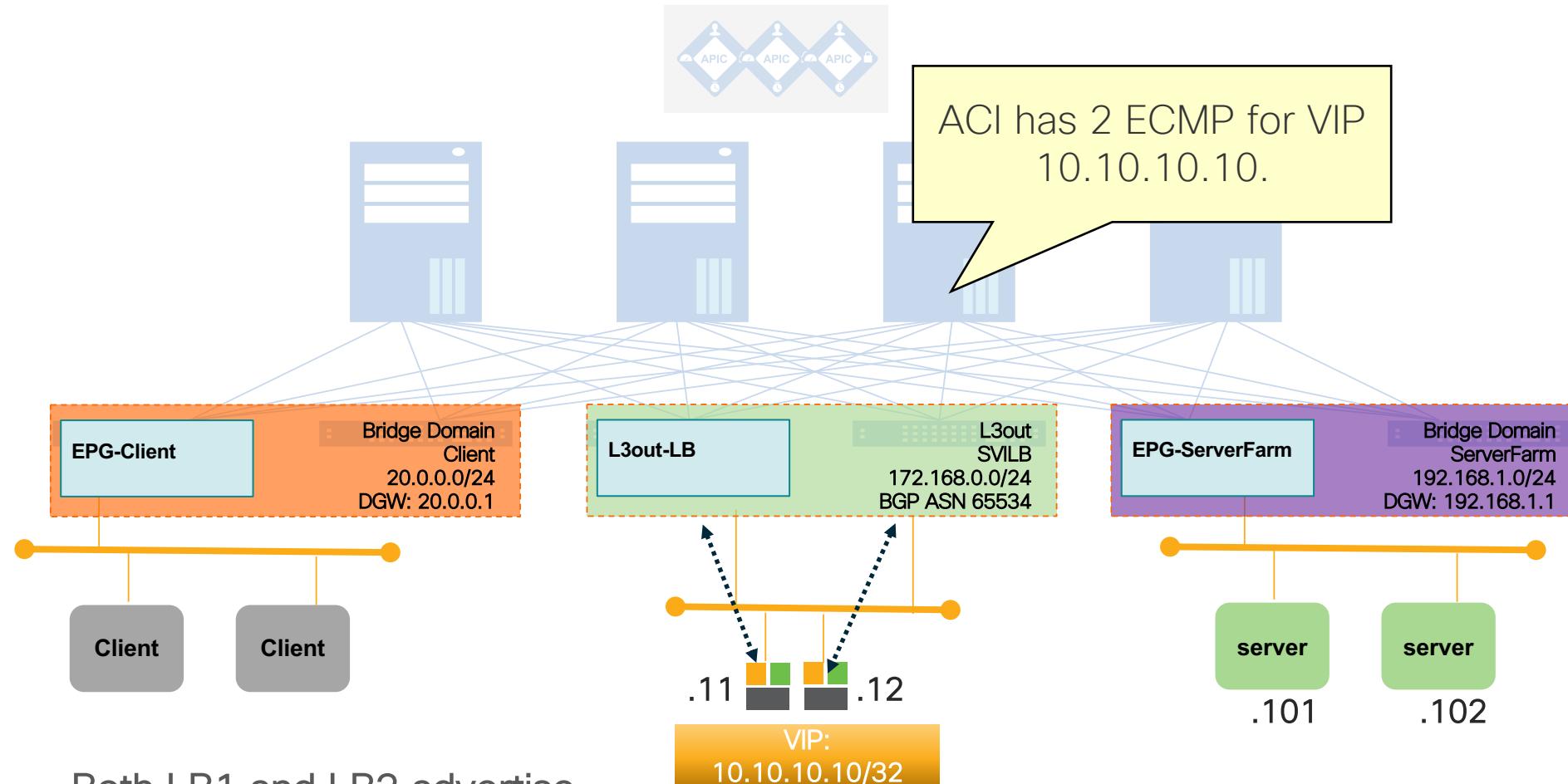
Each border leaf evenly distribute traffic flows to each VNF instance. Traffic destined to some VNFs will be forwarded via fabric



