



Defining SDN

Overview of SDN Terminology & Concepts

Presented by:

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Panelist:

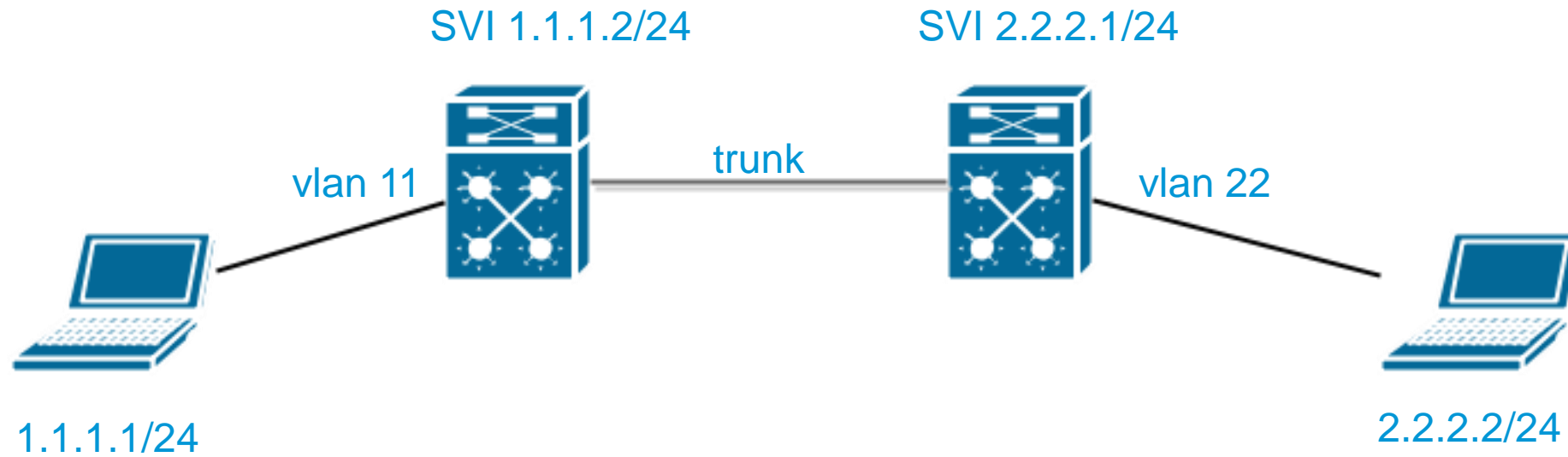
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Jan 2014

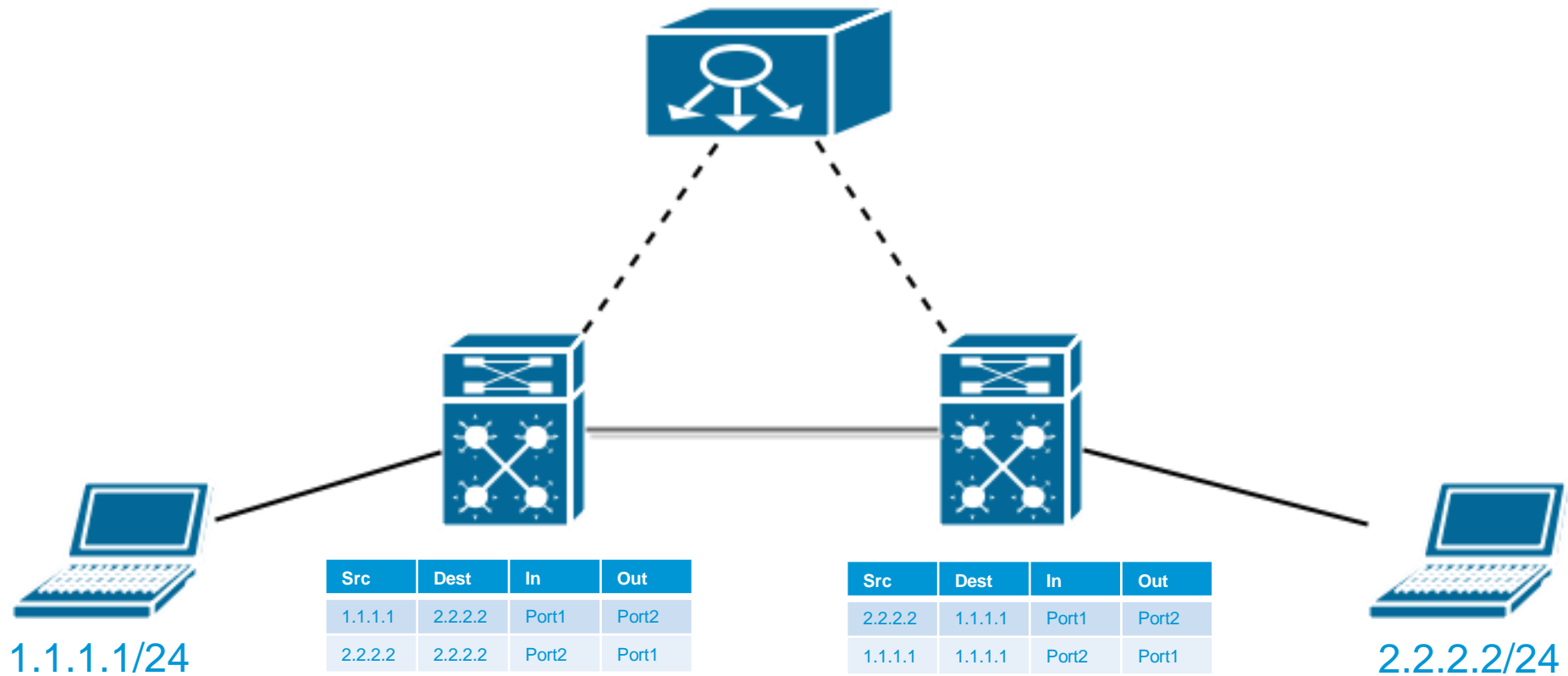
What is SDN?



Before we start...



Before we start...



“A way to optimize link utilization in my network enhanced, application driven routing”

“An open solution for customized flow forwarding control in and between Data Centers”

“A platform for developing new control planes”

“An open solution for VM mobility in the Data-Center”

“A solution to automated network configuration and control”

“Develop solutions at software speeds: I don’t want to work with my network vendor or go through lengthy standardization.”

“A way to reduce the CAPEX of my network and leverage commodity switches”

“A means to get assured quality of experience for my cloud service offerings”

“A solution to build a very large scale layer-2 network”

“A means to do traffic engineering without MPLS”

“A solution to build virtual topologies with optimum multicast forwarding behavior”

Diverse Drivers **Common Concepts** Different Execution Paths

“A means to scale my fixed/mobile gateways and optimize their placement”

“A way to optimize broadcast TV delivery by optimizing cache placement and cache selection”

“A way to build my own security/encryption solution”

“A way to scale my firewalls and load balancers”

“A way to distribute policy/intent, e.g. for DDoS prevention, in the network”

“A way to configure my entire network as a whole rather than individual devices”

“A solution to get a global view of the network – topology and state”

Traditional SDN Definition



“ ... In the SDN architecture, the control and data planes are decoupled, network intelligence and state are logically centralized, and the underlying network infrastructure is abstracted from the applications ... ”

<https://www.opennetworking.org/images/stories/downloads/white-papers/wp-sdn-newnorm.pdf>



“ ... open standard that enables researchers to run experimental protocols in campus networks. Provides standard hook for researchers to run experiments, without exposing internal working on vendor devices ... ”

<http://www.openflow.org/wp/learnmore/>

Traditional SDN Definition

Abstracted
OpenFlow **Decoupled**

... open standard that enables researchers to run experimental protocols in campus networks. Provides standard hook for researchers to run experiments, without exposing internal working on vendor devices ... “

<https://www.opennetworking.org/images/stories/downloads/white-papers/wp-sdn-newnorm.pdf>

Control Plane
Applications
Data Plane

... open standard that enables researchers to run experimental protocols in campus networks. Provides standard hook for researchers to run experiments, without exposing internal working on vendor devices ...

<http://www.openflow.org/wp/learnmore/>

Control and Data Plane

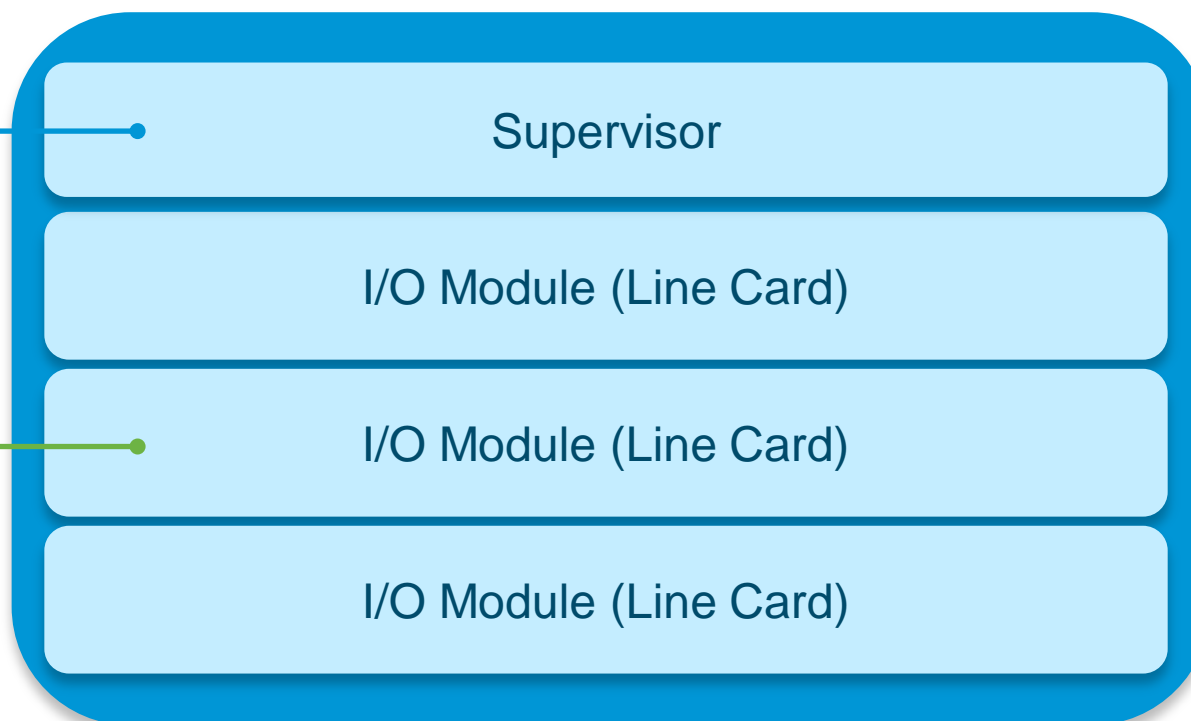
- Control plane and data plane components are typically* co-located on the same device

