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SAN FRANCISCO | APRIL 14-17, 2014

Software Defined Networking (SDN) OpenFlow and OpenStack

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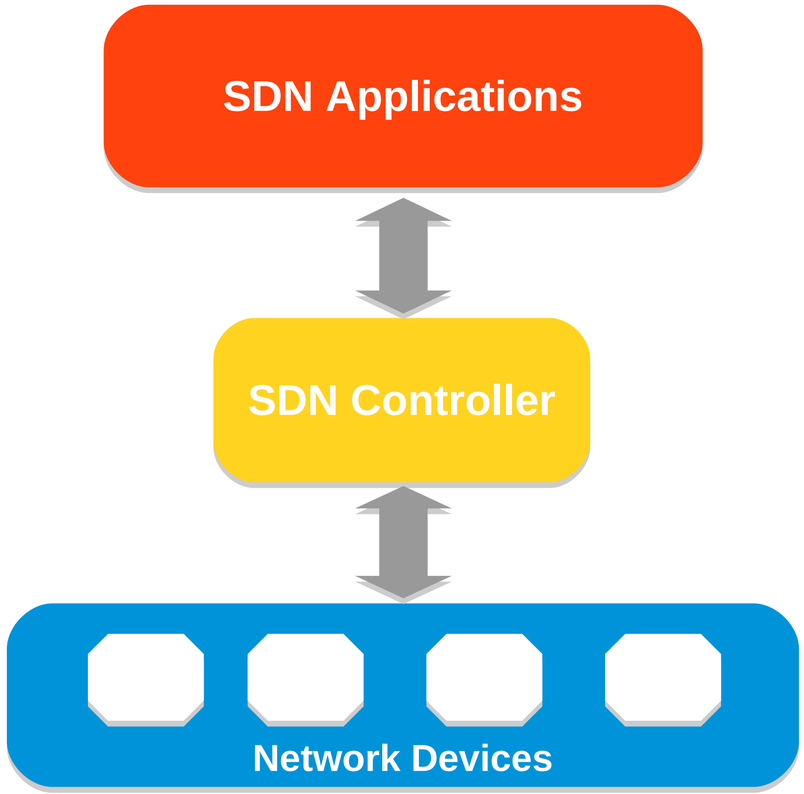
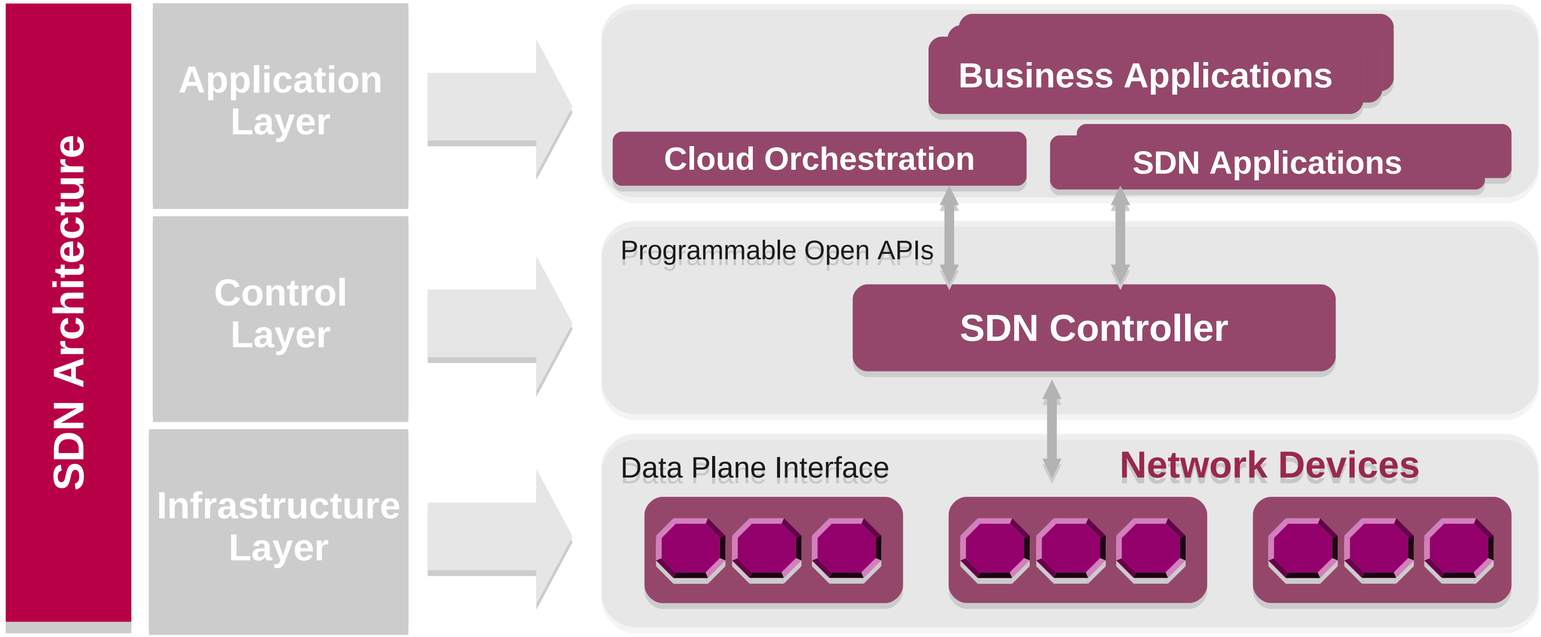


Introduction – SDN and related technologies

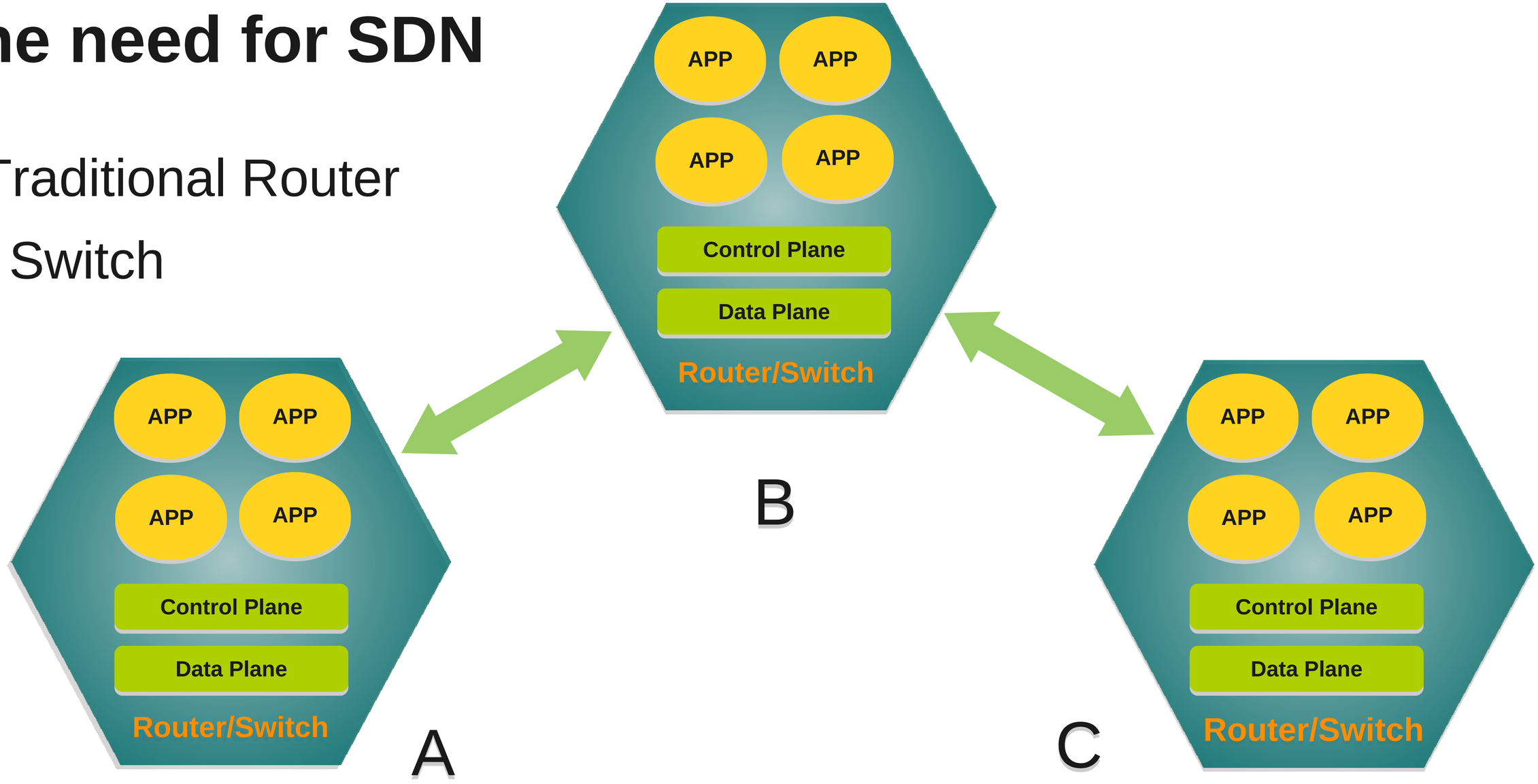
- SDN is a technology enabling **programmable networks**
- Using software running on general purpose OS/Hardware
- SDN – Separation of control and data plane




