



Leading the Way:

Cisco Open Network Environment

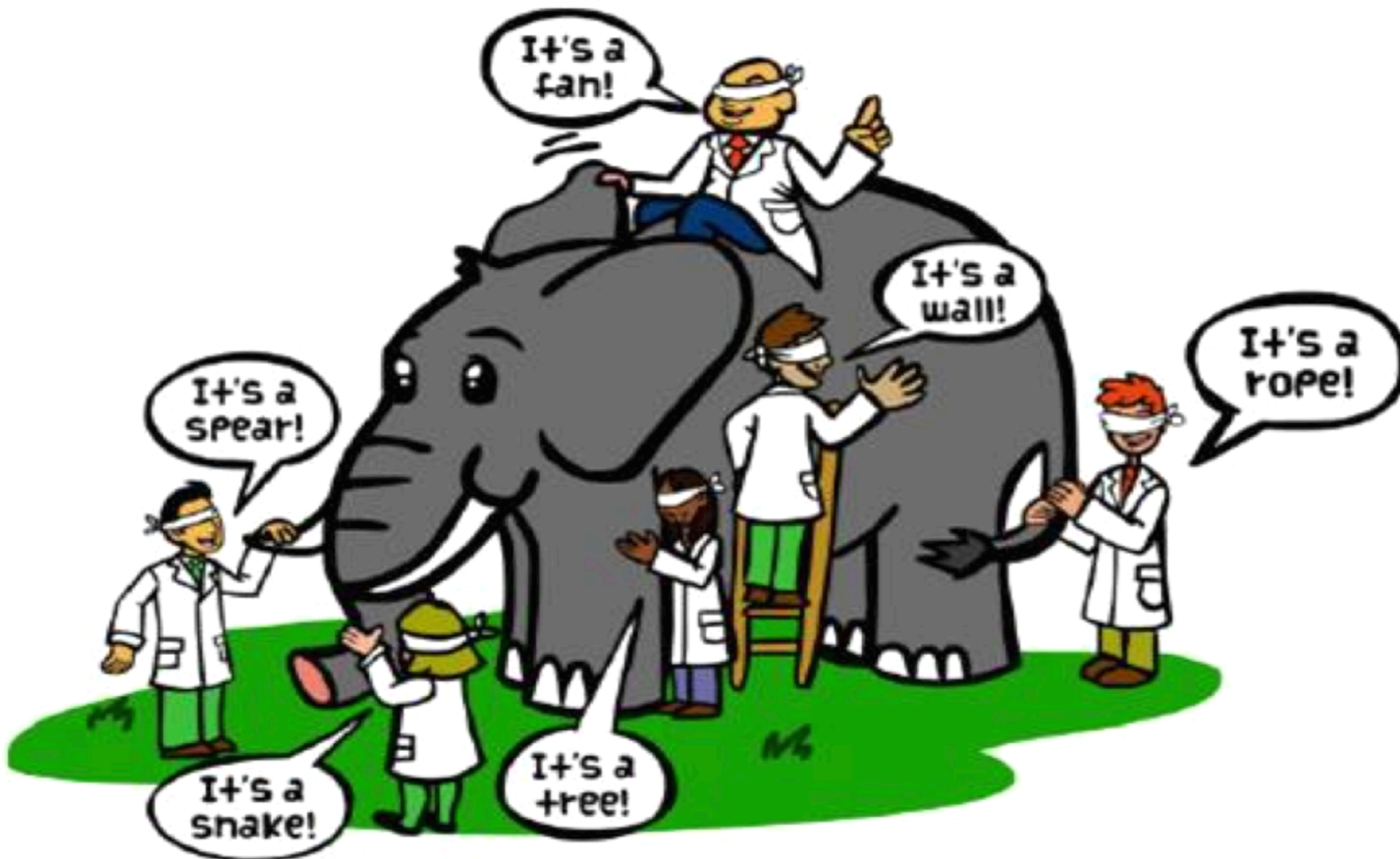
Flexible. Programmable. Application-aware.

www.cisco.com/go/one

San Antonio Castilleja

octubre 2013

What IS Software Defined Networking (SDN)?



Many Definitions

- Openflow
- Controller
- Openstack
- Overlays
- Network virtualization
- Automation
- APIs
- Application oriented
- Virtual Services
- Open vSwitch
- ...

What's driving the Buzz: Business & Technology trends

Cloud



Video



Mobility



Data Deluge



Operational
Simplicity

Agility

Business
Value

IS THE NETWORK READY?

