Towards Nirvana Stack:
The Evolution of OpenDaylight Network Control

OpenStack Summit 2017 - Boston

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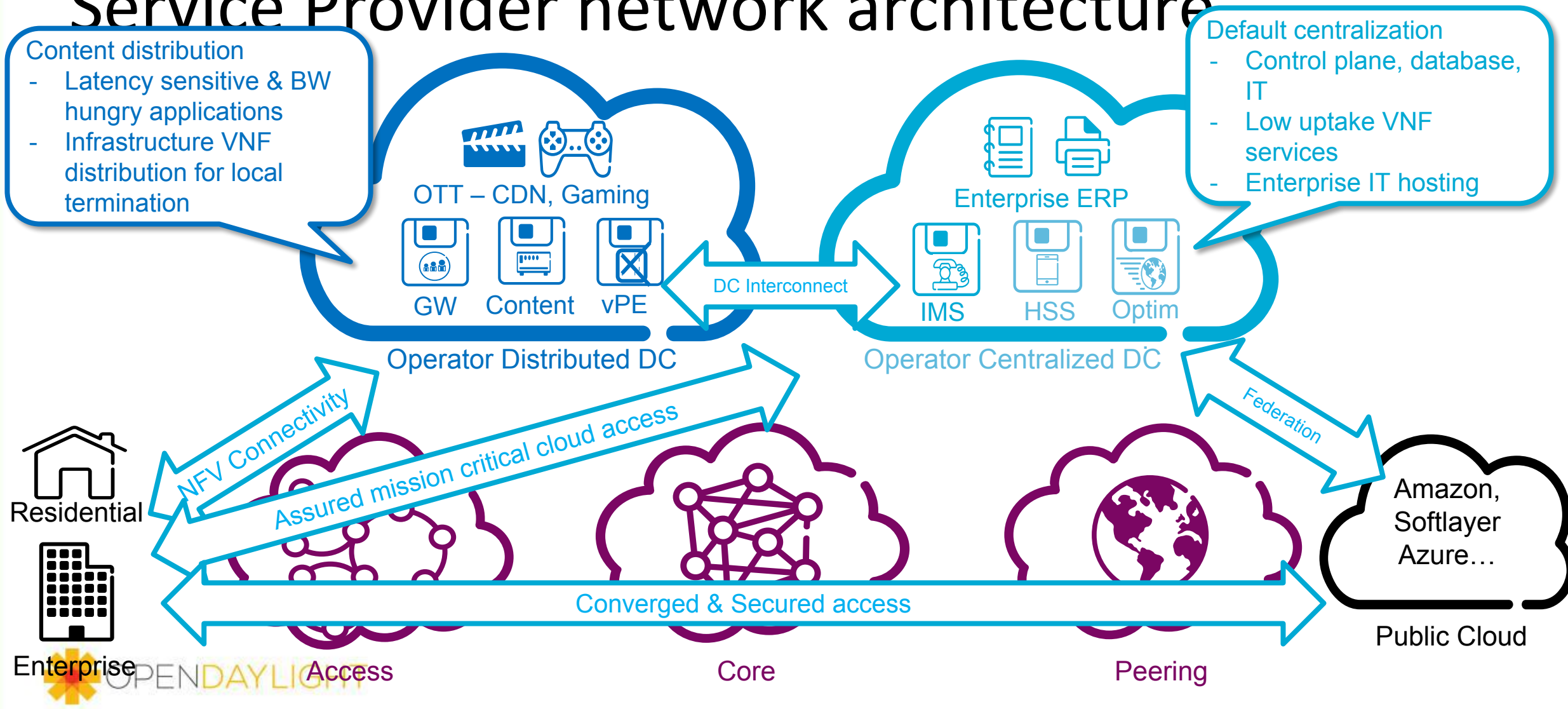
LINUX FOUNDATION
COLLABORATIVE PROJECTS

Service Provider network architecture



Cloud Networking Evolution

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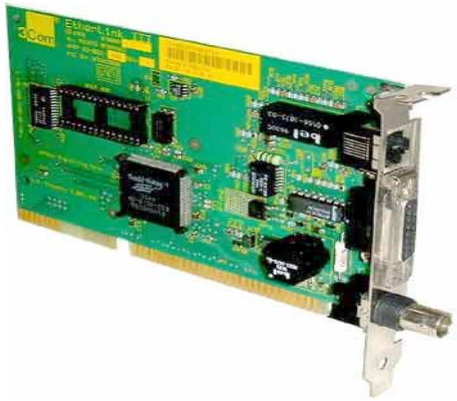

- 20 year old technologies
  - Subnets
  - Networks
  - Routers/static routes
  - VLAN's / VRRP

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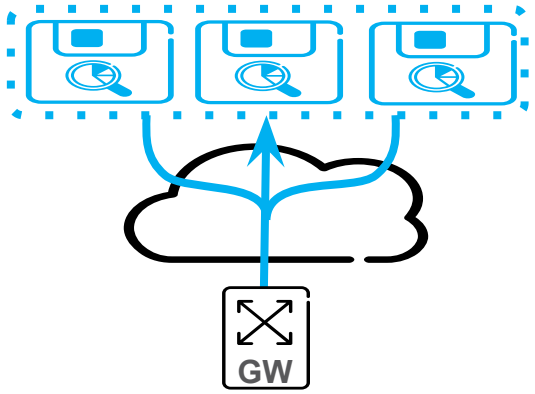
- Modern Platform
  - Open and hybrid datapath
  - Collaborative development
  - API/Model driven control plane and state distribution
  - Continuous Delivery

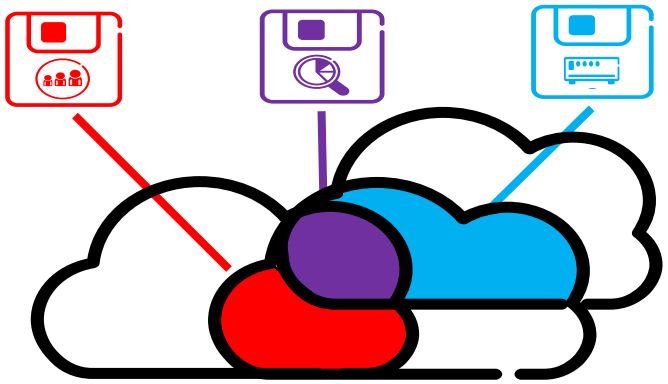
- Modern IP Routing
  - Inter-Domain, Hierarchical
  - P2P, P2MP, MP2MP
  - Policy driven routing
  - Traffic engineering
  - Fast Reroute / Segment Routing

Routing Capabilities Highlights

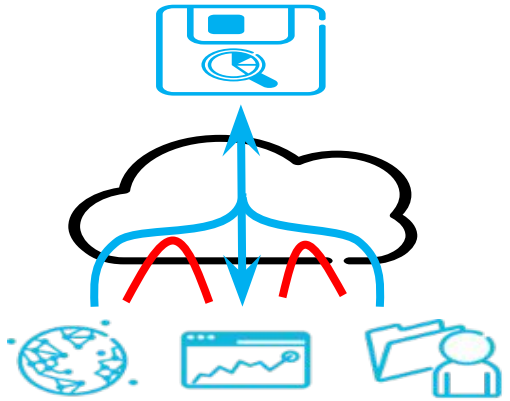
Native Fabric IP ECMP



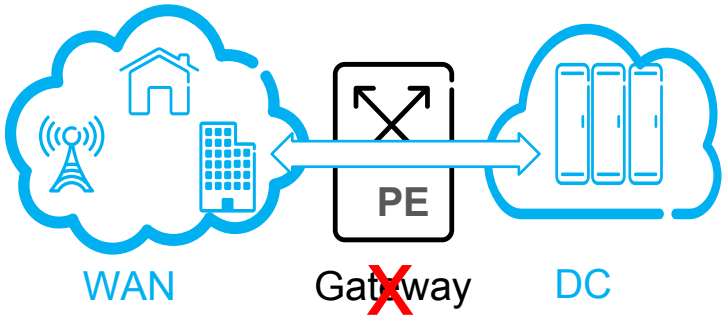
Intranet & Extranets



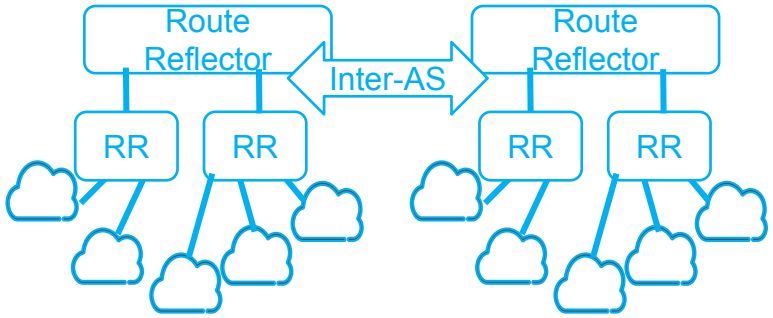
Hub & Spoke / Segmentation



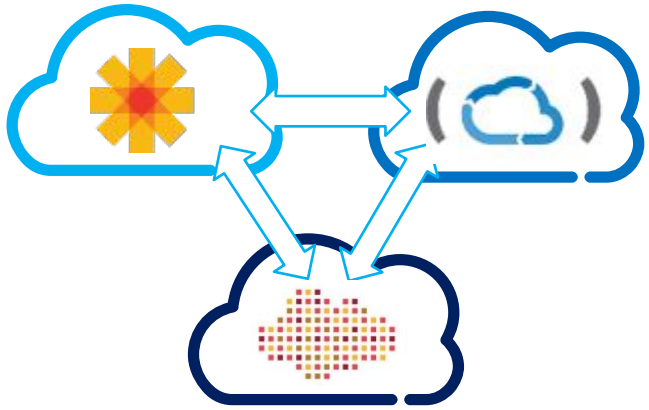
And seamlessly (zero touch)



Dot it at Scale (of the internet)