Control Plane:

Routing protocols (i.e. OSPF, IS-IS, BGP), Spanning Tree, SYSLOG, AAA (Authentication Authorization Accounting), CLI, SNMP

Data Plane:

L2/L3 switching, MPLS forwarding, VRF forwarding, QoS, Marking, Classification, Policing, ACLs

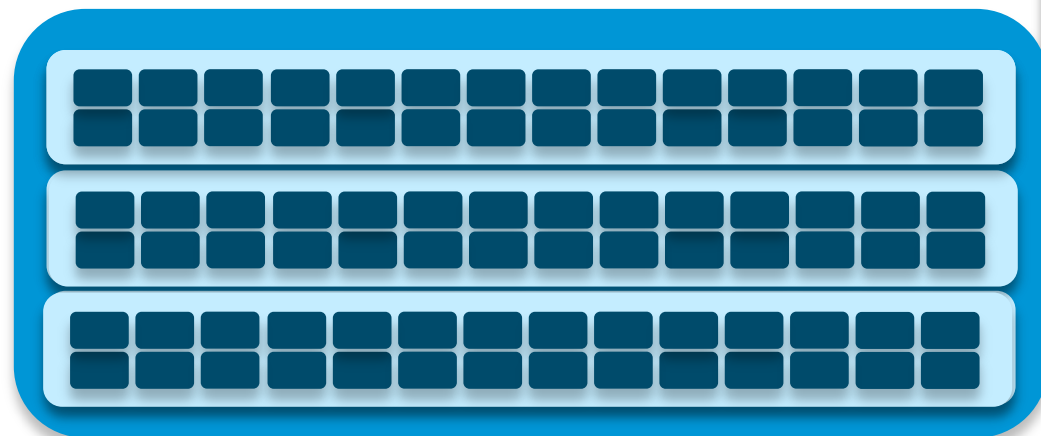


* Plenty of exceptions exist

Control and Data Plane Decoupled

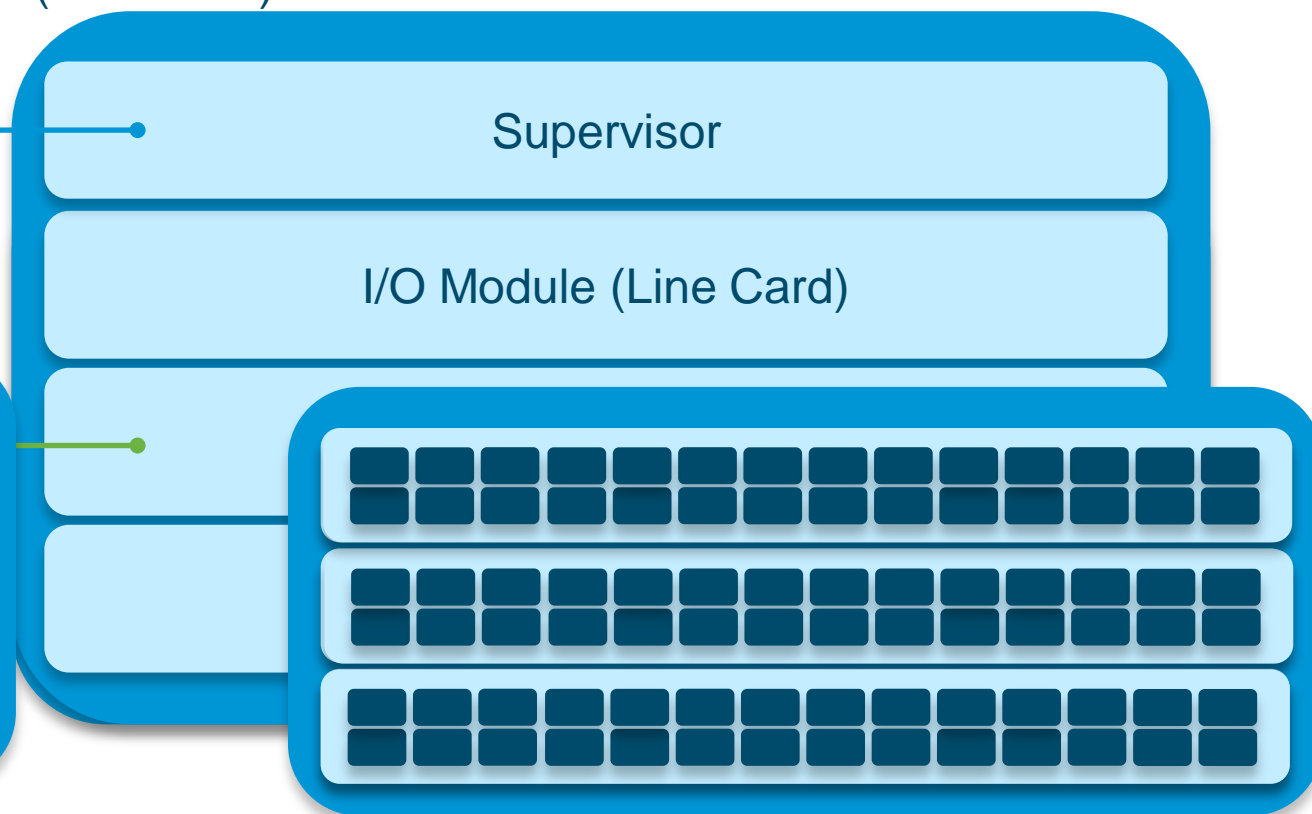
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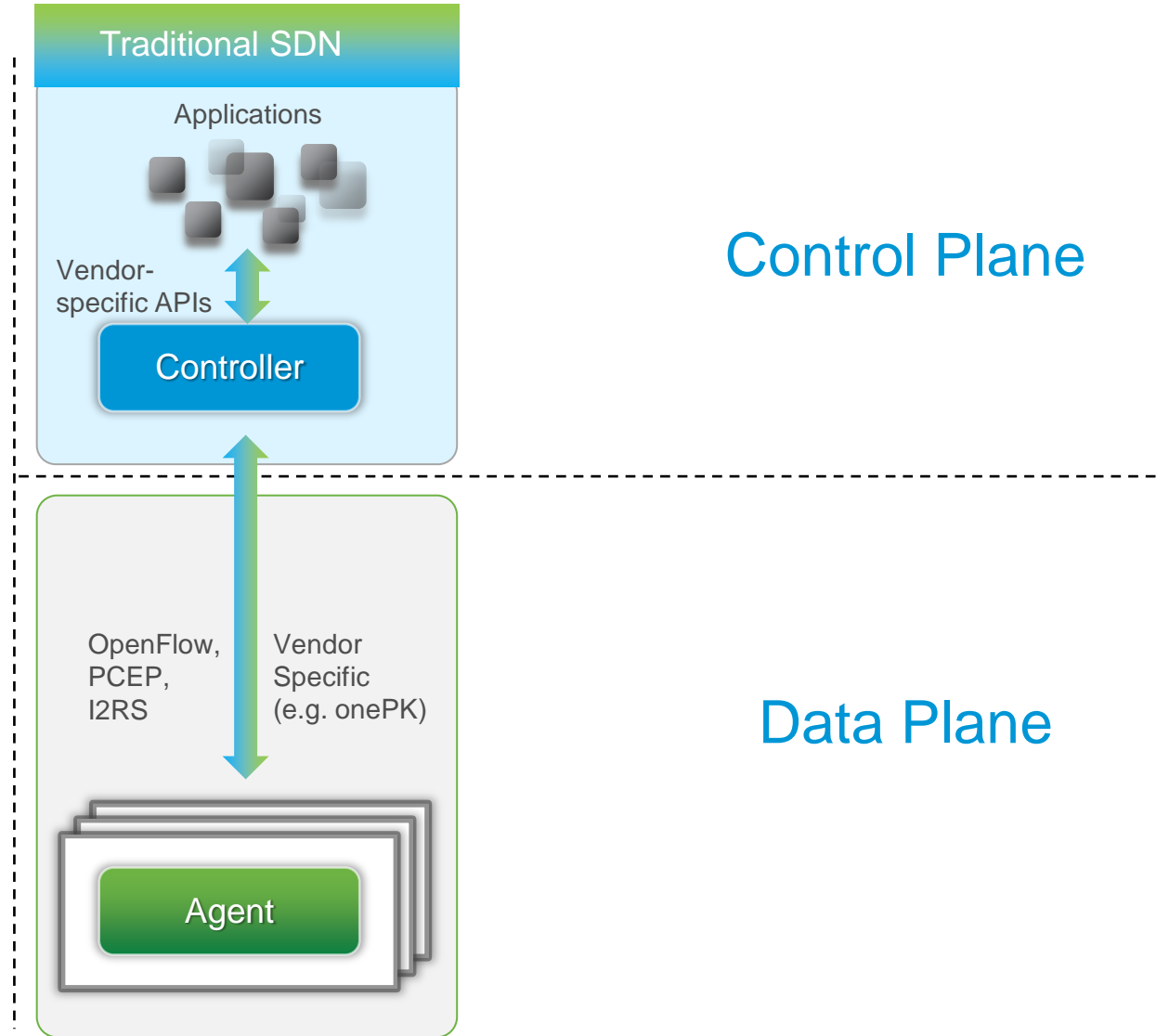


Network Element

“Intelligence & State”
(Controller)



Network Element



Controllers and Agents

- Some network delivered functionality benefits from logically centralized coordination across multiple network devices

