Creating and Using the OpenStack Aware Network
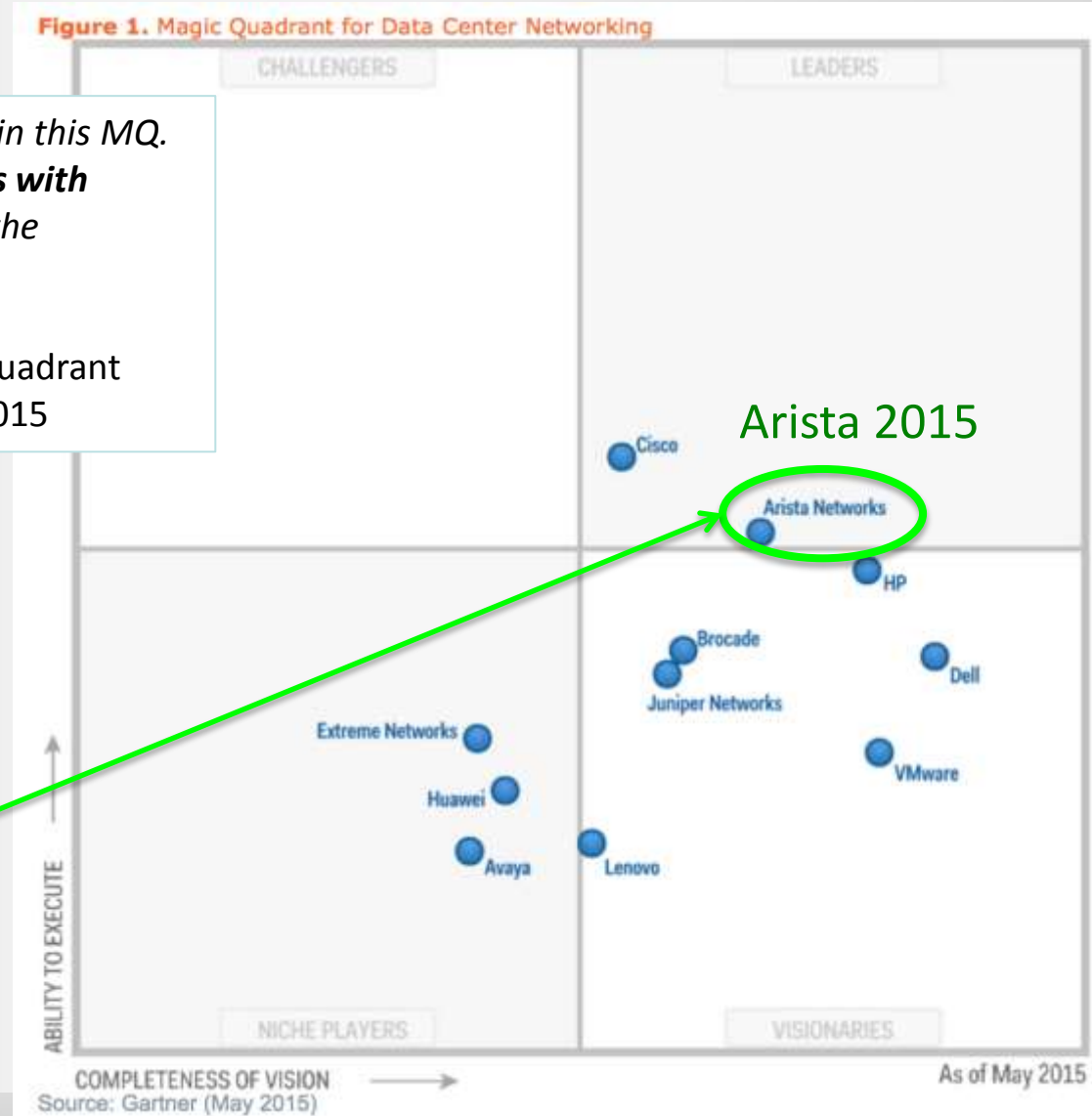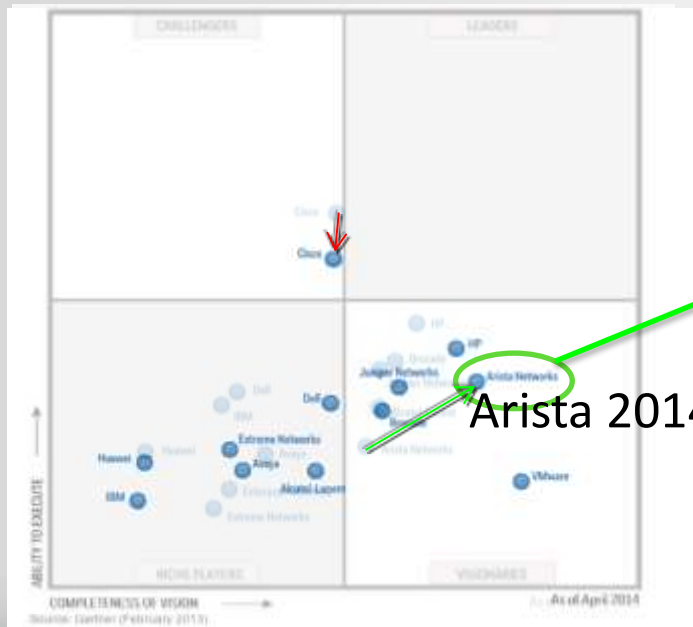
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Agenda

- Company overview
- Drive for Network Virtualization
- Components of Network Virtualization stack
- Concept of CVX
- OpenStack
- OpenStack Demo

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2015 Gartner MQ Data Center Networking
Arista placed in the leadership quadrant

*1. Arista is by far the **fastest-growing** vendor in this MQ.*
*2. Arista provides **high-performance solutions with deep buffers** and **low latency** to deal with the complexities of modern DC applications.*

Gartner Data Center Networking Magic Quadrant
May 11, 2015

Figure 1. Magic Quadrant for Data Center Networking

Arista 2015

Arista 2014

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About Arista Networks
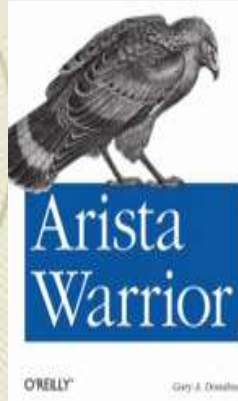
10/40/100GbE Networks for the Virtualized Cloud & Data Center

- ➤ Founded in 2004
- ➤ Shipping Since Mid-2008
- ➤ NYSE: ANET in 2014/6
- ➤ 3000+ Customers
- ➤ 1000+ Employees

Profitable, self-funded network infrastructure provider

Founded to build the best Network Operating System for Next Generation Data Centers

ARISTA

Key Executives

Andy Bechtolsheim
Founder, Chief Development Officer and Chairman

Founder of Sun Microsystems

Founder of Granite Systems

Initial investor in Google, Inc.

Jayshree Ullal
President and CEO

Part of Cisco's 1st acquisition of Crescendo

15 yr Cisco SVP for Data Center, Switching & Services

Joined Arista in 2008

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Arista : The Best Data Center Portfolio

Extensible Operating System(EOS) - Single image

Openstack Integration for all plaform

7010T & 7048T

48-port Data Center Class Gigabit Ethernet Switch

7150S

Ultra Low Latency 24,52,64-port SFP+ 1G-40GbE Switches LANZ and DANZ

7050X & 7250X

Dense Low Latency 32 & 64-port QSFP

96xSFP+/8xQSFP Advanced Virtualization Scale-out Visibility

100G

7280SE

10/40/100G

Ultra Deep Buffers VOQ and Lossless Enhanced Visibility LANZ/DANZ NEBS

7300X

High Density, Modular System supporting up to 512 40GbE
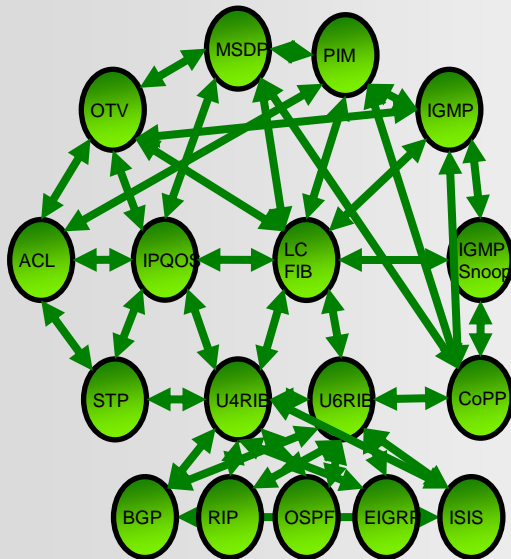
Cloud Scale Leaf and Spine 10/40G

100G

7500E

Lossless, High Density, Modular Switching System supporting up to 1152 Wire speed 10GbE Ports LANZ / DANZ Spine 10/40/100G

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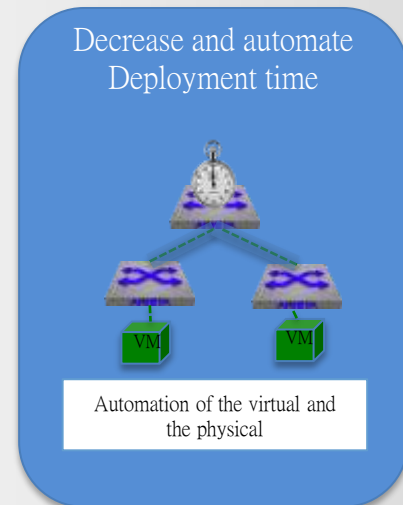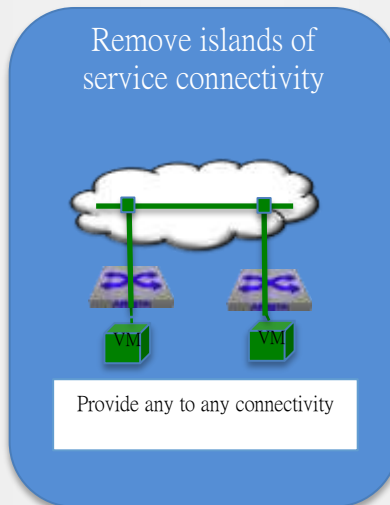# Benefits of EOS Architecture

Other Network OS

Arista EOS

VS

Network Virtualization
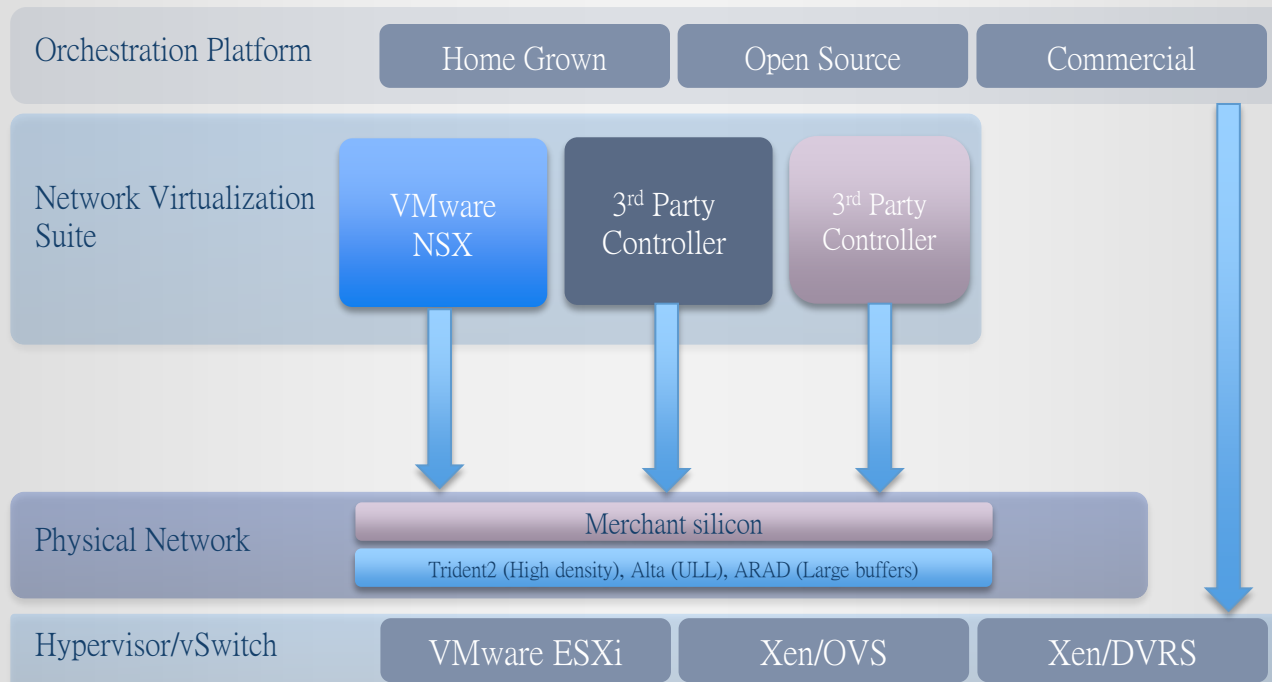
- Goals and drive for Network Virtualization
  - Remove underutilized islands of resources
  - Single resource pool to allow optimal utilization of all available resources
  - Provide any-to-any L2 or L3 communication within the Data Center
  - Deployment and connect resources in seconds rather than days/weeks