Evolution of the Intelligent Network

Preserve What's Working

- Resiliency
- Scale
- Rich feature-set



Evolve for Emerging Requirements

- Operational Simplicity
- Programmability
- Application aware

Evolve the Network for the Next Wave of Application Requirements

Customer Insights:



Research/ Academia

Research
OpenFlow/SDN
components for
production
networks

Network
“Slicing”



Massively Scalable Data Center

- Customize with Programmatic APIs to provide deep insight into network traffic

Network Flow
Management



Cloud

- Automated provisioning and programmable overlay, OpenStack

Scalable
Multi-Tenancy



Service Providers

- Policy-based control and analytics to optimize and monetize service delivery

Agile Service
Delivery



Enterprise

- Virtual workloads, VDI, Orchestration of security policies

Private Cloud
Automation

Diverse Programmability and Automation Requirements Across Segments

Basic Definitions

What Is Software Defined Network (SDN)?

“...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...”

Note: SDN is not mandatory for network programmability nor automation

Source: www.opennetworking.org

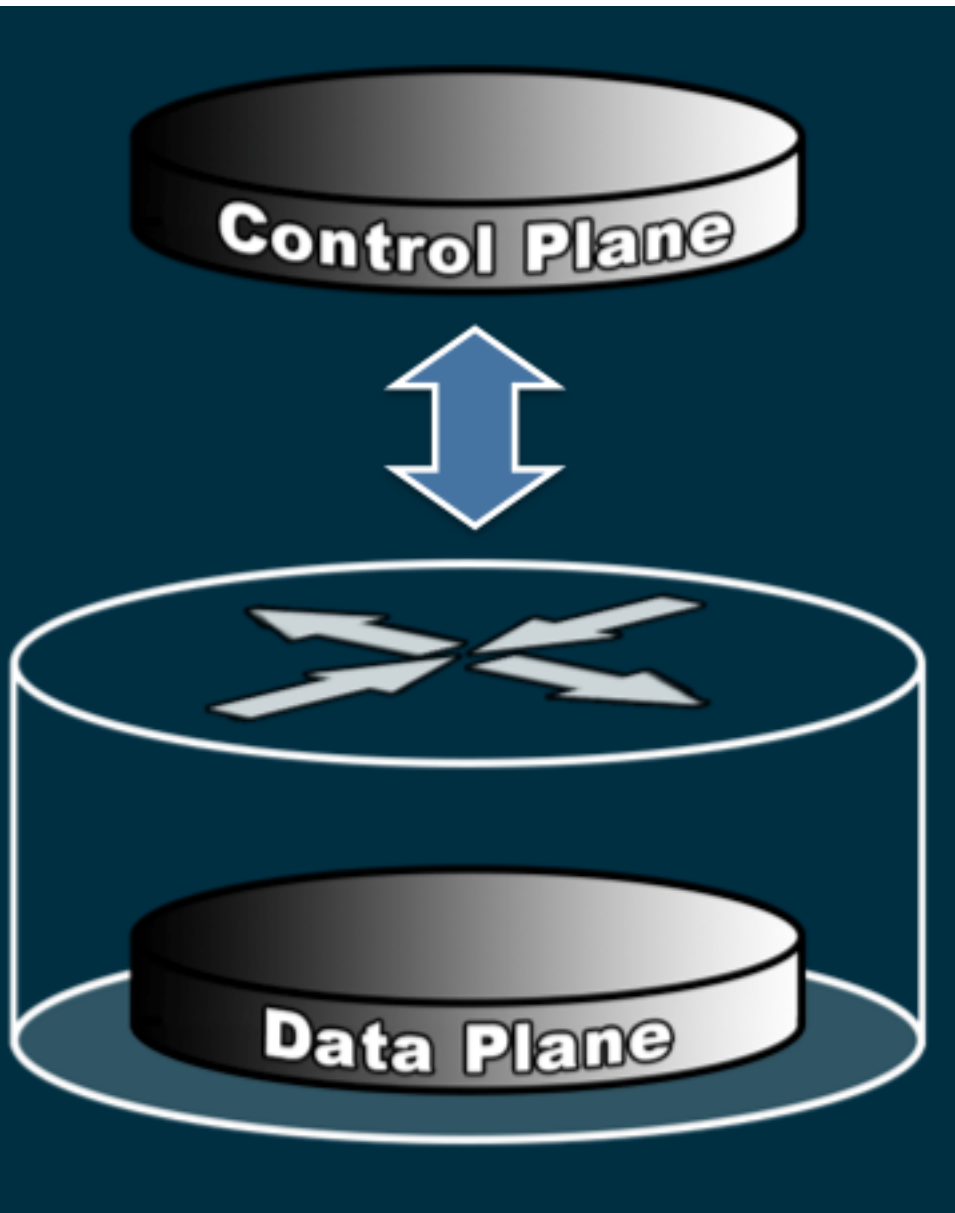
step back...



Control and Data Plane resides within Physical Device

step back...