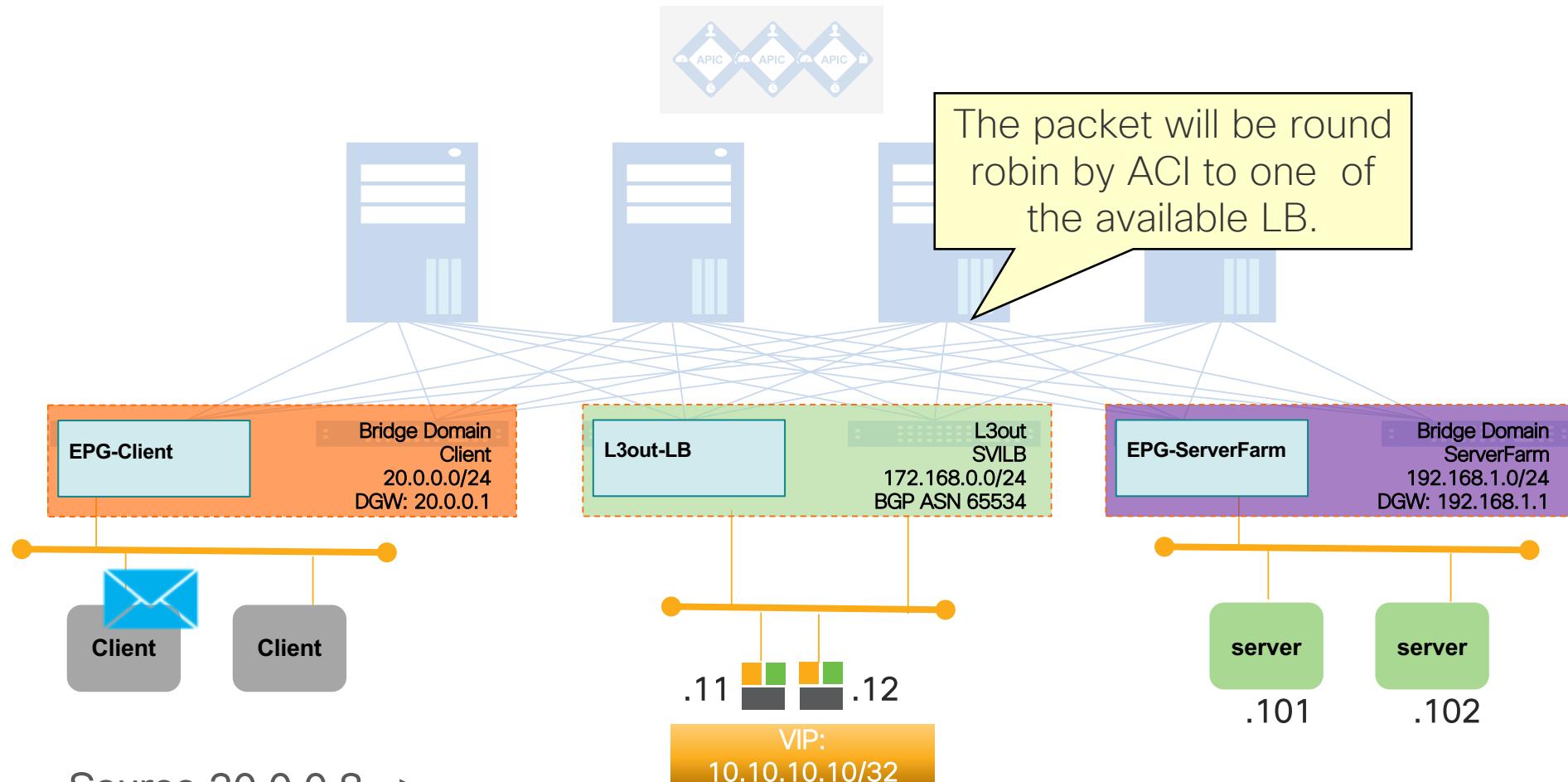
Example: Topology



Example: BGP Peering

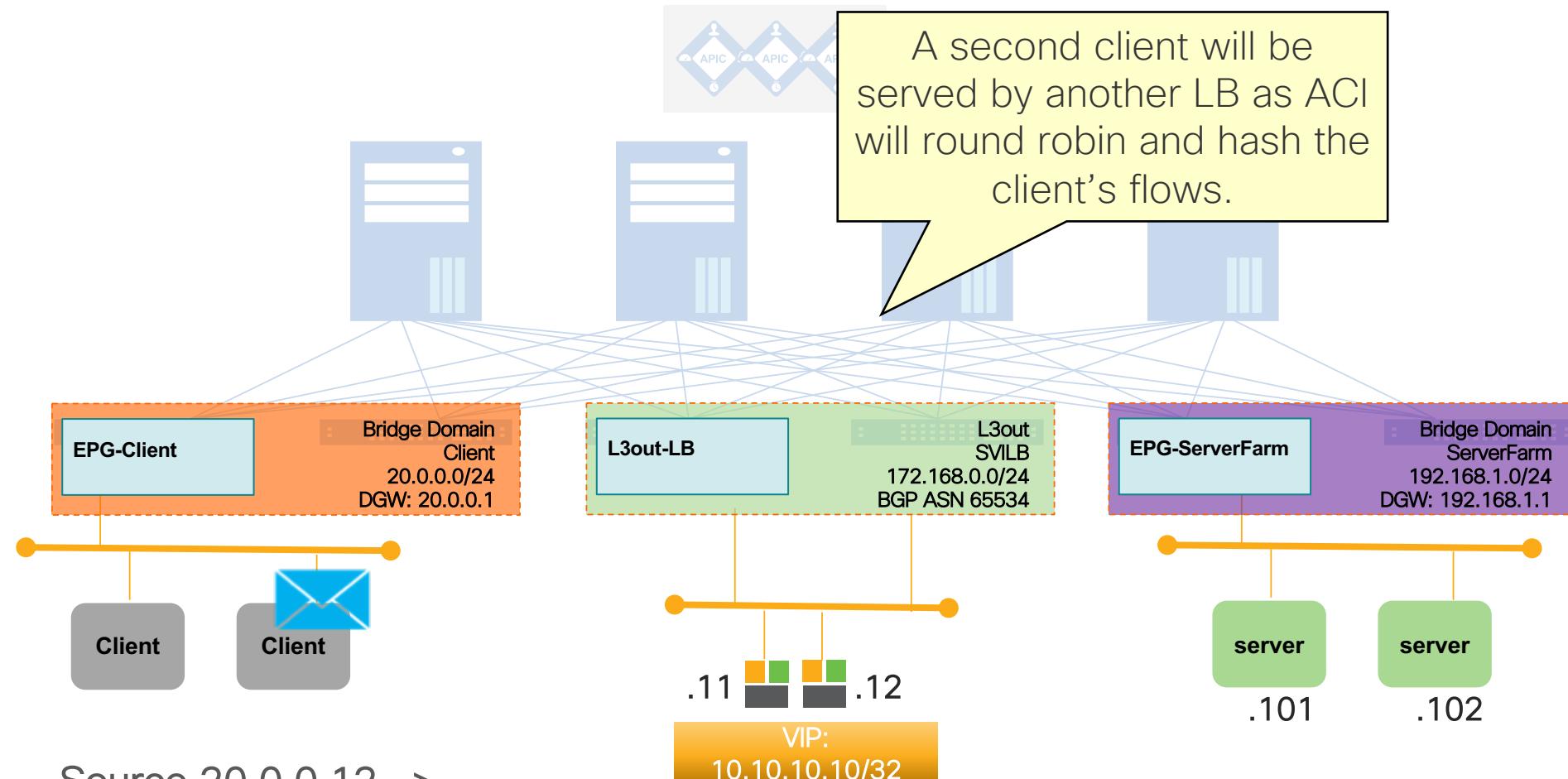


Example: Packet Flow - Client1 to LB

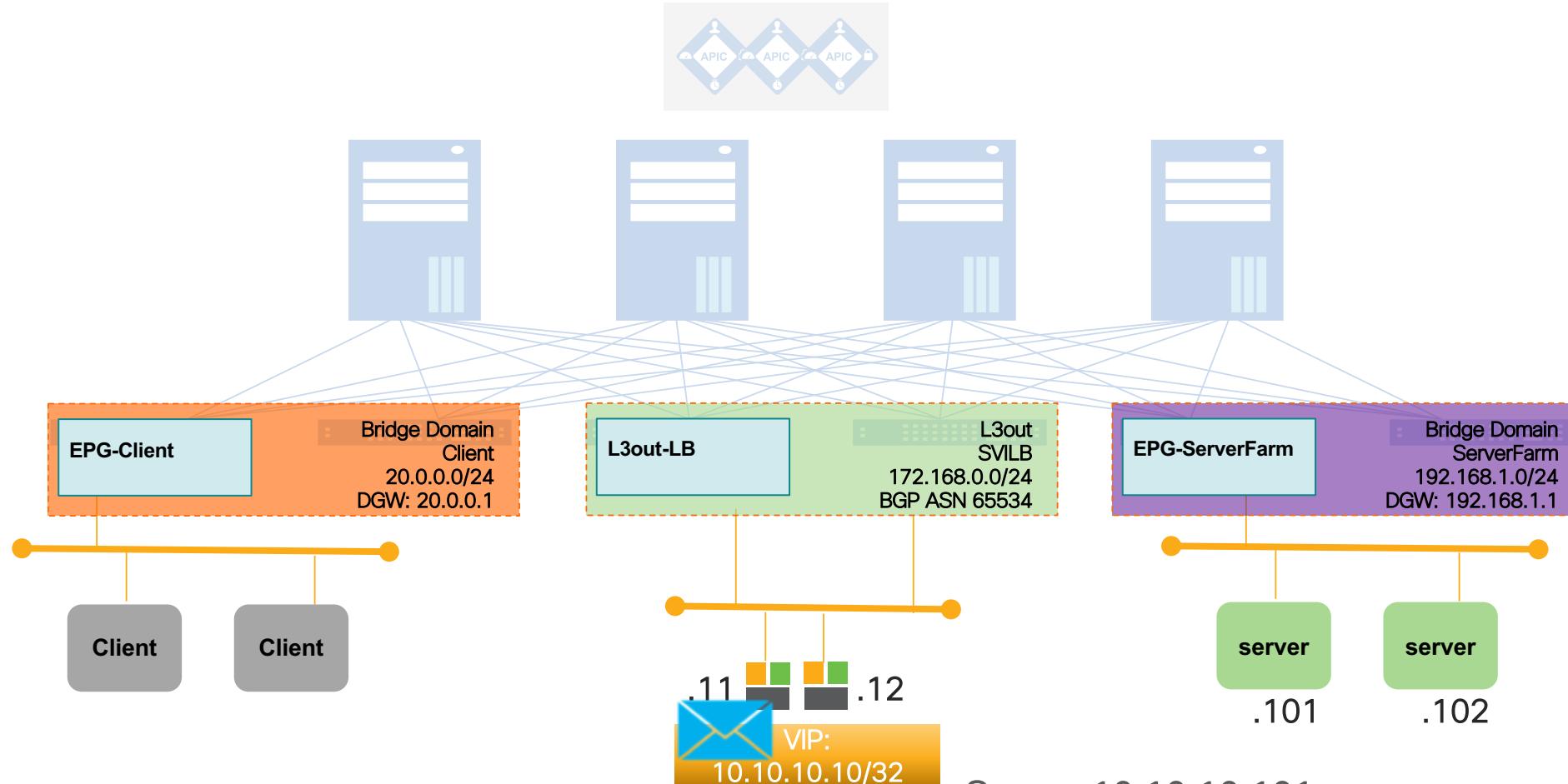


Source 20.0.0.8 ->
Destination 10.10.10.10
Is served by LB1 172.168.0.11

Example: Packet Flow – Client2 to LB



Example: Packet Flow – LB to serverfarm



Source 10.10.10.101 ->
Destination 192.168.1.101
LB will sNAT and send packet to one server of the farm



Deployment of service chaining using Neutron SFC API



What is SFC

- Neutron Service Function Chaining is the upstream OpenStack API to configure service chaining.