Optimisation of the resource pool

Apps deployed based on resource utilization not location

Remove islands of service connectivity

Provide any to any connectivity

Decrease and automate Deployment time
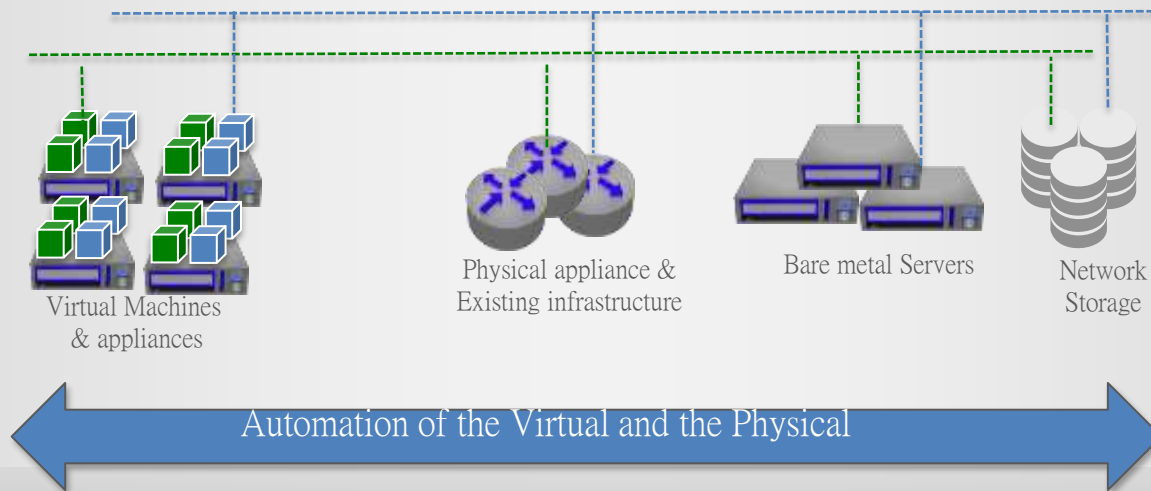
Automation of the virtual and the physical

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Network Virtualization

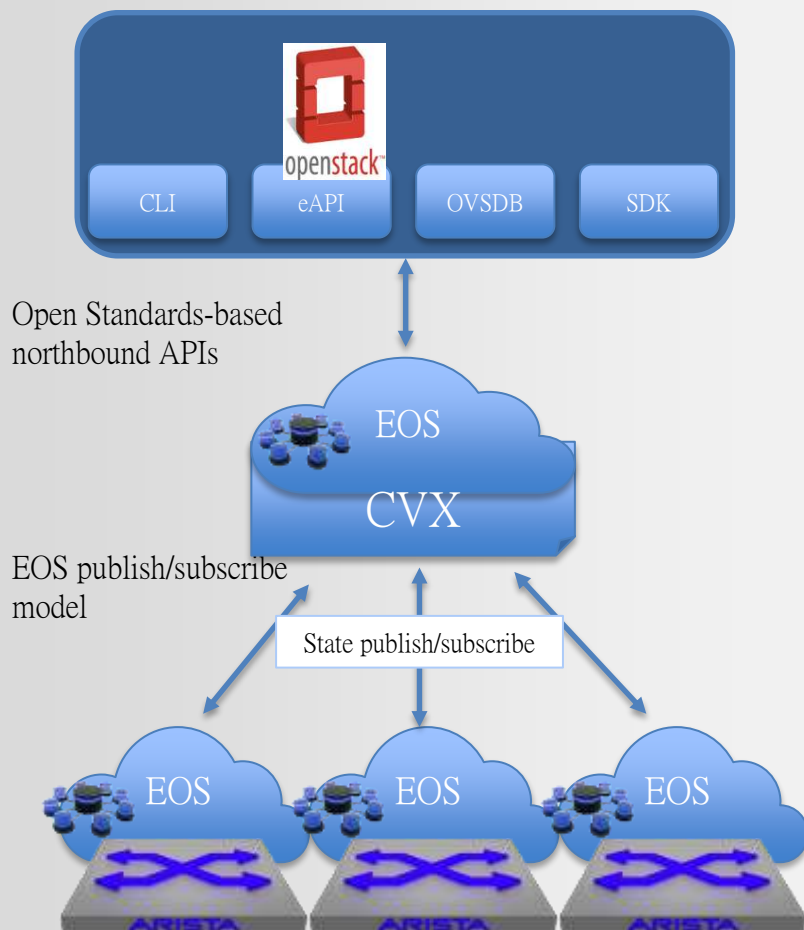- Components of a Network Virtualization stack

Network Virtualization

- Requirement to automate connectivity for Physical appliances
  - Virtualization stack today or in the future, will need to provide connectivity to the physical infrastructure
  - Provide connectivity for Bare Metal Server, Storage, DC routers
  - Connectivity needs to be provided in an automated manner, similar to the service delivered for virtual appliances

Virtual Machines & appliances

Physical appliance & Existing infrastructure

Bare metal Servers

Network Storage

Automation of the Virtual and the Physical

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Introducing CloudVision eXchange (CVX)

Single Interface to EOS devices

CLI eAPI OVSDB SDK

Open Standards-based
northbound APIs

EOS

CVX

EOS publish/subscribe
model

State publish/subscribe
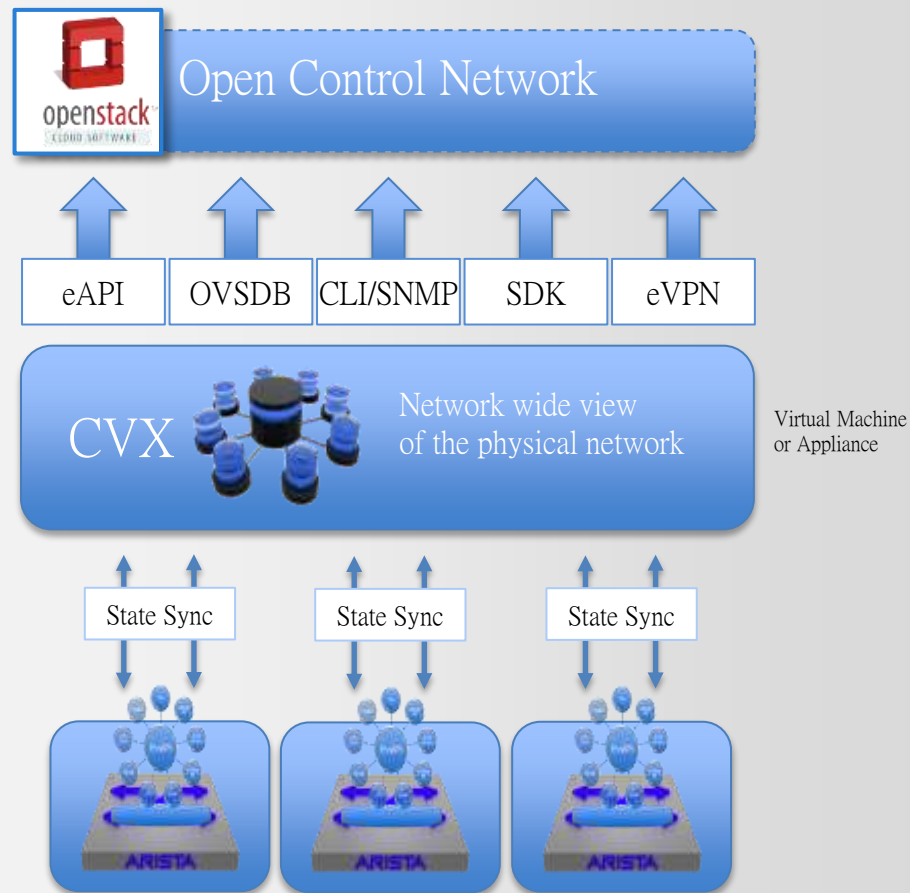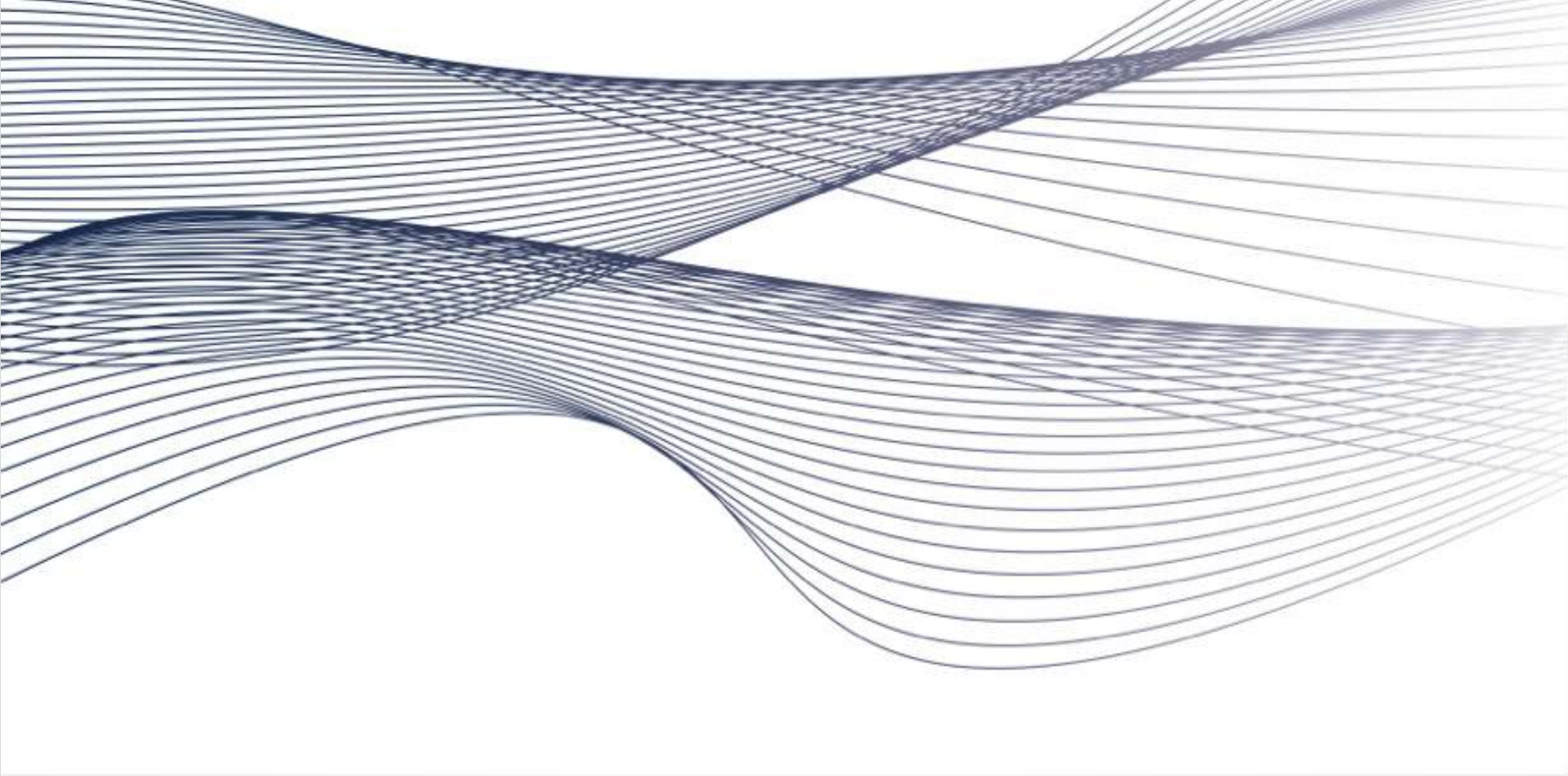
EOS EOS EOS

- Part of EOS CloudVision Framework

- Abstracts the physical switch infrastructure

- Provides a single access point for real-time provisioning, orchestration and integration with multi-vendor controllers

- Distributed EOS state: CVX mounts state from all switches (sysDBs) in the network

- No new protocol needed – uses EOS framework

- Management plane, not data plane

- May be a VM or Appliance

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CVX – more detail

- CVX is software Agent enabled on the EOS operating System.