FedEx
FedEx
Federal Express
FedEx
ILS
R 22L-4R
NO
TRESPASSING
KEEP BACK 100

The need for SDN

- Traditional Router / Switch



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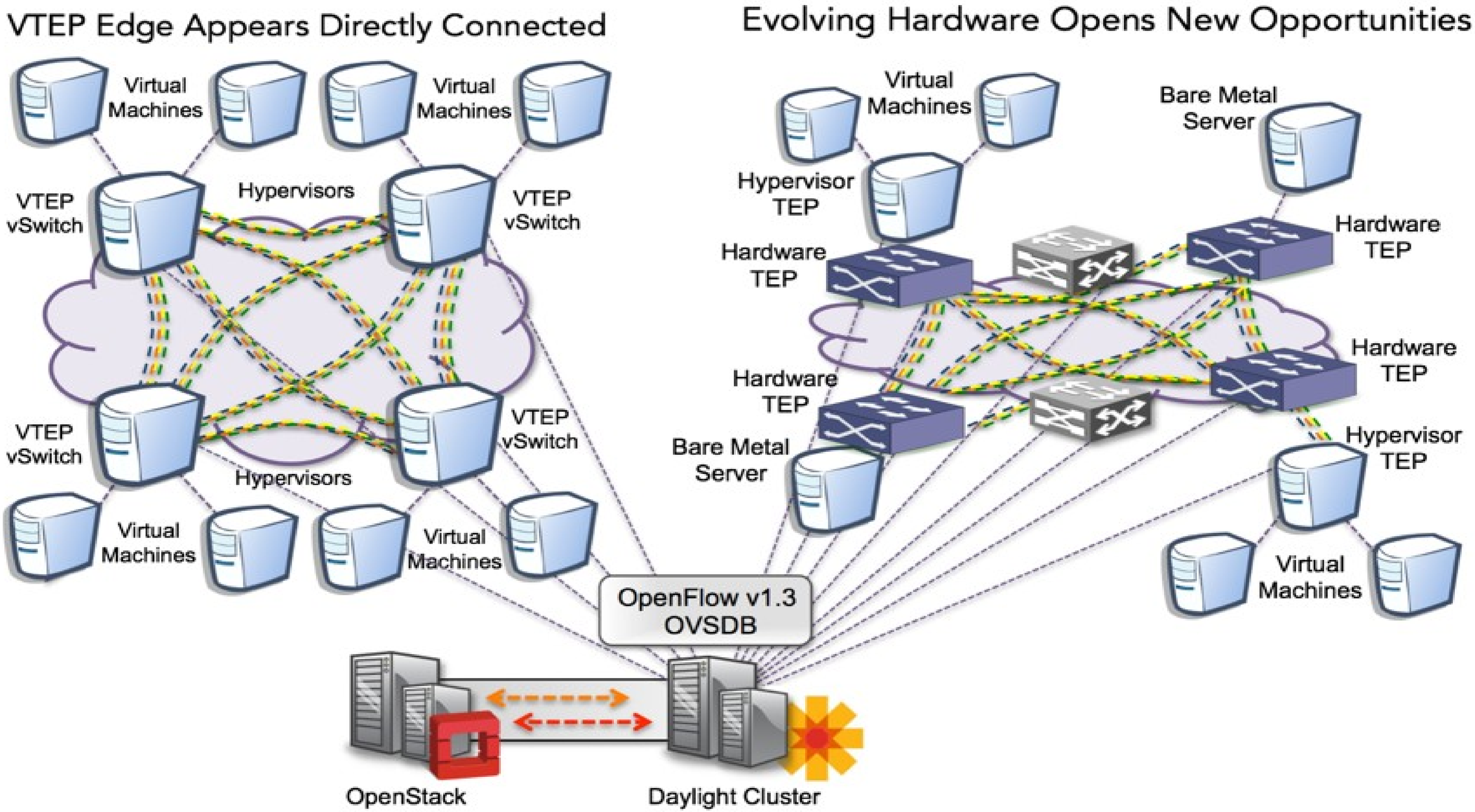
VTEP Edge Appears Directly Connected
Virtual Machines
Virtual Machines
VTEP vSwitch
Hypervisors
VTEP vSwitch
VTEP vSwitch
Hypervisors
VTEP vSwitch
Virtual Machines
Virtual Machines
Evolving Hardware Opens New Opportunities
Virtual Machines
Bare Metal Server
Hypervisor TEP
Hardware TEP
Hardware TEP
Hardware TEP
Hardware TEP
Bare Metal Server
Hypervisor TEP
Virtual Machines
OpenFlow v1.3
OVSDB
OpenStack
Daylight Cluster

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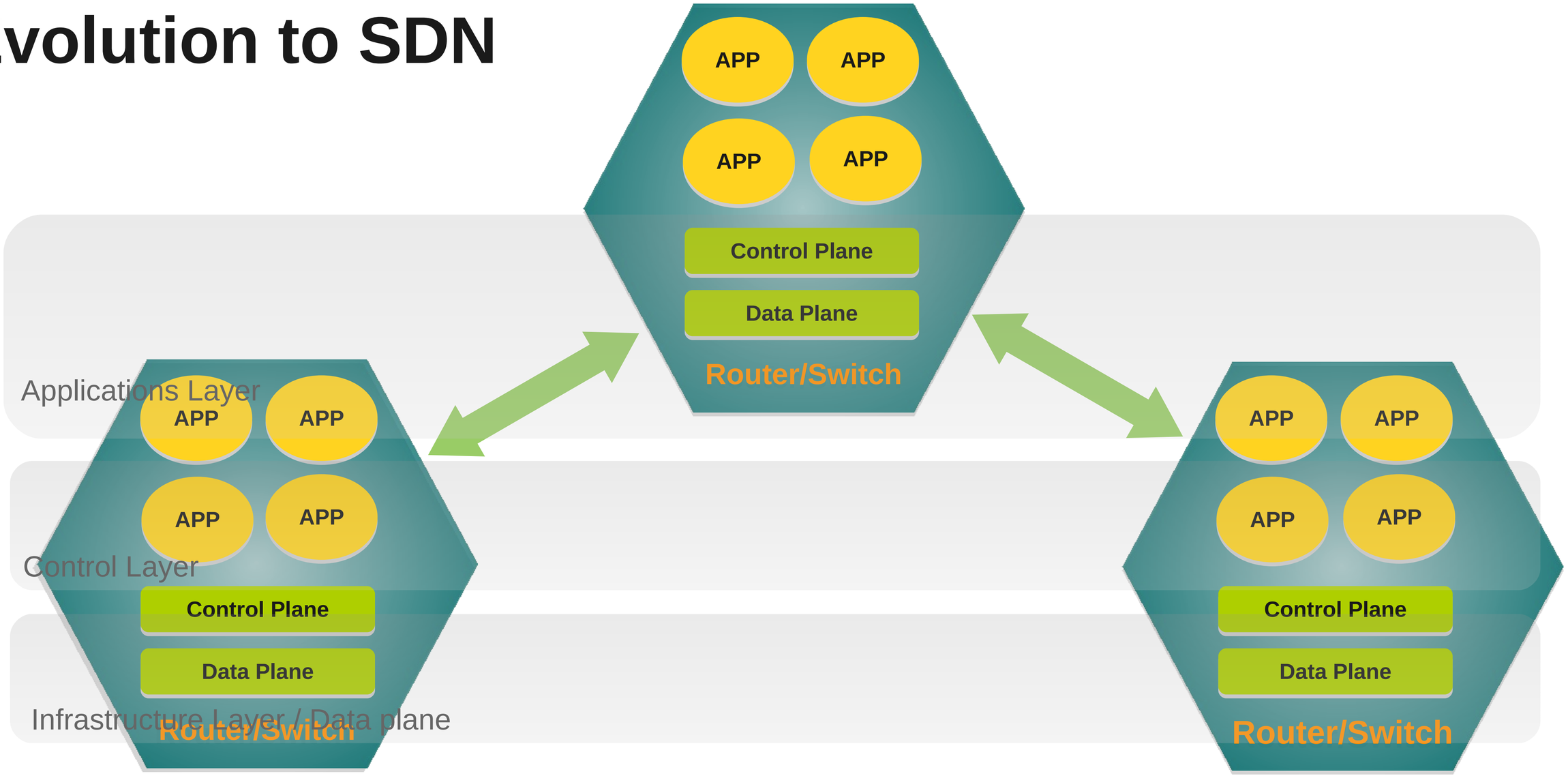
Evolution to SDN



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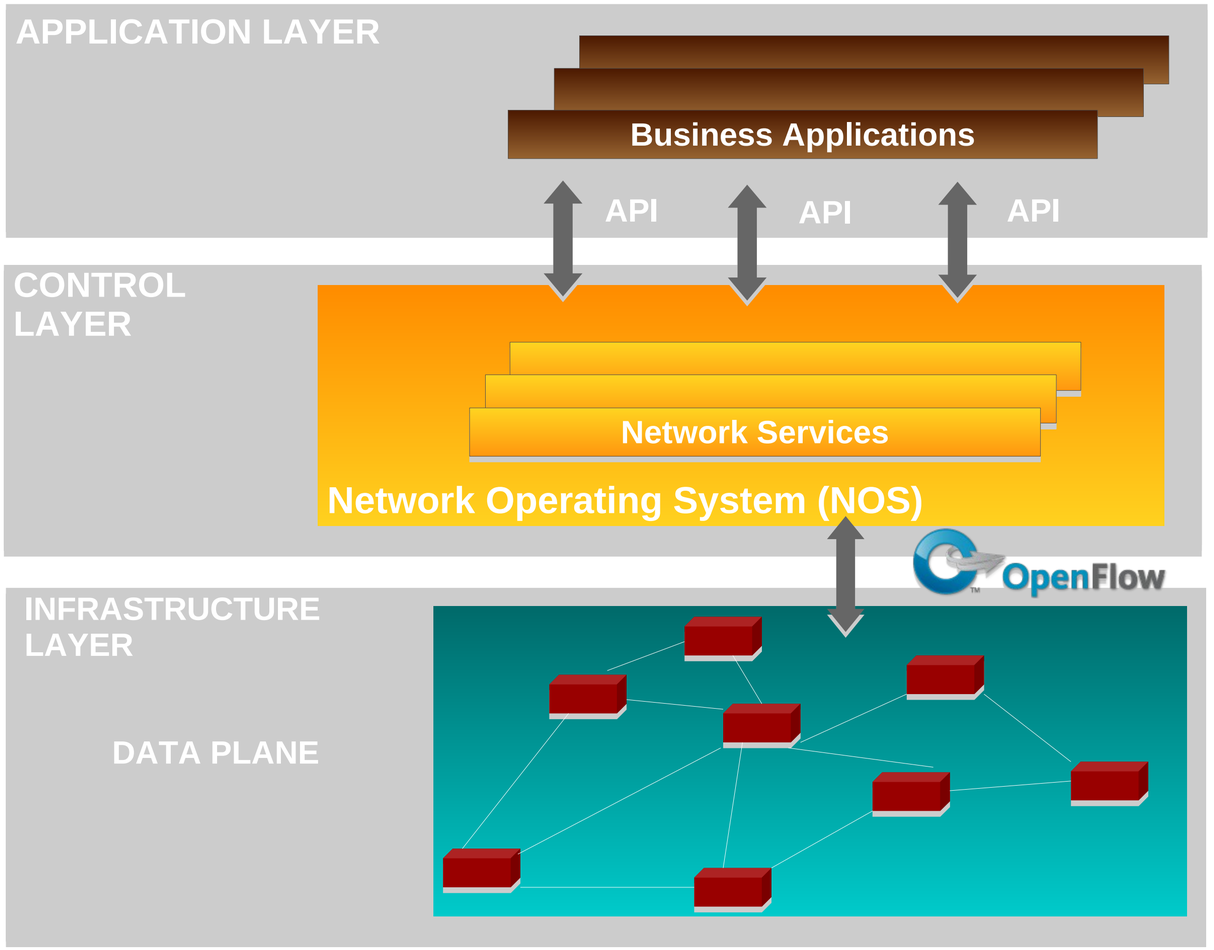
SDN Architecture