Interoperable



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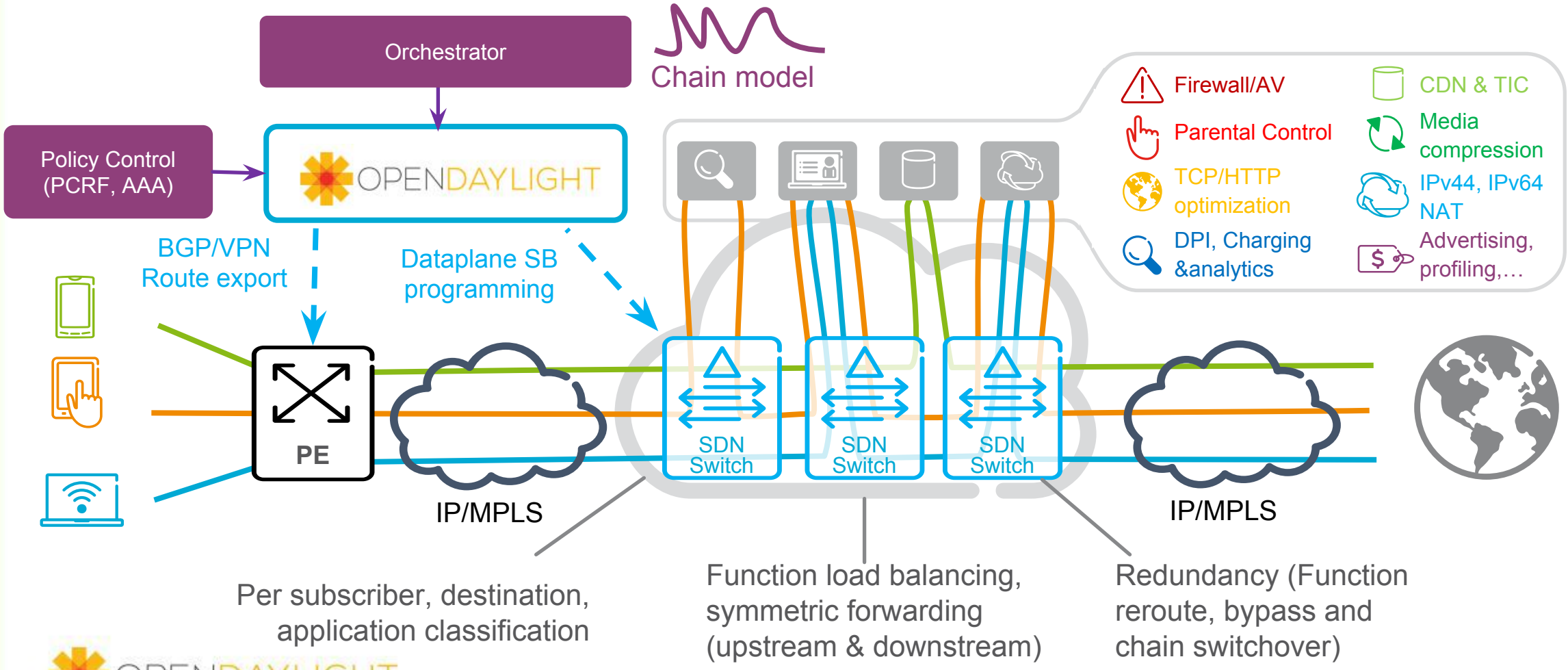
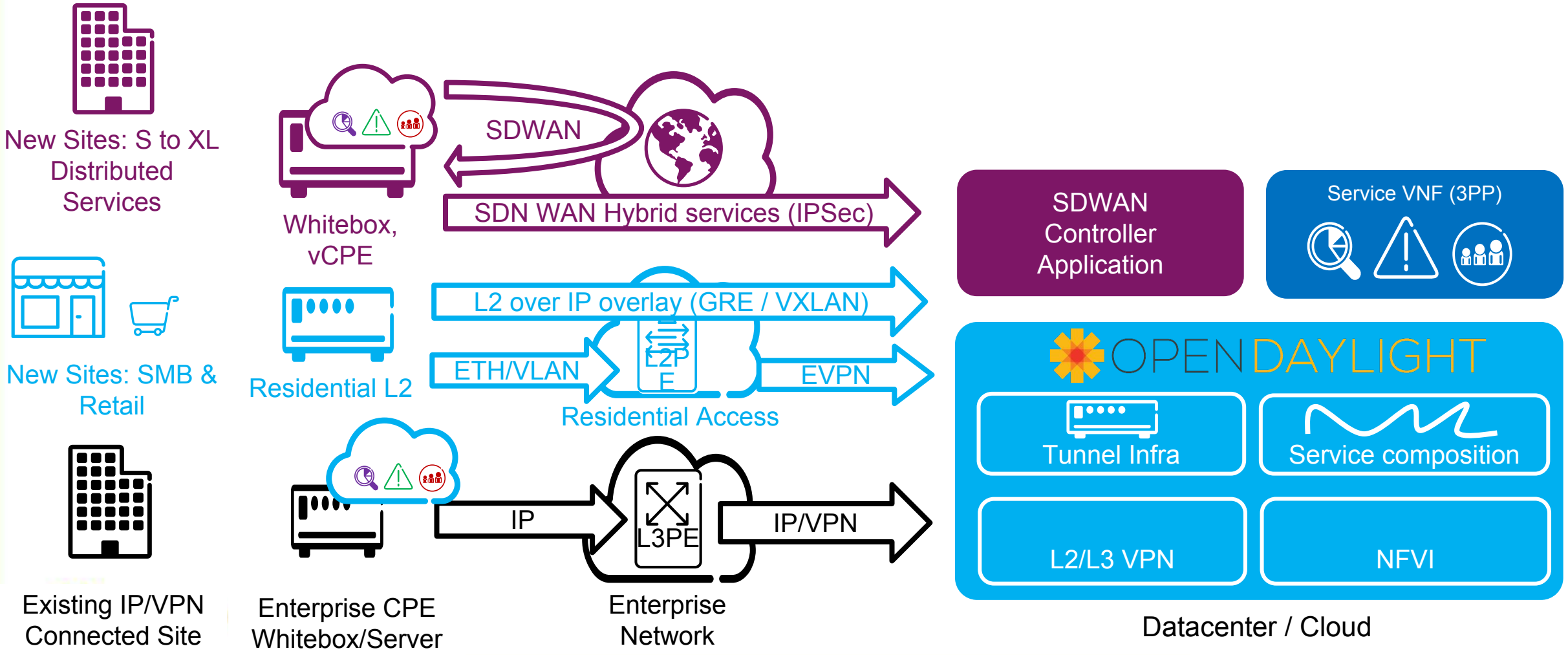
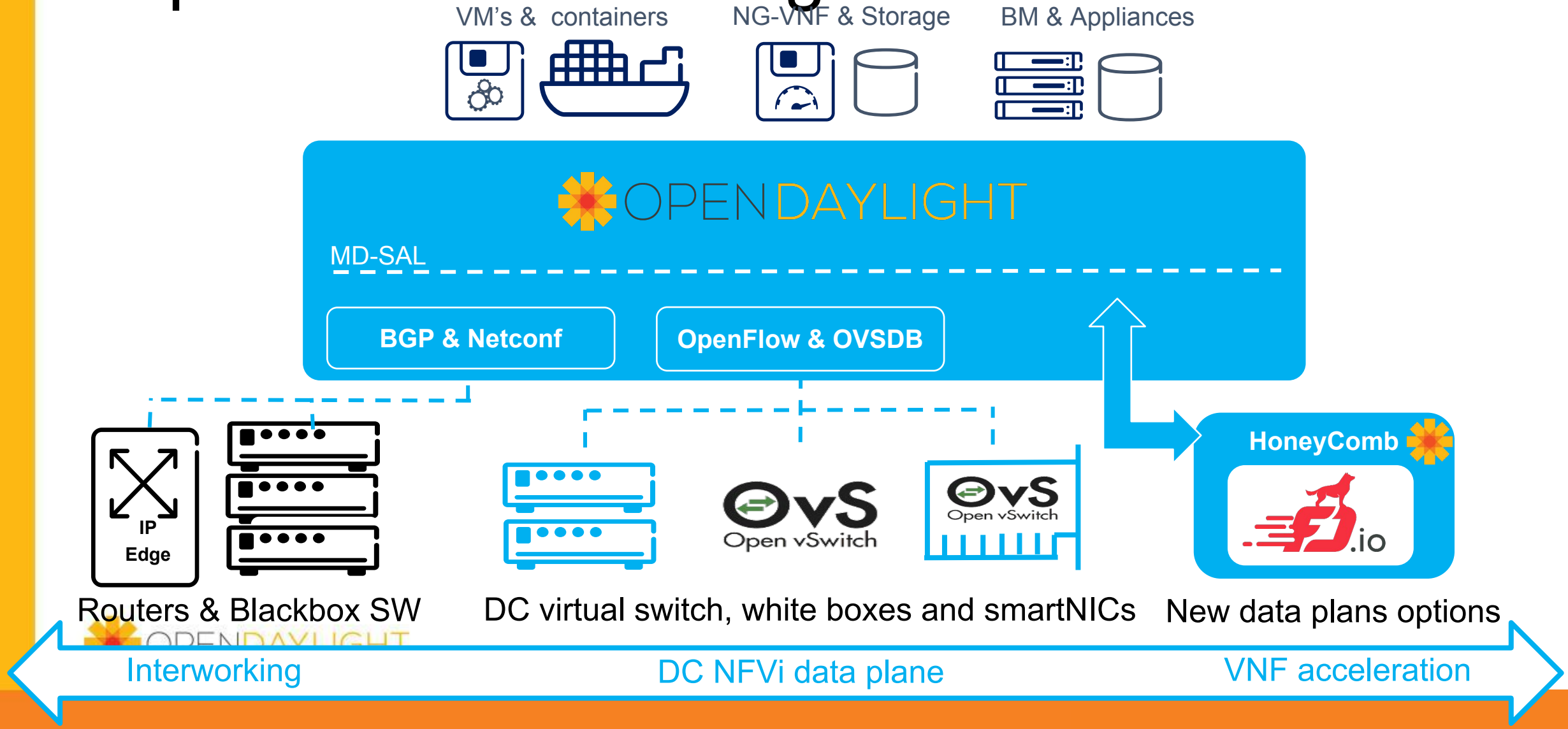
Policy Driven Service Chaining