Processing Plane	Where it runs	How fast these processes run	Type of processes performed
Control Plane	Switch CPU	In the order of thousands of packets per second	Routing protocols (i.e. OSPF, IS-IS, BGP), Spanning Tree, SYSLOG, AAA (Authentication Authorization Accounting), NDE (Netflow Data Export), CLI (Command Line interface), SNMP
Data Plane	Dedicated Hardware ASIC's	Millions or Billions of packets per second	Layer 2 switching, Layer 3 (IPv4 IPv6) switching, MPLS forwarding, VRF Forwarding, QOS (Quality of Service) Marking, Classification, Policing, Netflow collection, Security Access Control Lists



In other words...

In the SDN paradigm, not all processing happens inside the same device

Where this SDN “thing” comes from?

Home About Sponsors Research People Contact

Stanford University
CLEAN SLATE
An Interdisciplinary Research Program

Clean Slate Program

We created Clean Slate Program more than five years ago with Stanford's depth and breadth of expertise to explore what kind of Internet we would design if we were to start with a clean slate and 20-30 years of hindsight. Though the mission was well defined, the potential approach was not. We began with a number of small exploratory projects that led to a few flagship projects that show lot of promise.

We are pleased to report that Clean Slate Program led to many small projects and the following four on-going flagship projects that have the potential to transform different parts of the Internet.

- Internet Infrastructure: [OpenFlow and Software Defined Networking](#)
- Mobile Internet: [POMI 2020](#)
- Mobile Social Networking: [MobiSocial](#)
- Data Center: [Stanford Experimental Data Center Lab](#)

Clean Slate Program has ceased to exist as of January 2012 and has successfully transformed into these four large projects. We invite you to visit the website of these projects, become familiar and get involved.

Past Sponsors

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Stanford University – Clean Slate Project

“...explore what kind of Internet we would design if we were to start with a clean slate and 20-30 years of hindsight.”

<http://cleanslate.stanford.edu/>

... Clean Slate led to the development of...



Basic Definitions

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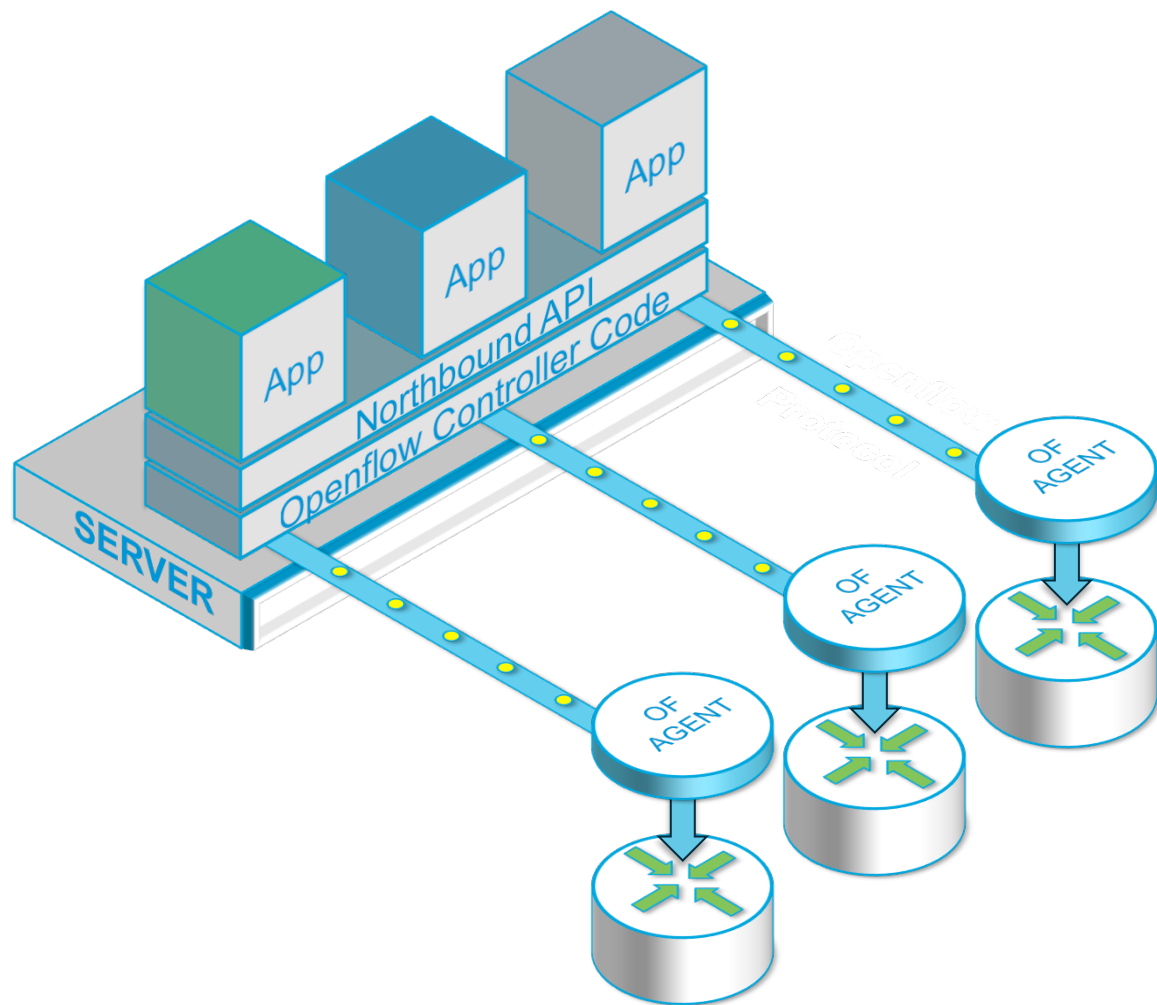
What Is OpenFlow?