- **SDN Applications**
- **SDN Control Plane**

  Controller

  NOS
- **SDN Data Plane**

  Devices

  OpenFlow

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OVERNIGHT
HANDLE WITH CARE
RUSH
FRAGILE
OVERNIGHT


RIGHT
ON TIME
DELIVERY
RIGHT
ON TIME
DELIVERY

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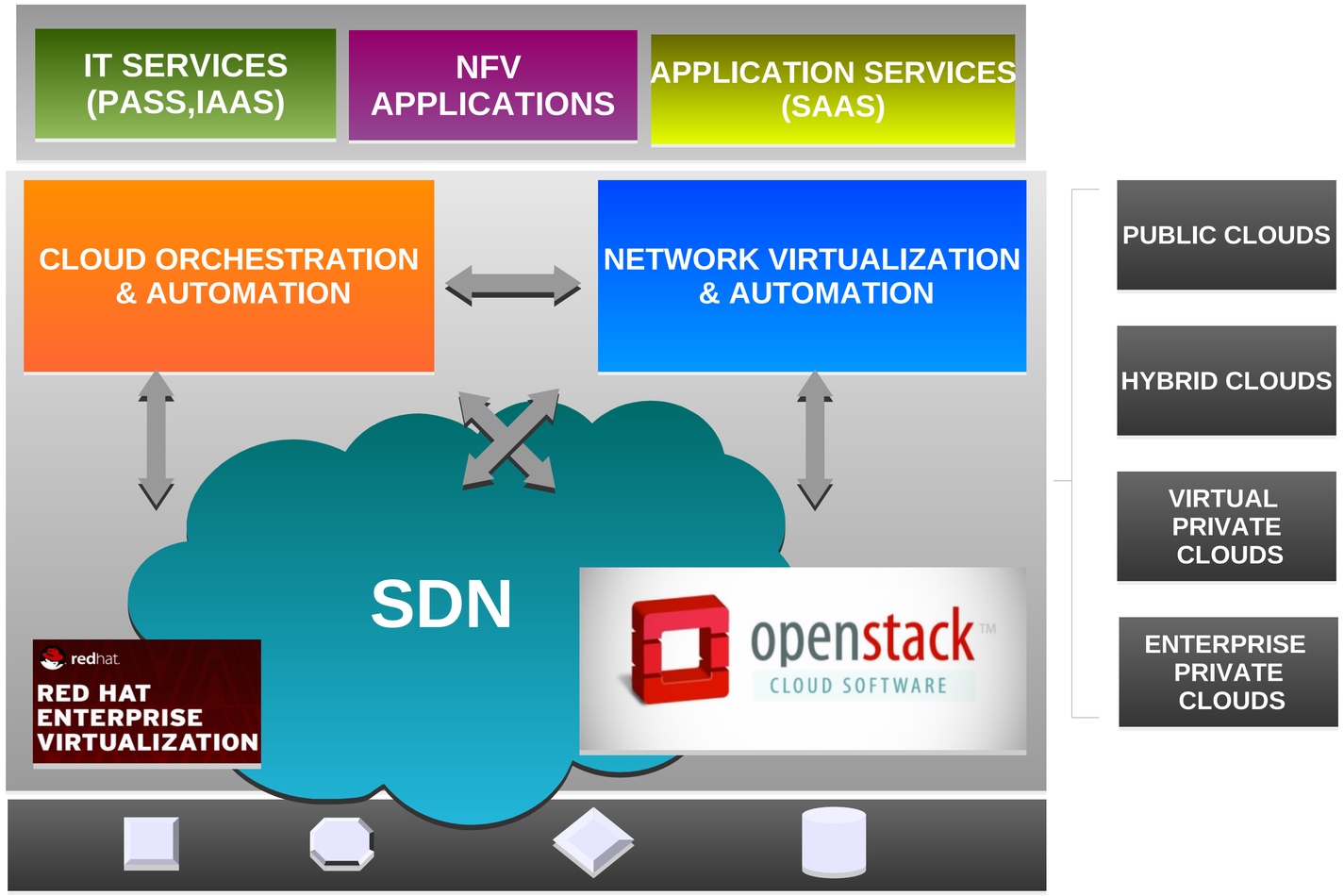
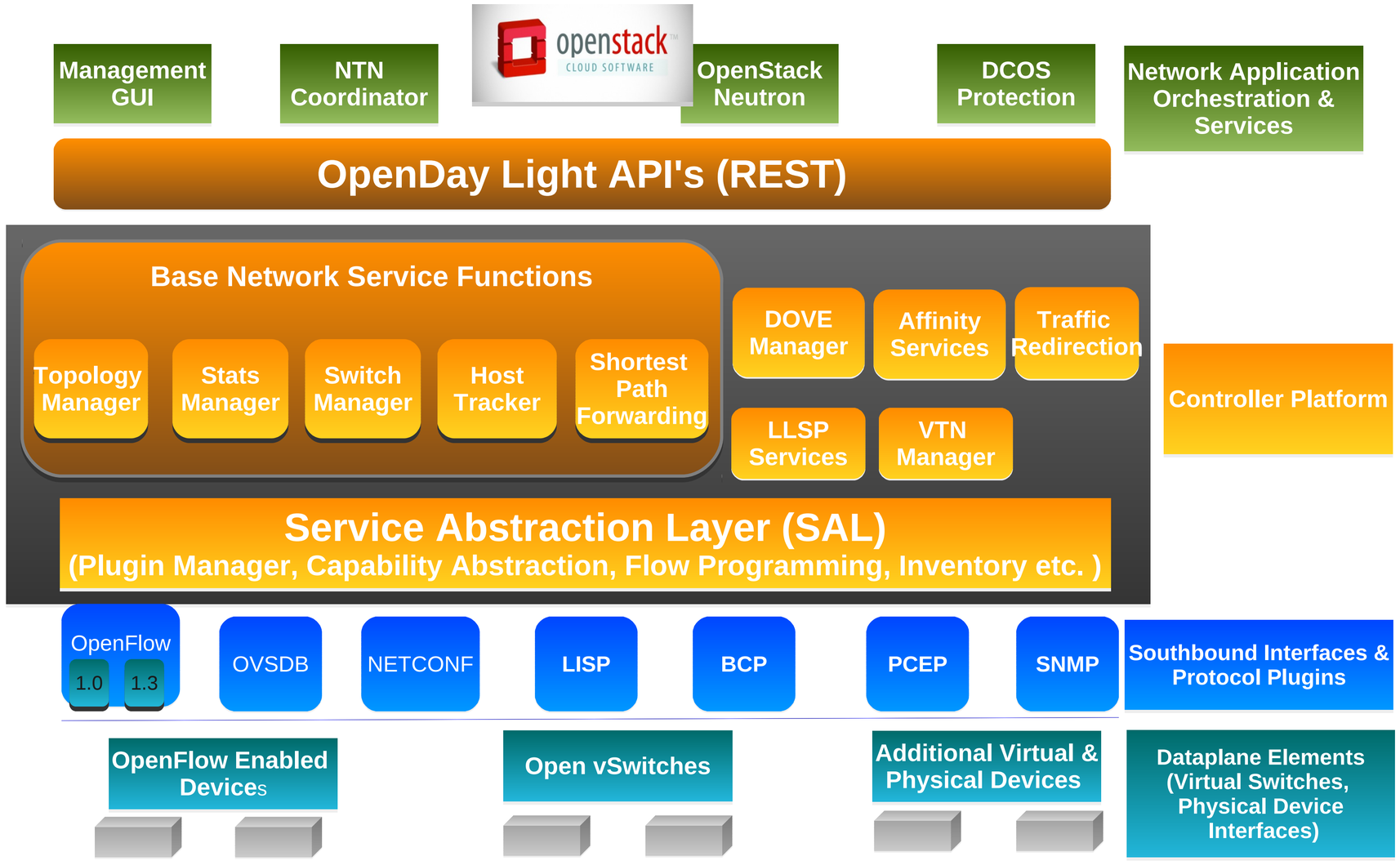
SDN Components - (Ecosystem)

- Cloud Orchestration
- Network Virtualization
- Network Functions Virtualization (NFV)



SDN Controller OpenDayLight

- Open Source
- Southbound - OF
- Northbound -> Neutron
- Plugin -> Red Hat Enterprise Linux OpenStack Platform



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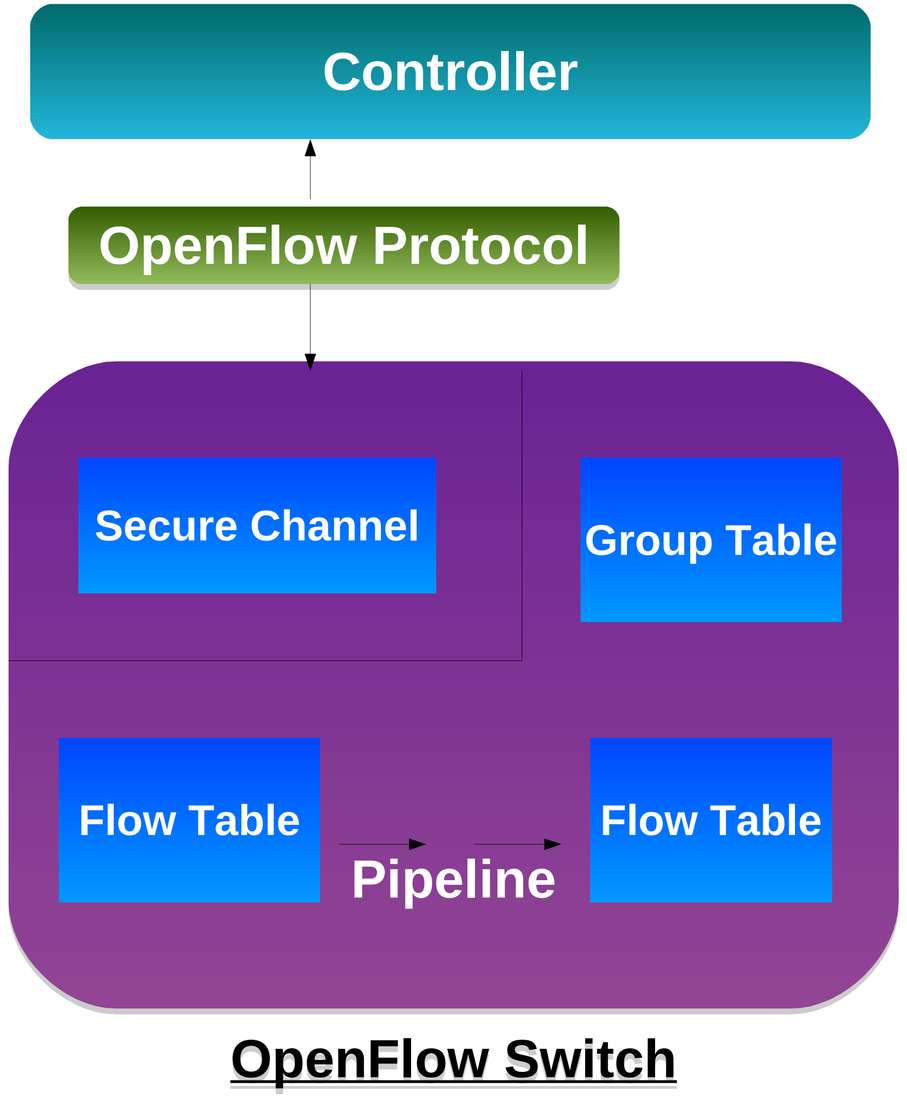
OpenFlow / Open vSwitch