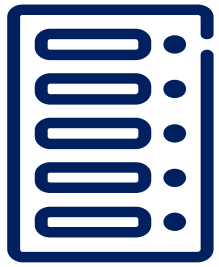
Virtual CPE: Site to Site Connectivity



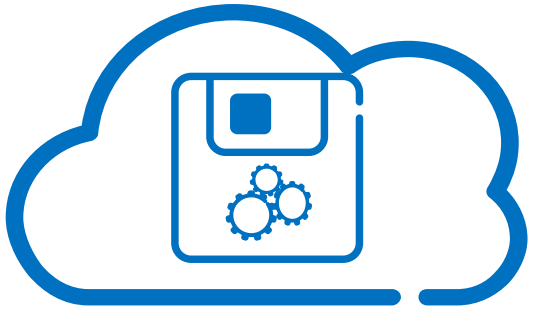
Open Data Plane Integration



Complementary Technologies – Coexistence Required



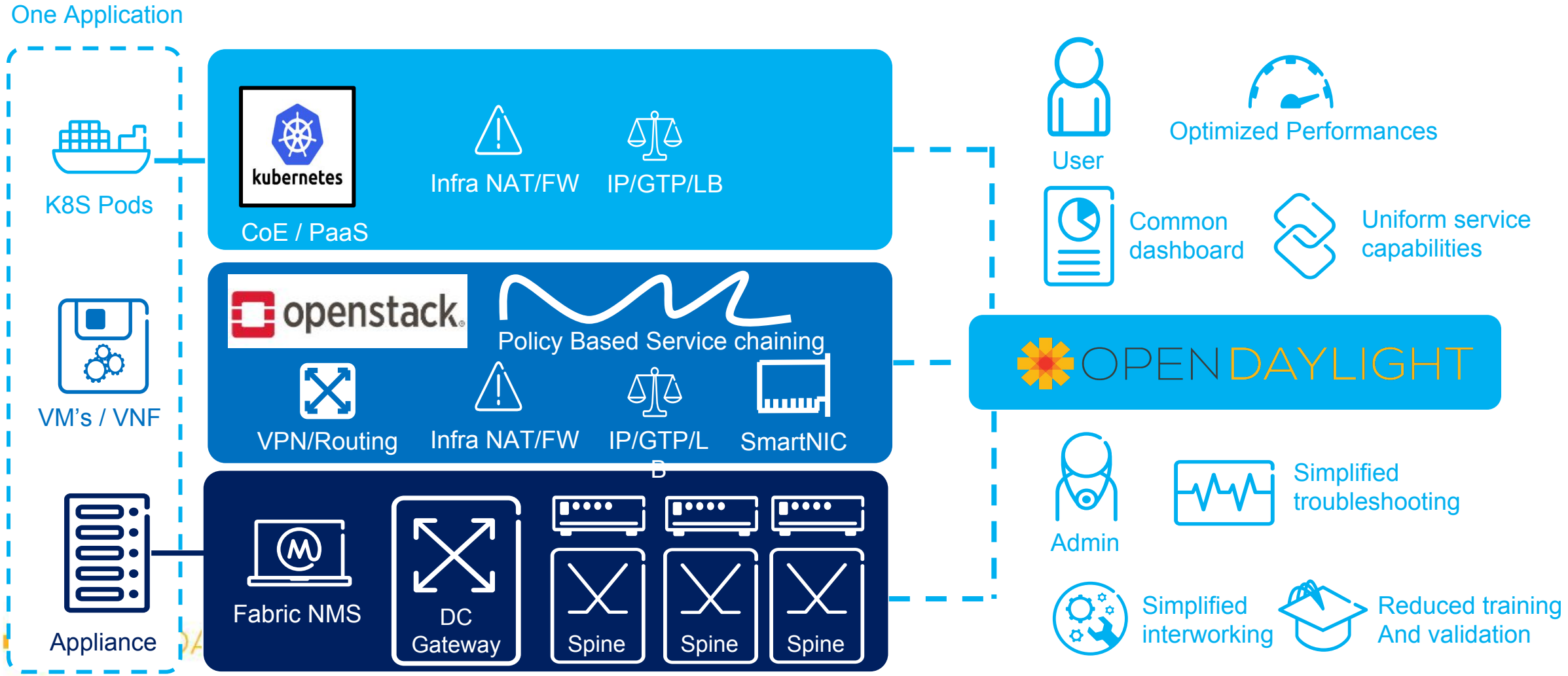
- Legacy Appliances
- SRIOV VNF
- Extreme performance
  - HW assisted
  - Specific HW/interfaces (e.g access GPON/Radio)



- Ease for legacy software (full stack bundling)
- Good performances
  - Multi-tenant VM optimized vs fragmented
  - DPDK enabled

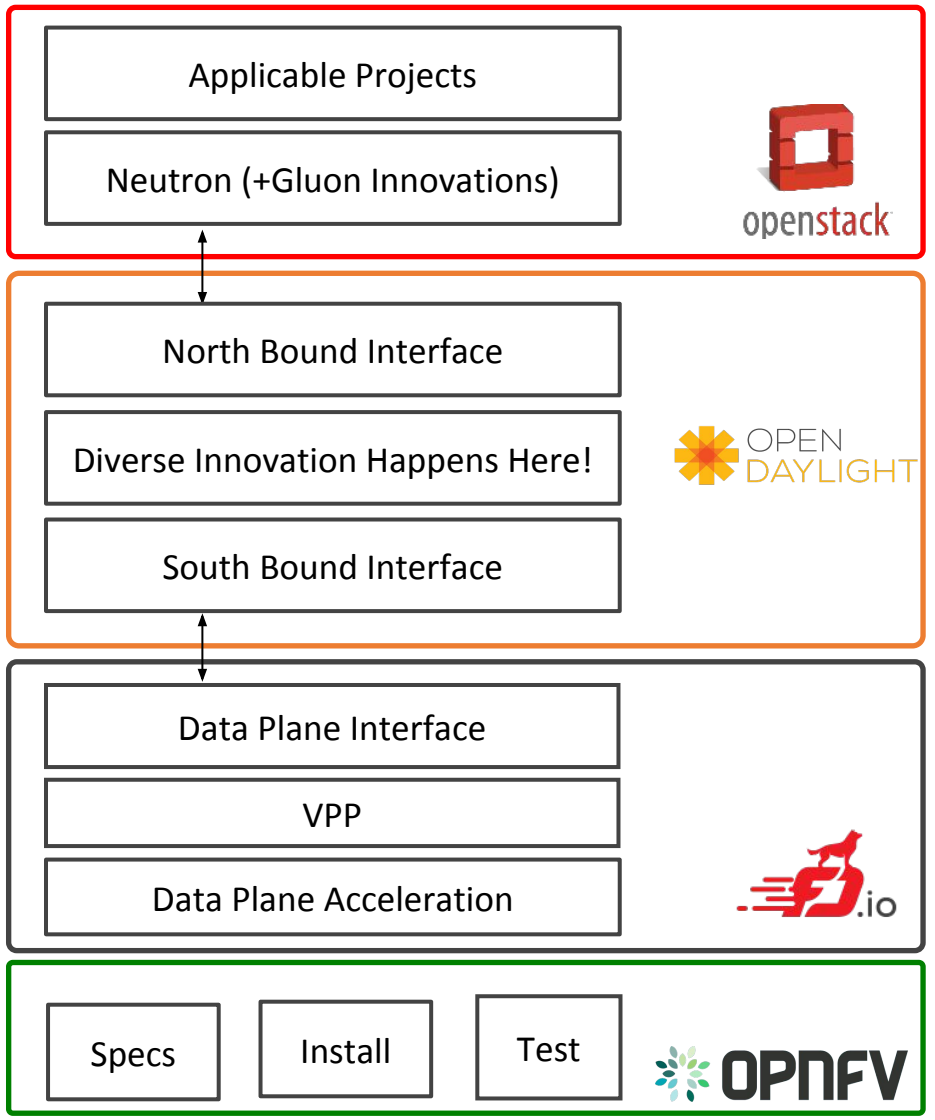
- Scalable multi-tenancy model for non multi-tenant software
- Best fit for cloud native software / PaaS optimized code

Issues with duplication of networking layers



“Nirvana” SDN Stack

- Proposed Target Stack
  - OpenStack
  - OpenDaylight
  - FD.io
- Integration
  - OPNFV



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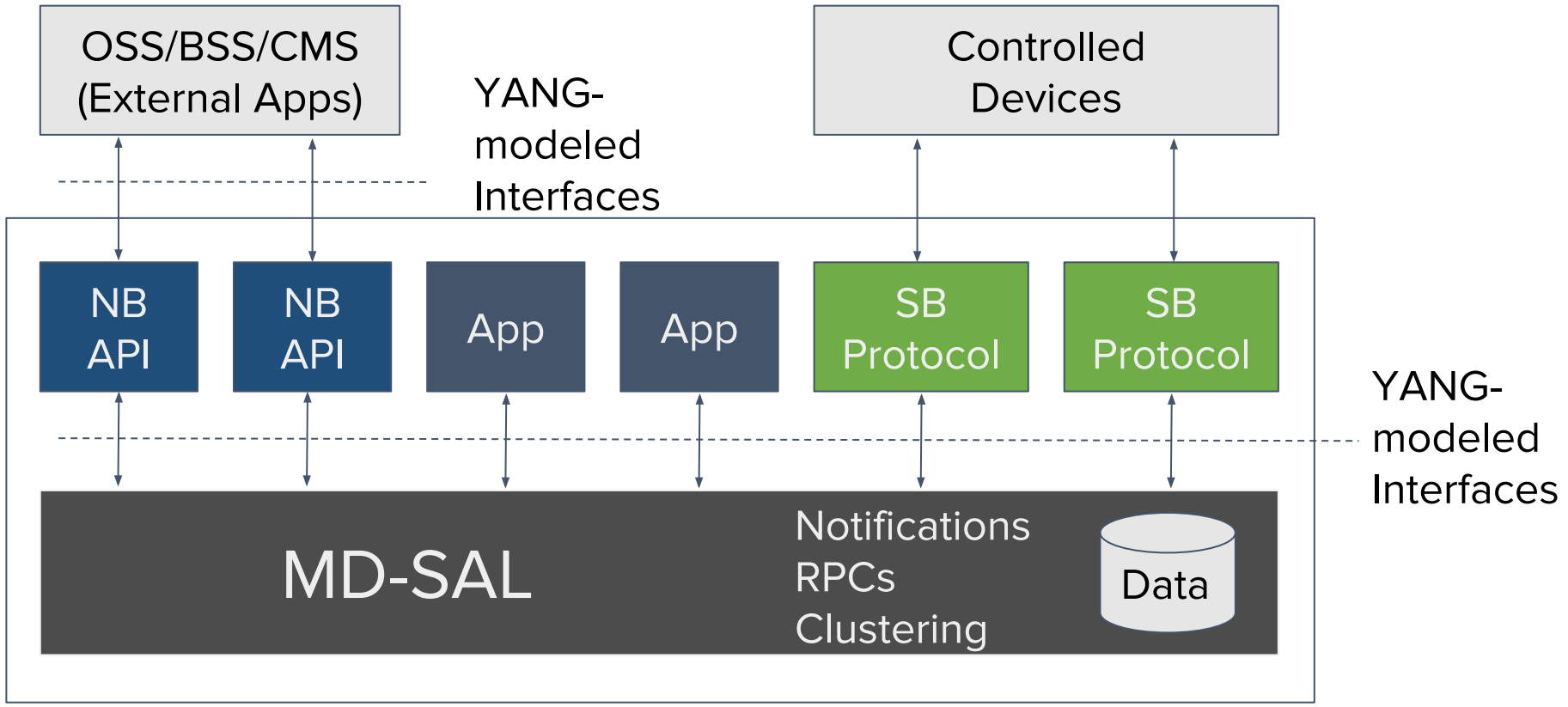
Courtesy: Slide from AT&T’s presentation on Nirvana Stack in OpenDaylight summit 2016

What is OpenDaylight?