- CVX mounts and synchronizes configurable state from the physical switches

- Providing CVX with an aggregated view of the network state

- The state mounted is depended on the service being deployed

- Each service specifies what state it mounts from / pushes to each switch

- Services include:
  - VCS (VXLAN Control Service)
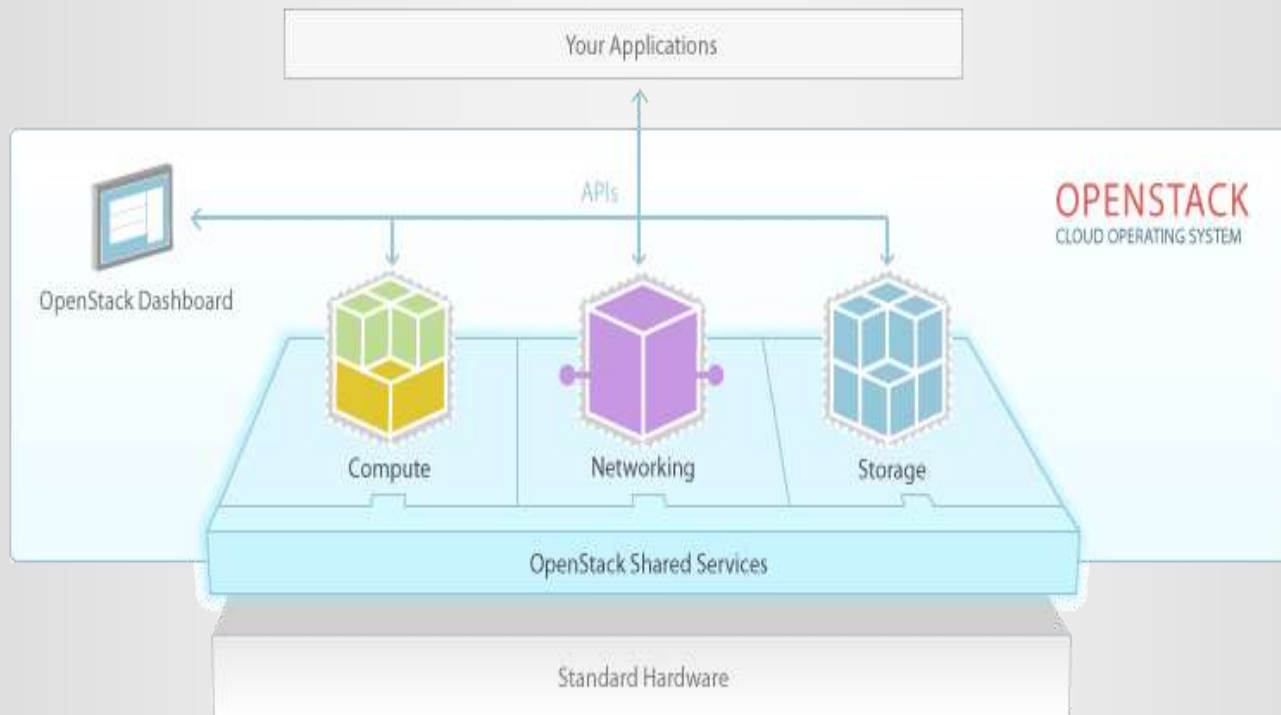 - OpenStack
  - Network Topology

Open Control Network

eAPI OVSDB CLI/SNMP SDK eVPN

CVX Network wide view of the physical network

Virtual Machine or Appliance

State Sync State Sync State Sync

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OpenStack Overview

OpenStack Overview

OpenStack is a cloud operating system that controls large pools of compute, storage, and networking resources throughout a datacenter, all managed through a dashboard that gives administrators control while empowering their users to provision resources through a web interface.

OpenStack Core Services

- Compute ("Nova") provides virtual servers upon demand.

- Network ("Neutron") is a pluggable, scalable and API-driven system for managing networks and IP addresses.
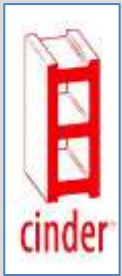
- Block Storage ("Cinder") provides persistent block storage to guest VMs

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OpenStack Core Services

- Dashboard ("Horizon") provides a modular web-based user interface for all the OpenStack services

- Object Store ("Swift") provides object storage. It allows you to store or retrieve files

- Image ("Glance") provides a catalog and repository for virtual disk images

- Identity ("Keystone") provides authentication and authorization for all the OpenStack services

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OpenStack Development Cycle

- From the Diablo release onwards, 6-month release cycle

  - Two releases a year, ~April and October

  - Release names are alphabetic and based on the cities/counties where the corresponding OpenStack summit took place

Release	Release Date	Status
Folsom	September 2012	EOL
Grizzly	April 2013	EOL
Havana	October 2013	EOL
Icehouse	April 2014	Security Supported (patches built)
Juno	October 2014	Previous release
Kilo	April 2015	Current release
Liberty	Under Discussion	Q4 2015

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Neutron Overview

- OpenStack Networking Service
  - Introduced in the Folsom release
- Manages
  - Tenant Networks
  - Logical Routers
  - L4-7 Services – NAT, LBAAS, FWAAS, ⋯
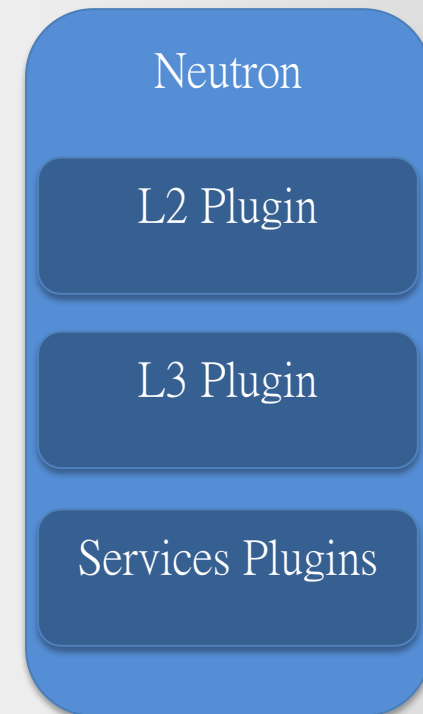
Modular Layer 2 (ML2) Plugin

- Neutron plugin introduced in Havana which provides:

  - Separation between the state of tenant networks and how that state is then realized across the network

  - Flexibility in how the virtual and physical network are managed

  - Multi-vendor support via multiple "Mechanism Drivers" managing pieces of the network in parallel

- "Monolithic" plugins are being deprecated in favor of ML2
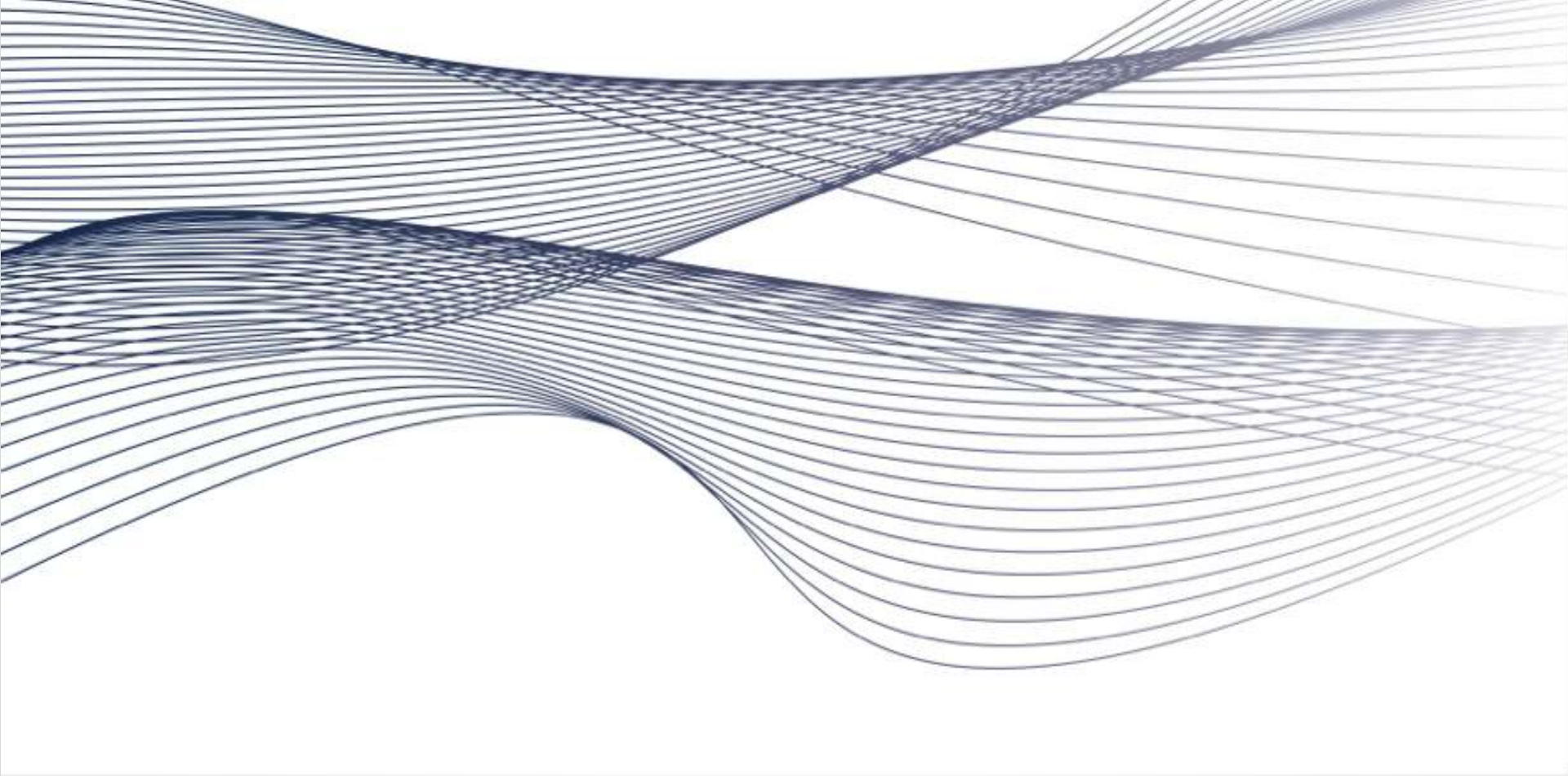
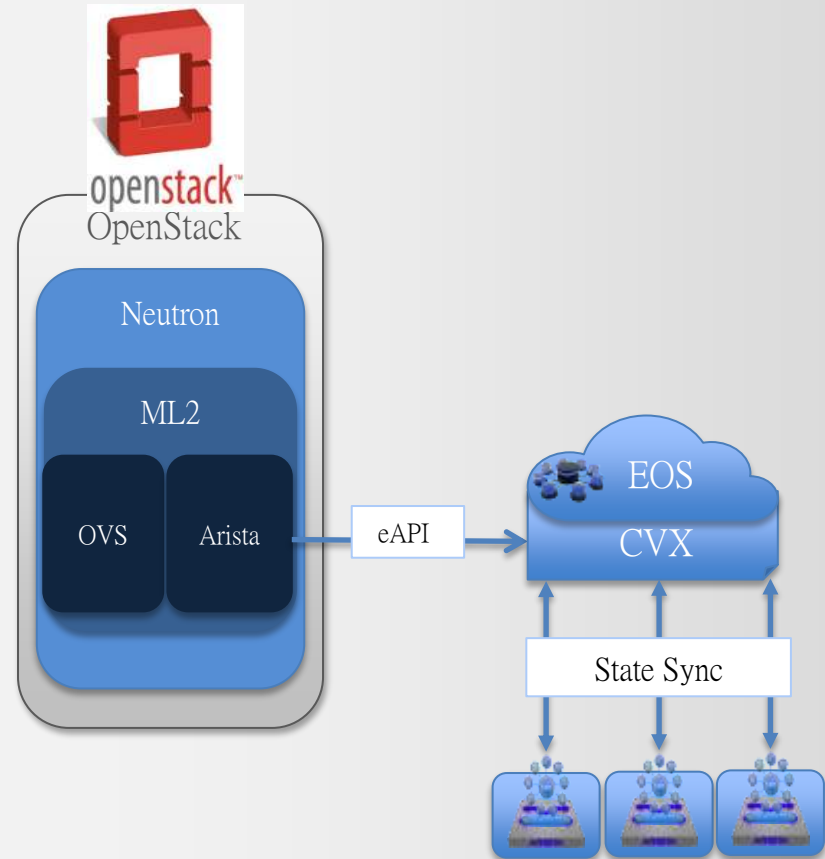# Arista CVX Integration with OpenStack