Why SFC

- Makes multinode PBR easier
- Use upstream Openstack API to deploy Service Graph with Multinode PBR
- No ACI manual configuration

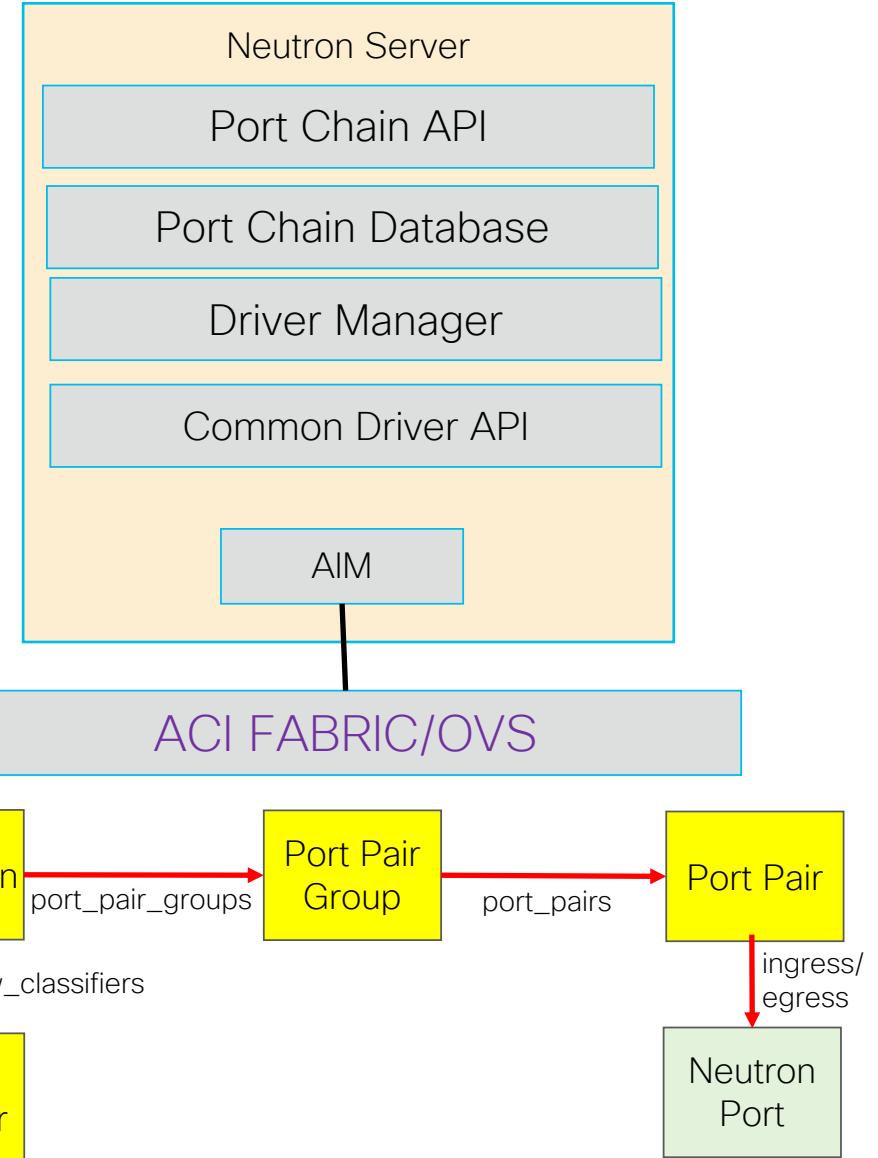
Usage

- Create Left and Right networks (BD's)
- Create port-pairs
- Create port-pair groups
- Create flow-classifier
- Create Service Chain
- Update Service Chain