Functionality typically domain, task or customer specific

Typically multiple Controller/Agent pairs are combined for a network solution

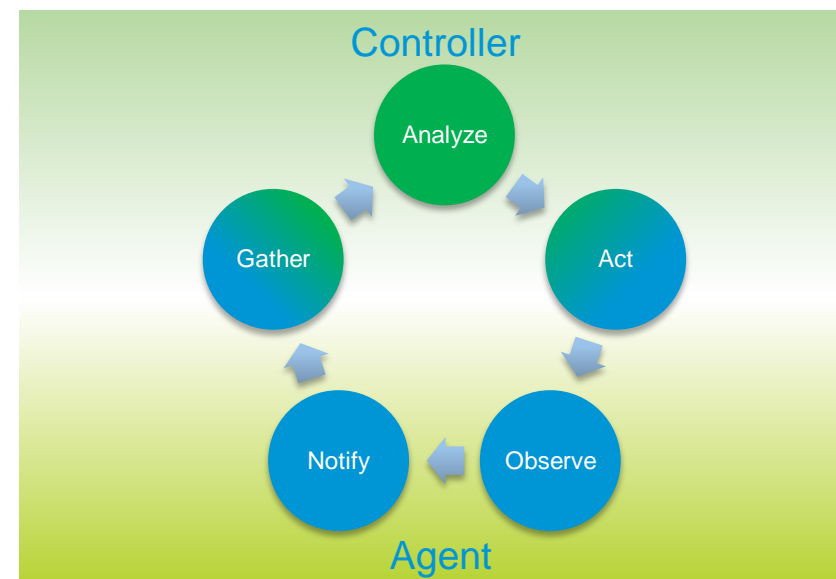
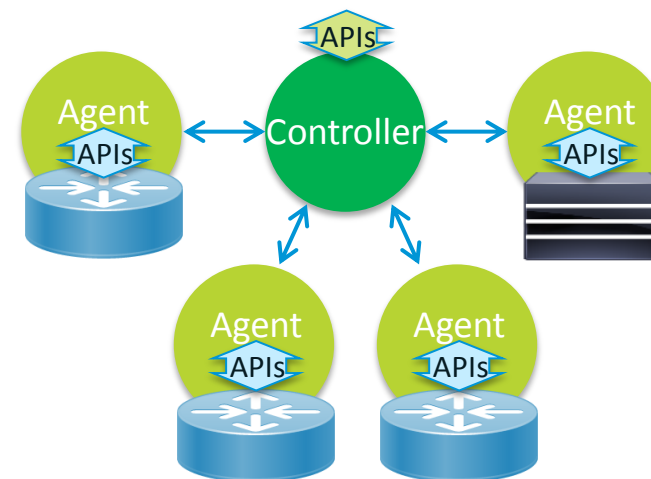
- Controller

Process on a device interacting with a set of devices using a set of APIs or protocols