Open protocol that specifies **interactions between de-coupled control and data planes**

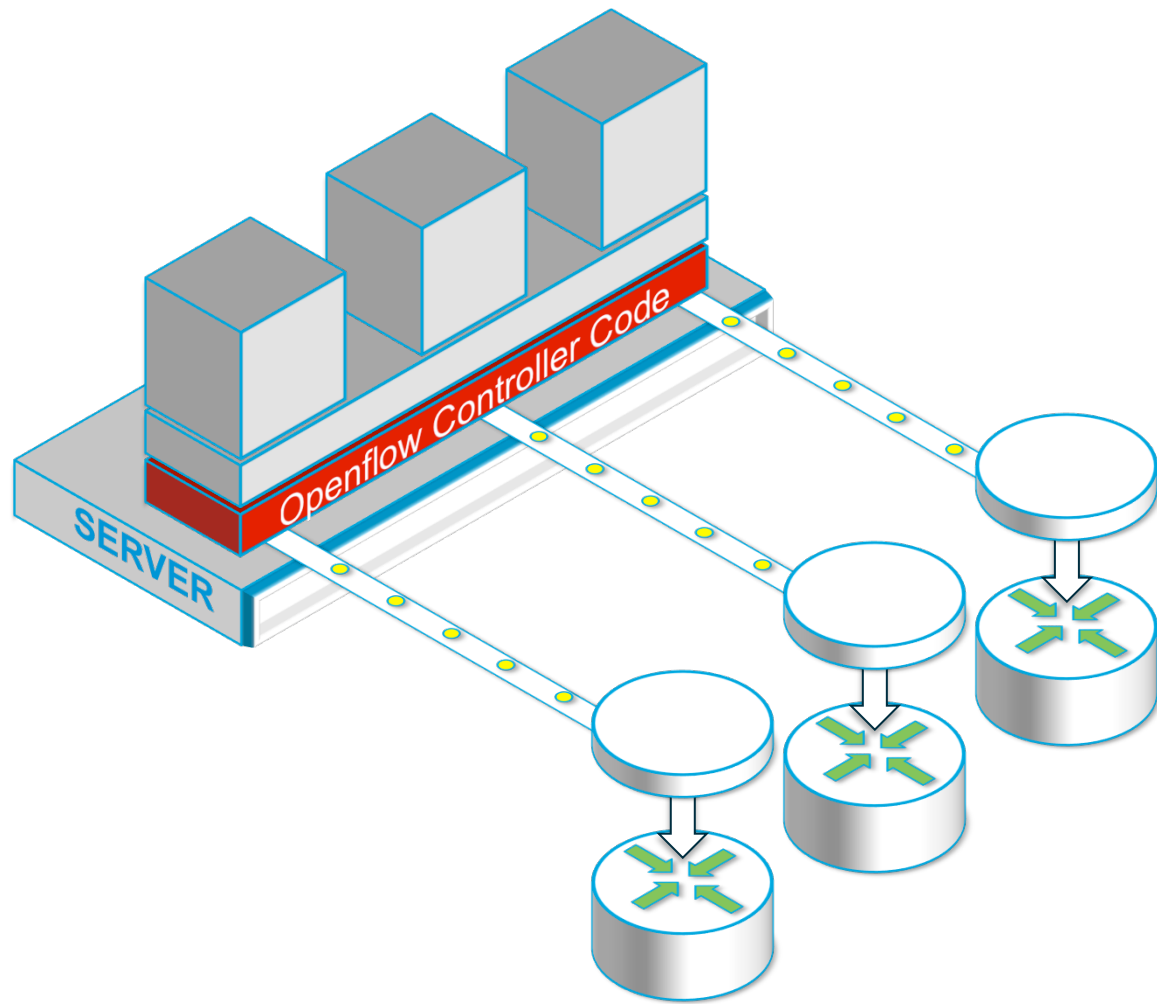
Note: OF is not mandatory for SDN