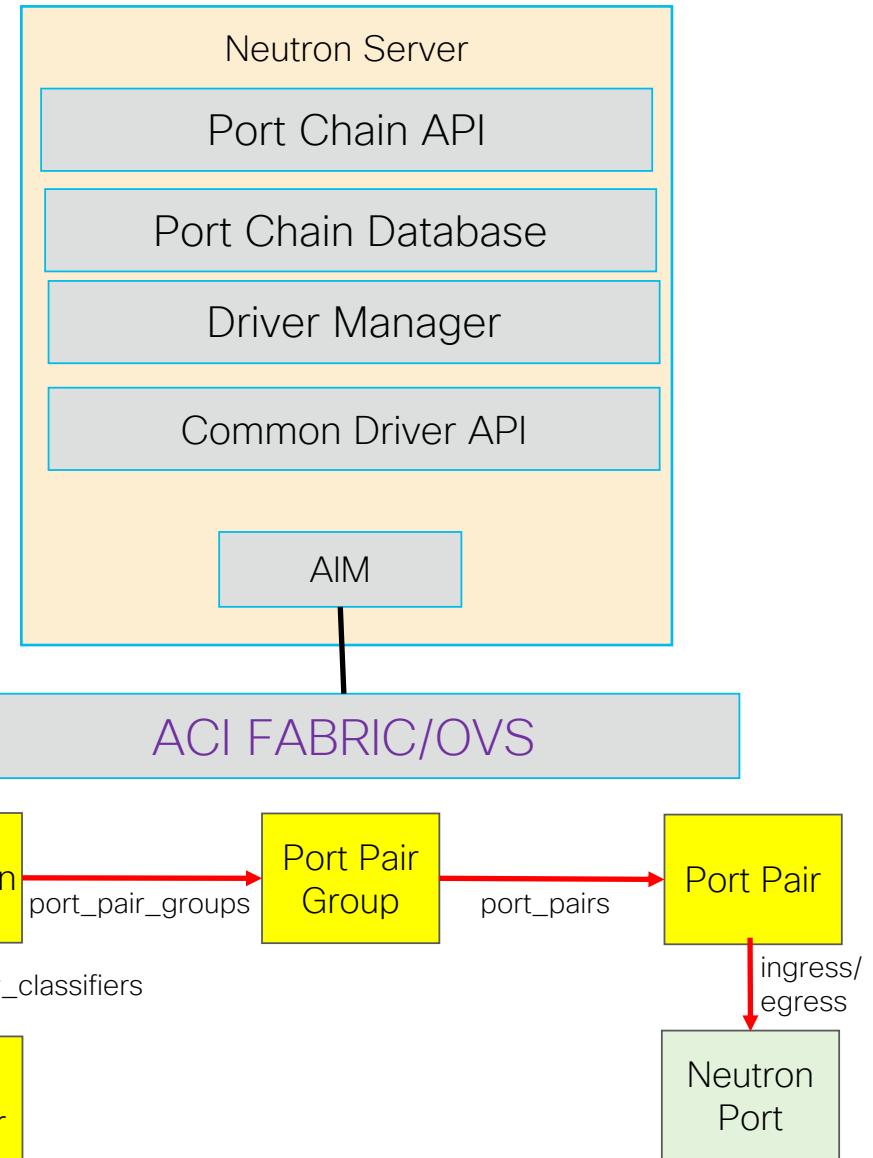
Neutron SFC API

- Port chain, or service function path, consists of the following:
- Port pairs
- Set of ports that define the sequence of service functions.
- Flow classifiers that specify the classified traffic flows entering the chain.
- Port chain update
- Port pair group update
- CLI support depends on OpenStack vendor
 - We support API

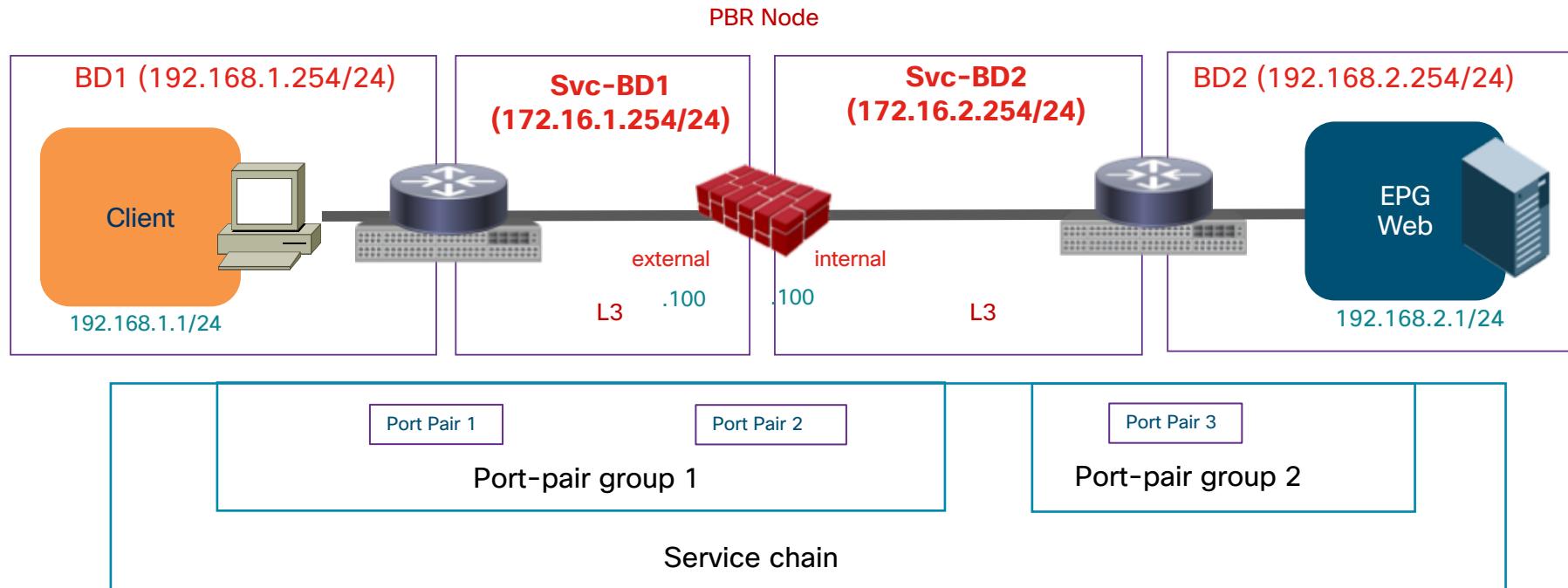


OpenStack Orchestrates

- Virtual Networks (via Neutron API)
 - Extended to reference existing L3Outs, configuring SVI & BGP peering on them
- VNF lifecycle management (via Nova API)
- Service Function Chaining API
 - Port Pair (ingress and egress interface of a VNF)
 - Port Pair Group (VNF HA cluster)
 - Port Chain (linear chain of VNF clusters)
 - Flow Classifier (forwarding classification)



APIC Mapping of neutron Service Chain



Deployed Service Graph

Tenant Peets (prj_84)

L4-L7 Service Graph Instance - flc_50bd036d-9d19-434c-a69b-76622488a80d-ptc_db112d31-