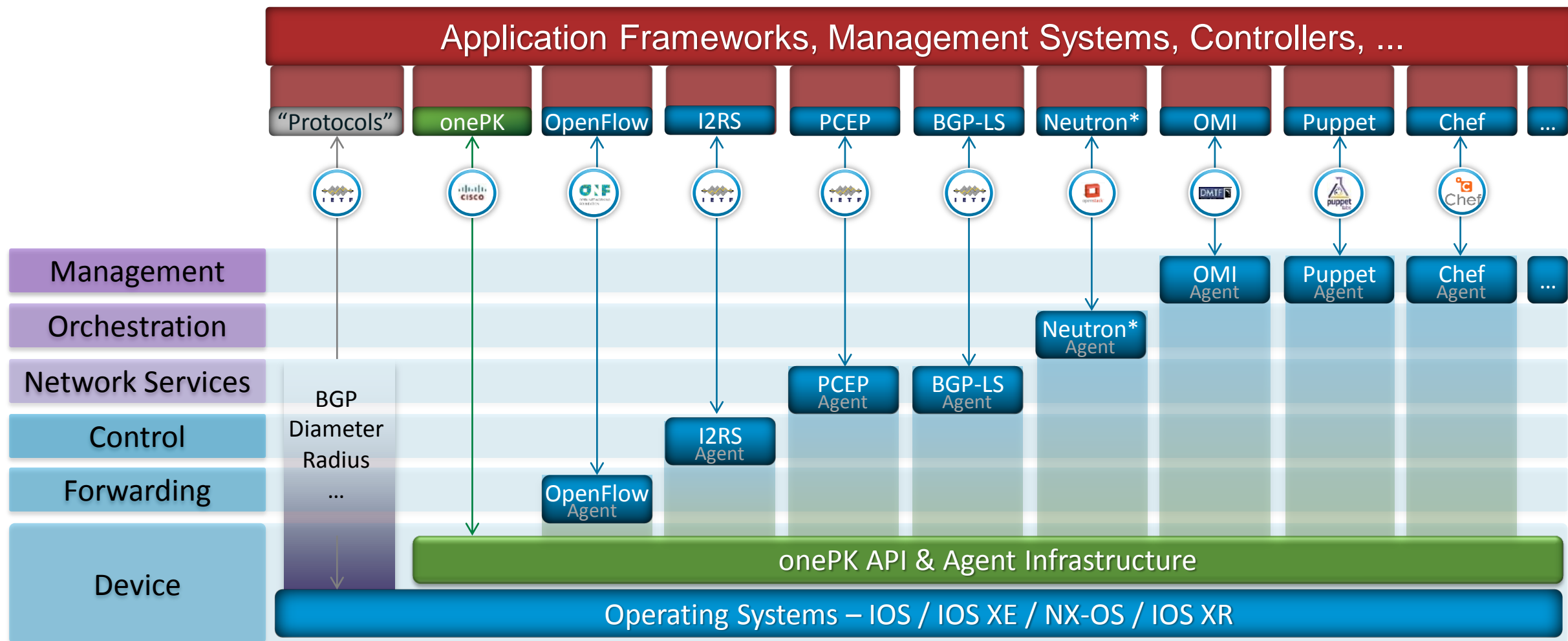
Offer a control interface/API

- Agent

Process on a device that delivers a task/domain specific function

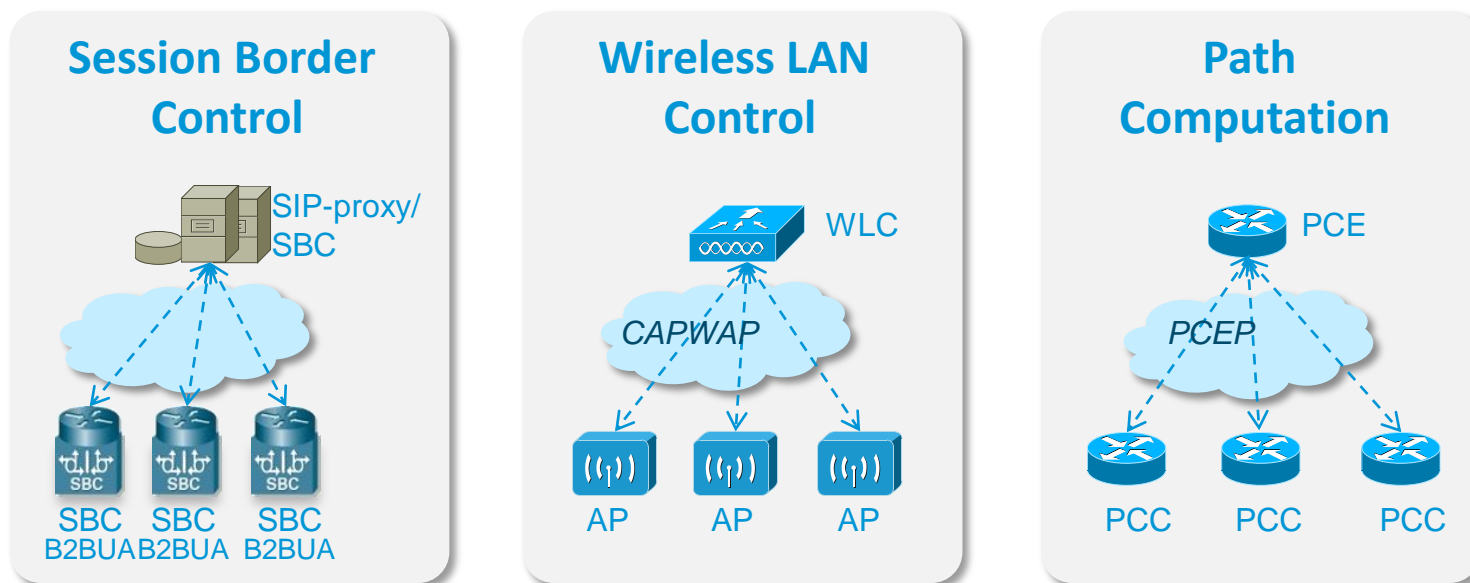


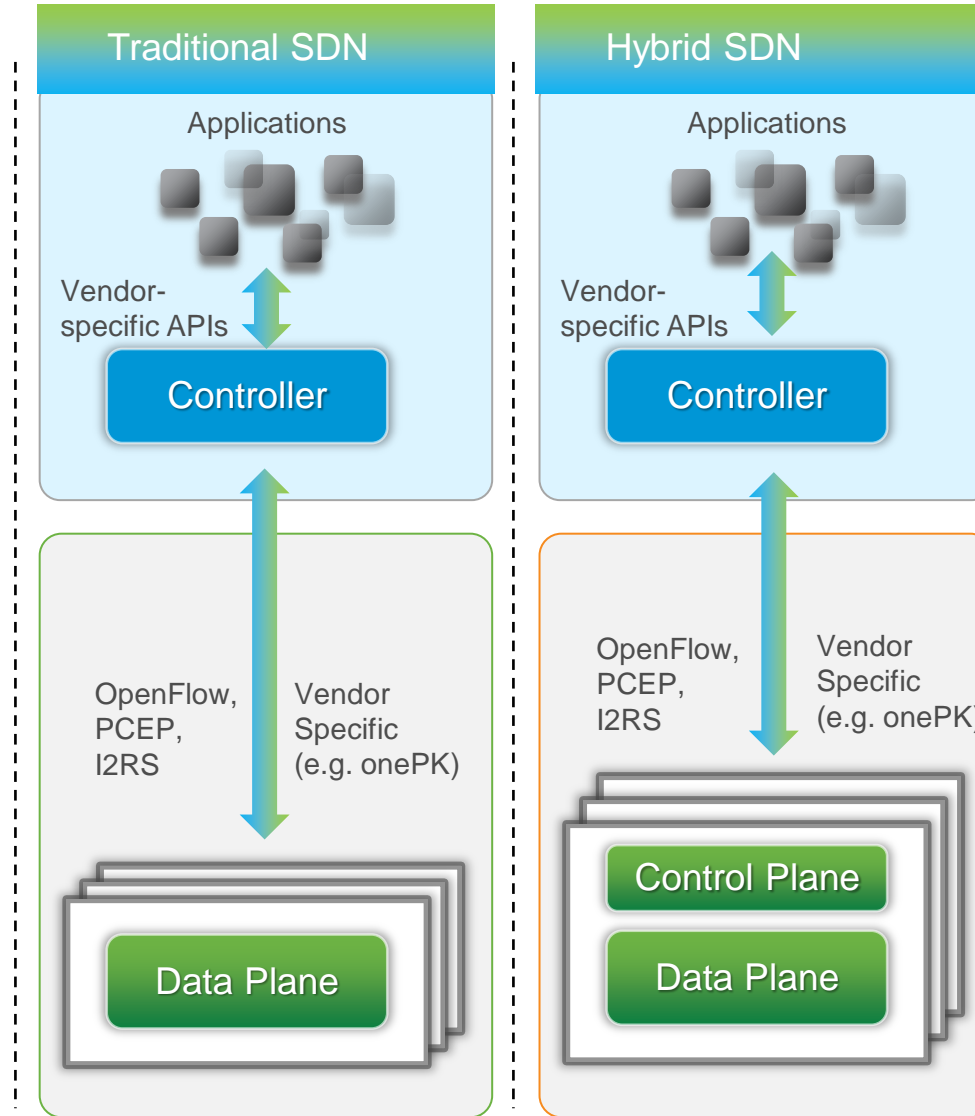
Agents: Flexible Integration Vehicles



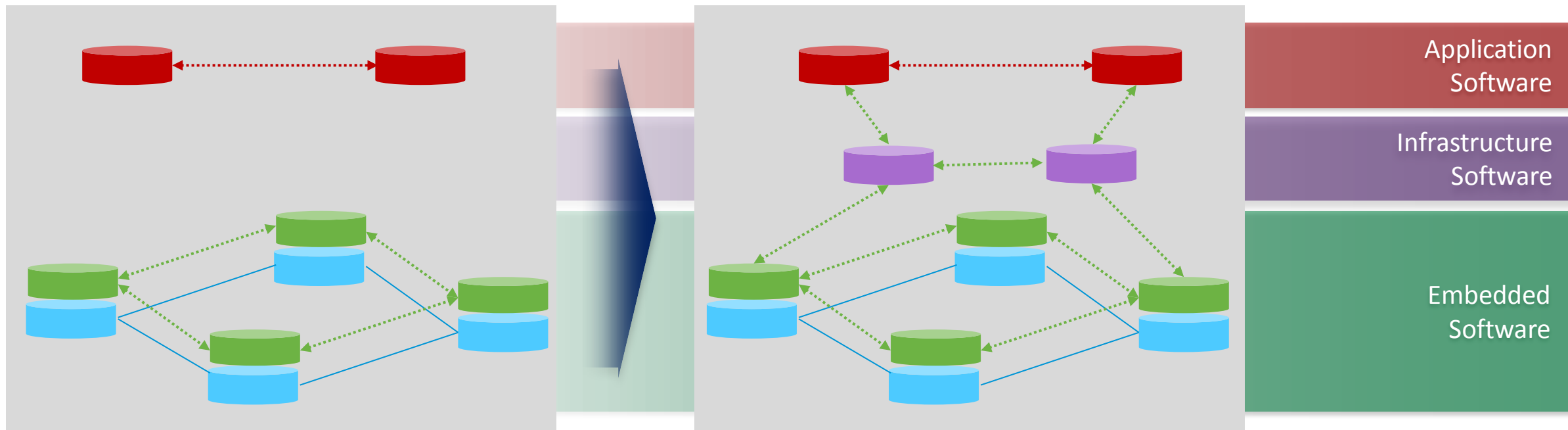
Look familiar?

- Networking already leverages a number of different Controllers and Agents
 - Controller/Agent pairs always serve a specific task (or set of tasks) in a specific domain
- System design tradeoff between Controller/Agent and fully distributed control
 - Control loop requirements differ per function/service and deployment domain





Evolving the Control and Management Plane



Fully Distributed Control Plane:
Optimized for reliability

Hybrid Control plane:
Distributed control combined with
logically centralized control for
optimized behavior
(e.g. reliability and performance)

Two Instances of Controller



What is OpenDaylight?

- OpenDaylight is an open source project under the Linux Foundation with the mutual goal of furthering the adoption and innovation of Software Defined Networking (SDN) through the creation of a common industry supported framework.

- For more information:

www.opendaylight.org

https://wiki.opendaylight.org/view/Main_Page

Platinum Members



Gold Members



Silver Members



Cisco Extensible Network Controller (XNC)

- Platform for generic control functions – state consolidation across multiple entities

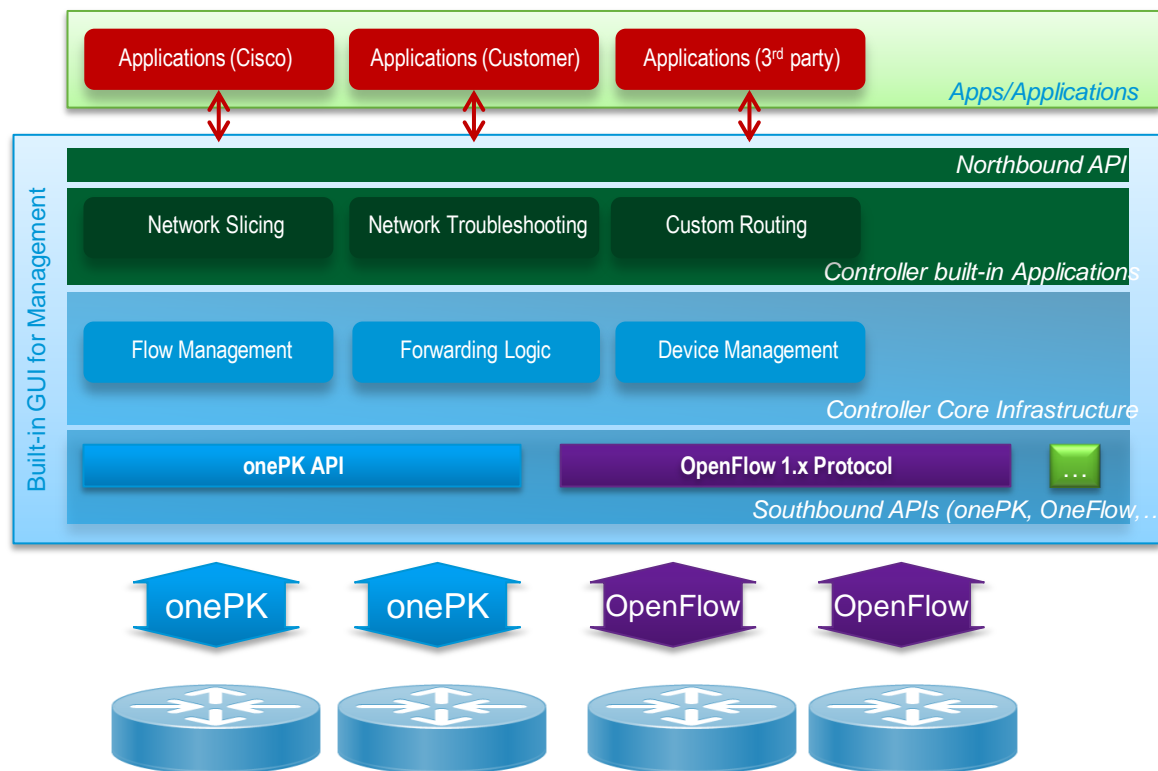
- Current Showcase Examples

Flexible Network Partitioning and Provisioning (“Slicing”)

Network Troubleshooting

Custom Routing

- Java-based



How does Controller talk to Agents

OpenFlow

- Original Motivation
 - Research community's desire to be able to experiment with new control paradigms
- Base Assumption
 - Providing reasonable abstractions for control requires the control system topology to be decoupled from the physical network topology
- OpenFlow was designed to facilitate separation of control and data planes in a standardized way
- Current OpenFlow specification defines an abstract flow-based switch model (OpenFlow switch) **and** a standardized interface (OpenFlow protocol)
 - OpenFlow switch**: An abstraction of an Ethernet switch; currently focused on Forwarding abstraction
 - OpenFlow protocol**: A communication protocol that provides access to the forwarding plane of an OpenFlow switch