Note: North-bound Controller APIs are vendor-specific



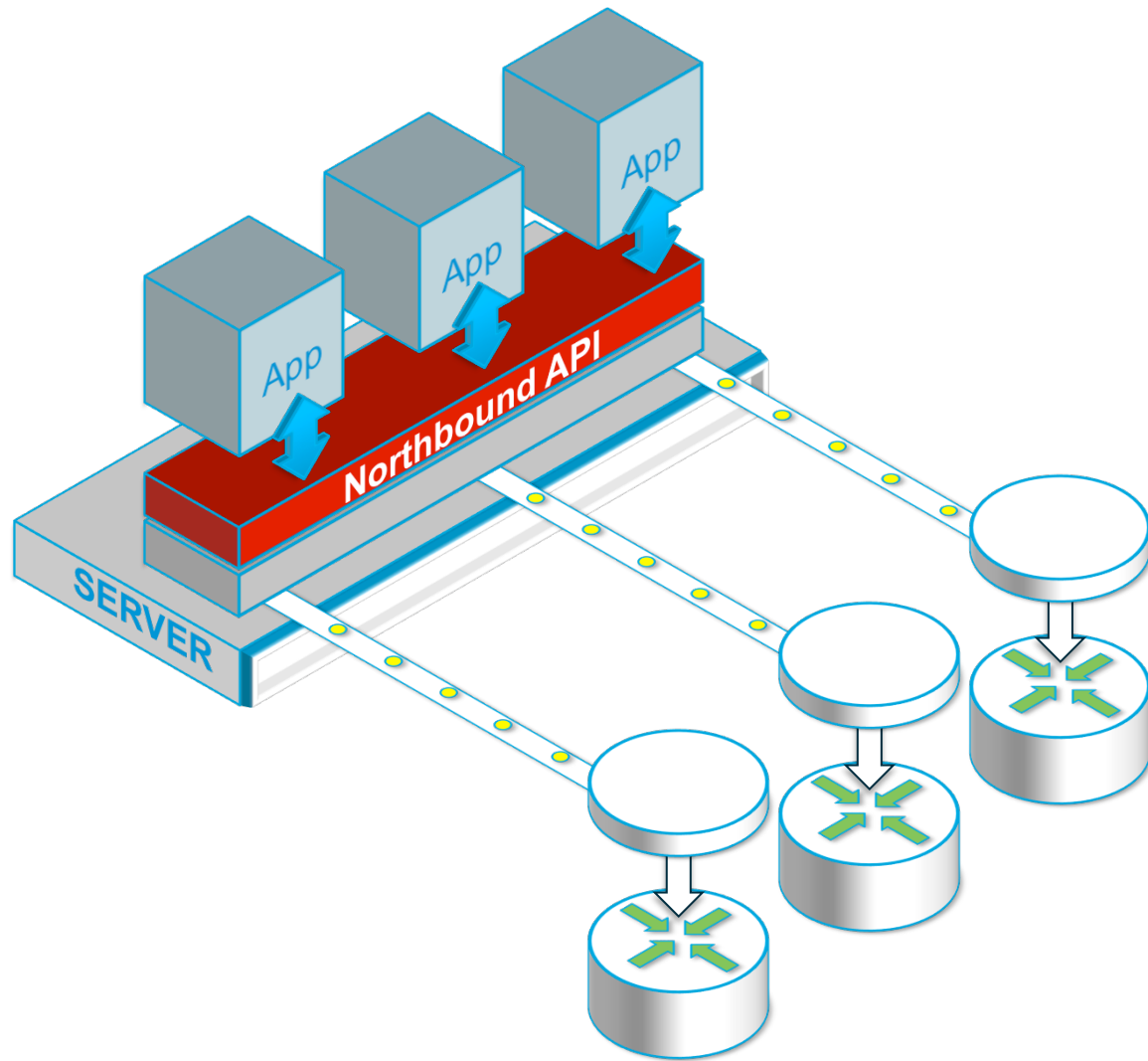


Four parts to Openflow



*Central Administration
and Operations
point for
Network Elements*

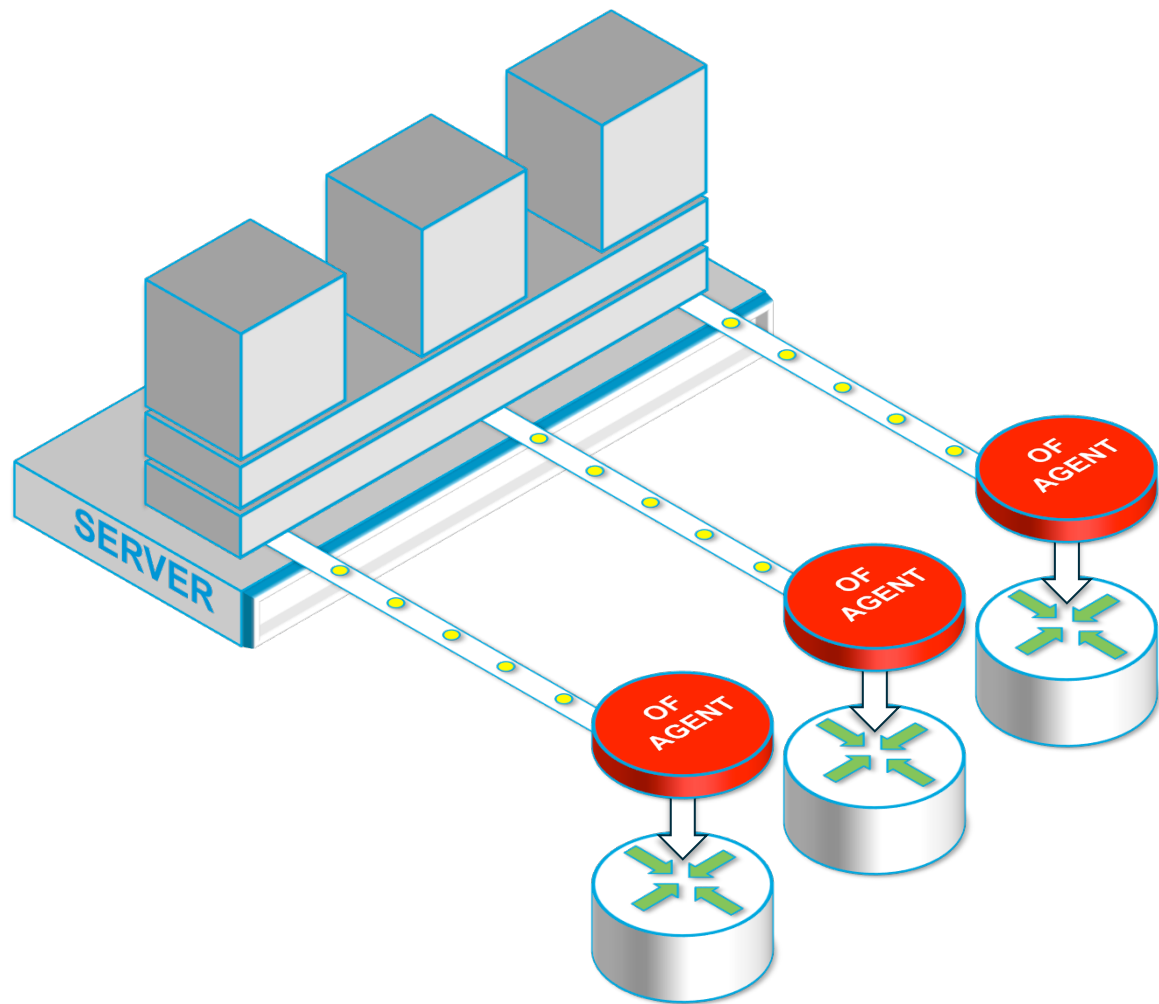
Openflow Controller



Northbound API Integral part of Controller

*“Network enabled” application can
make use of Northbound API to
request services from the
network...*