Arista OpenStack Integration

- Arista Focus - Provide end-to-end tenant network visibility and provisioning across virtual and physical infrastructure for the highest performance VLAN and VXLAN fabrics

- Key Solution Features

  - Provide full visibility to the network team of the OpenStack state

  - Automatically provision the physical network in response to tenant configuration within OpenStack
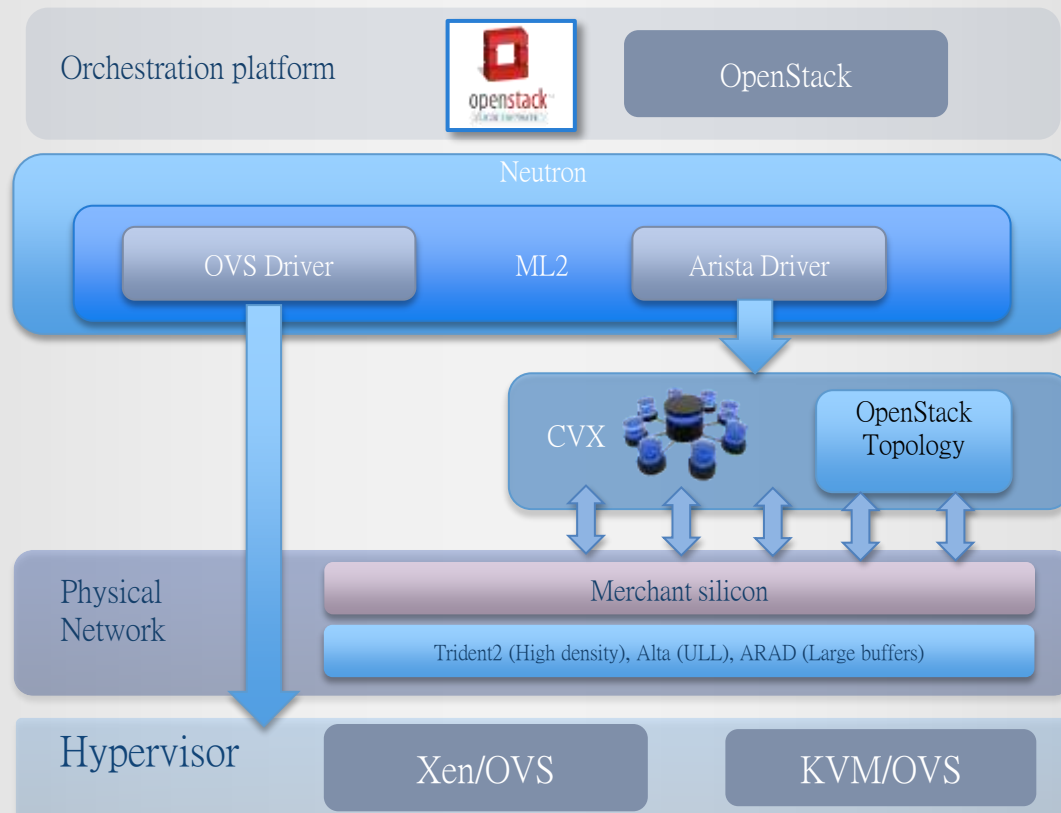
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Arista OpenStack Integration

- Arista CVX
  - Collection of global network topology from switches
  - Provisioning of the switches via eAPI
- Arista ML2 mechanism driver
  - Notify created OpenStack state to the CVX
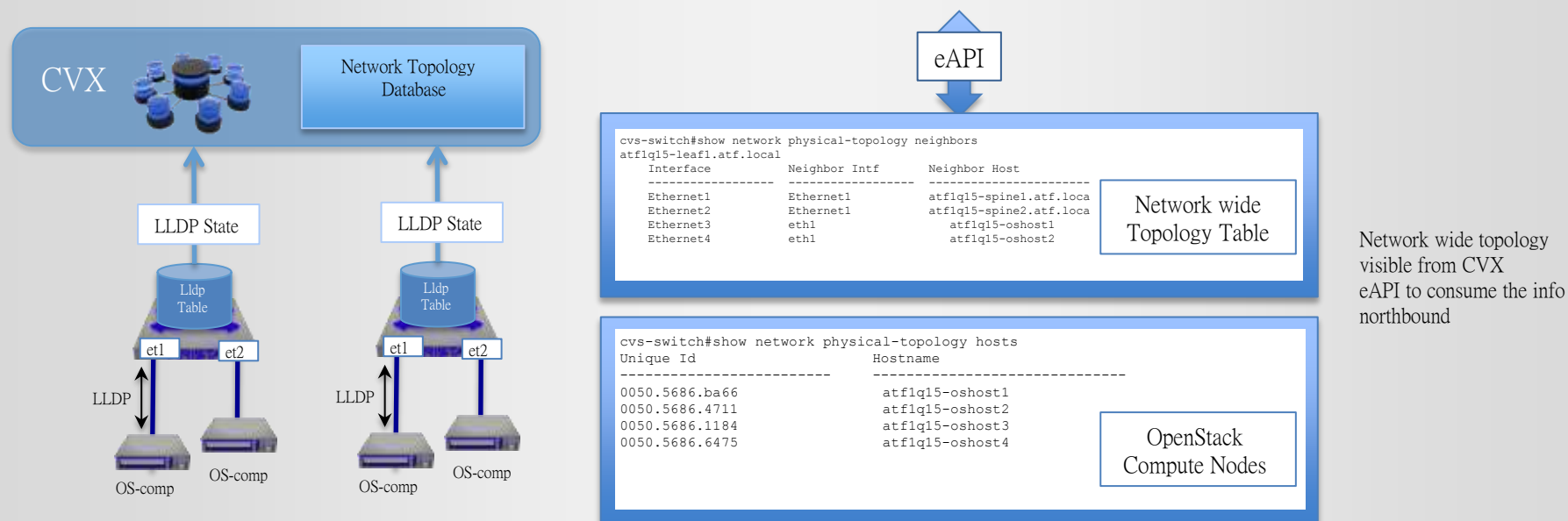 - Communication via the Arista eAPI

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Arista OpenStack Integration

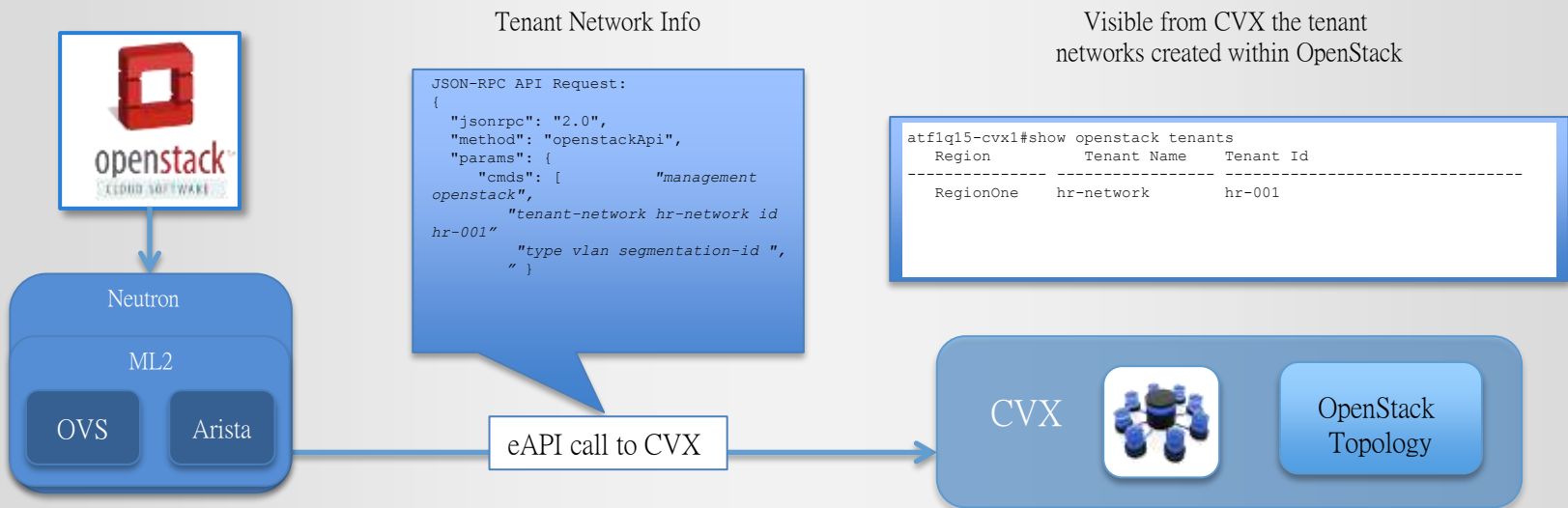- Network orchestration with OpenStack Neutron ML2 Plug

Arista OpenStack Integration

- ## CVX builds a full topology of the physical infrastructure

  - Leaf switch builds their local topology table using standard LLDP

  - Contains directly attached OpenStack compute nodes, which will host the virtual machines

  - CVX mounts the local LLDP tables, providing a network wide view

  - CVX knows the physical location (switch and interface) each OS compute node is attached



```
cvs-switch#show network physical-topology neighbors
atf1q15-leaf1.atf.local
    Interface           Neighbor Intf          Neighbor Host
    -----------------   -----------------      ----------------------
    Ethernet1           Ethernet1              atf1q15-spine1.atf.loca
    Ethernet2           Ethernet1              atf1q15-spine2.atf.loca
    Ethernet3           eth1                   atf1q15-oshost1
    Ethernet4           eth1                   atf1q15-oshost2
```

Network wide Topology Table

```
cvs-switch#show network physical-topology hosts
Unique Id                      Hostname
-----------------------        -----------------------------
0050.5686.ba66                 atf1q15-oshost1
0050.5686.4711                 atf1q15-oshost2
0050.5686.1184                 atf1q15-oshost3
0050.5686.6475                 atf1q15-oshost4
```

OpenStack Compute Nodes

Network wide topology visible from CVX eAPI to consume the info northbound

Arista OpenStack Integration

- ## Step1: OpenStack, Horizon portal create a tenant network
  - ML2 plugin with the Arista driver installed
  - Plugin converts the network create call to an eAPI to CVX
  - CVX is now aware of all networks created with OpenStack
  - Network only deployed on the physical infrastructure if a VM is attached to the network

Tenant Network Info

Visible from CVX the tenant
networks created within OpenStack

```
JSON-RPC API Request:
{
  "jsonrpc": "2.0",
  "method": "openstackApi",
  "params": {
    "cmds": [         "management
openstack",
       "tenant-network hr-network id
hr-001"
        "type vlan segmentation-id ",
       " }
```

```
atf1q15-cvx1#show openstack tenants
   Region          Tenant Name      Tenant Id
--------------- ---------------- --------------------------------
   RegionOne    hr-network         hr-001
```

Neutron

ML2

OVS   Arista

eAPI call to CVX

CVX

OpenStack
Topology

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Arista OpenStack Integration