onePK for Rapid Application Development

DEVELOPER ENVIRONMENT

- Language of choice
- Programmatic interfaces
- Rich data delivery via APIs

COMPREHENSIVE SERVICE SETS

- Better apps
- New services
- Monetization opportunity

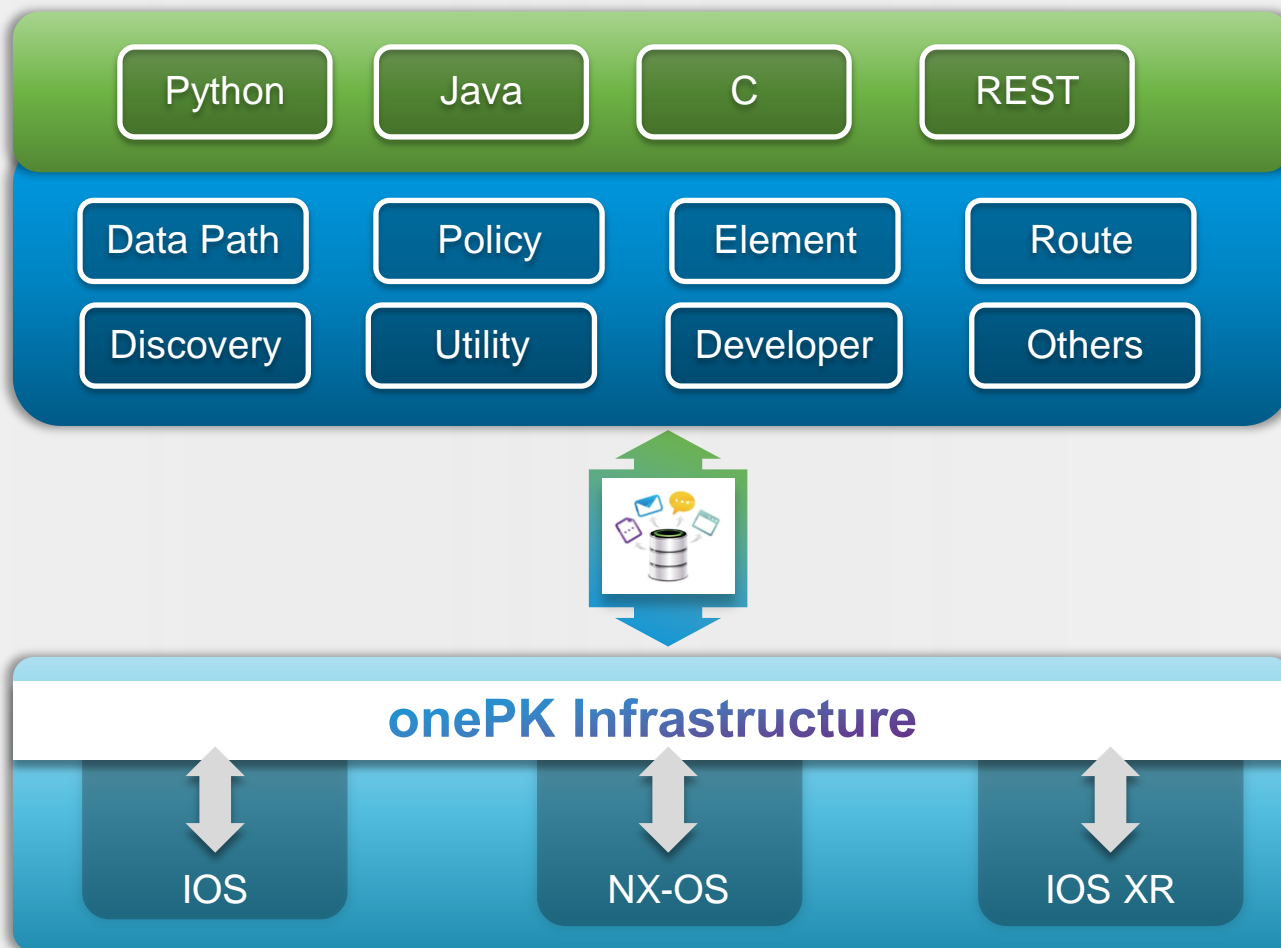
DEPLOY

- On a server blade
- On an external server
- Directly on the device

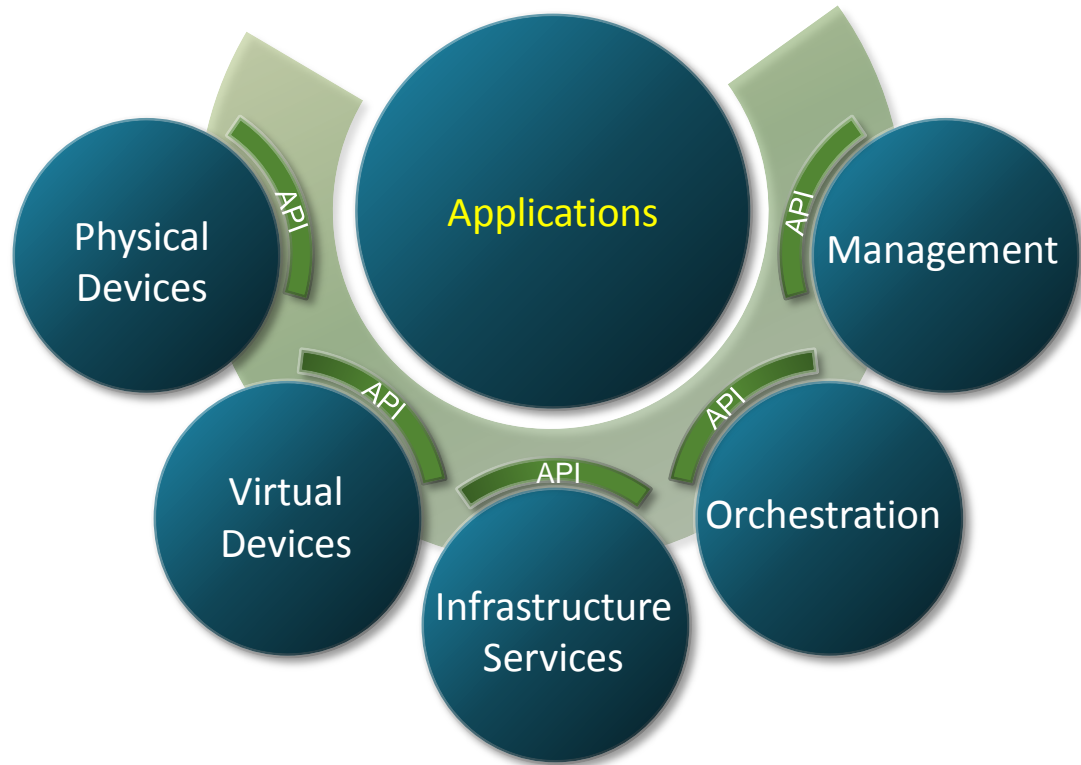


CONSISTENT PLATFORM SUPPORT

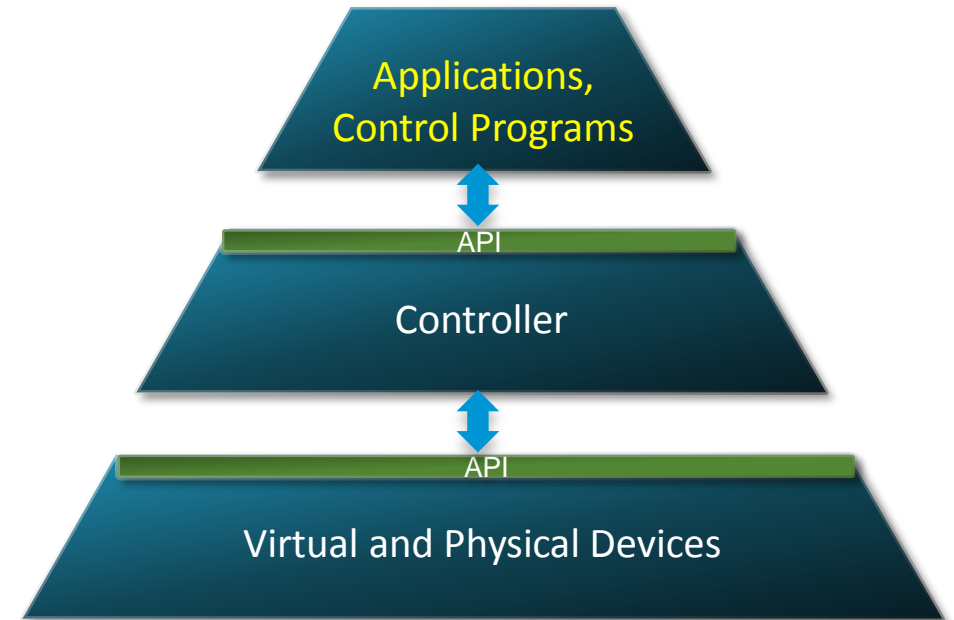
- IOS
- NX-OS
- IOS XR