OpenFlow introduction

- **Openflow** - standard for interacting with forwarding behaviours of switches
- Control the behaviour of switches dynamically and programmatically

- **Flow tables**, Group tables and OpenFlow Channel (**TCP port 6633**)



OpenFlow protocol - Messages

- **Controller to Switch** :: Switch / Flow table config, ***Packet out***, Barrier, Role Req, Bundle [Controller to Switch messages]

- **Asynchronous** :: ***Packet-in***, Flow-removed, Port-status, Controller Role status, Table status, Request forward [Async messages]

- **Symmetric messages** :: Hello, Echo Req/Reply, Error, Experimenter [Symmetric messages]

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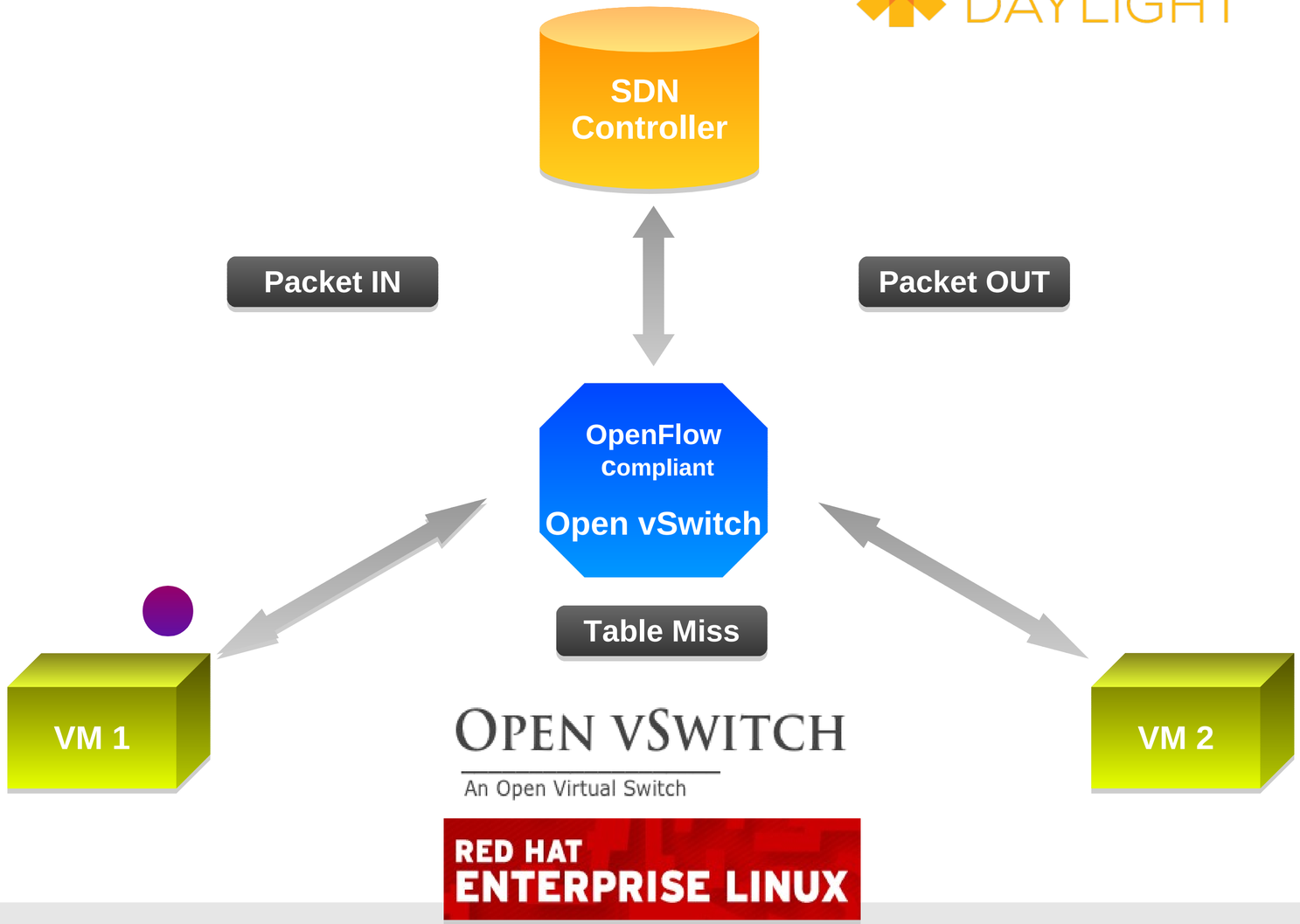
OpenFlow – FlowTables and Routing

- **Packet-in** message for table miss
- Controller sends a **packet-out** mesg specifying action
- **Buffer id** -> packet
- **Flow** modification



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OpenFlow – FlowTables and Routing

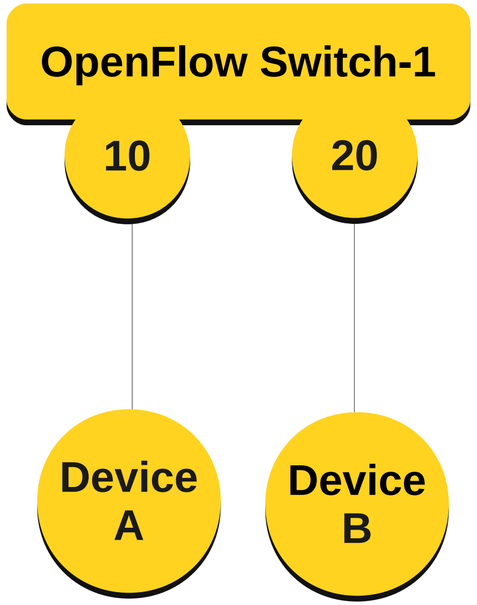
- **Flow Table Components**

  Match fields, Priority, Counters, Instructions, Timeouts, Cookie

- Flow table

  match vs miss

- Flow removal



Match	Action
Src. Port= 10	Fwd to Port 20
Src. Port= 20	Fwd to Port 10

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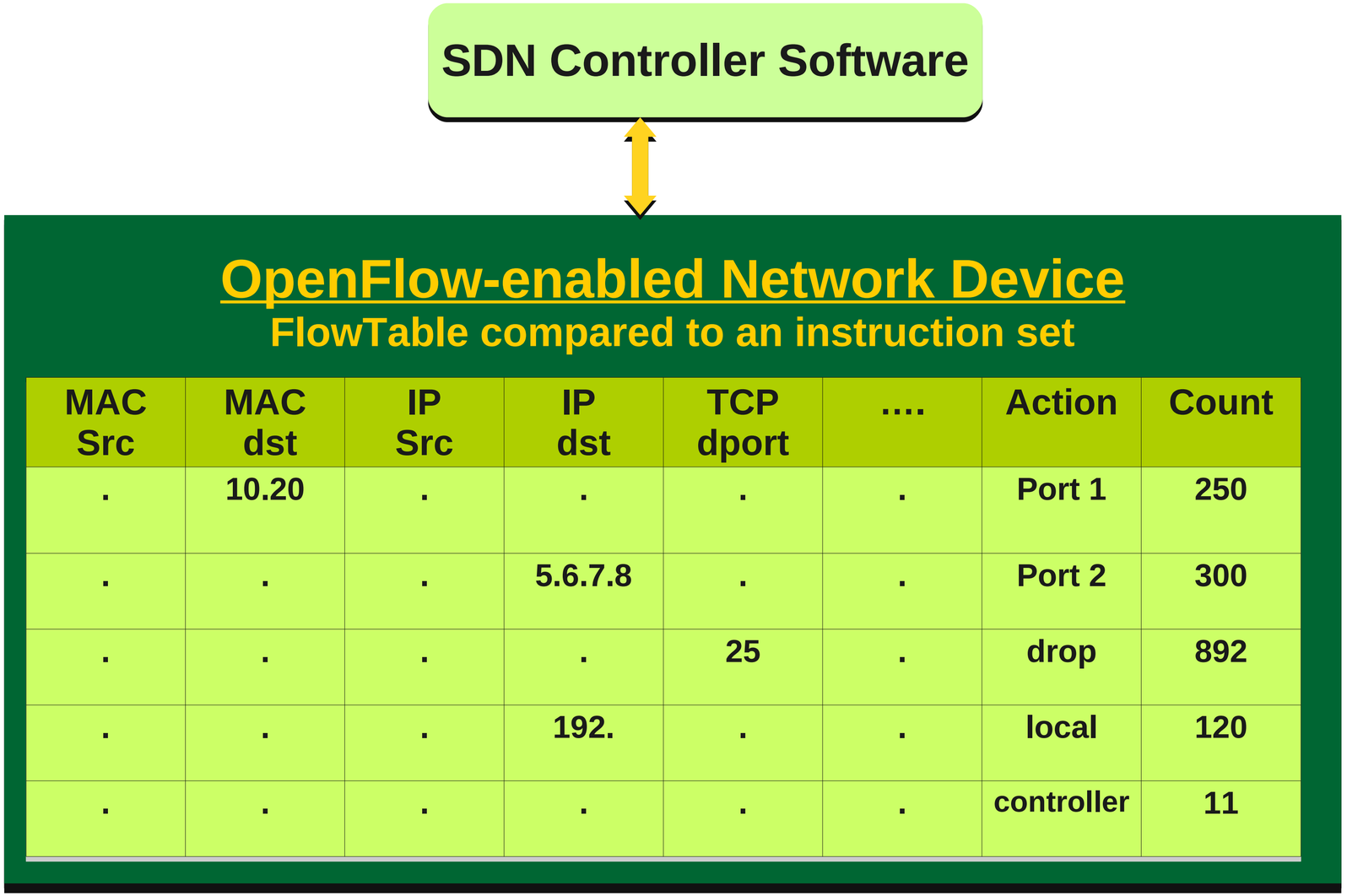
OpenFlow – FlowTables