Topology Policy Faults Help

Application Profiles

Networking

Contracts

Policies

Services

L4-L7

- Service Parameters
- Service Graph Templates
 - PEETS-CHAIN (ptc_db112d31-44)
 - Function Node - ppg_411b7ff5
 - consumer
 - provider
 - Router configurations
 - Function Profiles
 - Devices
 - Imported Devices
 - Devices Selection Policies
 - any-ptc_db112d31-4475-42e7-8
 - Deployed Graph Instances
 - flc_50bd036d-9d19-434c-a69b-76622488a80d-ptc_db112d31-4475-42e7-8
 - Deployed Devices
 - Device Managers
 - Chassis

Creating Service Chain

Create Left and Right Networks (BD)

```
neutron net-create SRC-NET
```

```
openstack subnet create --ip-version 4 --gateway 1.1.0.1 --network SRC-NET_ID --subnet-range 1.1.0.0/24 --host-route destination=10.0.0.0/16,gateway=1.1.0.1 "
```

```
neutron net-create DST-NET
```

```
openstack subnet create --ip-version 4 --gateway 2.2.0.1 --network DST-NET_ID --subnet-range 2.2.0.0/24 --host-route destination=0.0.0.0/0,gateway=2.2.0.1 "
```

Create Flow Classifier

```
neutron flow-classifier-create --destination-ip-prefix 0.0.0.0/0 --source-ip-prefix 10.0.1.0/24 --l7-parameters logical_source_network=SRC-NET_ID,logical_destination_network=DST-NET_ID CLASSIFIER1
```



Creating Service Chain (Cont)

Create Src and Dest neutron Ports

```
openstack port create SERVICE1-INGRESS --network SRC-NET_ID --no-security-group --disable-port-security --fixed-ip  
subnet=SRC-SUBNET_ID,ip-address=1.1.0.11
```

```
openstack port create SERVICE1-EGRESS --network DST-NET_ID --no-security-group --disable-port-security --fixed-ip  
subnet=DST-SUBNET_ID,ip-address=2.2.0.11
```

Create Port Pair

```
neutron port-pair-create --ingress SERVICE1-INGRESS-PORT_ID --egress SERVICE1-EGRESS-PORT_ID PORTPAIR1
```

Create Port Pair Group

```
neutron port-pair-group-create --port-pair PORTPAIR1_ID CLUSTER1
```

Create Service Chain

```
neutron -port-chain-create --flow-classifier CLASSIFIER1_ID --port-pair-group CLUSER1_ID SERVICE-CHAIN1
```

Create service VM

```
nova --os-project-name Peets boot --flavor medium --image ServiceImage1 --nic port-id=SERVICE1-INGRESS-PORT_ID --nic  
port-id=SERVICE1-INGRESS-_PORT_ID SERVICE-VM-1
```

More bumps on a wire

Create more Left and Right Networks (BD)

```
neutron net-create SRC-NET2
```

```
openstack subnet create --ip-version 4 --gateway 1.1.0.1 --network SRC-NET2_ID --subnet-range 1.1.0.0/24 --host-route destination=10.0.0.0/16,gateway=1.1.0.1 "
```

```
neutron net-create DST-NET2
```

```
openstack subnet create --ip-version 4 --gateway 2.2.0.1 --network DST-NET2_ID --subnet-range 2.2.0.0/24 --host-route destination=0.0.0.0/0,gateway=2.2.0.1 "
```

Create Src and Dest neutron Ports for service 2

```
openstack port create SERVICE2-INGRESS --network SRC-NET2_ID --no-security-group --disable-port-security --fixed-ip subnet=SRC-SUBNET2_ID,ip-address=3.3.0.11
```

```
openstack port create SERVICE2-EGRESS --network DST-NET2_ID --no-security-group --disable-port-security --fixed-ip subnet=DST-SUBNET2_ID,ip-address=4.4.0.11
```



Adding more bumps on a wire

Create Port Pair for service 2

```
neutron port-pair-create --ingress SERVICE2-INGRESS_PORT_ID --egress SERVICE2-EGRESS_PORT_ID  
PORTPAIR2
```

Create Port Pair Group for service 2

```
neutron port-pair-group-create -port-pair PORTPAIR1_ID CLUSTER2
```

Update Service Chain (add new Port Pair Group)

```
neutron port-chain-update SERVICE-CHAIN1_ID --flow-classifier CLASSIFIER1_ID --port-pair-group CLUSTEER1  
--port-pair-group CLUSTER2
```

Create service2 VM

```
nova --os-project-name Peets boot --flavor medium --image ServiceImage1 --nic port-id=SERVICE2-INGRESS-  
PORT_ID --nic port-id=SERVICE2-EGRESS-PORT_ID SERVICE_VM-2
```



Service chaining - PBR

Tenant Peets (prj_84)

L4-L7 Policy Based Redirect

Name	Hashing Algorithm	Threshold Enable	Resilient Hashing Enabled	Min Threshold Percent (percentage)	Max Threshold Percent (percentage)	Threshold Down Action	IP	MAC	Description
egr_ppg_411b7ff5-03c1-...	sip-dip-prot...	False	False	0	0	permit action	2.2.0.11	FA:16:3E:B0:...	
egr_ppg_8d9baa0a-c644-...	sip-dip-prot...	False	False	0	0	permit action	4.4.0.11, 4.4....	FA:16:3E:4F:...	
egr_ppg_93dbc6f1-f7b4-...	sip-dip-prot...	False	False	0	0	permit action	6.6.0.11	FA:16:3E:96:...	
ingr_ppg_411b7ff5-03c1-...	sip-dip-prot...	False	False	0	0	permit action	1.1.0.11	FA:16:3E:E2:...	
ingr_ppg_8d9baa0a-c644...	sip-dip-prot...	False	False	0	0	permit action	3.3.0.11, 3.3....	FA:16:3E:30:...	
ingr_ppg_93dbc6f1-f7b4-...	sip-dip-prot...	False	False	0	0	permit action	5.5.0.11	FA:16:3E:93:...	