Different Programmability Models

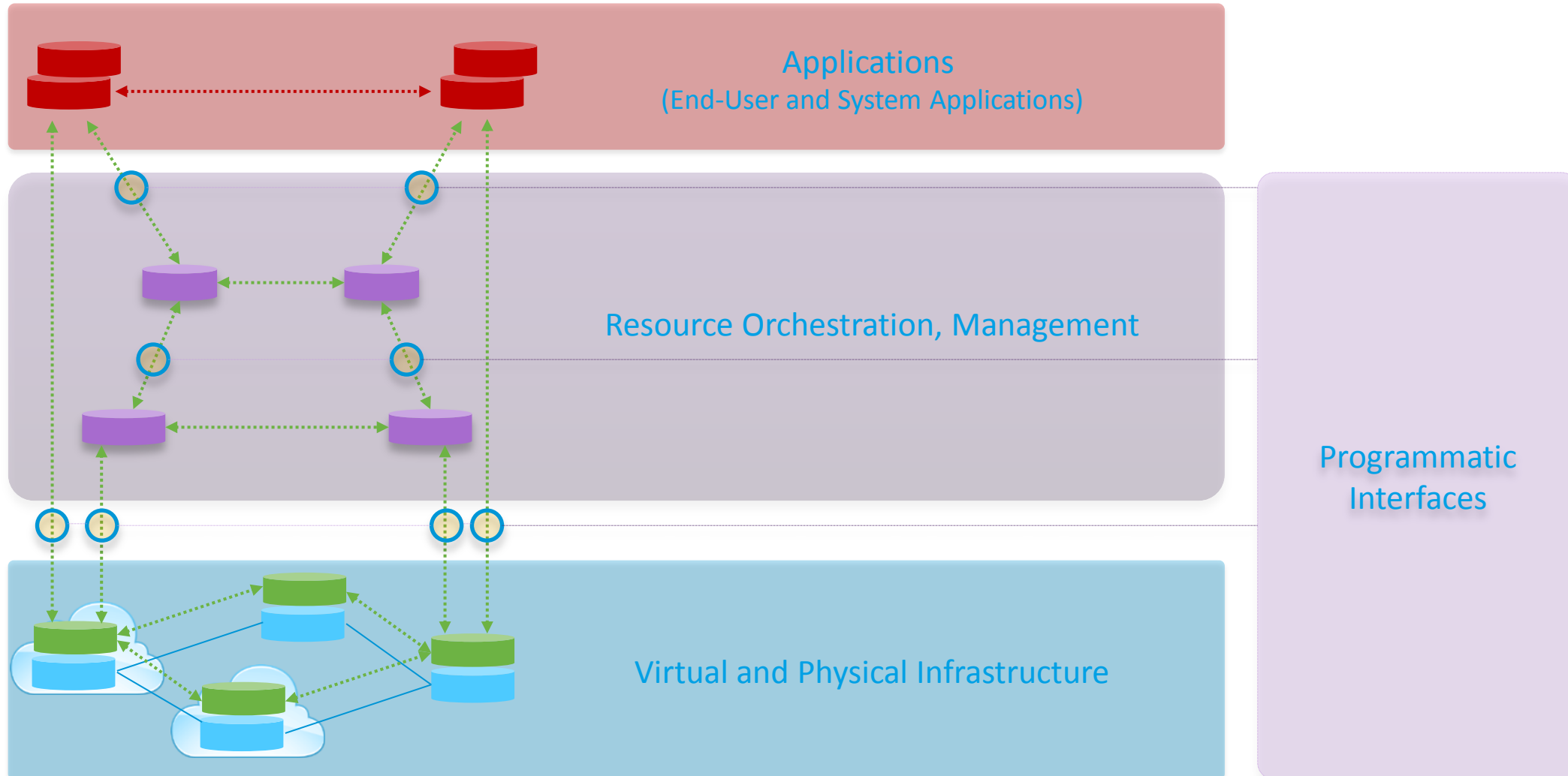


Peering Model

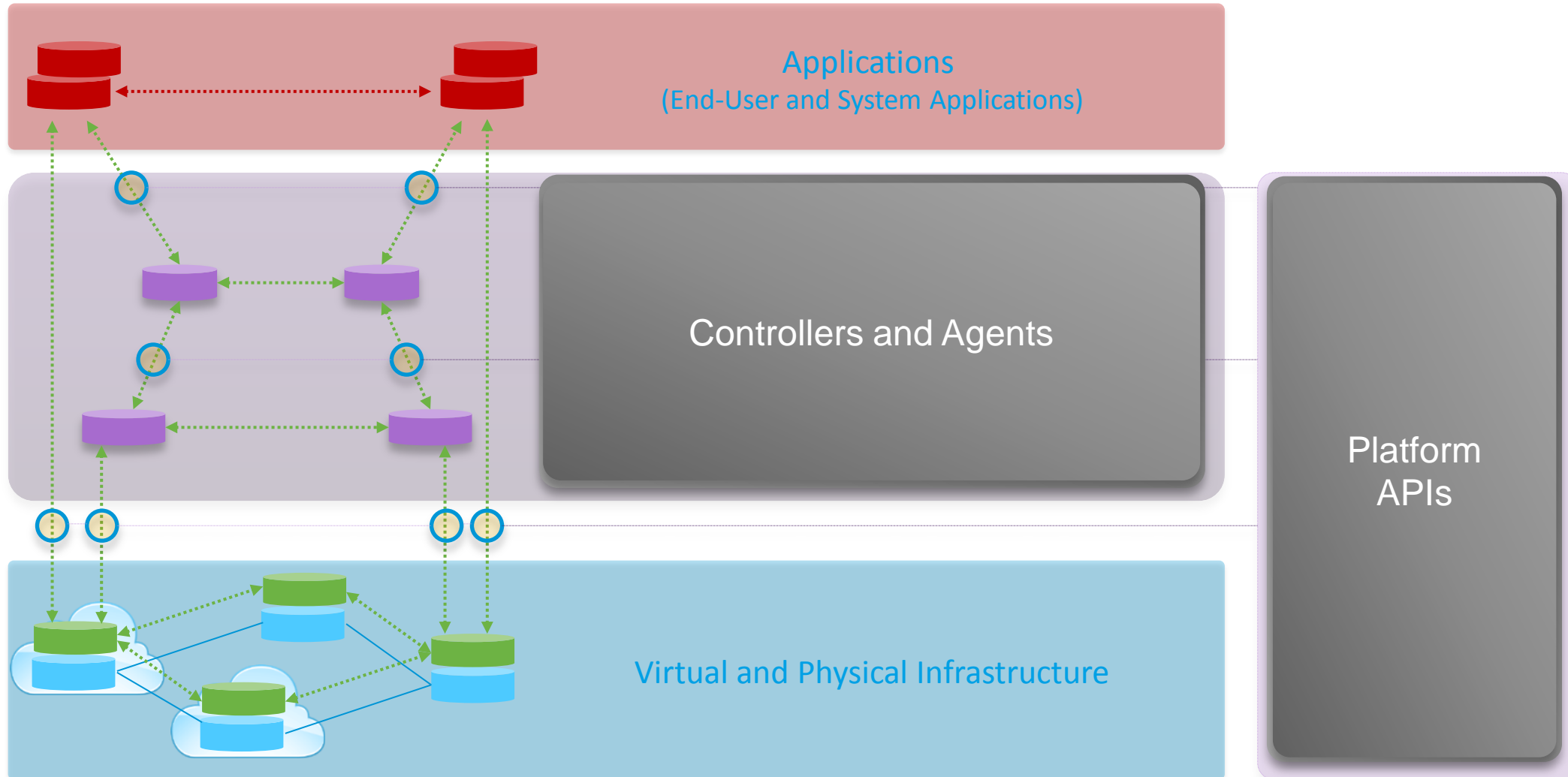


Hierarchical Model
(followed by traditional SDN)

Beyond SDN: Full Network Programmability



Cisco Open Network Environment (ONE)



Network Functions Virtualization (NFV)

Virtual Overlays

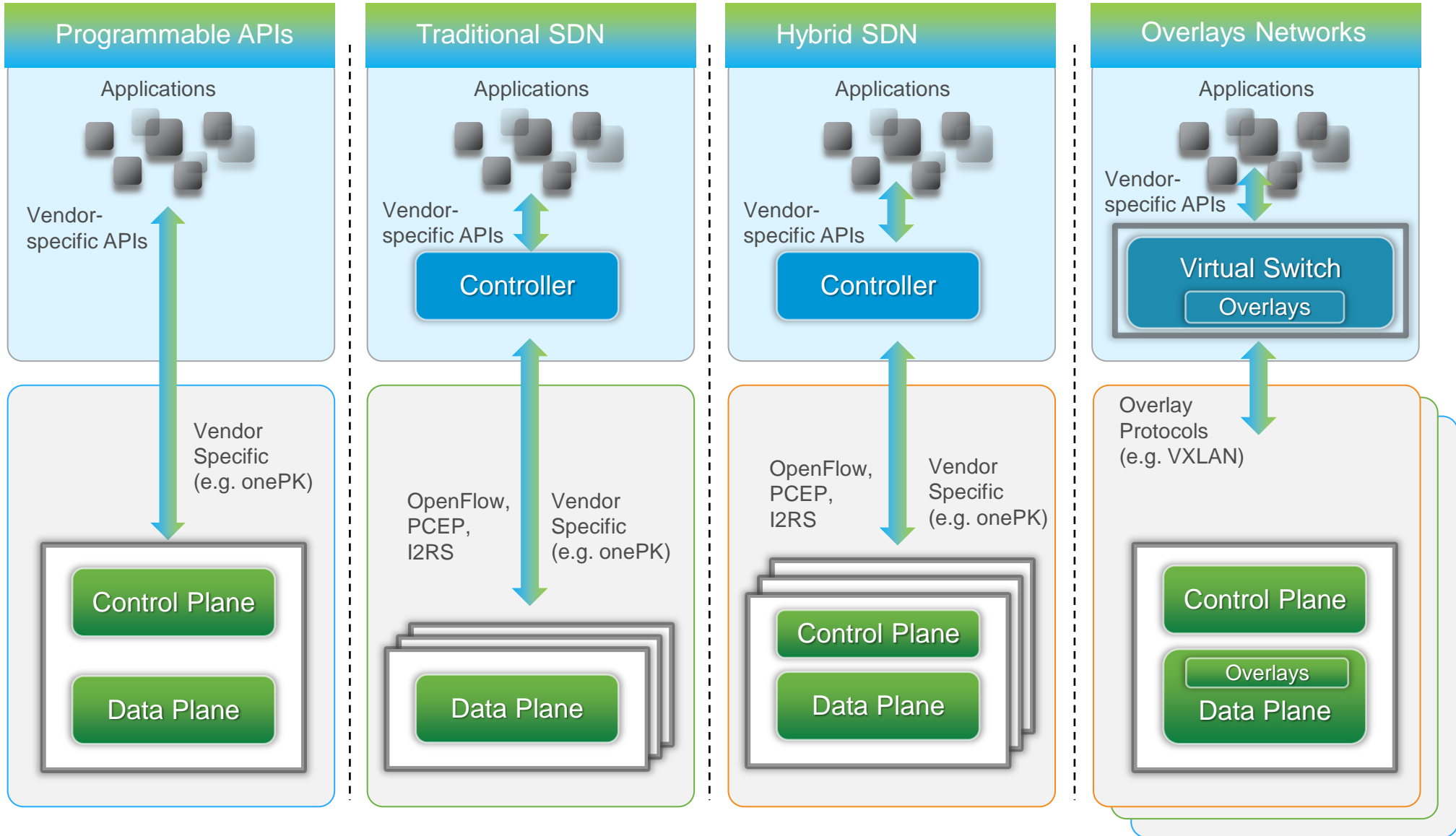
What about the *Network*?



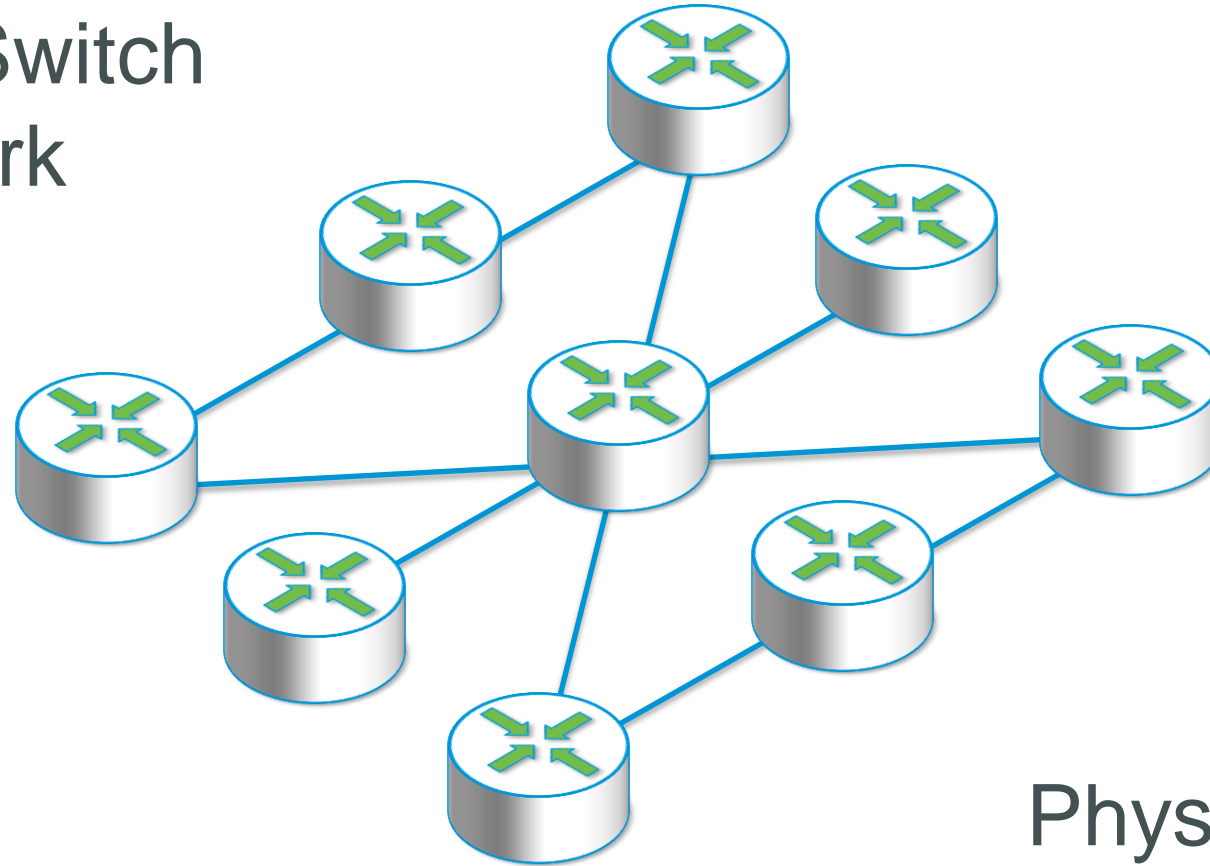
Network Functions Virtualization (NfV)