- Group table
- Meter table
- Counters
- Instructions
- Actions



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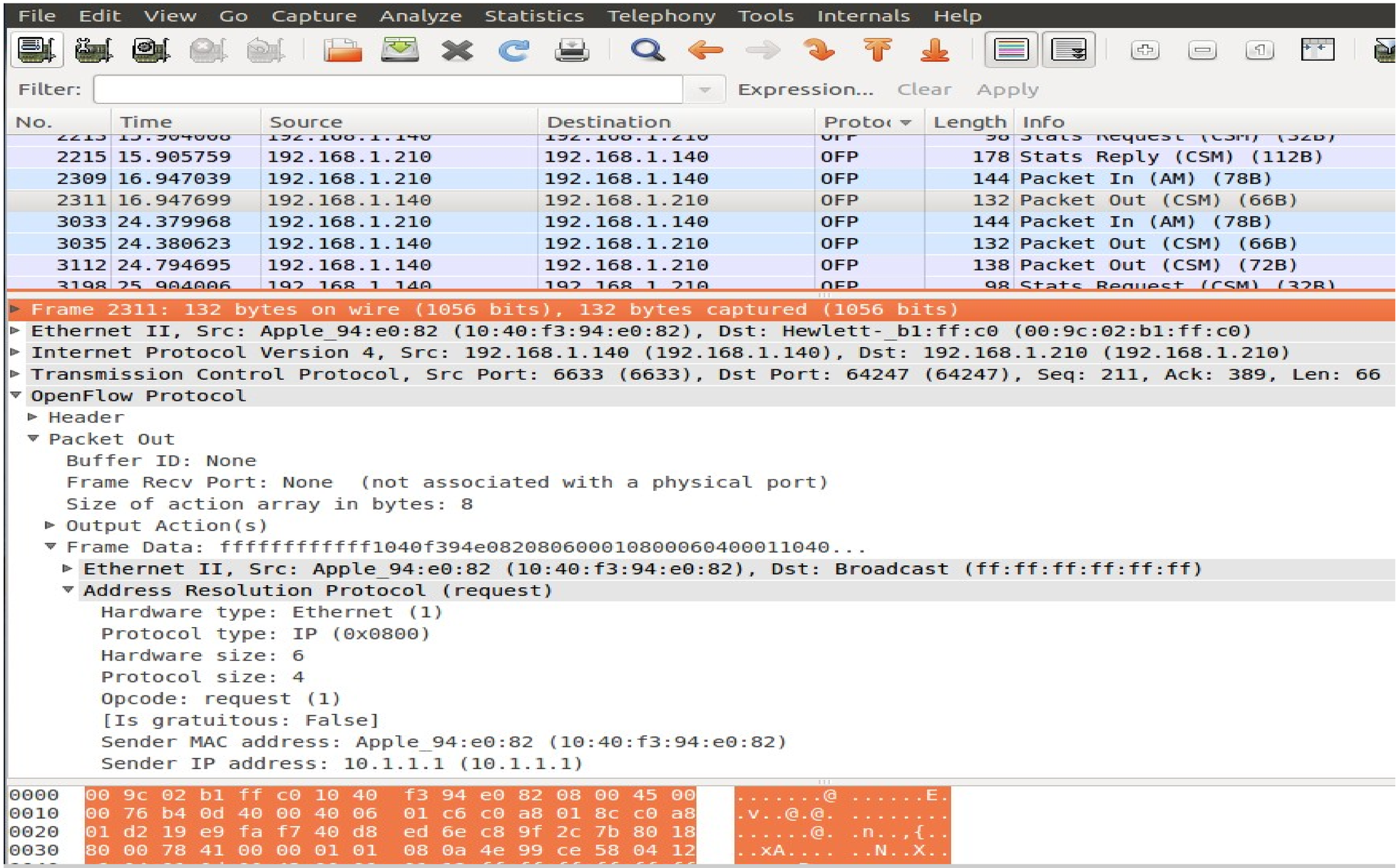
- OpenFlow Packet Capture



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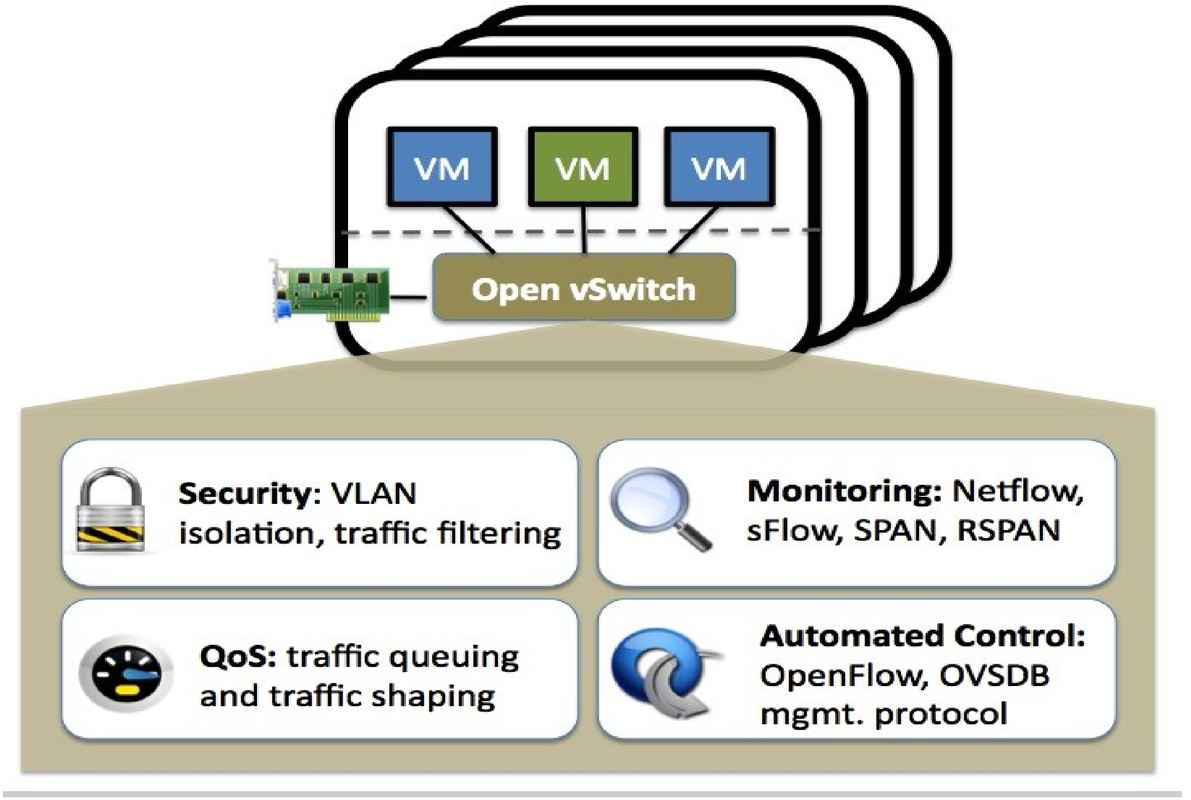
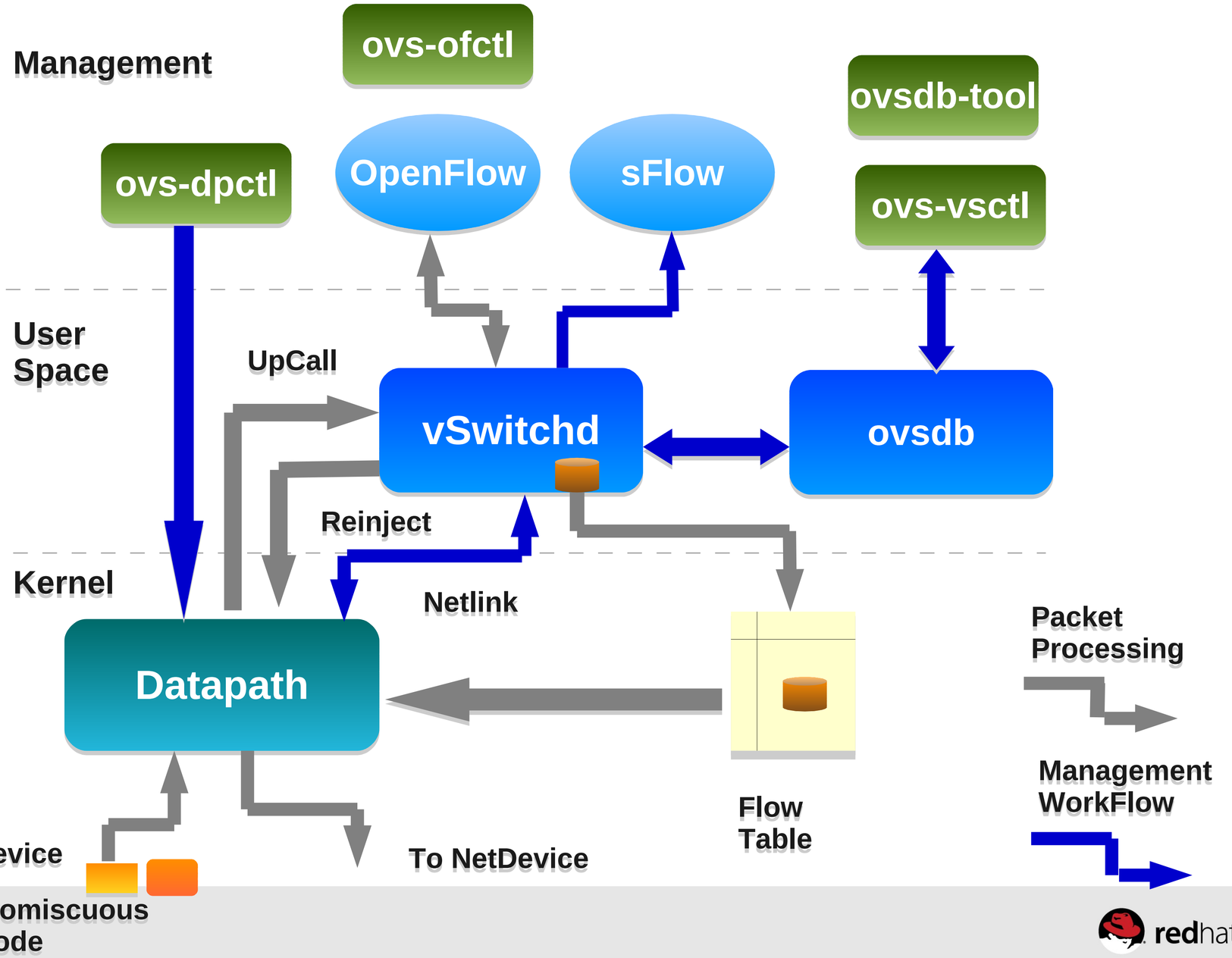
Open vSwitch