- Open Source SDN Controller Platform hosted by the Linux Foundation
- ~4 Years Old
- Mature, Open Governance
- Mature code base
- ~1000 Individual Contributors from ~140 organizations
- Dozens of OpenDaylight-based solutions
- Over 100 deployments

OpenDaylight: a YANG-Based Microservices Platform

- Based on Model-Driven Service Abstraction Layer (MD-SAL)
- YANG (RFC 6020)
- Data Modeling Language for NETCONF
- Creates well-defined APIs
- Java and RESTCONF APIs auto-generated from YANG



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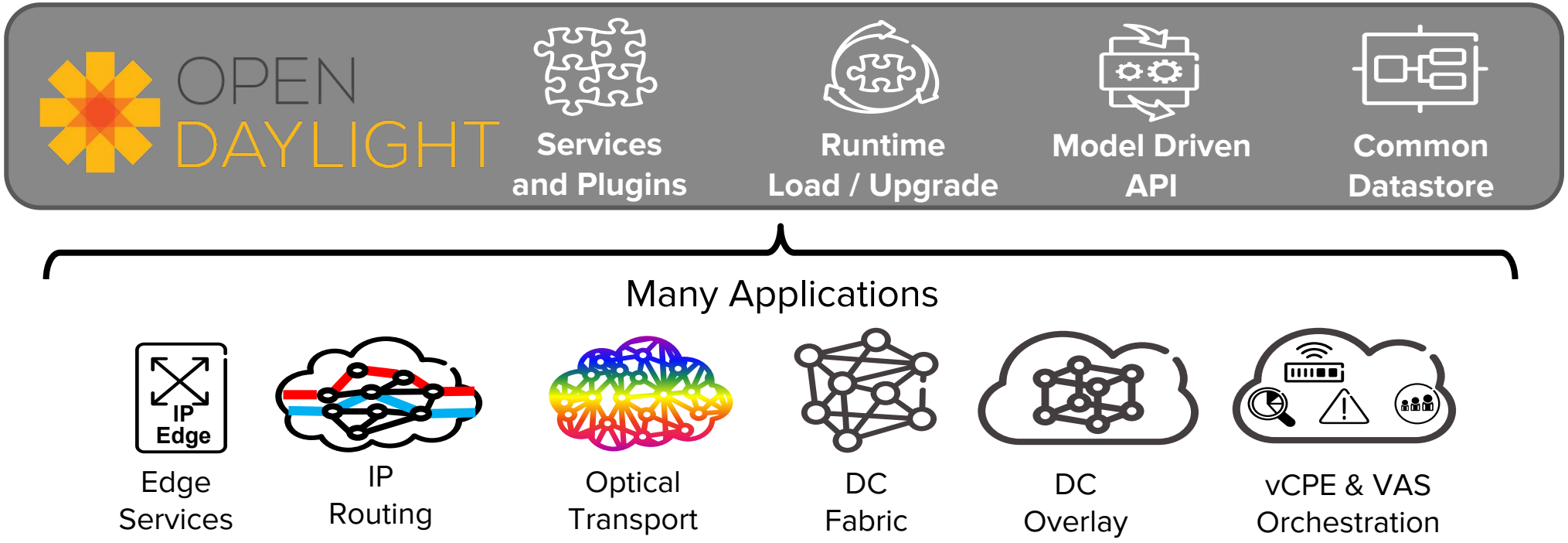
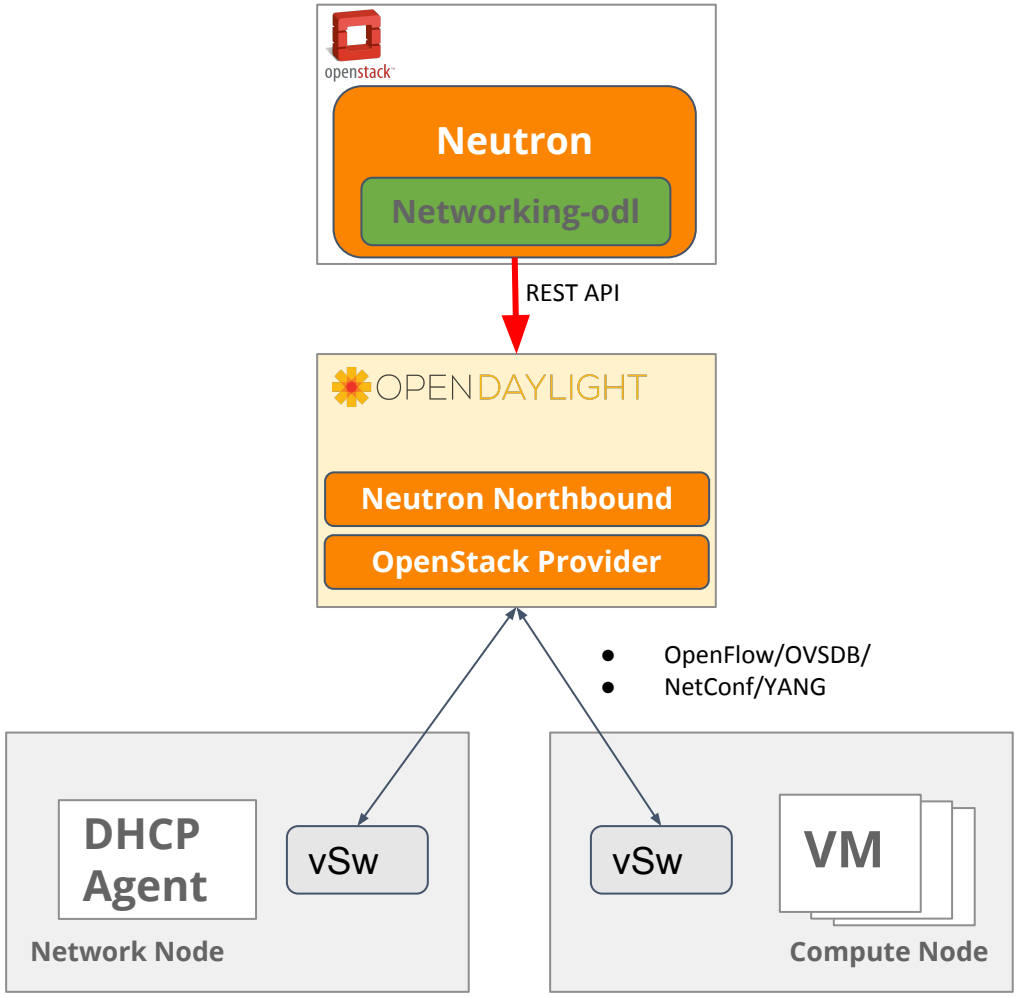
Wide Range of Applications



OpenStack and OpenDaylight Integration

- OpenDaylight provides OpenStack tenant virtual networking services
- Integrated through Neutron ***networking-odl*** driver



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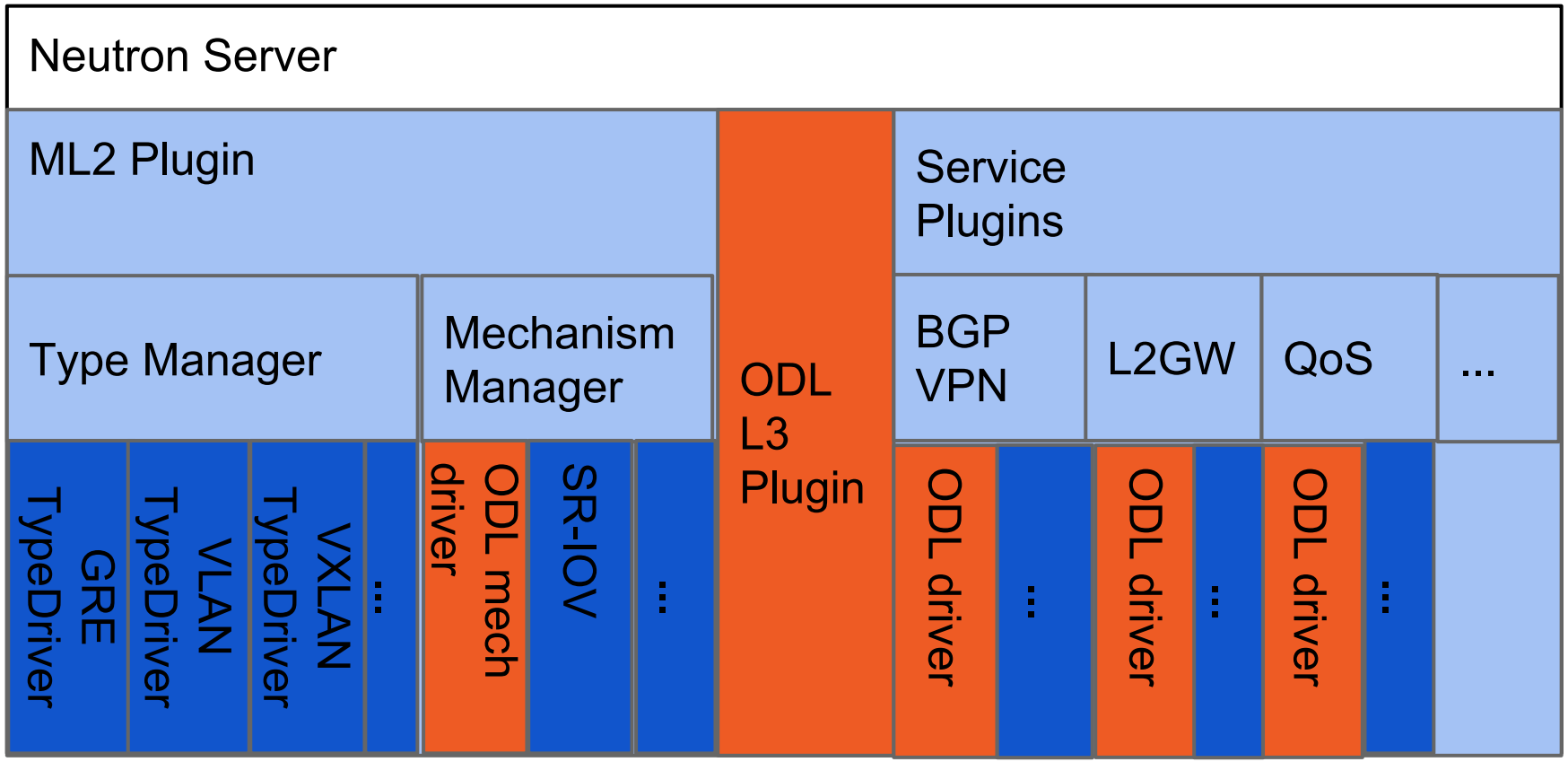
Networking-odl Driver

- L2: ML2 Plugin
- L3: ODL L3 Plugin
- Services
  - BGPVPN
  - L2GW
  - QoS
  - SFC
  - VLAN trunk
  - FWaaS
  - LBaaS