- NfV initiative announced at *SDN and OpenFlow World Congress*, October 2012
Industry Specification Group (ISG) with ETSI
- Leveraging cloud technology to support virtualizing specific network functions

Nexus/Catalyst <i>vSwitch (Nexus 1000v)</i>	ASR/ISR/CRS <i>vRouter (CSR1000v)</i>	Identity/Policy - ISE <i>vISE</i>	Firewall - ASA <i>vFW (ASA 1000v)</i>
WAAS <i>vWAAS</i>	Email Security - ESA <i>vESA</i>	Wireless LAN Controller <i>vWLC</i>	Security Gateway <i>VSG</i>
Video Cache <i>vVideoCache</i>	Web Security - WSA <i>vWSA</i>	Network Analysis - NAM <i>vNAM</i>	IOS/XR RR <i>vRouteReflector</i>

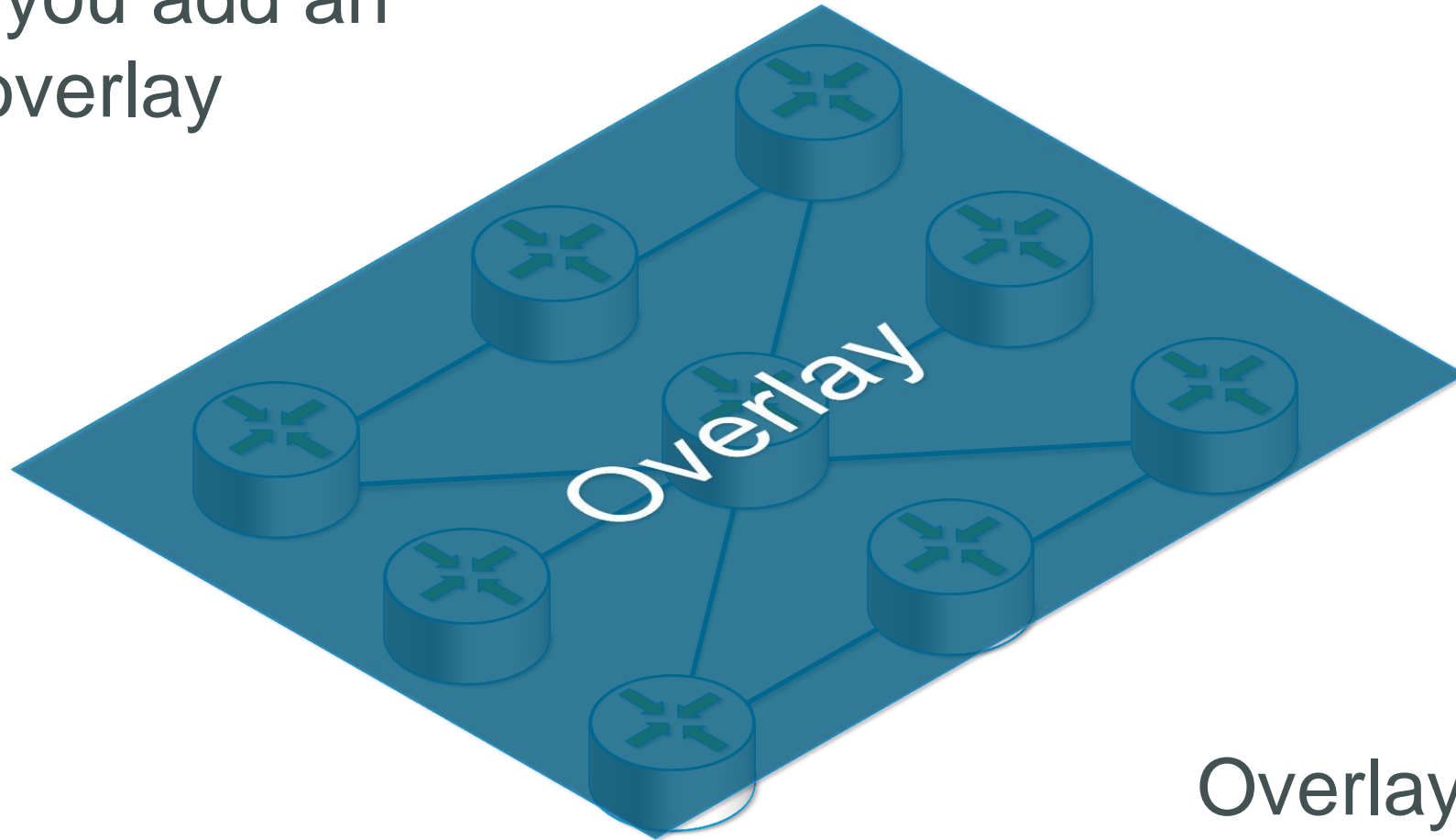


You start with a Physical Switch Network



Physical Devices and
Physical Connections

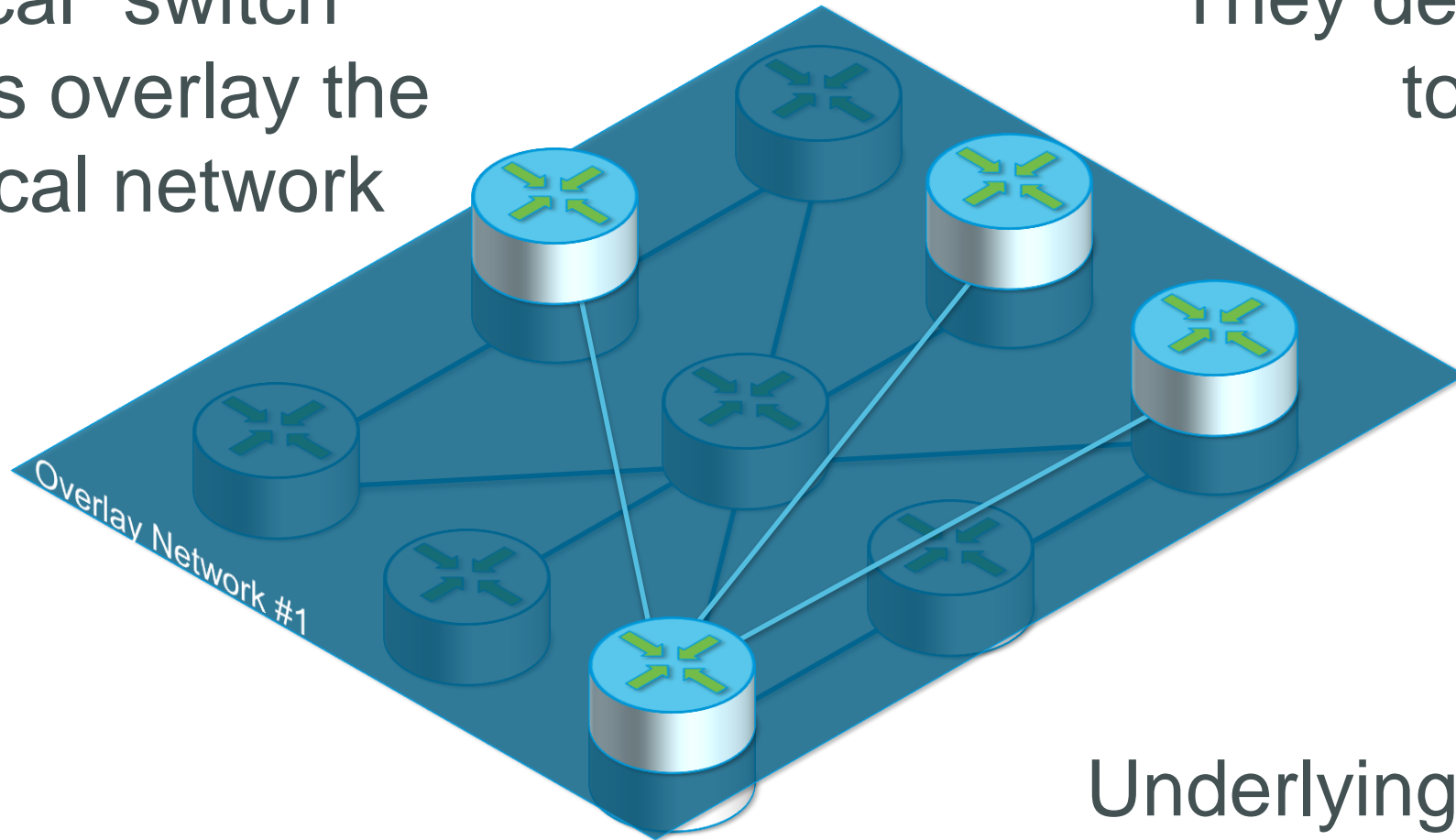
Then you add an
overlay



Overlay provides
base for logical
network

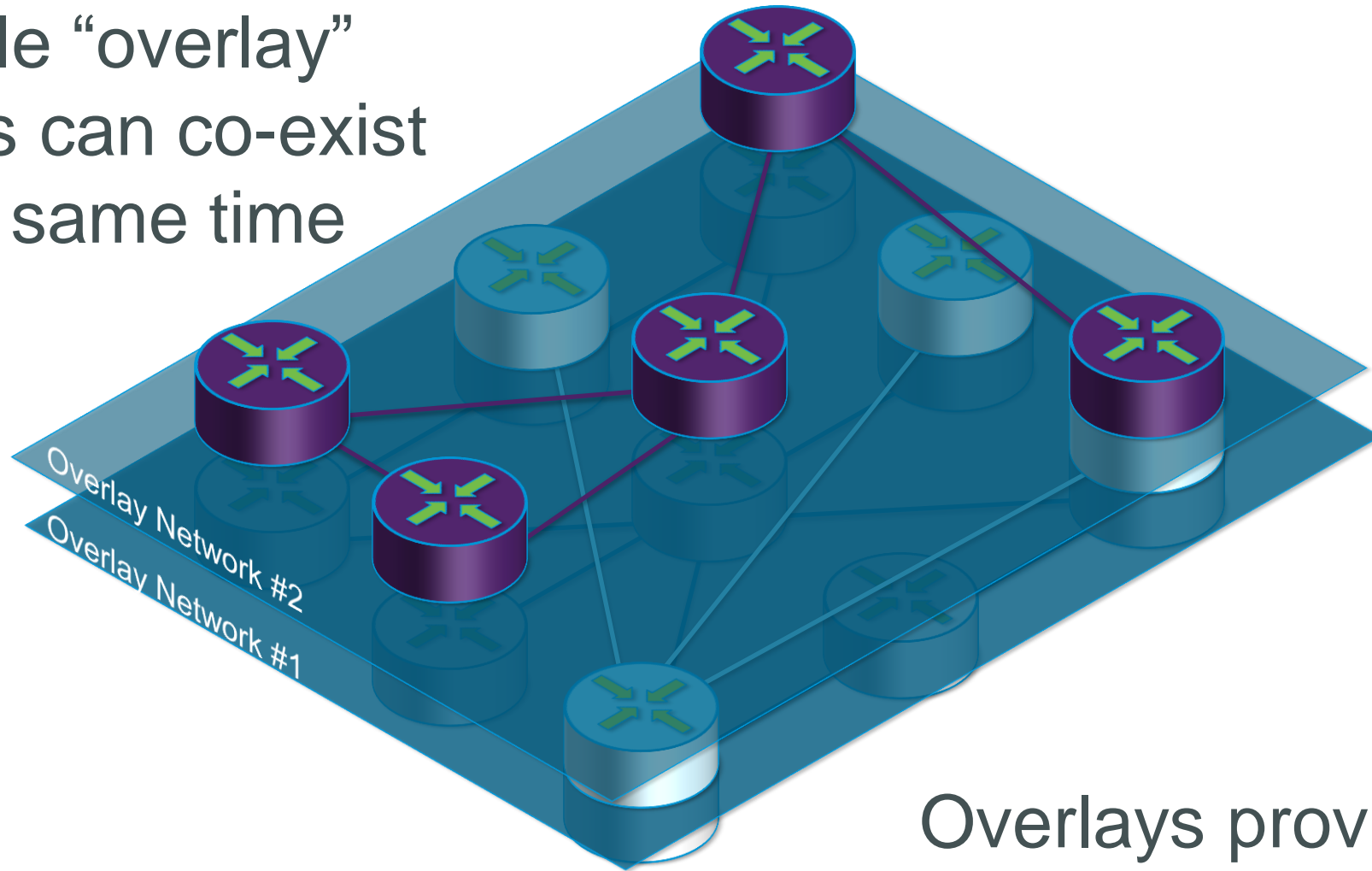
Logical “switch”
devices overlay the
physical network

They define their own
topology



Underlying physical
network carries data
traffic for overlay network

Multiple “overlay”
networks can co-exist
at the same time



Overlays provides logical
network constructs for
different tenants (customers)

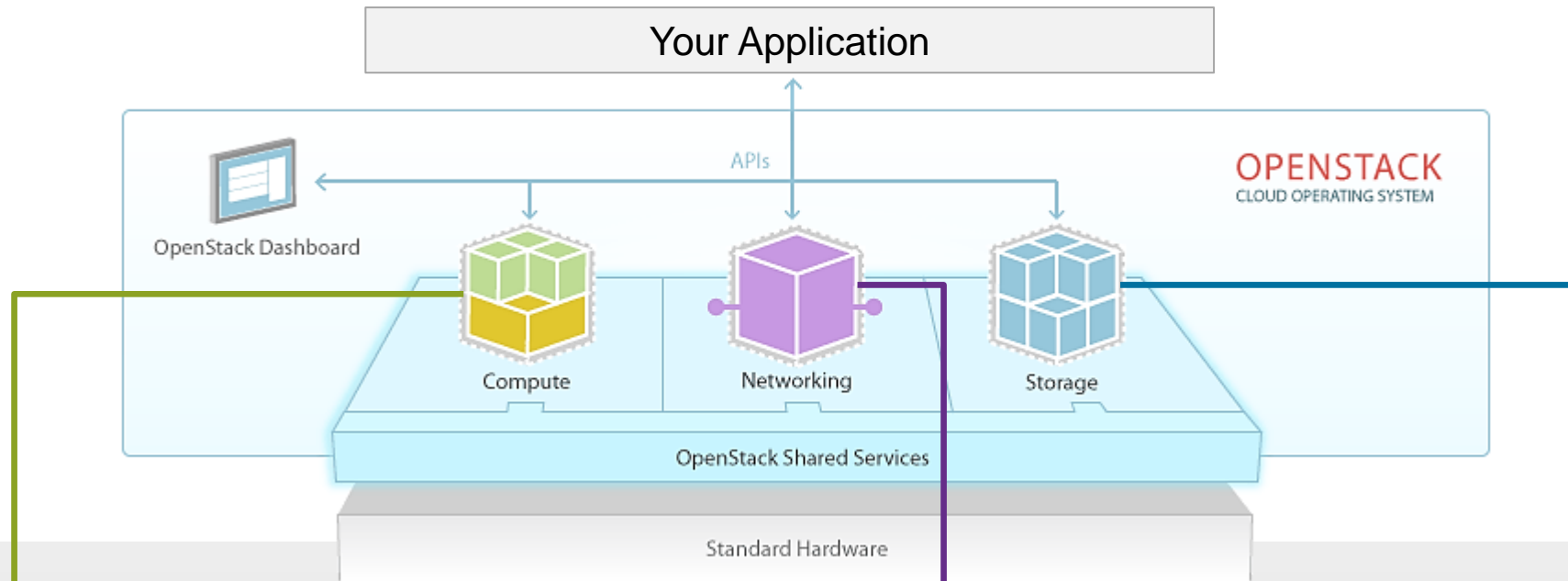
Overlay Encapsulations and Forwarding