- Networking in Software
- In 2012 – total # of virtual ports surpassed physical ports
- A opensource software switch
- High performance forwarding using **Linux Kernel Module**
- OpenFlow Compliant
- Advanced switching features



Open vSwitch

- Kernel Datapath
- Userspace daemon
- Configuration database
- Since RHEL 6.4



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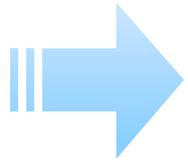
OPEN vSWITCH

An Open Virtual Switch

Open vSwitch operations

- Normal mode vs **Flow mode**
- Flow Table Match based on L2/L3/L4
- Forward, Drop Modify headers
- Systemtap Probe



```
 0 swapper(0): -> ovs_netdev_frame_hook
 7 swapper(0):  -> ovs_vport_receive
11 swapper(0):   -> ovs_dp_process_received_packet
15 swapper(0):    -> ovs_flow_extract
20 swapper(0):    <- ovs_dp_process_received_packet
24 swapper(0):    -> ovs_flow_tbl_lookup
28 swapper(0):     -> ovs_flow_hash
32 swapper(0):     <- ovs_flow_tbl_lookup
35 swapper(0):     -> find_bucket
38 swapper(0):     <- ovs_flow_tbl_lookup
41 swapper(0):    <- ovs_dp_process_received_packet
45 swapper(0):    -> ovs_flow_used
48 swapper(0):    <- ovs_dp_process_received_packet
52 swapper(0):    -> ovs_execute_actions
56 swapper(0):     -> do_execute_actions
```

```
 0 ovs-vswitchd(1302): -> ovs_vport_cmd_get
 4 ovs-vswitchd(1302):  -> lookup_vport
 8 ovs-vswitchd(1302):   -> ovs_vport_locate
12 ovs-vswitchd(1302):    -> hash_bucket
15 ovs-vswitchd(1302):    <- ovs_vport_locate
19 ovs-vswitchd(1302):    -> ovs_netdev_get_name
22 ovs-vswitchd(1302):    <- ovs_vport_locate
25 ovs-vswitchd(1302):   <- lookup_vport
28 ovs-vswitchd(1302):  <- ovs_vport_cmd_get
```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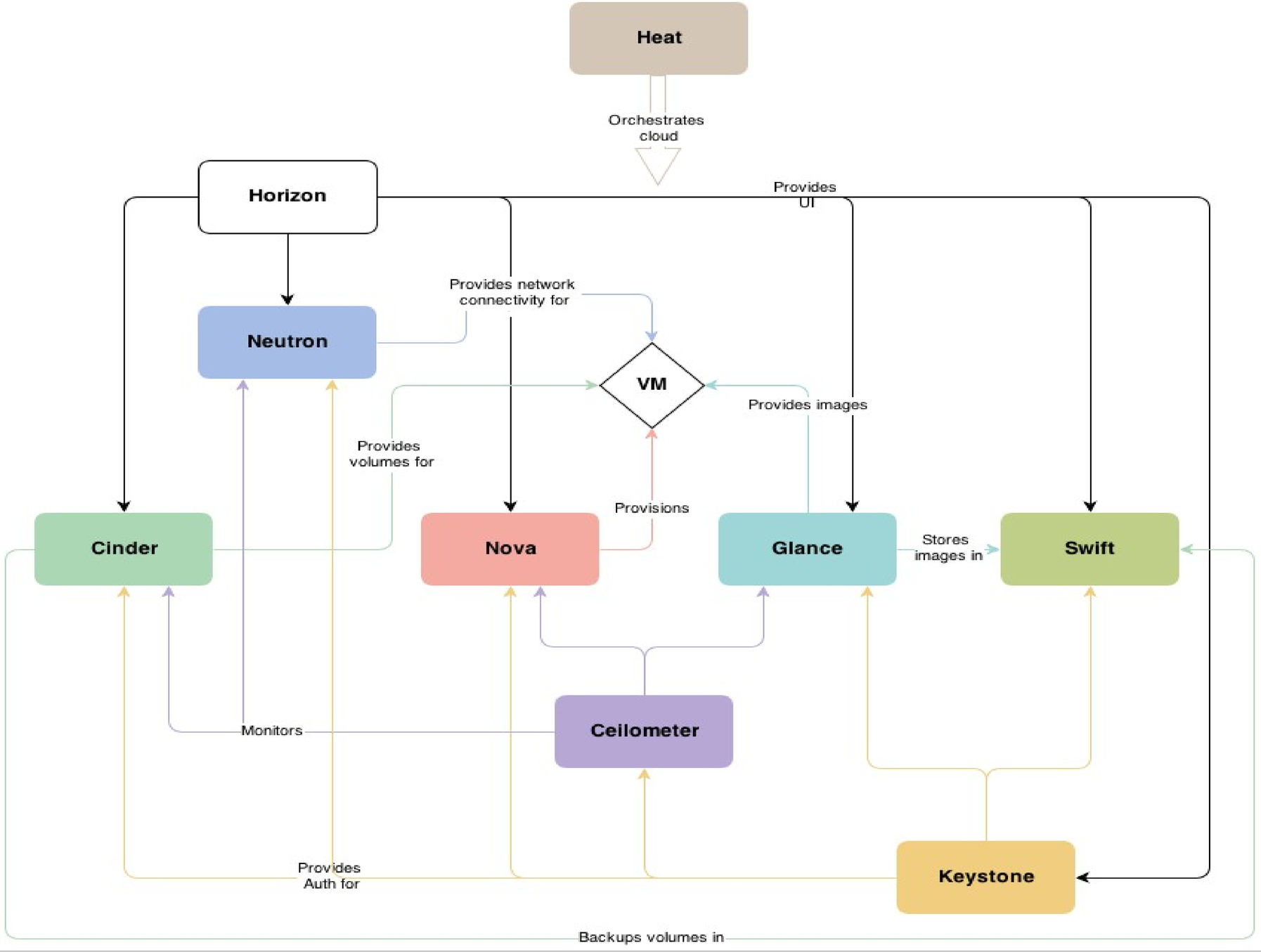
OpenStack (SDN)

OpenStack Architecture



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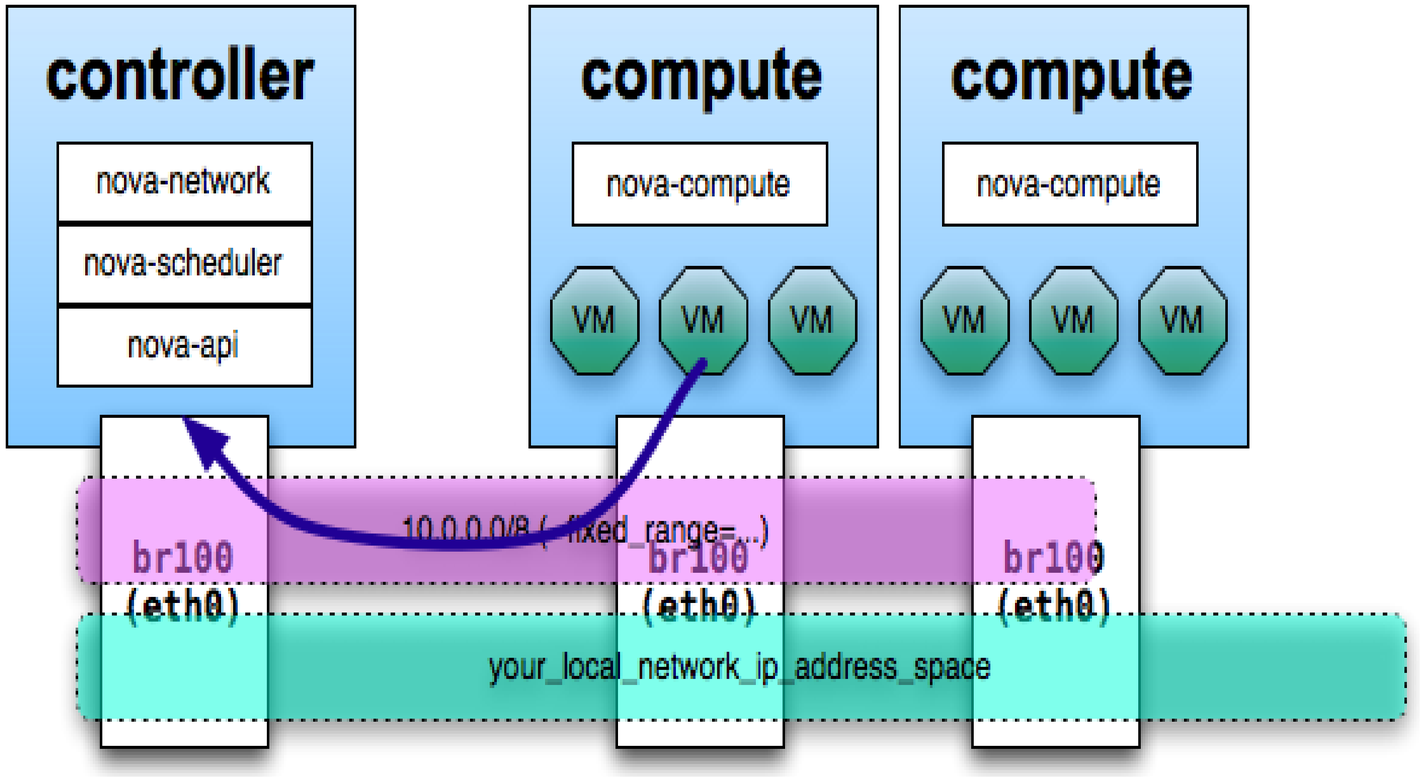
Nova Networking