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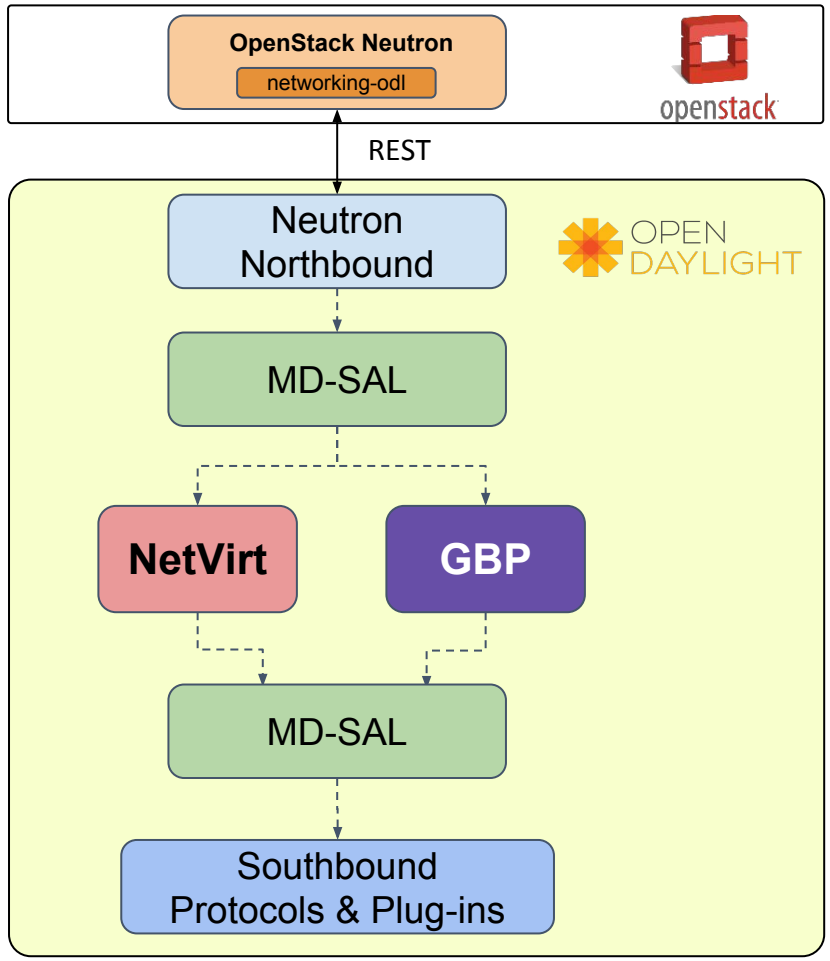
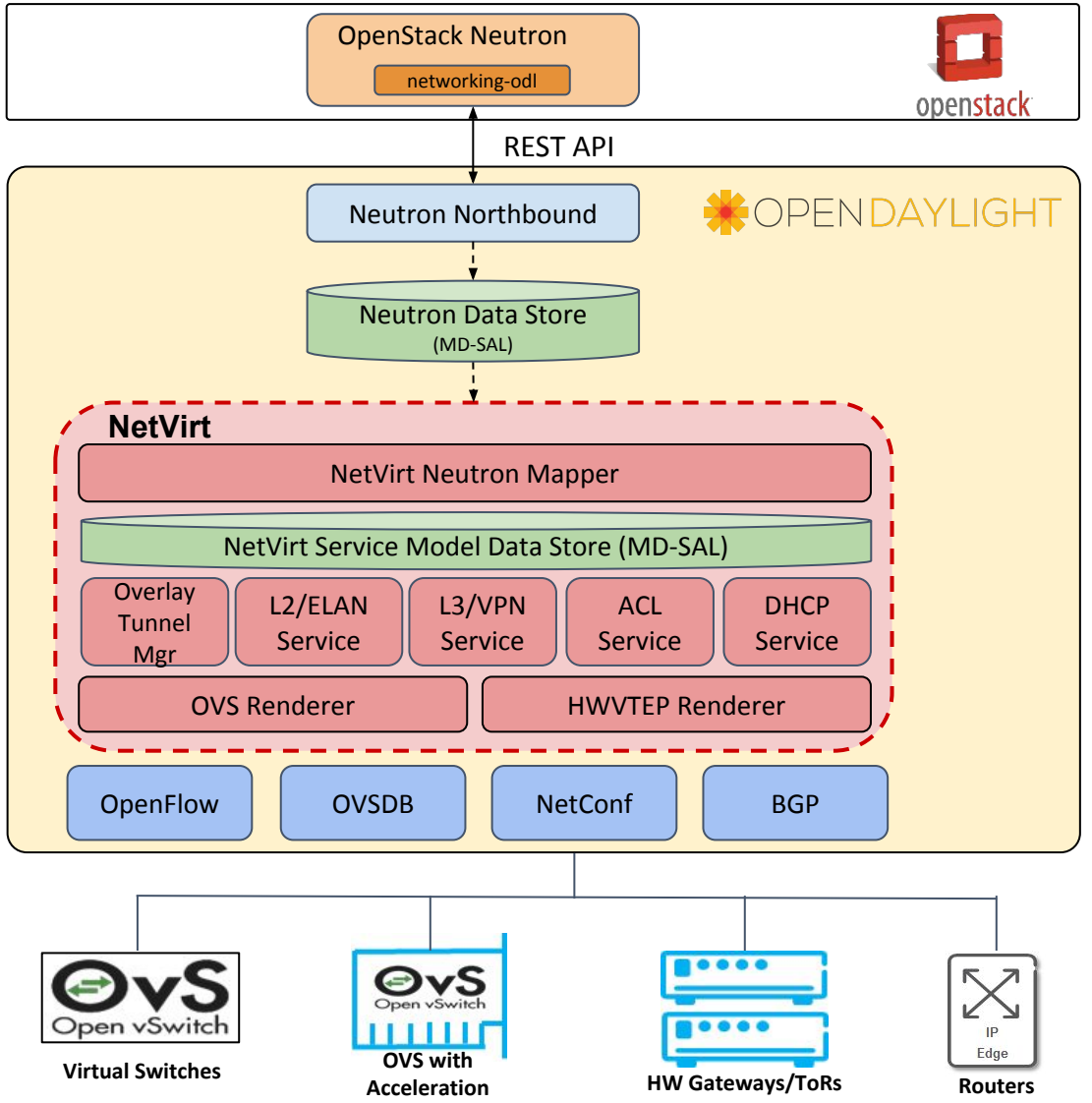
ODL Neutron Providers

- Single common northbound interface towards OpenStack
- Multiple implementations in ODL that can serve as Neutron providers
  - NetVirt
  - GBP (GroupBasedPolicy)



ODL NetVirt Solution

- One of the OpenStack service provider in OpenDaylight
- Translates NB constructs to forwarding plane agnostic service yang models
- Services: L2, L3, BGP L3VPN, EVPN, ACL, DHCP, QoS, SFC, IPv6, L2GW
- Supports OpenFlow and OVSDB based devices
- BGP to interwork with physical legacy routers



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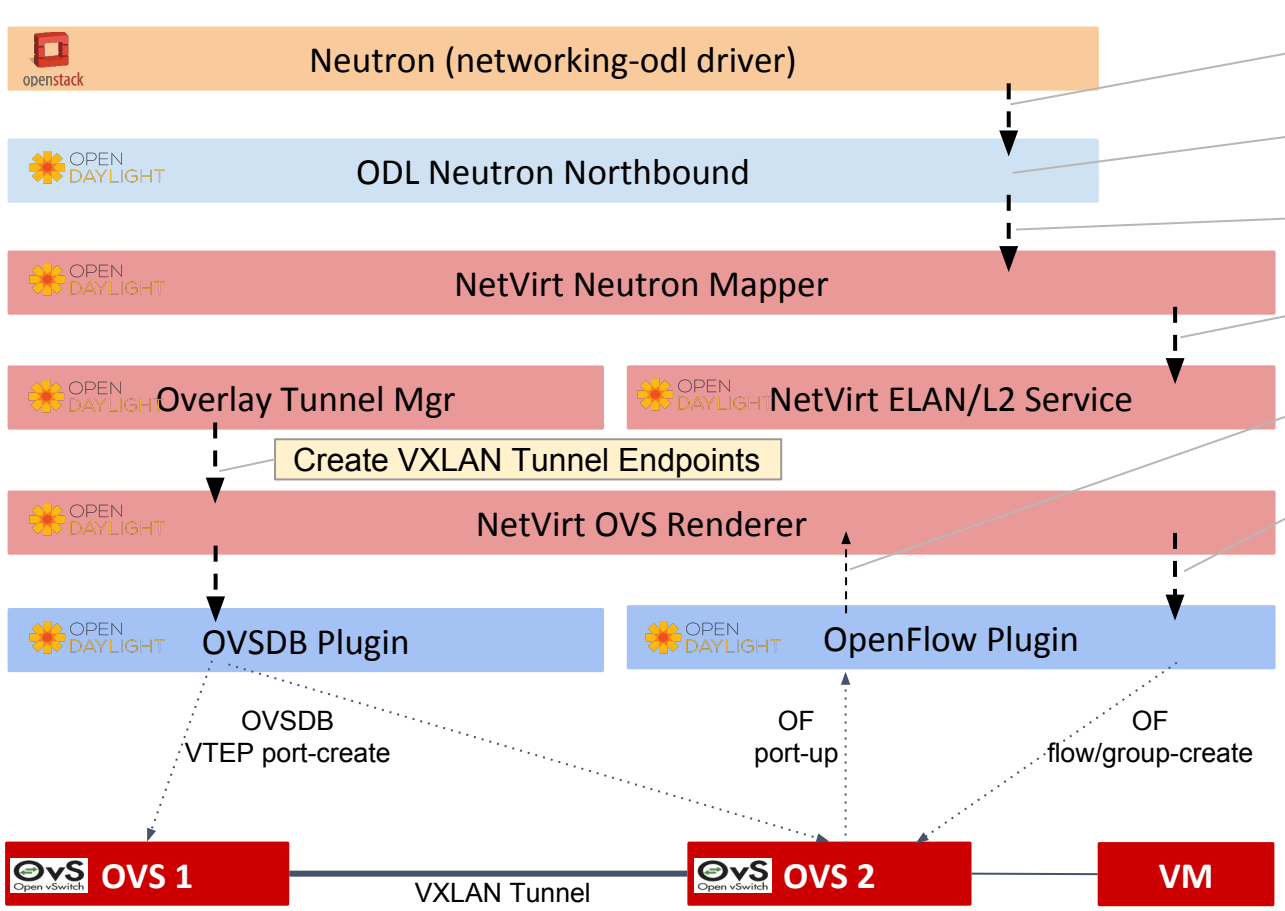
ODL NetVirt Solution



POST PORT
(id=<uuid>, vif_type=normal)

Update Port in Neutron MD-SAL store

NetVirt receives DCN (Data Change Notification) from MD-SAL

Map Neutron Port to NetVirt ELAN data model (ELANInterface)

Receive OpenFlow PORT_UP notification for Port <uuid> that provide the host information to which ELANinterface is bound