PROTOCOL
BFD
Route Maps
PIM
BGP
OSPF
EIGRP
IGMP Interface
IGMP Snoop
Custom QOS
End Point Retention
DHCP
ND Interface
ND RA Prefix
Route Tag
 L4-L7 Policy Based Redirect
egr_ppg_8d9baa0a-c644-49d0-1
egr_ppg_411b7ff5-03c1-4e86-8
egr_ppg_8d9baa0a-c644-49d0-1
ingr_ppg_8d9baa0a-c644-49d0-1
ingr_ppg_93dbc6f1-f7b4-47bd-a
L4-L7 Redirect Health Groups
Data Plane Policies

Service chaining - Deployed Service Graph

Tenant Peets (prj_84) L4-L7 Service Graph Instance - flc_50bd036d-9d19-434c-a69b-76622488a80d-ptc_db112d31- Topology Policy Faults History

Quick Start Tenant Peets (prj_84c2367497c54e2f8527881)

Application Profiles Networking Contracts Policies Services L4-L7 Service Parameters Service Graph Templates Router configurations Function Profiles Devices Imported Devices Devices Selection Policies Deployed Graph Instances flc_50bd036d-9d19-434c-a69b- Function Node - ppg_8d9baa0 Function Node - ppg_93dbc6f Function Node - ppg_411b7ff5 Deployed Devices Device Managers Chassis Inband Management Configuration for

Consumer

```
graph LR; Consumer((EPG)) --- C1[ ]; C1 --- P1[ppg_411b7...]; P1 --- C2[ ]; C2 --- P2[ppg_8d9ba...]; P2 --- C3[ ]; C3 --- P3[ppg_93dbc...]; P3 --- Provider((ExtEpg))
```

The diagram illustrates a service graph instance with three generic provider nodes (ppg_411b7..., ppg_8d9ba..., ppg_93dbc...) connected to a single consumer node (EPG). The connections are labeled C (Consumer) and P (Provider).

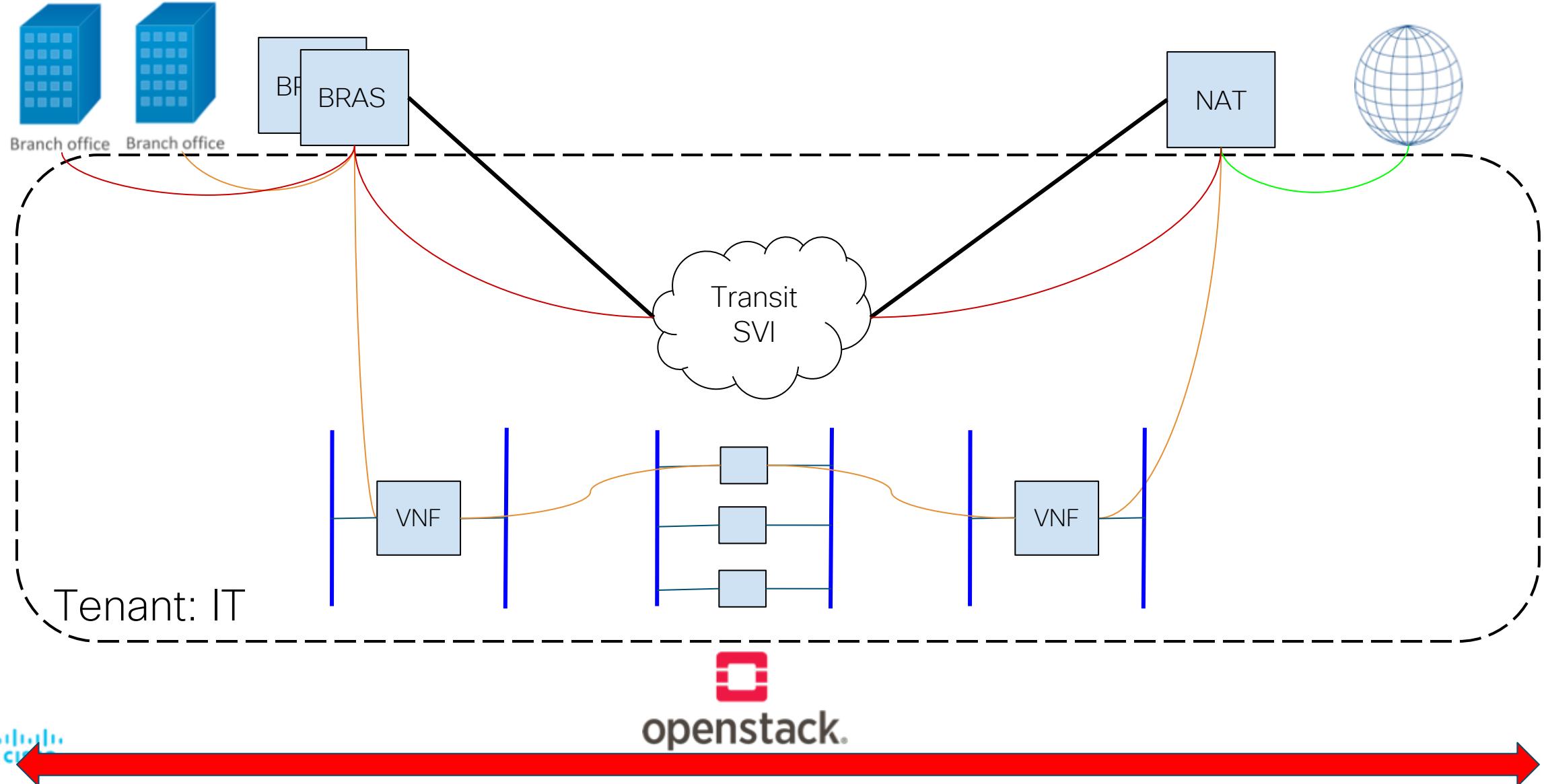
ppg_411b7ff5-03c1-4e86-870b-b1f686729e34 Information