- Early days of Openstack networking
-Flat, Flat-DHCP, VLAN
- No router, firewalls etc



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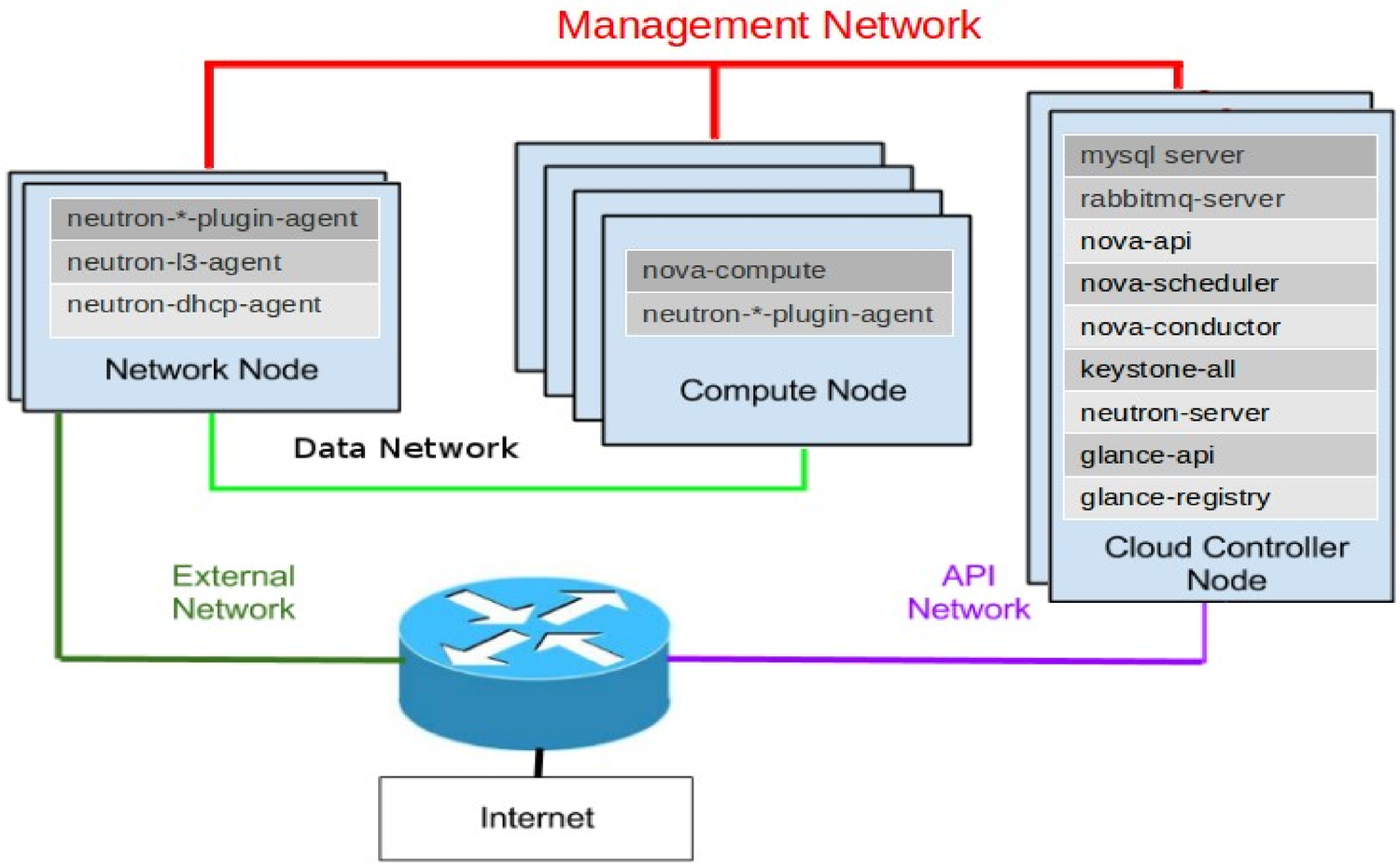
Neutron

- Neutron is at the northbound side of the SDN framework
- Neutron provides network services to the Nova compute

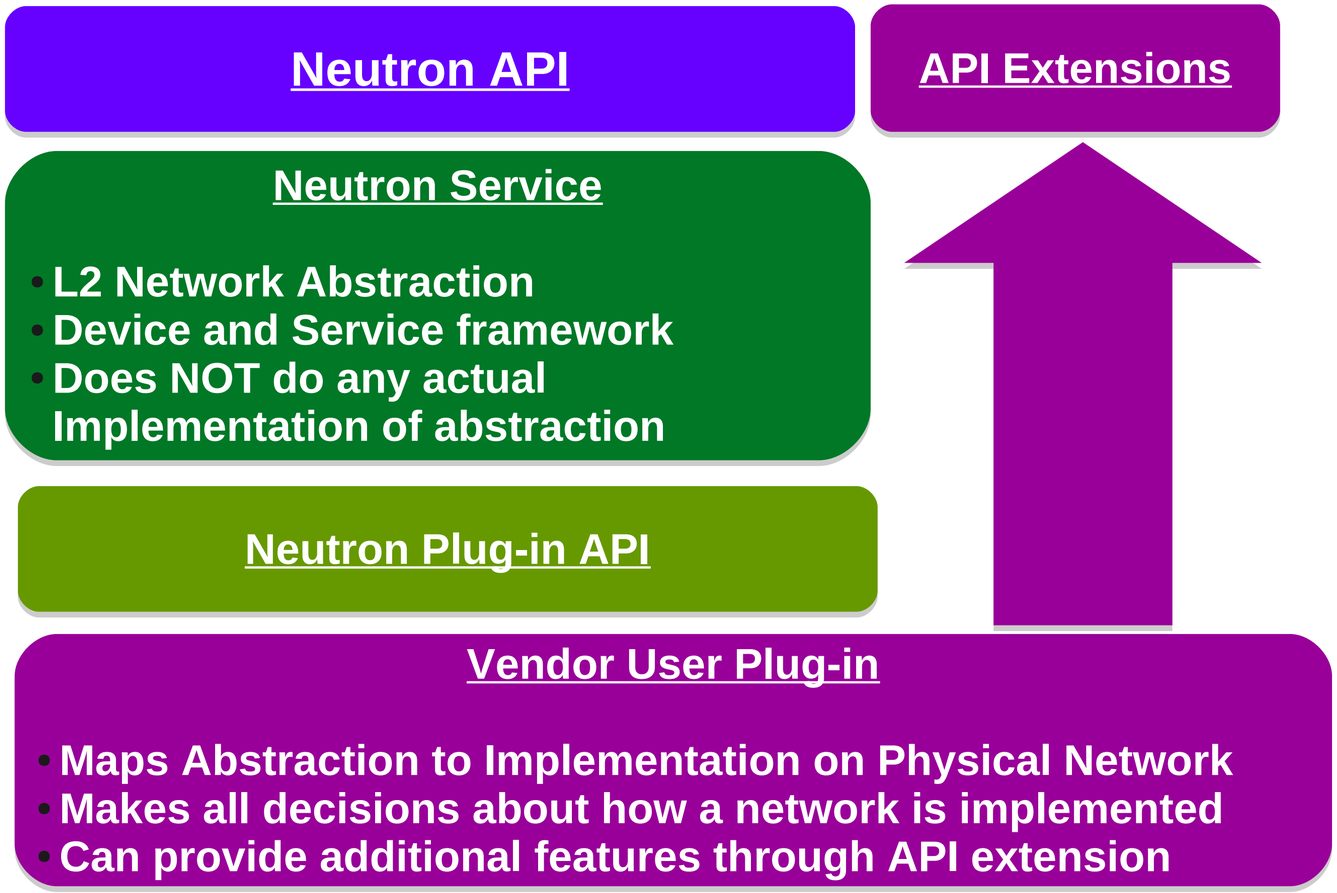


Neutron plugin architecture

- Neutron services
- Various plugins

  connect to controllers

  or OpenFlow Switches



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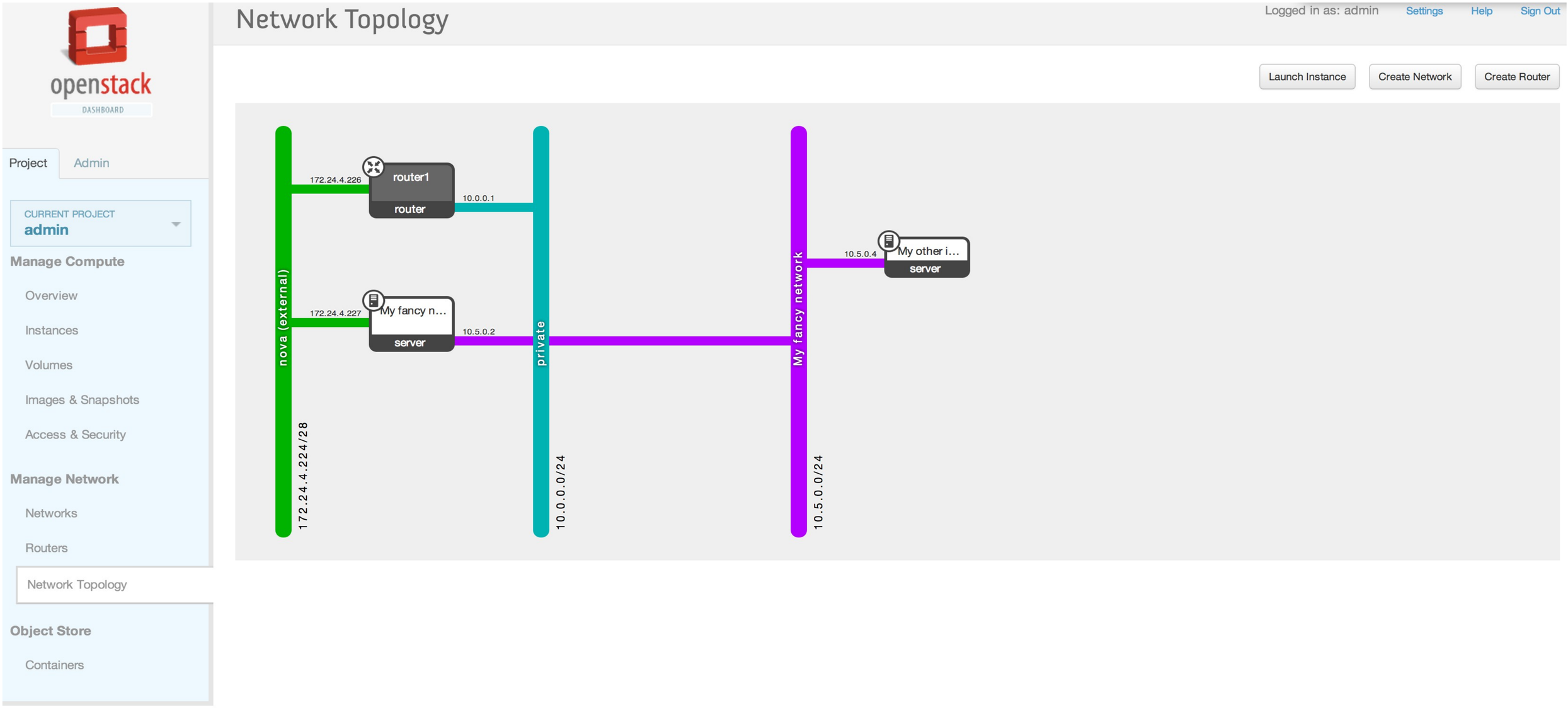
OpenStack Network Topology