Program OpenFlow Flow rules to allow traffic from Port <uuid>

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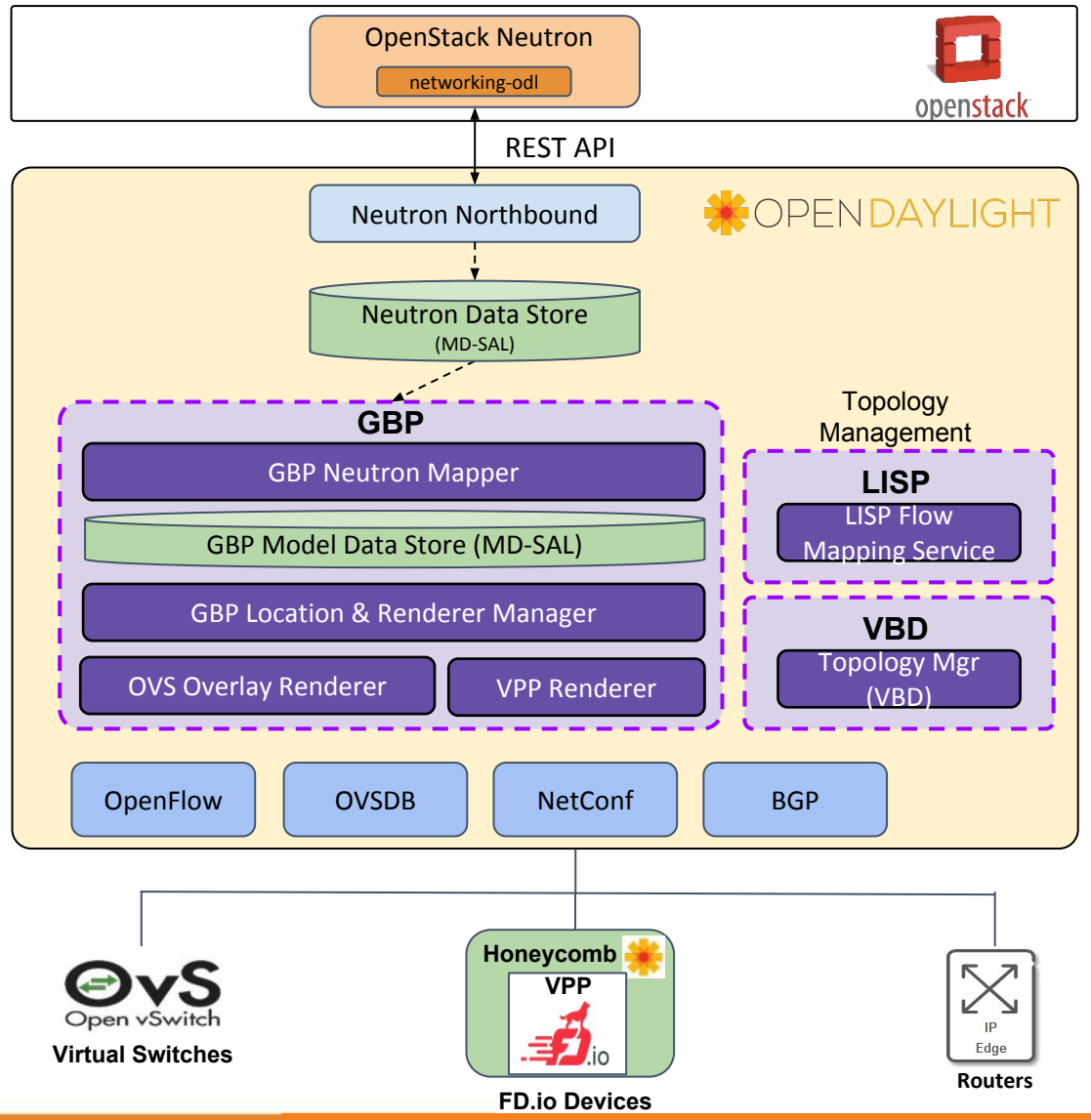
ODL GroupBasedPolicy (GBP) Solution

- Intent driven policy framework (control and forwarding policy) in OpenDaylight
  - Contract-based, policy-driven connectivity abstraction; generic endpoint identification
  - Generic northbound interface (adapter for Neutron-Northbound available)
  - Flexible southbound interfaces supported:
    - NetConf/YANG (for FD.io/VPP)
    - OF/OVSDB (for OVS)

- Services: Access-control policies (“ACLs”), Forwarding policies (“L2VPN/ELAN”, “L3VPN”)



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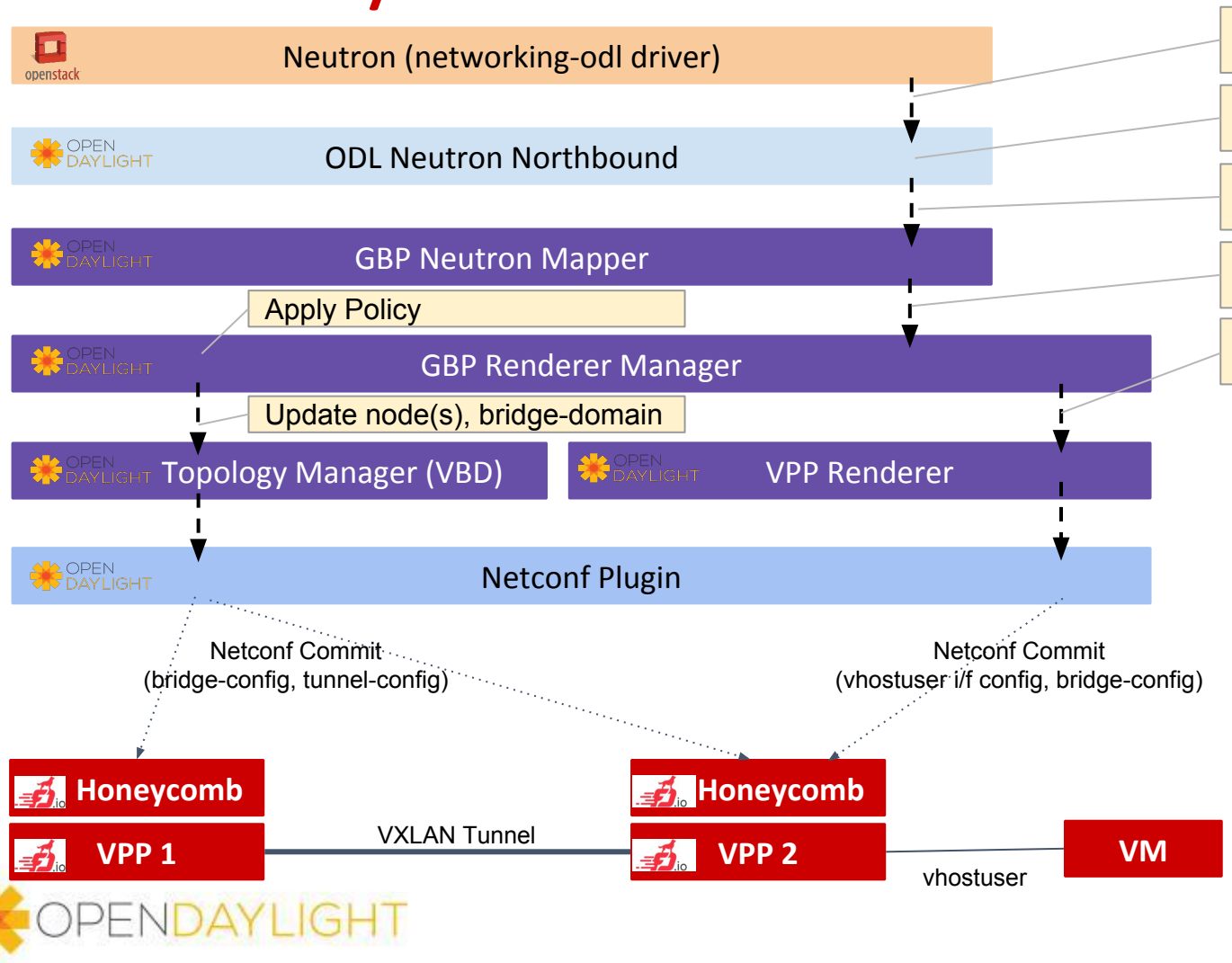
ODL GBP/VBD Solution



POST PORT
(id=<uuid>, host_id=vpp2, vif_type=vhostuser)

Update Port in Neutron MD-SAL store

GBP receives DCN (Data Change Notification) from MD-SAL

Map Neutron Port to GBP Endpoint

Update device end point

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Need for an Integrated Control solution

What we have

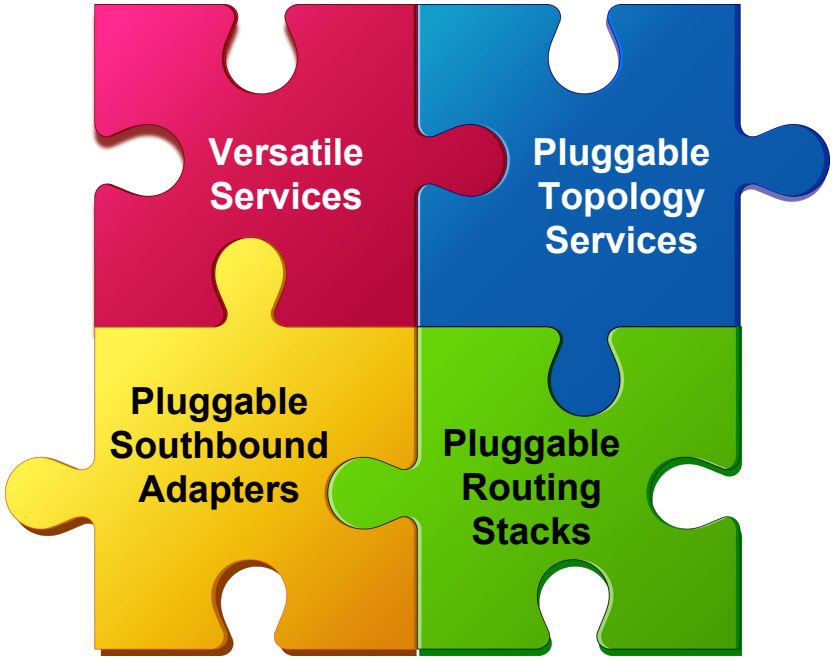
- OpenDaylight NetVirt and GBP are both network control solutions, each with its own strengths
- Both intended to support multiple northbound APIs and diverse set of southbound protocols & devices
- Two communities focused on two different applications with the same goals.