- Step 2: OpenStack, Horizon portal create VM and apply to network

  - Virtual Machine created within Horizon and attached to the tenant's network

  - Nova-scheduler deploys the VM on the compute node based on available resources

  - CVX has visibility of the compute node the VM is deployed on via the plug

  - From the global LLDP table maps the Compute node to a switch port, and dynamically deploys the tenant network on the switch
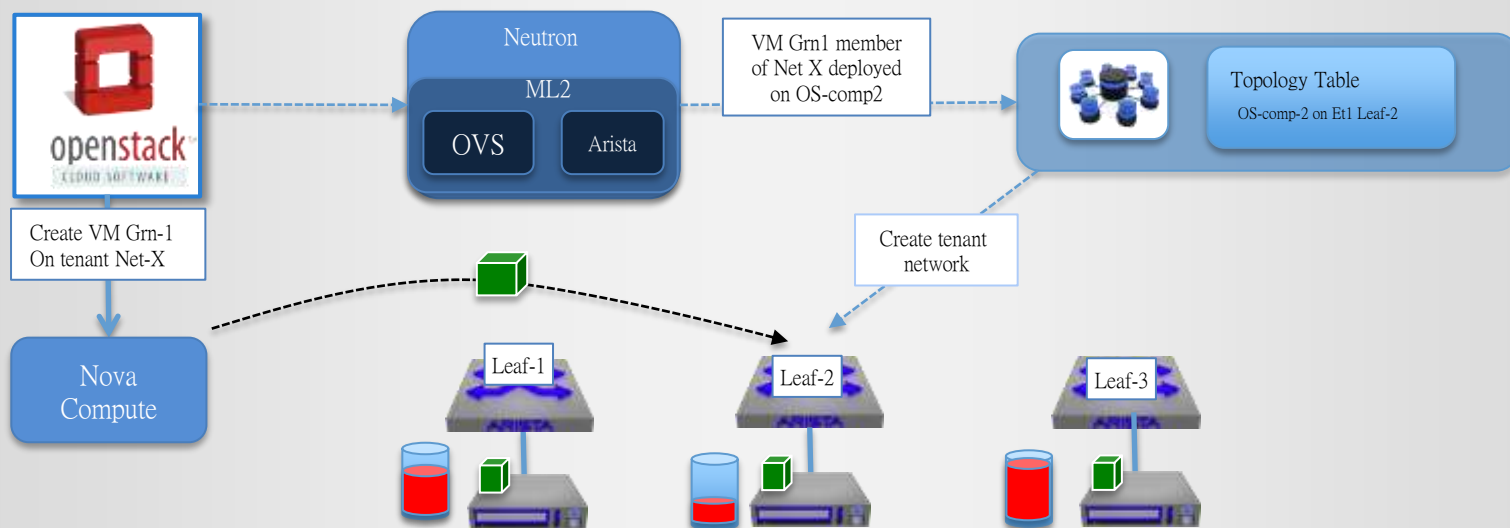
Arista OpenStack Integration – VLAN Based

- Network Type created by the CVX can be a simple Layer 2 VLAN
  - Tenants VMs deployed within dedicated tenant VLANs
  - CVX dynamically deploys the tenant VLAN on the appropriate Leaf edge port and Uplink
  - Deployed on a standard MLAG (Layer 2) topology
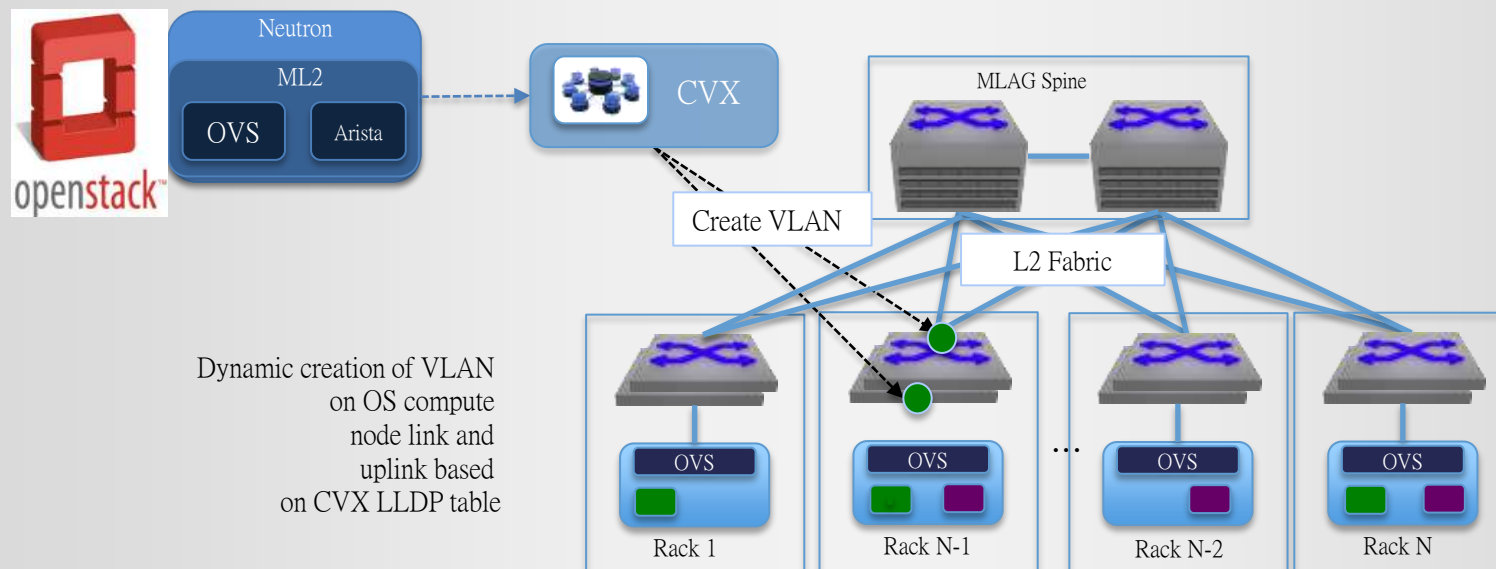
Arista OpenStack Integration – VXLAN Based

- ## OpenStack integration with VXLAN

  - Scalable IP fabric with a Layer 3 ECMP design

  - Hardware VXLAN VTEP configured on every leaf switch

  - Layer 2 connectivity between rack via VXLAN across the L3 fabric
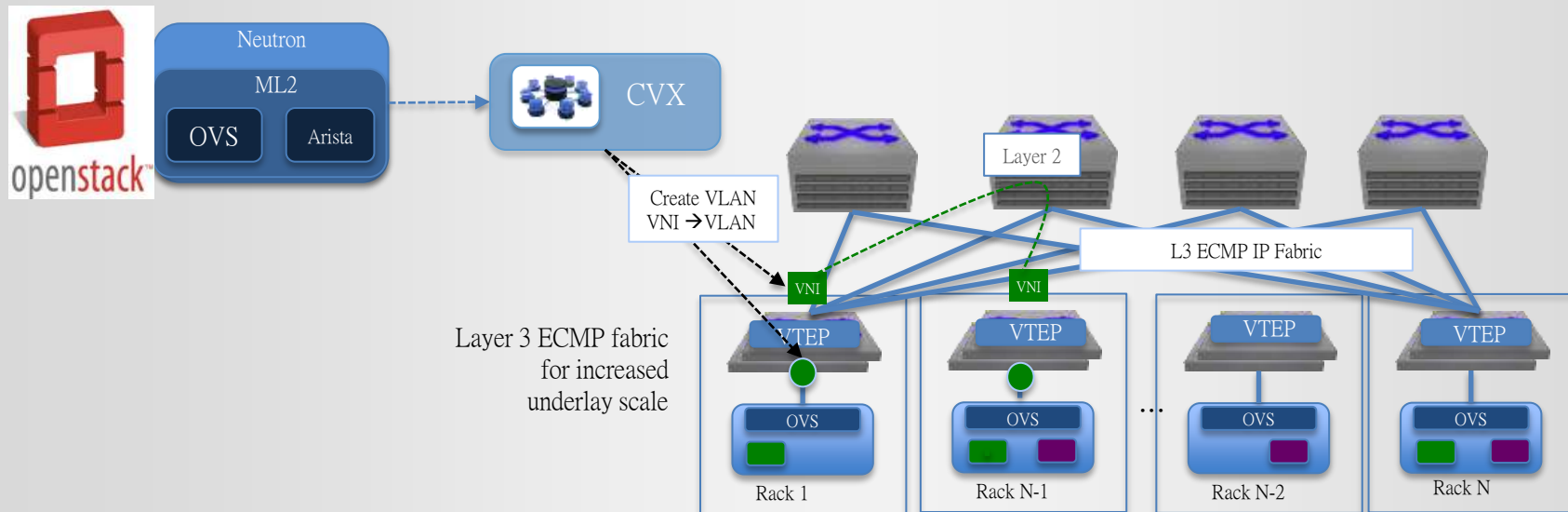
Scaling OpenStack

- Multiple OpenStack clusters supported per CVX instance
- Can be combined with other network virtualization
  - NSX
  - Etc
- VXLAN breaks out of the 4K VLAN limit
  - 16M VNIs mapped to locally significant VLANs

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Multi-Tenant OpenStack Deployment
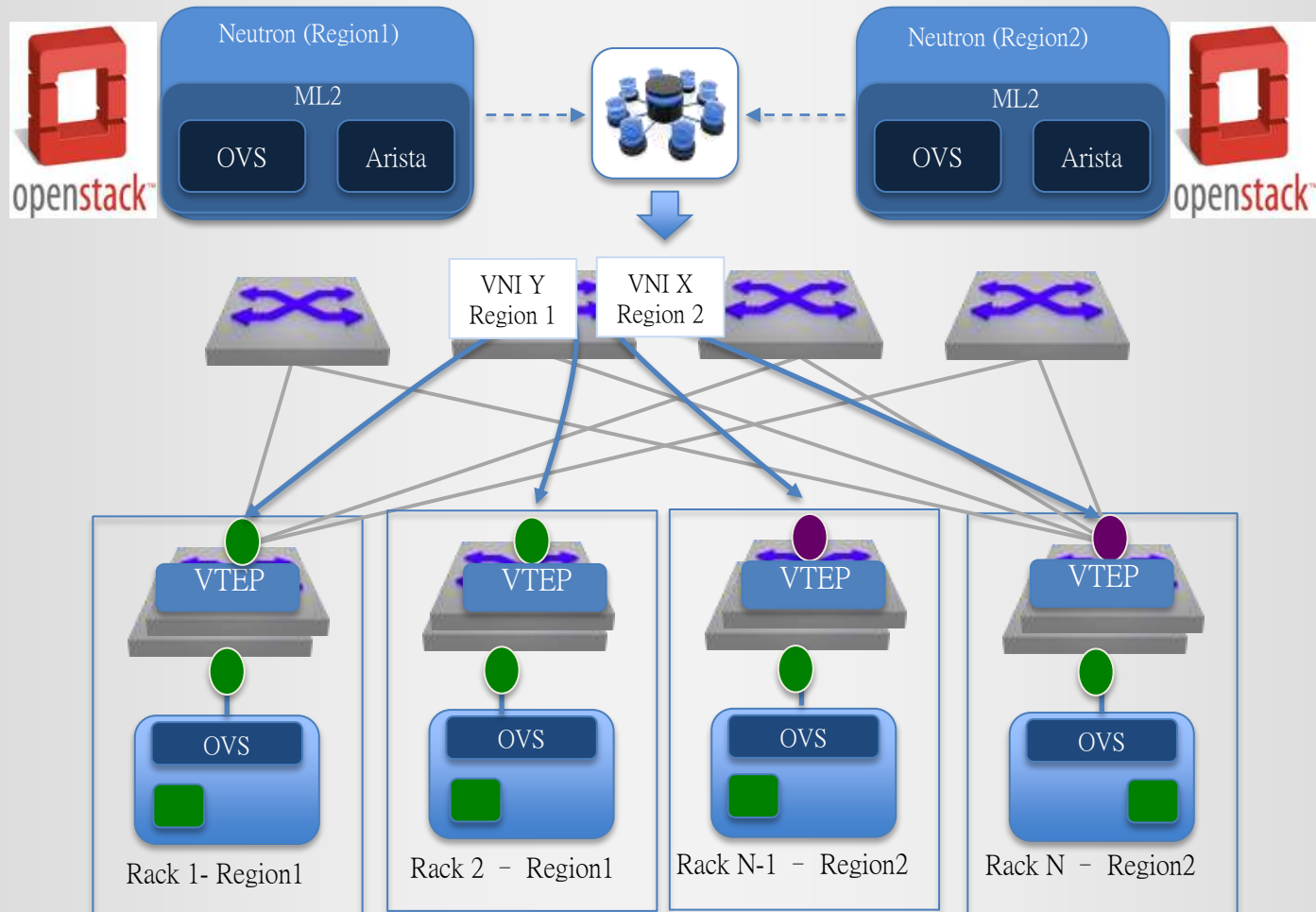
Routing with OpenStack

- L2 up until now, how do you route?