- Virtual Overlays in the SDN context usually refers to host-based encapsulation and forwarding
 - Extended L2 connectivity and scalability
 - Secure Segmentation (Multi-tenant environments, etc.)
- Stateless Tunneling Mechanisms
 - No static tunnel setup required
 - Frame formats recognized by hosts and treated as tunneled frame
- Ethernet frames encapsulated in IP packet
 - Physical network uses outer IP header to forward tunneled traffic
- 3 popular hypervisor-based overlay technologies:
 - Virtual Extensible Local Area Network (VXLAN)
 - Network Virtualization using Generic Routing Encapsulation (NVGRE)
 - Stateless Transport Tunneling (STT)

One more ...



OpenStack: The Open Source Cloud Platform



Compute (Nova)

Self-service provisioning of virtual machines through a software API

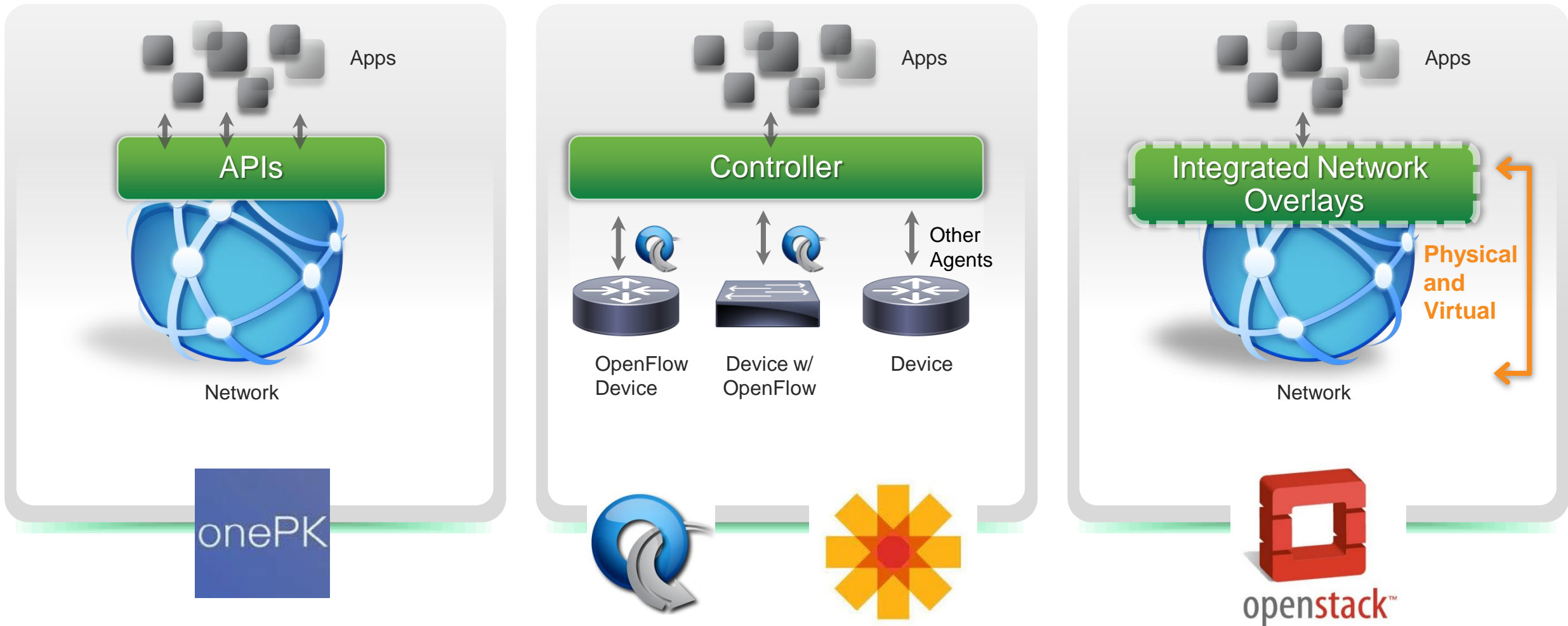
Network Service (Quantum)

For tenant created, virtual isolated networks and subnets, and services

Object Storage (Swift)

Massively scalable, distributed object store

Cisco Open Network Environment (ONE)



Additional Resources

- Cisco Open Network Environments
www.cisco.com/go/one/
- Cisco Developer Network (CDN)
developer.cisco.com/web/onepk-developer/
- OpenDaylight
www.opendaylight.org

Thank you.