What we want

- ***ODL Nirvana***: Single network control solution in OpenDaylight
- Provide rich set of common control services
- Provide broad support for different southbound forwarders (OVS, VPP, Hardware,...)
- Single Community that moves as one team with one direction

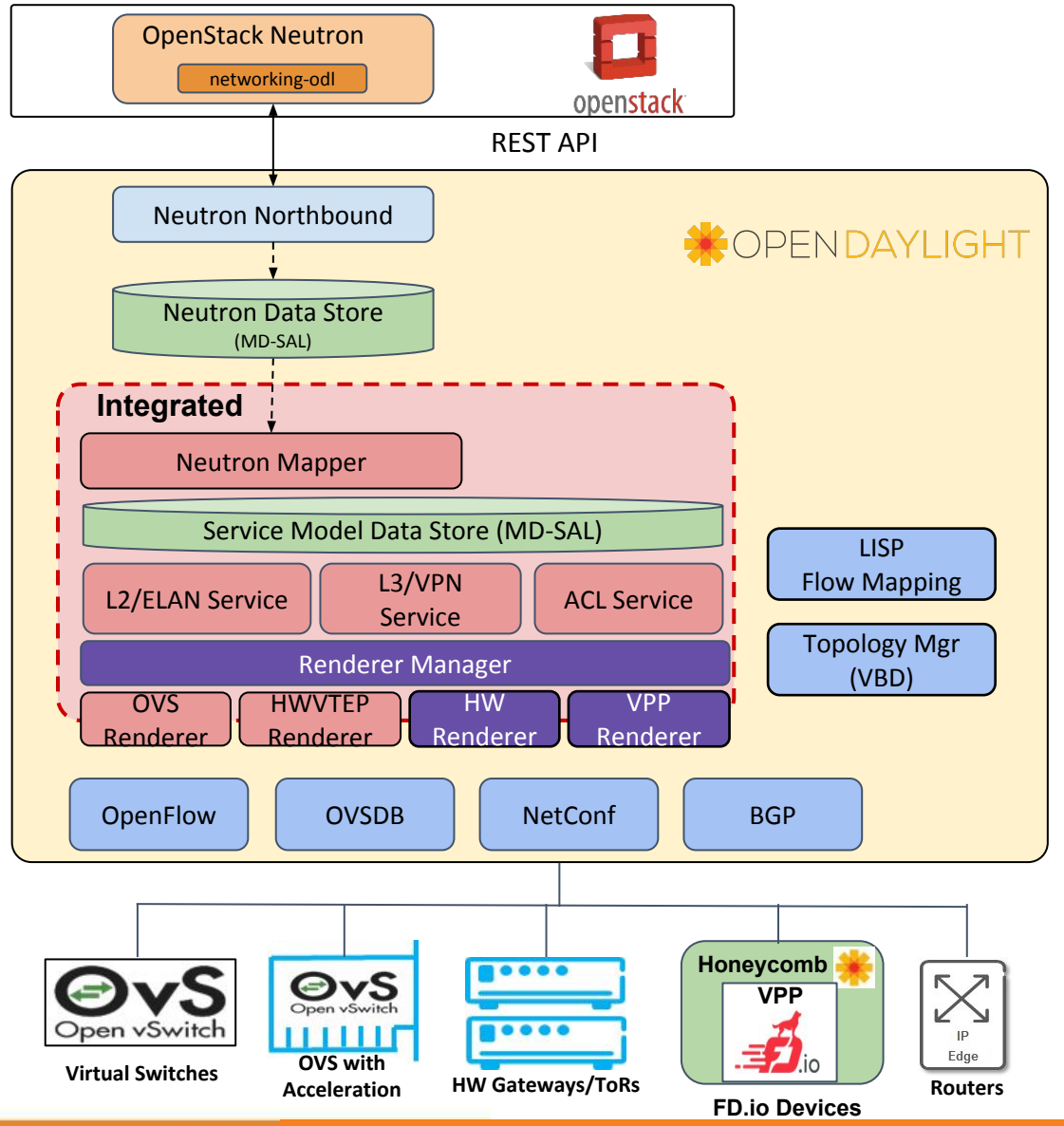
Integrated Approach

- Pluggable & Modular Architecture
  - Services decoupled from forwarding technology
    - Comprehensive set of Services (leverage NetVirt)
    - Modular and pluggable southbound adapters (leverage GBP)
  - BGP routing stacks: ODL BGP, Quagga, ..
  - Topology service: LISP, VBD, ..
- Model-driven northbound API



ODL Integrated Control Solution (PoC)

- ***Nirvana Stack Approach***:
  Integrated Control solution in OpenDaylight
- Services: L2, L3, BGP L3VPN, EVPN, ACL, DHCP, QoS, SFC, IPv6, L2GW
- Diverse set of forwarders: OpenFlow and OVSDB based devices, Netconf based devices (FD.io)
- BGP and Netconf to interwork with physical routers/switches



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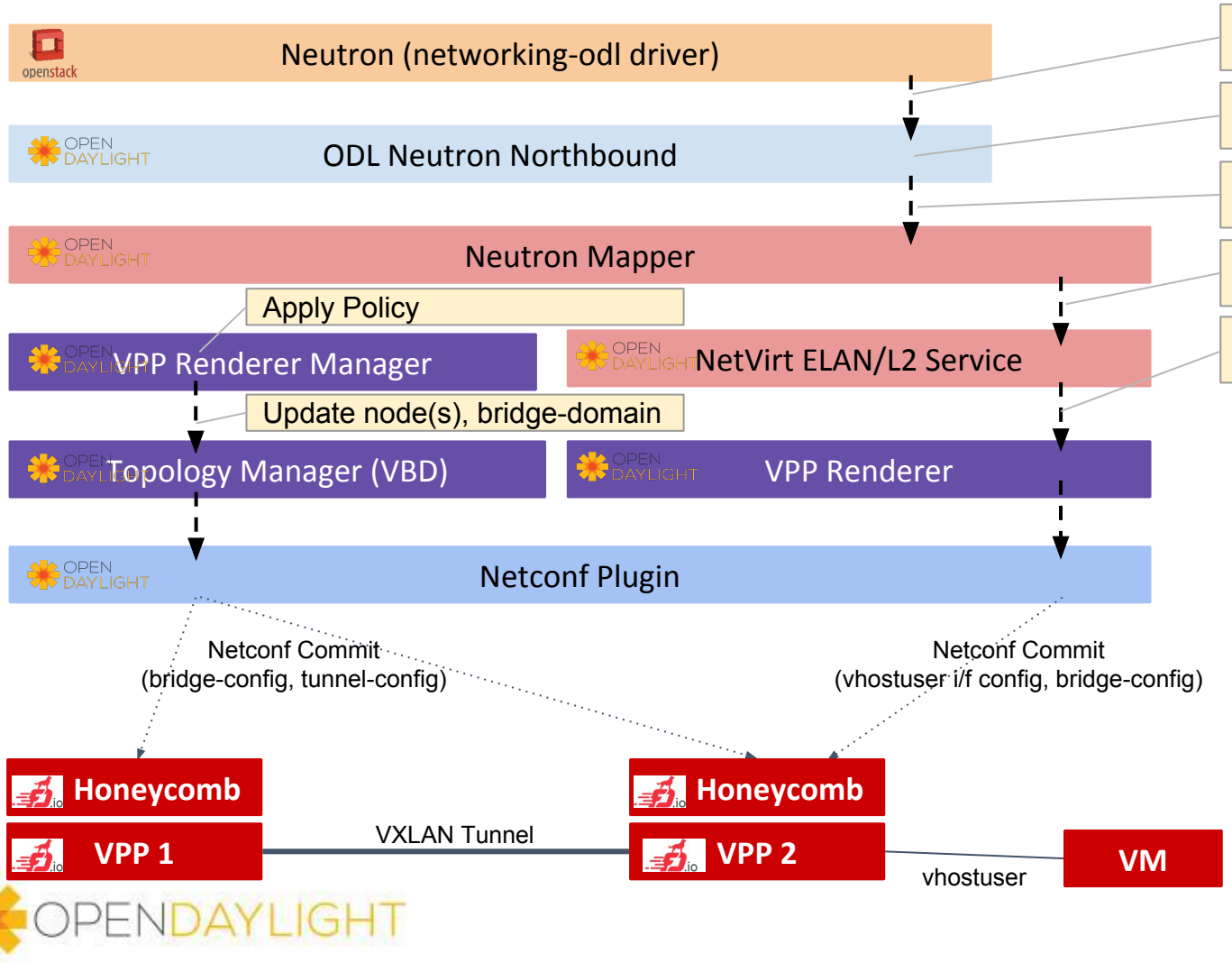
ODL Integrated Solution:
PoC: ELAN service with FD.io/VPP



POST PORT
(id=<uuid>, host_id=vpp2, vif_type=vhostuser)

Update Port in Neutron MD-SAL store

Data Change Notification(DCN) from MD-SAL

Map Neutron Port to NetVirt ELAN data model (ELANInterface)

If **interface is on a netconf node** and **is of type vhostuser**, Configure bridge-domains and vhostuser interface

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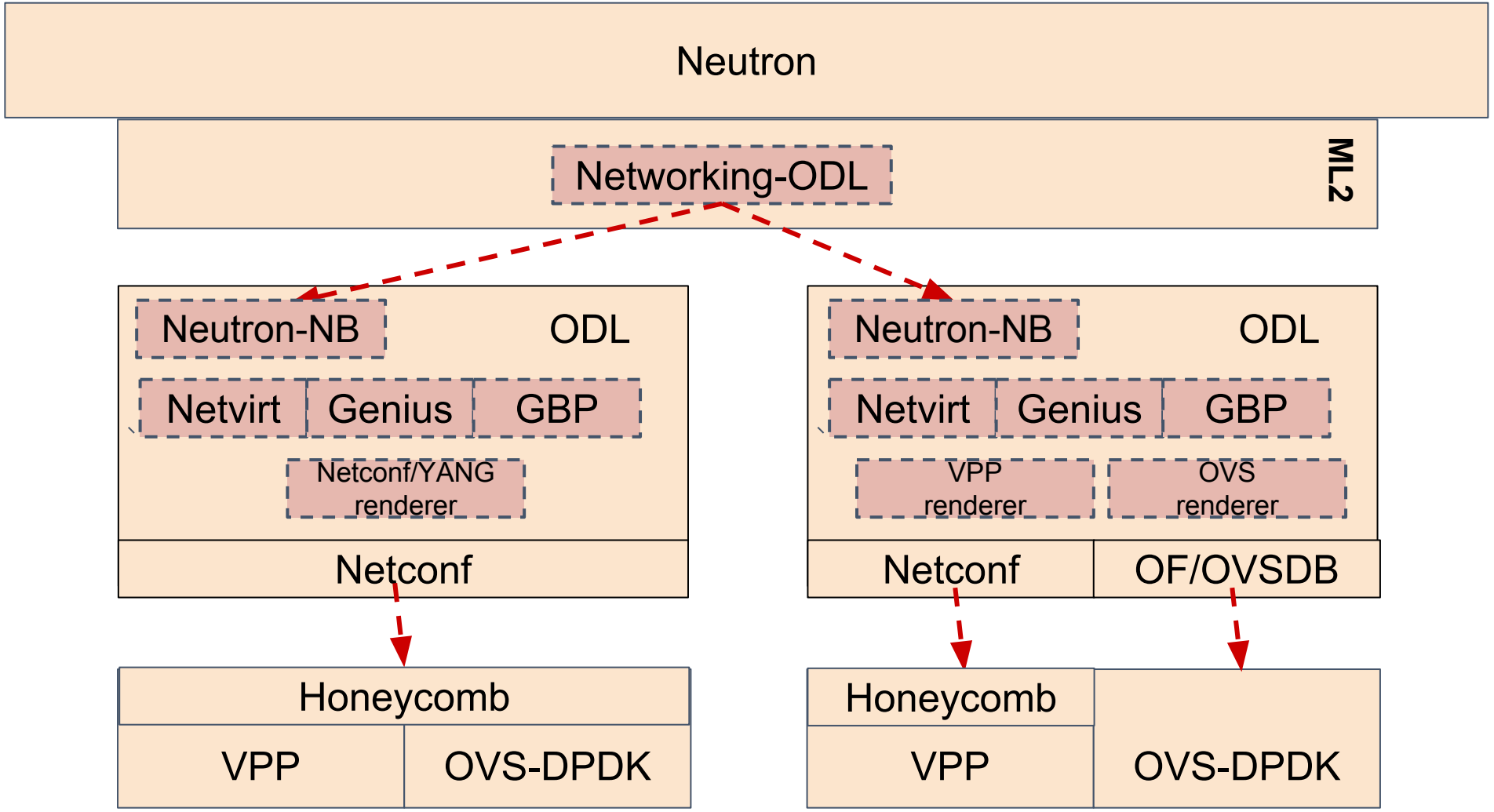
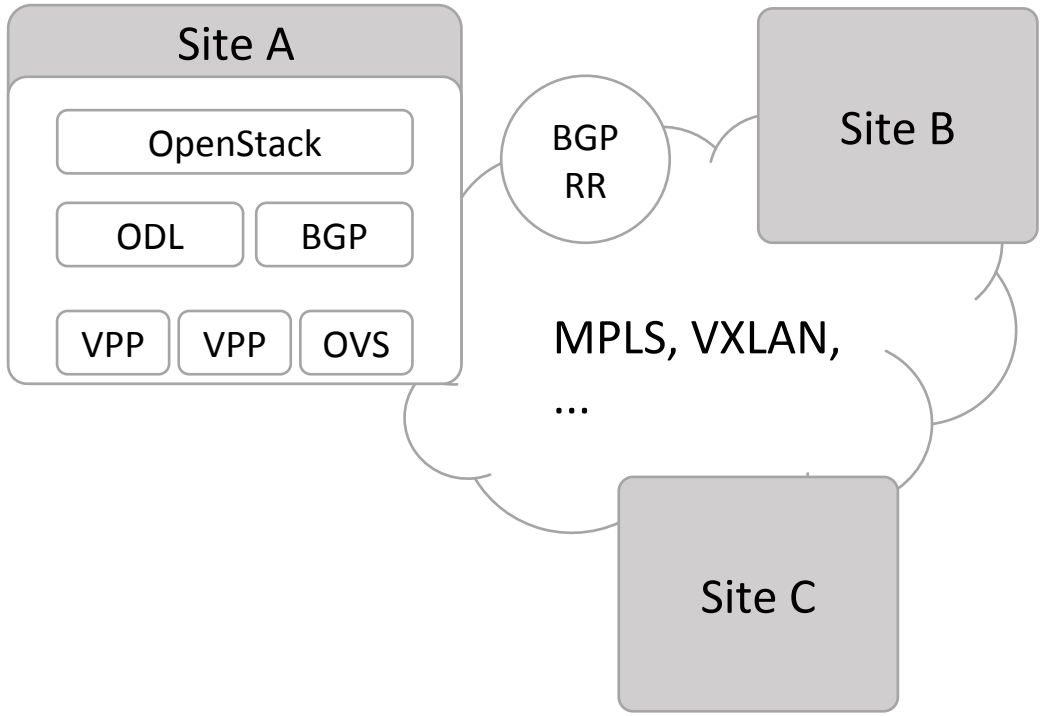
Stack Evolution Discussion: Options for integrating different data-planes