Openflow Controller | Northbound API

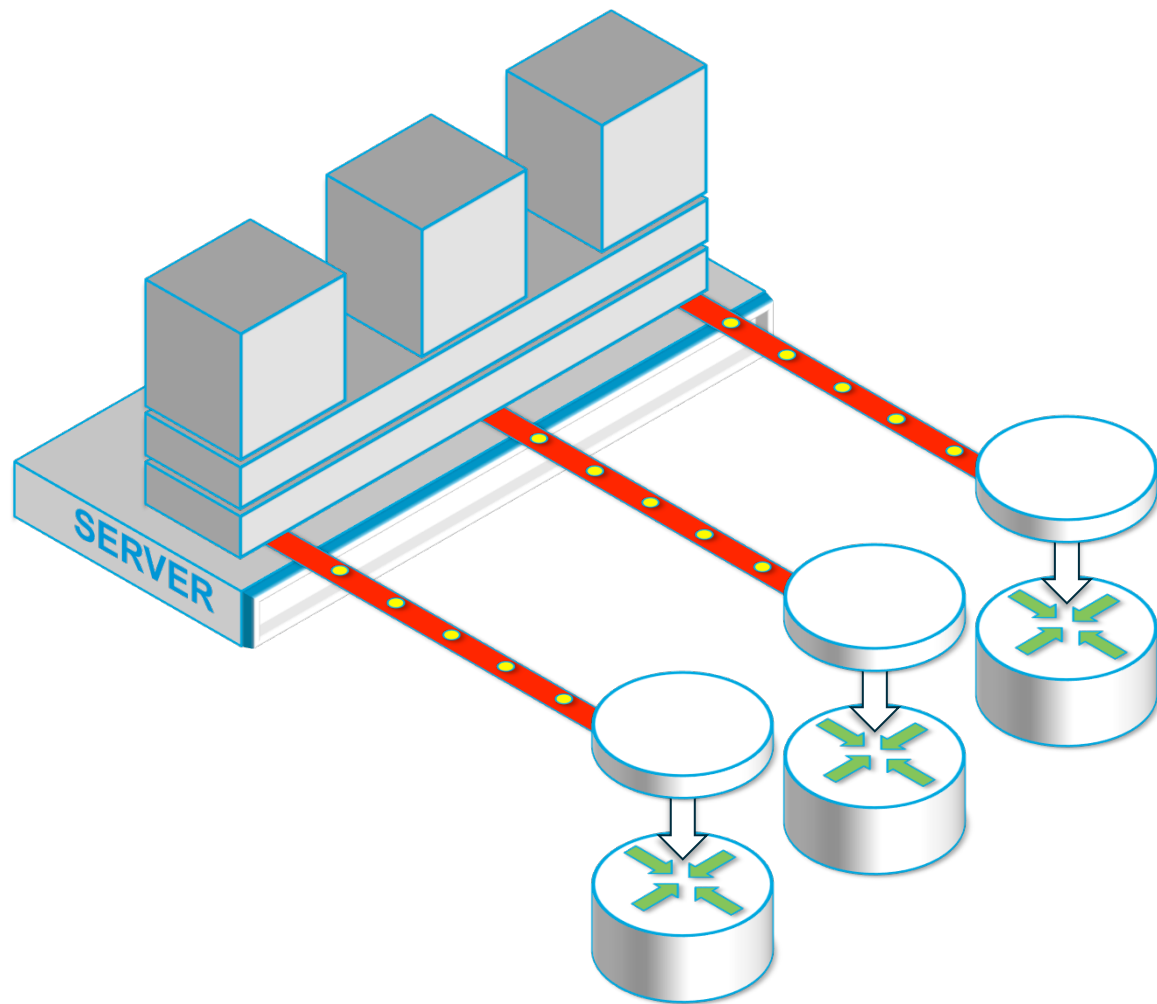


Agent runs on the network device

Agent receives instructions from Controller

Agent programs device tables

Openflow Device Agent

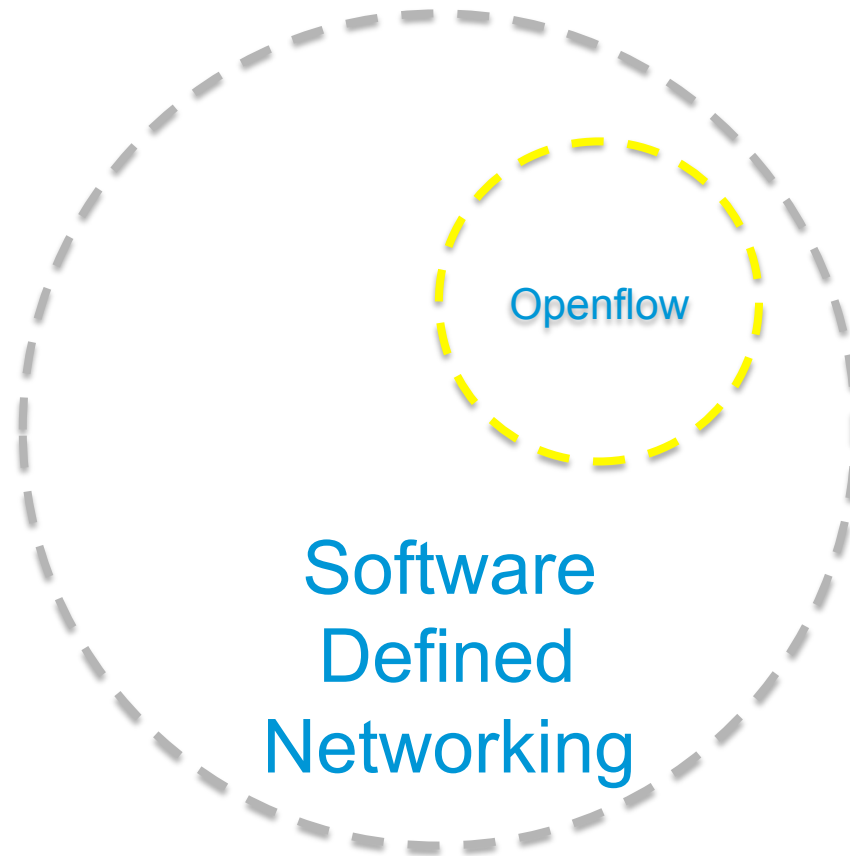


Openflow Protocol is...