Contract: prj_84c2367497c54e2f8527881384f5bf1a/flc_50bd09d19-434c-a69b-76622488a80d
Graph: prj_84c2367497c54e2f8527881384f5bf1a/ptc_db11; be77cba3d81b
Node: ppg_411b7ff5-03c1-4e86-870b-b1f686729e34
Device Cluster: ppg_411b7ff5-03c1-4e86-870b-b1f686729e34
Policy-based Routing: true
Consumer Connector
Type: bd
BD: prj_84c2367497c54e2f8527881384f5bf1a/net_acdc e472-46ed-976a-10779359f721
L3 Destination (VIP): false
Redirect Policy: svcCont/ingr_ppg_411b7ff5-03c1-4e86-870b-b1f686729e34
Cluster Interface: ingress

ppg_8d9baa0a-c644-49d0-b6bd-7ca9702d6bdf Information

Contract: prj_84c2367497c54e2f8527881384f5bf1a/flc_50bd09d19-434c-a69b-76622488a80d
Graph: prj_84c2367497c54e2f8527881384f5bf1a/ptc_db11; be77cba3d81b
Node: ppg_8d9baa0a-c644-49d0-b6bd-7ca9702d6bdf
Device Cluster: ppg_8d9baa0a-c644-49d0-b6bd-7ca9702d6bdf
Policy-based Routing: true
Consumer Connector
Type: bd
BD: prj_84c2367497c54e2f8527881384f5bf1a/net_f45de6358aa1c02b
L3 Destination (VIP): false
Redirect Policy: svcCont/ingr_ppg_8d9baa0a-c644-49d0-b6bd-7ca9702d6bdf
Cluster Interface: ingress

Application - Create full service chain with peering



Sum Up



OpenStack and ACI for VNFs – Better Together

- ACI Plugin for OpenStack:
 - Increases Visibility Overlay/Underlay and Simplifies Troubleshooting
 - Enables distribute L3 functions
 - Allows Accelerated VM technologies as DPDK and SR-IOV
 - Automatically LB distributed VNFs through Neutron SVI
 - Allows Neutron Service Function Chaining



Want to know more?

- <https://www.cisco.com/go/aci>
- <https://www.cisco.com/c/en/us/support/cloud-systems-management/application-policy-infrastructure-controller-apic/tsd-products-support-series-home.html#OpenStack Installation Guides>
- [https://www.cisco.com/c/en/us/td/docs/switches/datacenter/aci/apic/sw/1-x/openstack/b ACI with OpenStack OpFlex Architectural Overview/b ACI with OpenStack OpFlex Architectural Overview chapter 010.html](https://www.cisco.com/c/en/us/td/docs/switches/datacenter/aci/apic/sw/1-x/openstack/b_ACI_with_OpenStack_OpFlex_Architectural_Overview/b_ACI_with_OpenStack_OpFlex_Architectural_Overview_chapter_010.html)
- <https://www.cisco.com/c/dam/en/us/td/docs/Website/datacenter/aci/virtualization/matrix/virtmatrix.html>
- Facebook: [Cisco ACI User Group](#) 



Come talk to us!

Ifti Rathore
Domenico Dastoli



Cisco (A5)

Welcome to the OPEN INFRASTRUCTURE MARKETPLACE



C5	Ambedded Technology	C18	Cumulus Networks	A29	Fairbanks Technologies	C21	Mellanox Technologies	A9	Quobyte
A20	Avi Networks	C19	Datadog	B13	HUAWEI	C22	Hyper.sh	B6	Rackspace
C16	B1 Systems	C20	scaleUp - by ScaleUp & HKN	C22	iNNOVO Cloud GmbH	A6	Mirantis	B1	Red Hat
A5	Cisco	C21	Dell EMC	B13	Nokia	C23	NetApp	A26	SvOne
A22	Cloudbase Solutions	B4	Deutsche Telekom	B5	Juniper Networks	C24	OBJECTIF LIBRE	B7	Tencent Cloud
C6	Component Soft	C6	EasyStack	A24	Kontron	A19	NetApp	C3	Trilio
C10	ENTER Sri	C10	ENTER Sri	B11	OVH	C25	OBJECTIF LIBRE	B10	Ubuntu
				B12	Oerlikon	C17	Storage Made Easy	C4	VEXXHOST
				B14	Pure Storage	A28	Storpool Storage	B14	VMware
				B15	Supernicro	C20	Wind River	A25	ZTE

Check the official Summit app for schedule details and more!



That's all Folks!