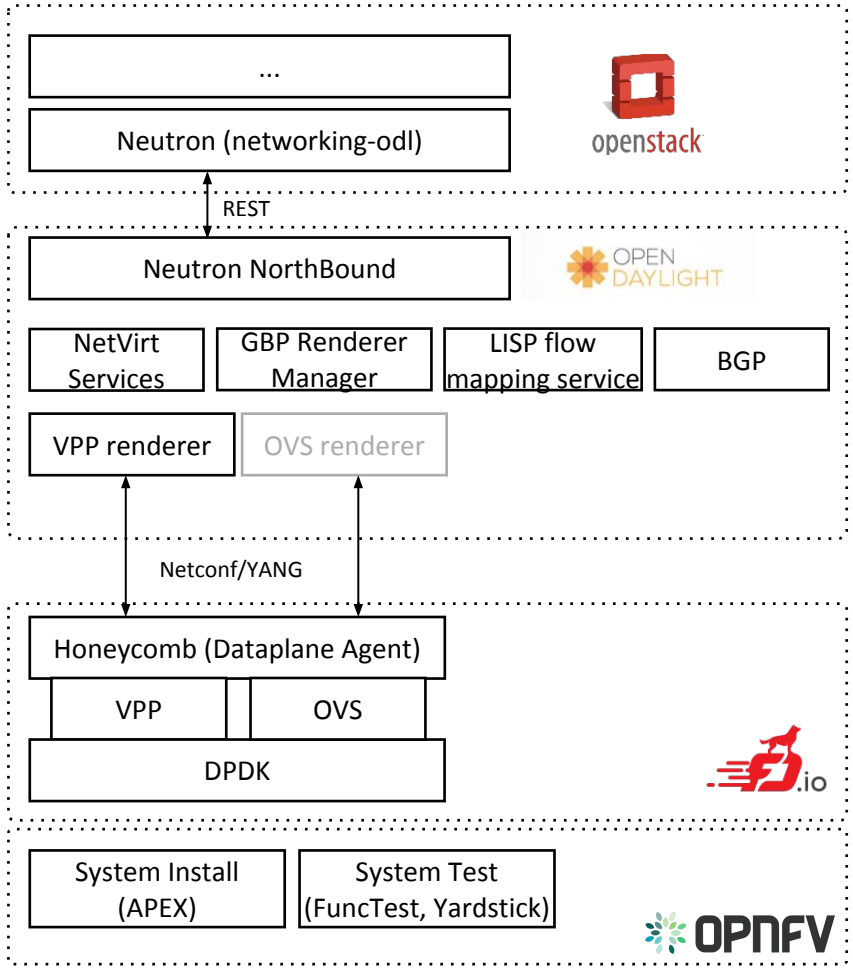
Stack Evolution Discussion: Towards L3VPN with a Nirvana Stack approach

- Sites interconnected via flexible tunnel technology (MPLS, MPLSoGRE, VXLAN,...) for “north-south” traffic
  - MP-BGP for routing per VRF
- Individual sites to implement fully distributed routing (i.e. DVR)
  - Every forwarder serves as a L3-router
- Converged Network Control solution
  - ODL GroupBasedPolicy + ODL NetVirt
  - Pluggable BGP stack (e.g. ODL BGP) – integrated or associated with Controller
  - Support for multiple forwarders (SW + HW), incl. FD.io/VPP

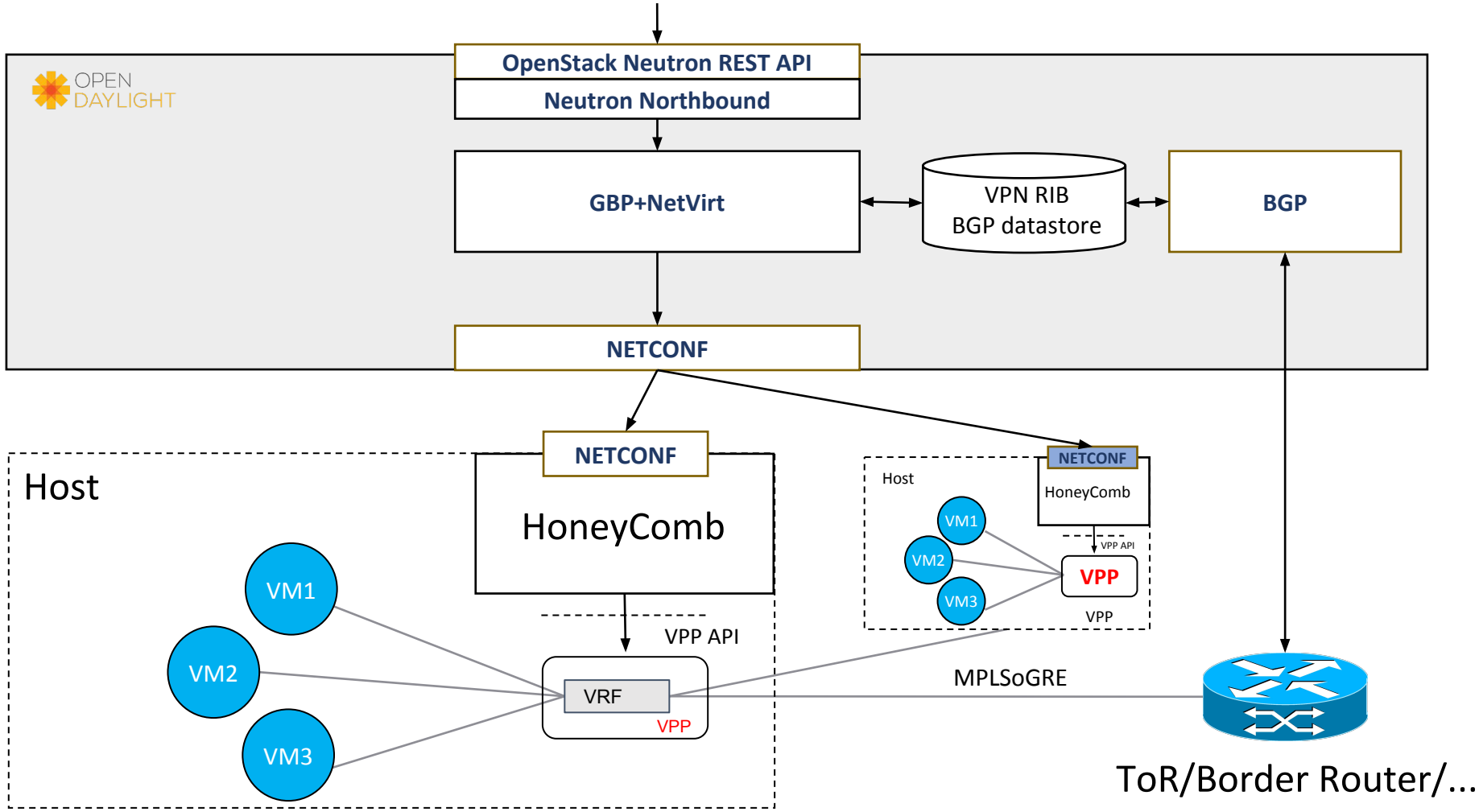


Towards L3VPN with a Nirvana Stack approach: Stack Composition

- Converged Network Control Solution
  - ODL NetVirt Service Control
  - ODL BGP stack (inter-DC traffic)
  - ODL GBP for forwarder control
  - ODL LISP flow mapping service (intra-DC traffic)
- Converged Dataplane Control
  - HoneyComb for VPP, OVS control
  - Netconf/YANG as Dataplane management protocol
- OPNFV for automated system installation and testing
  - APEX (TripleO) installer



Stack Evolution: L3VPN with BGP and MPLS



More Information

- OpenDaylight ***"Nirvana"*** stack proof-of-concept
  - https://git.opendaylight.org/gerrit/#/c/50259/
  - https://git.opendaylight.org/gerrit/#/c/53632/
  - https://git.opendaylight.org/gerrit/#/c/48962/

- Weekly Community Meeting: Every Wednesday 7AM pacific

Thank You