- Can be performed by a Network Node
- Allows connectivity between tenants and external networks
  - NAT Support
  - VRF Support
- Limited by software

- Alterative is perform this at the switch...with limitations!

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OpenStack Integration – L3 Plugin

- Arista L3 plugin provisions SVIs over eAPI in response to tenant's creating logical routers
- Routing happens at dedicated network nodes
  - Pair of MLAGed physical devices
  - Active-Active HA via MLAG
  - Performs routing for the OpenStack cluster
    - Can be scaled out horizontally by tenant as needed
- TORs can also be used as the routing nodes
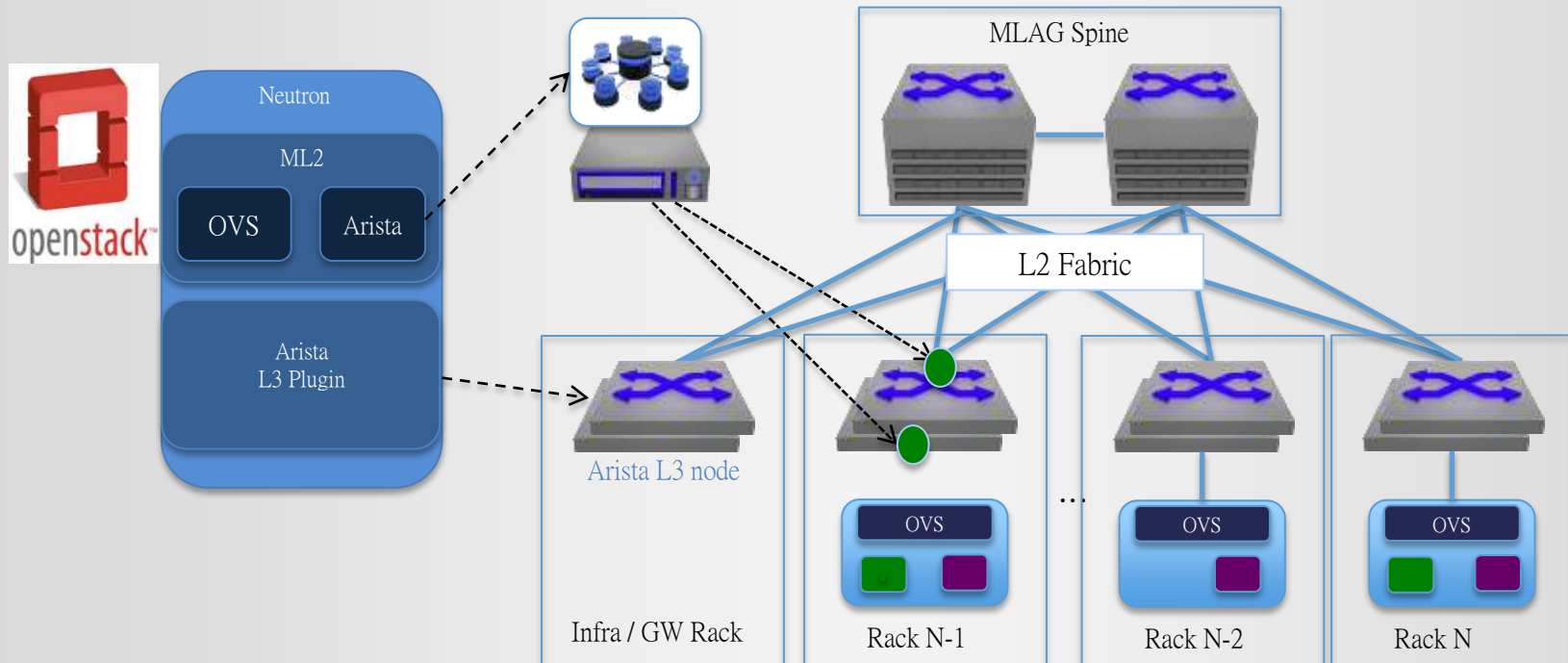
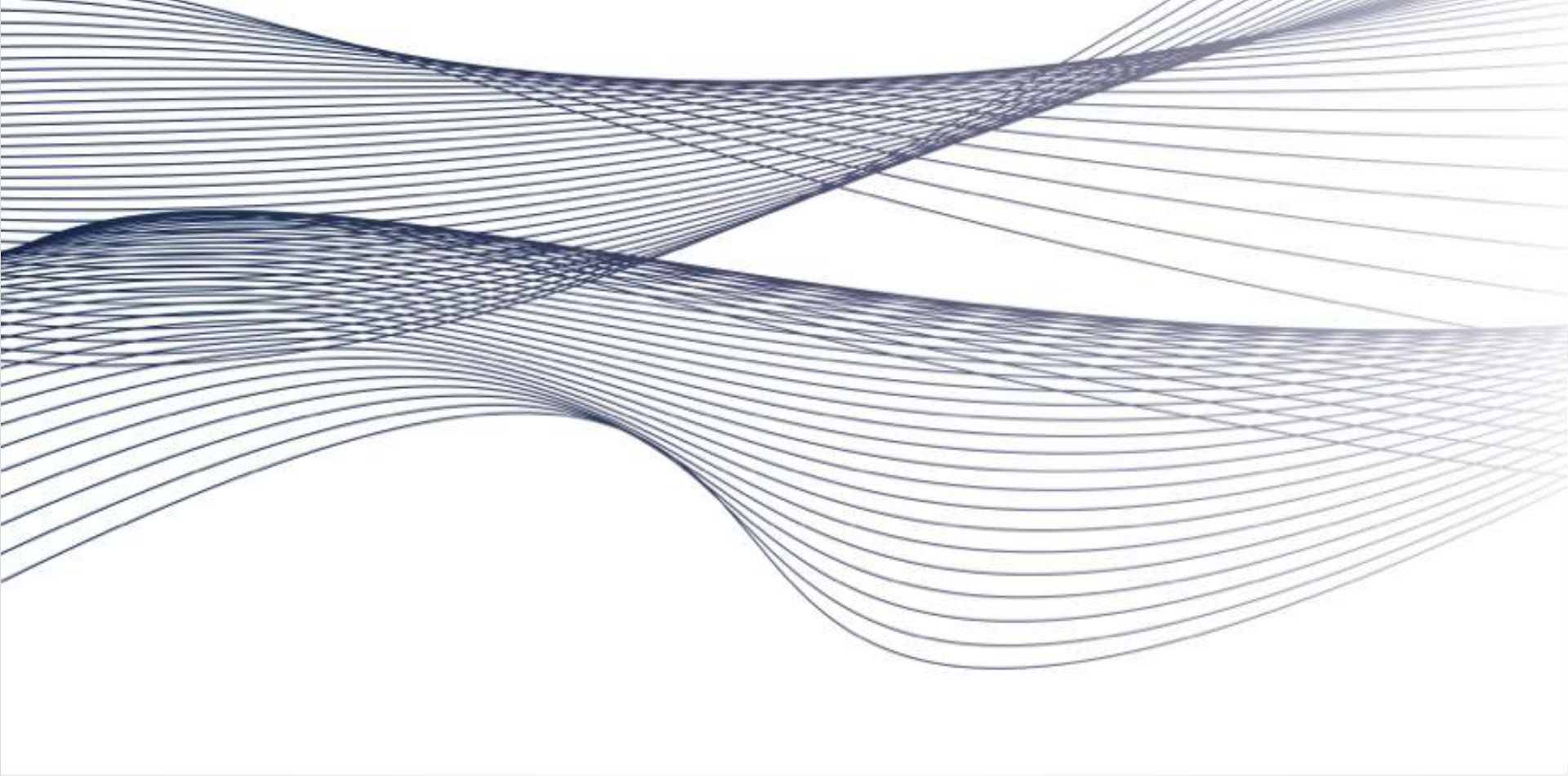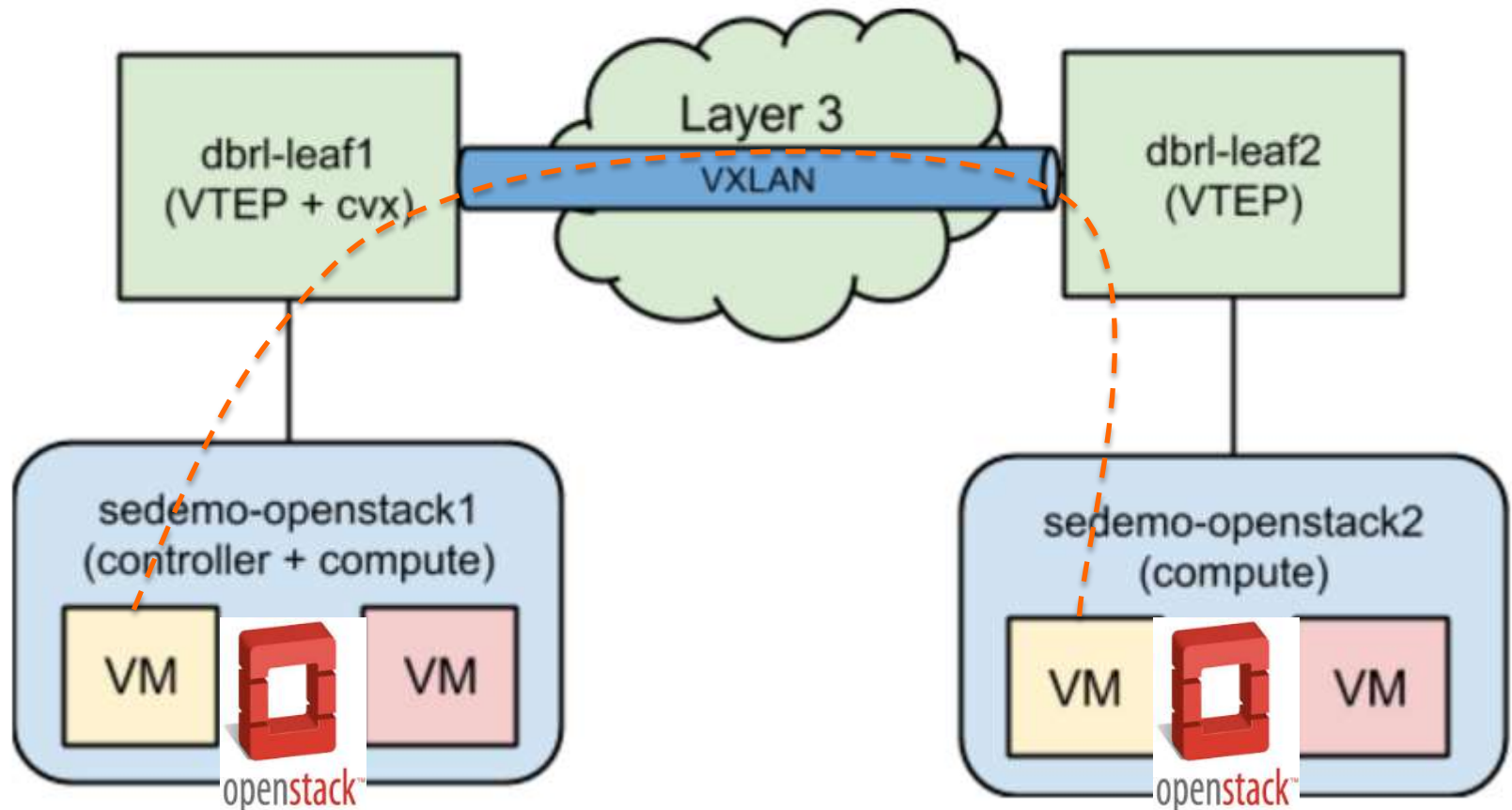# OpenStack Orchestration models