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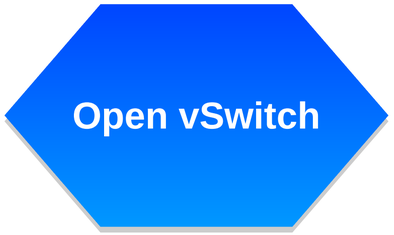
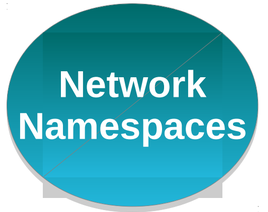
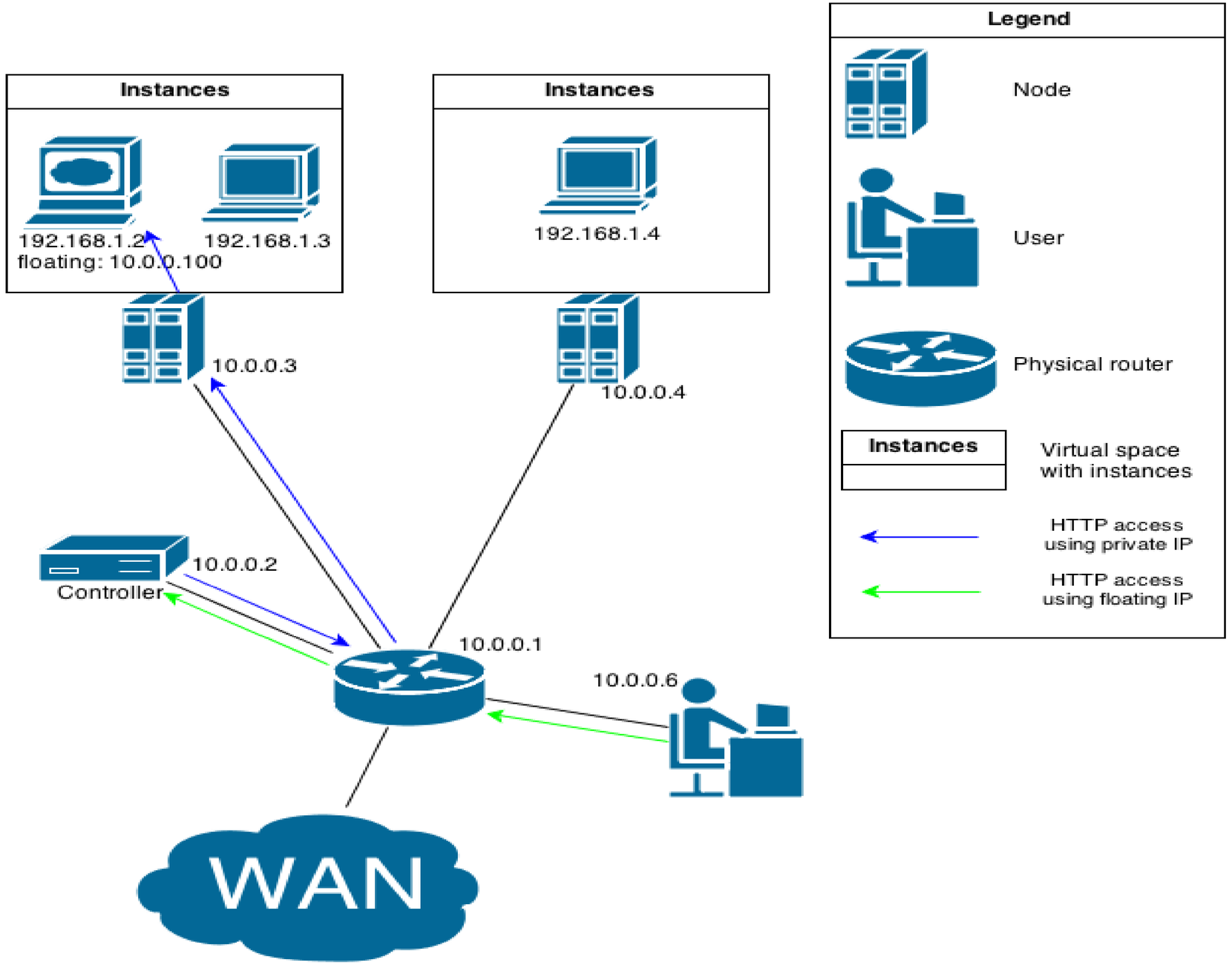
OpenStack SDN

- Various Components
- Iptables
- Open vSwitch
- Overlay networks
- Tunnels – GRE/VXLAN
- Network Namespace
- Netfilter NAT for Floating IP addresses





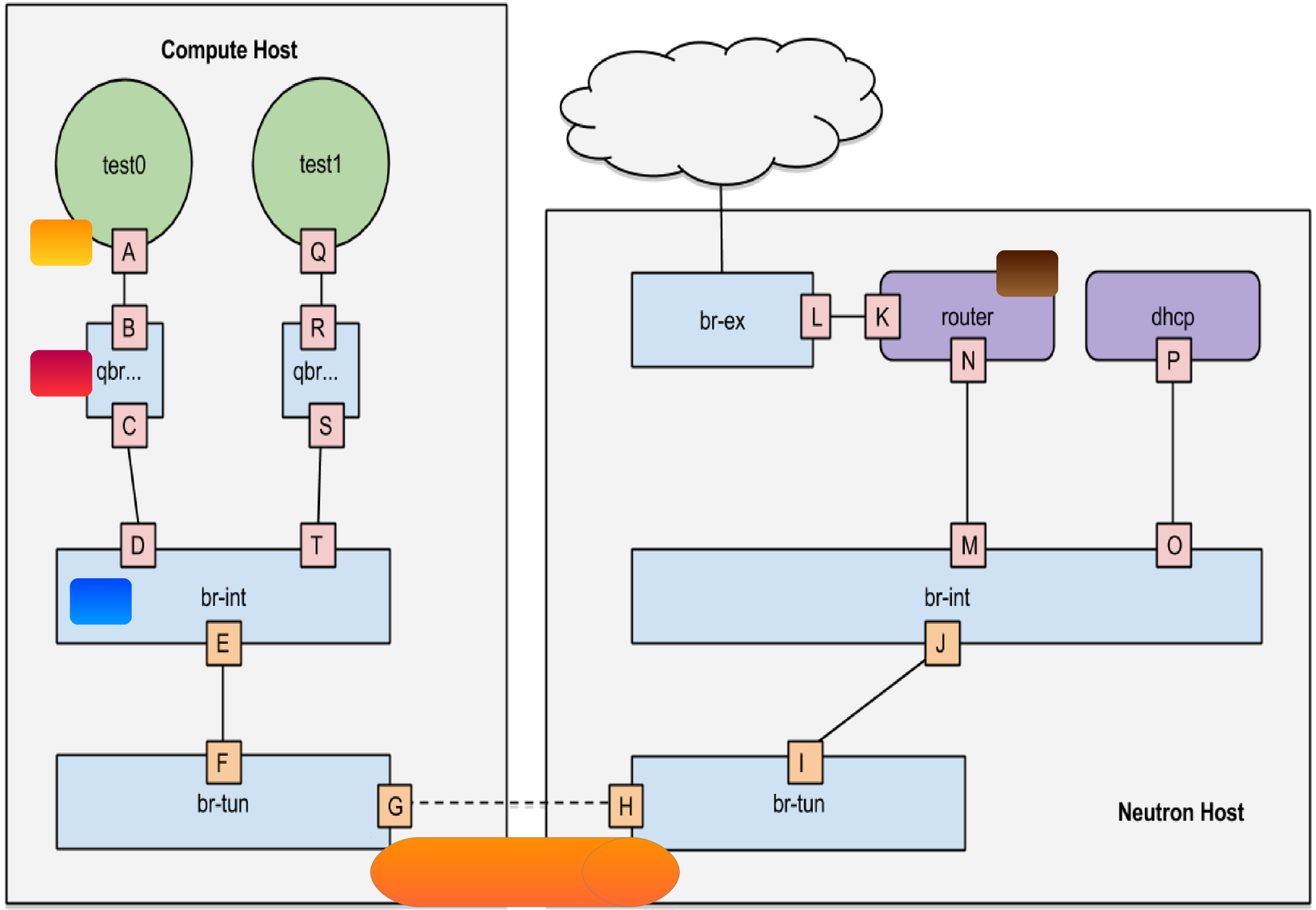
OpenStack Floating IP



Red Hat Enterprise Linux OpenStack Platform

OpenStack SDN

- A, B, C :: Tap,
  Fw Bridge, Iptables
- D, E :: VLAN tagging
- F, G :: Tunnels
- Open vSwitch, GRE
- O, P :: DHCP
- M, N :: Router
  Netfilter NAT



Future Trends

- Need to stick to **open standards**
- Need to have a stable SDN ecosystem
- Standardization for various components
- Allows for various vendor solutions

  (open/closed source)
- Scope for **Innovation at each layer**- Apps, Controller, Protocols, Devices (Physical/Virtual)
- Possible scope for **Hardware acceleration** products in SDN space
- Evolution of **NOS**

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Thank You ! Questions ?

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