Openstack Ironic Integration

https://www.youtube.com/watch?v=1lvXppxQUCQ
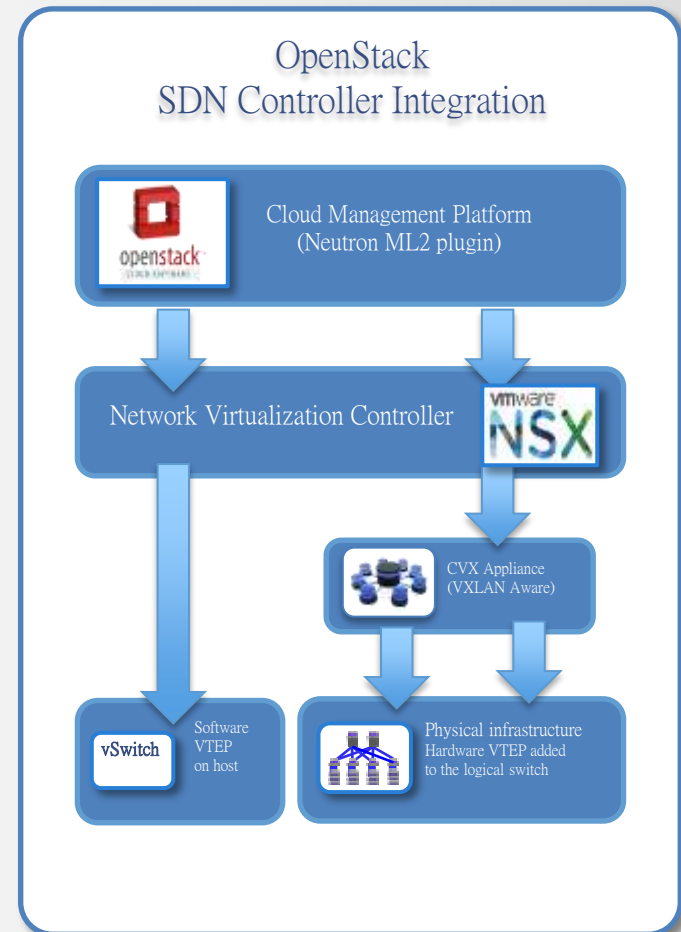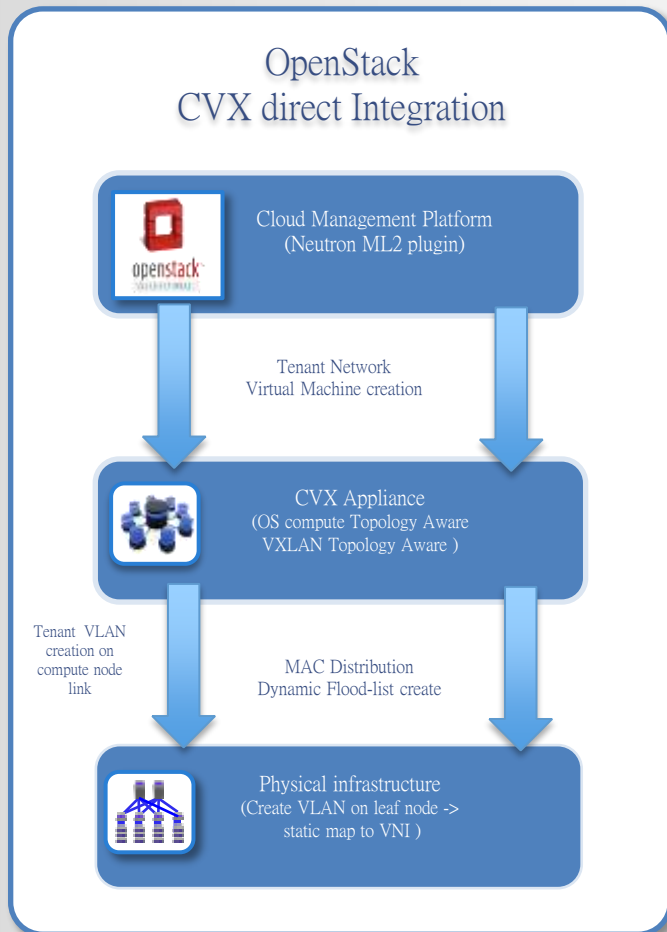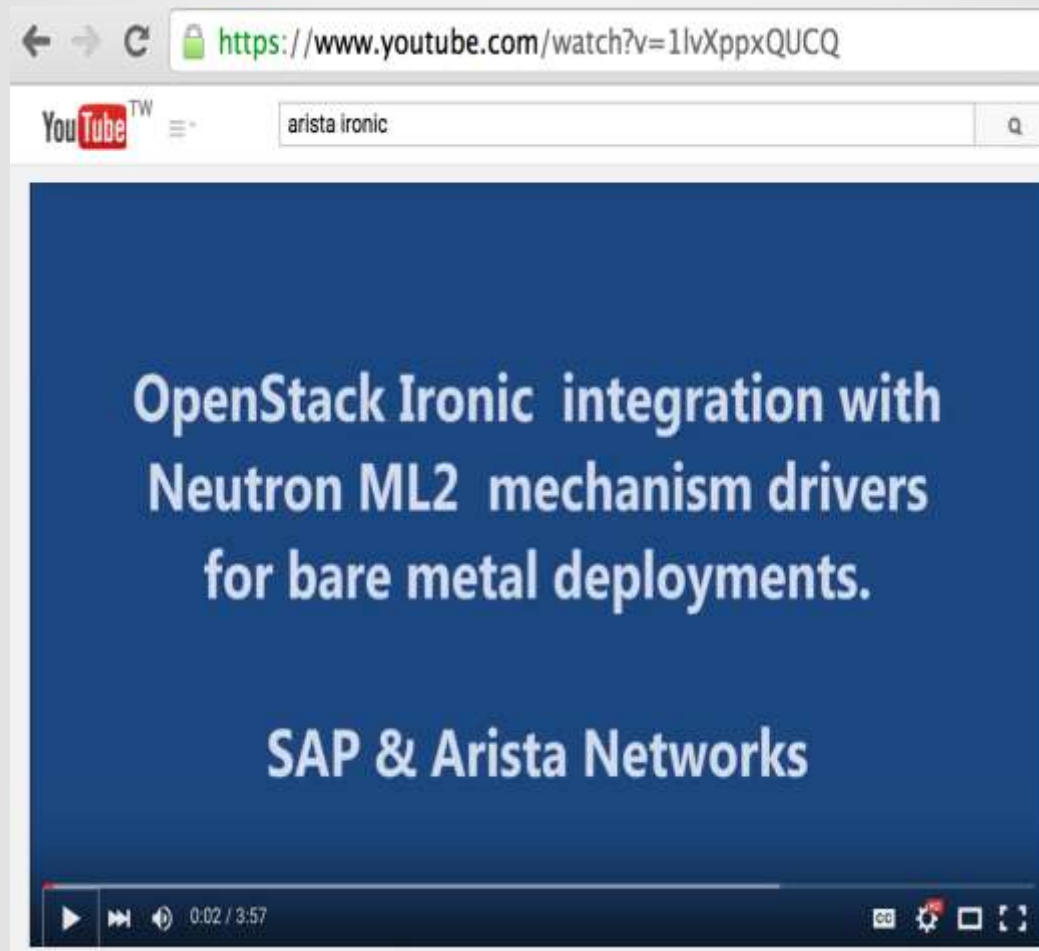
ARISTA

OpenStack Demo

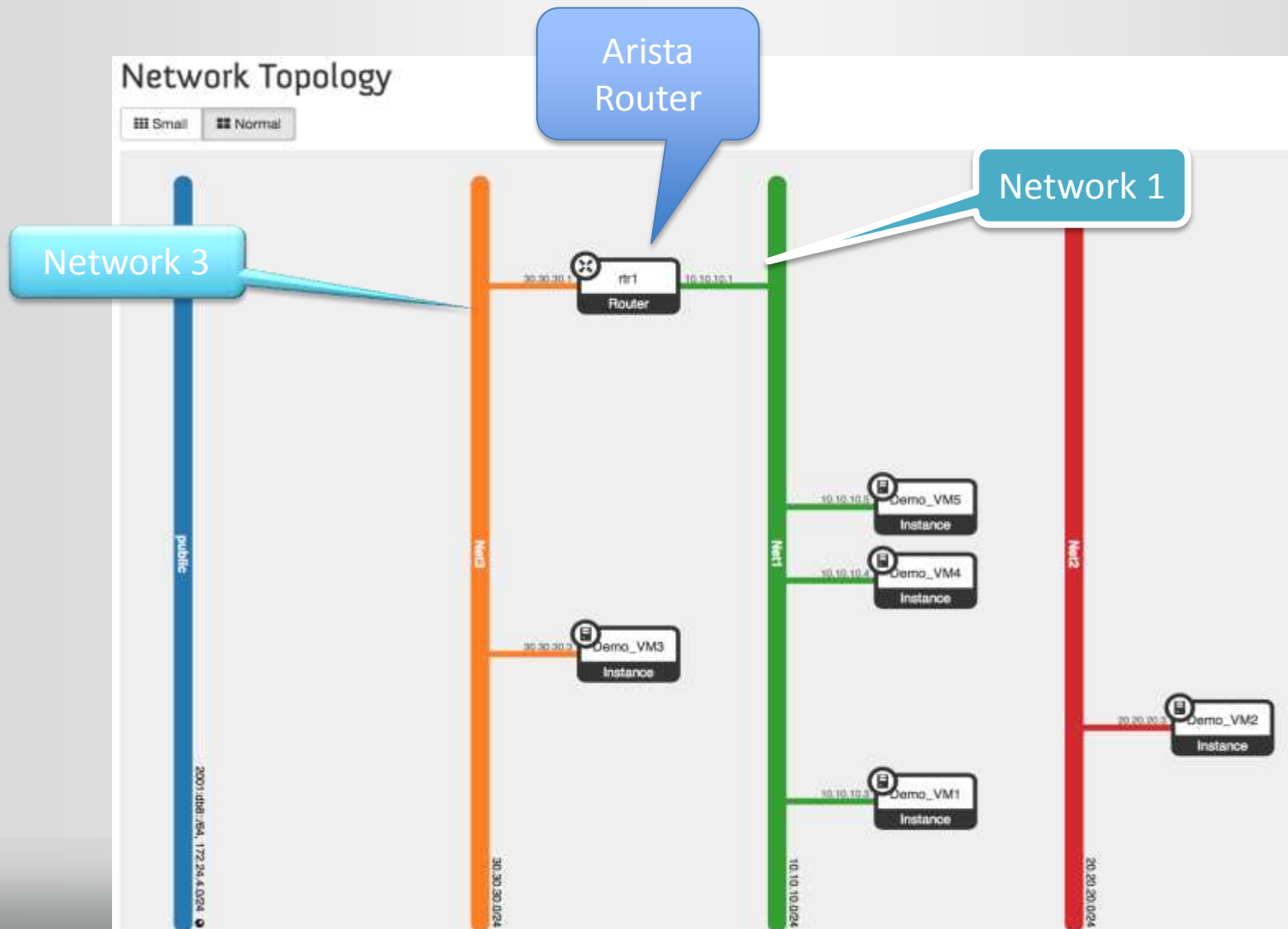# Arista OpenStack Integration – VXLAN Based Network Architecture

Openstack Dashboard
Network Topology 1

Create Network and Instance

Network Details: Net1

Network Overview

Name	Net1
ID	8b950923-6b52-4e16-8257-49c4c8f294c1
Project ID	c832cc8c4739426cbb0c08824fabe10b
Status	ACTIVE
Admin State	UP
Shared	No
External Network	No
MTU	Unknown
Provider Network	Network Type: vlan
	Physical Network: default
	Segmentation ID: 1174

Create Network

Create Network

Create Network

| Network | Subnet * | Subnet Details |

Network Name

Net1

Create a new network. In addition, a subnet associated with the network can be created in the next panel.

Admin State ?

UP

Cancel   « Back   Next »

Create Network

| Network | Subnet * | Subnet Details |

☑ Create Subnet

Subnet Name

Create a subnet associated with the new network, in which case "Network Address" must be specified. If you wish to create a network without a subnet, uncheck the "Create Subnet" checkbox.

Network Address * ?

10.10.10.0/24

IP Version *

IPv4

Gateway IP ?

☐ Disable Gateway

Cancel   « Back   Next »

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Launch Instance

Launch Instance

Display Network information on Arista switch


```
bleaf1#show openstack networks
Region: RegionOne

 Tenant Name: admin
 Tenant Id: c832cc8c4739426cbb0c08824fabe10b

   Network Name          Network Id                              Seg Type          Seg Id        Maps to VNI
   ------------------    --------------------------------------  ----------------  ------------  ------------
   Medialinks_net1       ed297f0d-ea00-474d-8726-17d2c7b10dd6    vlan              1145          11145
   Net1                  8b950923-6b52-4e16-8257-49c4c8f294c1    vlan              1174          11174
   Net2                  963448c9-a685-4a73-ad76-0e63aba59463    vlan              1190          11190
   Net3                  131b0b55-f4dc-4602-9510-6eb744a1bd3a    vlan              1143          11143
   public                4f2810e6-9940-4308-b5c9-8c82a86335bb    vlan              1194          11194
```

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Display VM visibility on Arista switch (1)

```
bleaf1#show openstack vms
Region: RegionOne

    Tenant Name: admin
    Tenant Id: c832cc8c4739426cbb0c08824fabe10b


        VM Name                VM Id                                    Host        Network Name
        ----------------       -----------------------------------      ----------  ----------------
        Demo_VM1               12fc3936-29c4-47a4-b8b3-33b73b04d75c      kilo1       Net1
        Demo_VM2               6ad8e5d3-41ae-41c3-a449-48681173ee1f      kilo2       Net2
        Demo_VM3               14ecafb6-6011-48f7-ab3f-9ffdf3475ce8      kilo1       Net3
        Demo_VM4               6bc4eeb3-3ed9-43da-9c6f-b8b3b6885fc3      kilo2       Net1
        Demo_VM5               f2c4f755-df2b-49b0-9e47-3a221ad759e6      kilo1       Net1
```

ARISTA

Display VM visibility on Arista switch (2)

```
bleaf1#show openstack vms vm Demo_VM1 detail
Region: RegionOne

  Tenant Name: admin
  Tenant Id: c832cc8c4739426cbb0c08824fabe10b

   VM Name: Demo_VM1
   VM Id: 12fc3936-29c4-47a4-b8b3-33b73b04d75c
  Host: kilo1

   Switch Name             Switch Id            Switch Interface       Seg Type       Seg Id
   ---------------------   ------------------   --------------------   -------------  ----------
   bleaf1.aristanetworks.com   001c.7300.4406       Ethernet18            vlan           1174
```

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Display physical-network visibility on Arista switch

```
bleaf1#show openstack physical-network switch bleaf1.aristanetworks.com

Switch: 001c.7300.4406 ( bleaf1.aristanetworks.com )
Ethernet18:
    Allowed vlans: 1120,1143,1145,1174,1190
    Connected host: kilo1
      Region: RegionOne
        Tenant: admin ( c832cc8c4739426cbb0c08824fabe10b )
...skipping...
      VM: Demo_VM1 ( 12fc3936-29c4-47a4-b8b3-33b73b04d75c )
          Network Name        Network Id                              Seg Type        Seg Id
          --------------      -----------------------------------     --------------  ------
          Net1                8b950923-6b52-4e16-8257-49c4c8f294c1    vlan            1174
```

ARISTA

VXLAN enable con Arista switch

```
bleaf1#show int vxlan1
Vxlan1 is up, line protocol is up (connected)
  Hardware is Vxlan
  Source interface is Loopback0 and is active with 3.3.3.3
  Replication/Flood Mode is headend with Flood List Source: VCS
  Remote MAC learning via VCS
  Static vlan to vni mapping is
    [100, 10000]
  Dynamic vlan to vni mapping for 'vcs' is
    [1120, 11120]    [1190, 11190]    [1174, 11174]    [1143, 11143]
    [1145, 11145]
  Headend replication flood vtep list is:
  1120 3.3.3.3
  1143 3.3.3.3
  1145 3.3.3.3              4.4.4.4
  1174 3.3.3.3              4.4.4.4
  1190 3.3.3.3              4.4.4.4
```
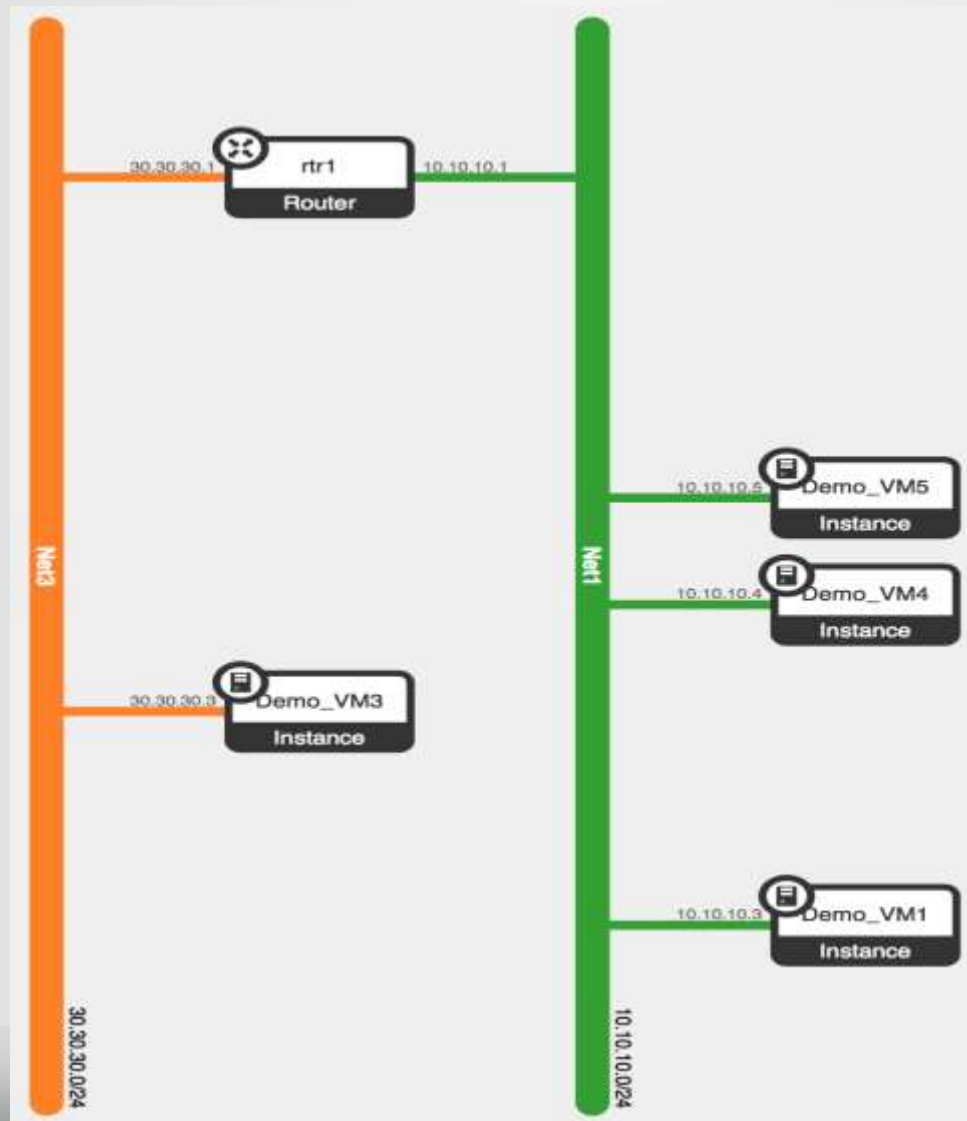
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L3 plugin - Arista is L3 router

Create Network Net3

Create Network

Network | Subnet * | Subnet Details

Network Name

Net3

Create a new network. In addition, a subnet associated with the network can be created in the next panel.

Admin State ❓

UP

Cancel | « Back | Next »

Network Details: Net3

Network Overview

Name	Net3
ID	131b0b55-f4dc-4602-9510-6eb744a1bd3a
Project ID	c832cc8c4739426cbb0c08824fabe10b
Status	ACTIVE
Admin State	UP
Shared	No
External Network	No
MTU	Unknown
Provider Network	Network Type: vlan
	Physical Network: default
	Segmentation ID: 1143

ARISTA

Create router which connect 2 networks

Router Details

Set Gateway ▼

Overview | Interfaces | Static Routes

+ Add Interface   ✖ Delete Interfaces

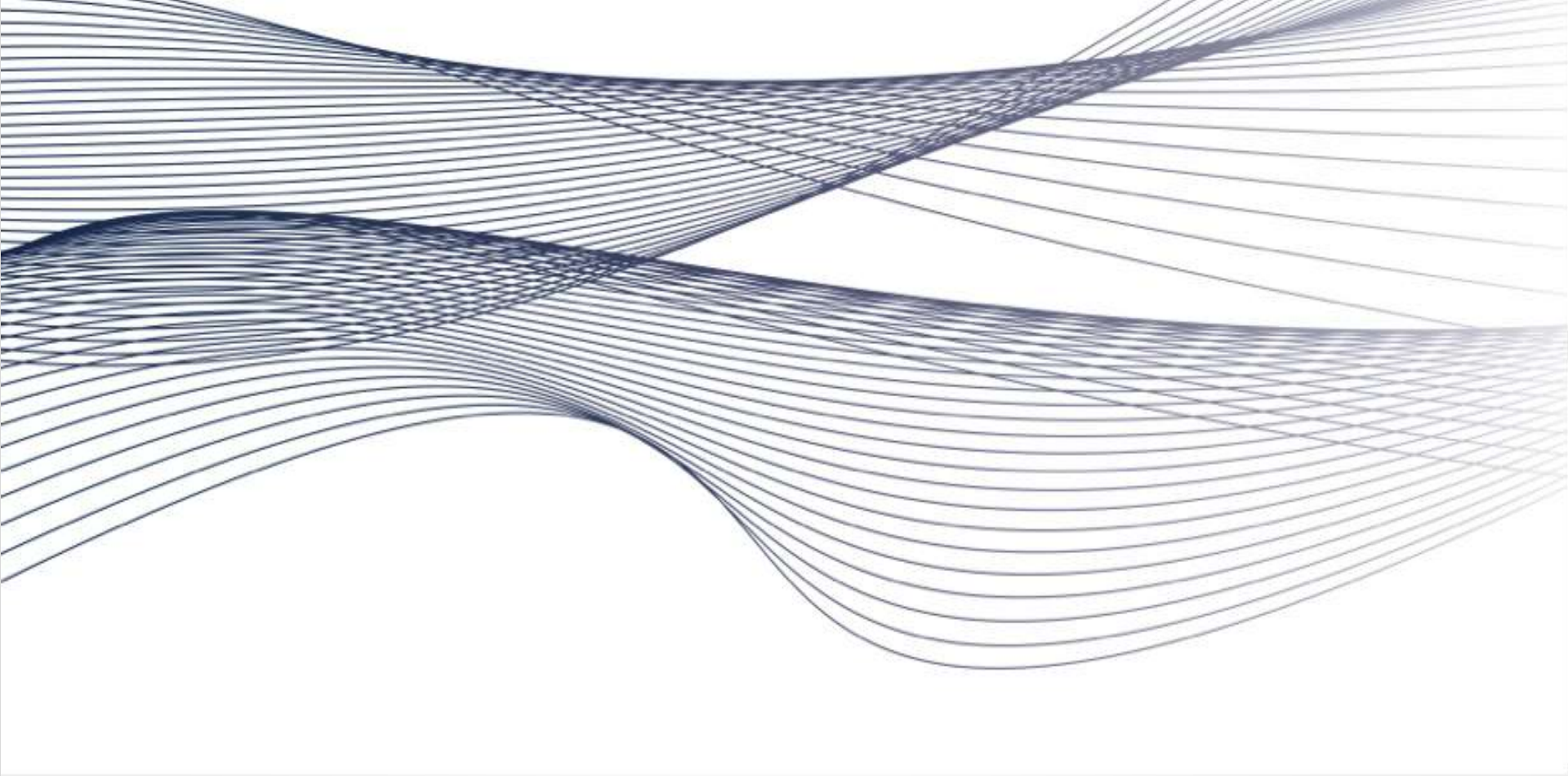|	Name	Fixed IPs	Status	Type	Admin State	Actions
☐	(2e2d1f16-f9fe)	30.30.30.1	Active	Internal Interface	UP	Delete Interface
☐	(88540a4a-3542)	10.10.10.1	Active	Internal Interface	UP	Delete Interface

Displaying 2 items

ARISTA

L3 Gateway on Arista switch


```
bleaf1#show run int vlan 1174
interface Vlan1174
    ip address 10.10.10.254/24
    ip virtual-router address 10.10.10.1
bleaf1#
bleaf1#
bleaf1#
bleaf1#show run int vlan 1143
interface Vlan1143
    ip address 30.30.30.254/24
    ip virtual-router address 30.30.30.1
```

```
bleaf1#show ip int bri | include 1174|1143
Vlan1143              30.30.30.254/24    up      up              1500
Vlan1174              10.10.10.254/24    up      up              1500
```

ARISTA

Thank-You

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