“A mechanism for the Openflow Controller to communicate with Openflow”

Openflow Protocol

First Lesson for Today... Openflow does not equal SDN



Openflow is one flavor of SDN

OpenFlow Thesis

OpenFlow: Enabling Innovation in Campus Networks

March 14, 2008

Nick McKeown
Stanford University

Tom Anderson
University of Washington

Hari Balakrishnan
MIT

Guru Parulkar
Stanford University

Larry Peterson
Princeton University

Jennifer Rexford
Princeton University

Scott Shenker
University of California,
Berkeley

Jonathan Turner
Washington University in
St. Louis

Abstract
This paper proposes OpenFlow: a way for researchers to run experimental protocols in the networks they use even though the network is based on an Ethernet switch, with a simple flow-table, and a standardized interface to add and remove flow entries. Our goal is to encourage network researchers to add OpenFlow to their switch products for use in college campus backbones and wiring closets. OpenFlow is a pragmatic compromise: on the one hand, it allows researchers to run experiments on heterogeneous networks in a uniform way at line-rate and with high accuracy, while on the other hand, vendors do not need to reveal the internal workings of their switches. In addition, it allows researchers to evaluate their ideas in real-world settings. OpenFlow could serve as a useful campus network in proposed large-scale testbeds like GENI. Two Stanford University researchers will soon run OpenFlow on existing commercial Ethernet switches and routers. We hope to encourage deployment at other schools; and we hope you to consider deploying OpenFlow in your own network too.

There is almost no practical way to experiment with new network protocols (e.g., new routing protocols, or alternatives to IP) in sufficiently realistic settings (e.g., at scale carrying real traffic) to gain the confidence needed for their widespread deployment. The result is that most new ideas from the networking research community go untried and untested; hence the commonly held belief that the network infrastructure has "ossified".

Having recognized the problem, the networking community is hard at work developing programmable networks, such as GENI [1] a proposed nationwide research facility for experimenting with new network architectures and distributed systems. These programmable networks call for programmable switches and routers that (using *virtualization*) can process packets for multiple isolated experimental networks simultaneously. For example, in GENI it is envisaged that a researcher will be allocated a *slice* of resources across the whole network, consisting of a portion of network links, packet processing elements (e.g. routers) and end-hosts; researchers program their slices to behave as they wish. A slice could extend across the backbone, into access networks, into college campuses, industrial research

"Our goal is to enable experiments to take place in an existing production network alongside regular traffic and applications. Therefore, to win the confidence of network administrators, OpenFlow-enabled switches must isolate experimental traffic (processed by the Flow Table) from production traffic that will be processed by the normal Layer 2 and Layer 3 pipeline of the switch."

<http://www.openflow.org/documents/openflow-wp-latest.pdf>

Basic Definitions

What Is Software Defined Network (SDN)?

“...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...”

Note: SDN is not mandatory for network programmability nor automation

Source: www.opennetworking.org

What Is OpenFlow?

Open protocol that specifies **interactions between de-coupled control and data planes**

Note: OF is not mandatory for SDN

Note: North-bound Controller APIs are vendor-specific



What is OpenStack?

Opensource software for building public and private Clouds; includes Compute (Nova), Networking (Quantum) and Storage (Swift) services.

Note: Applicable to SDN and non-SDN networks

Source: www.openstack.org



What is OpenDaylight

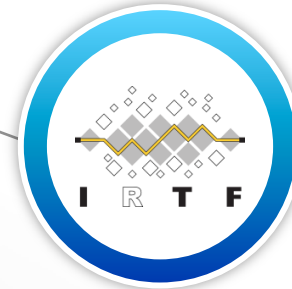
An **Open source Project** under the Linux foundation to develop community led SDN solutions

Note: Applicable to SDN and non-SDN networks



Industry Standards and Forums

802.1 Overlay Networking Projects



SDN WG

Open Network Research Center at Stanford University

Technical Advisory Group, Working Groups:
Config, Extensibility, Futures/FPMOD/OF2.0



Open Source Cloud Computing project



Initiatives:

Quantum (Folsom release)
Donabe



ETSI SGI on "Network Function Virtualization"



Overlay Working Groups:

NVO3, L2VPN, TRILL, L3VPN, LISP, PWE3

API Working Groups/BOFs

NETCONF, ALTO, CDNI, XMPP, SDNP, I2AEX

Controller Working Groups:

PCE, FORCES

Protocol Working Groups:

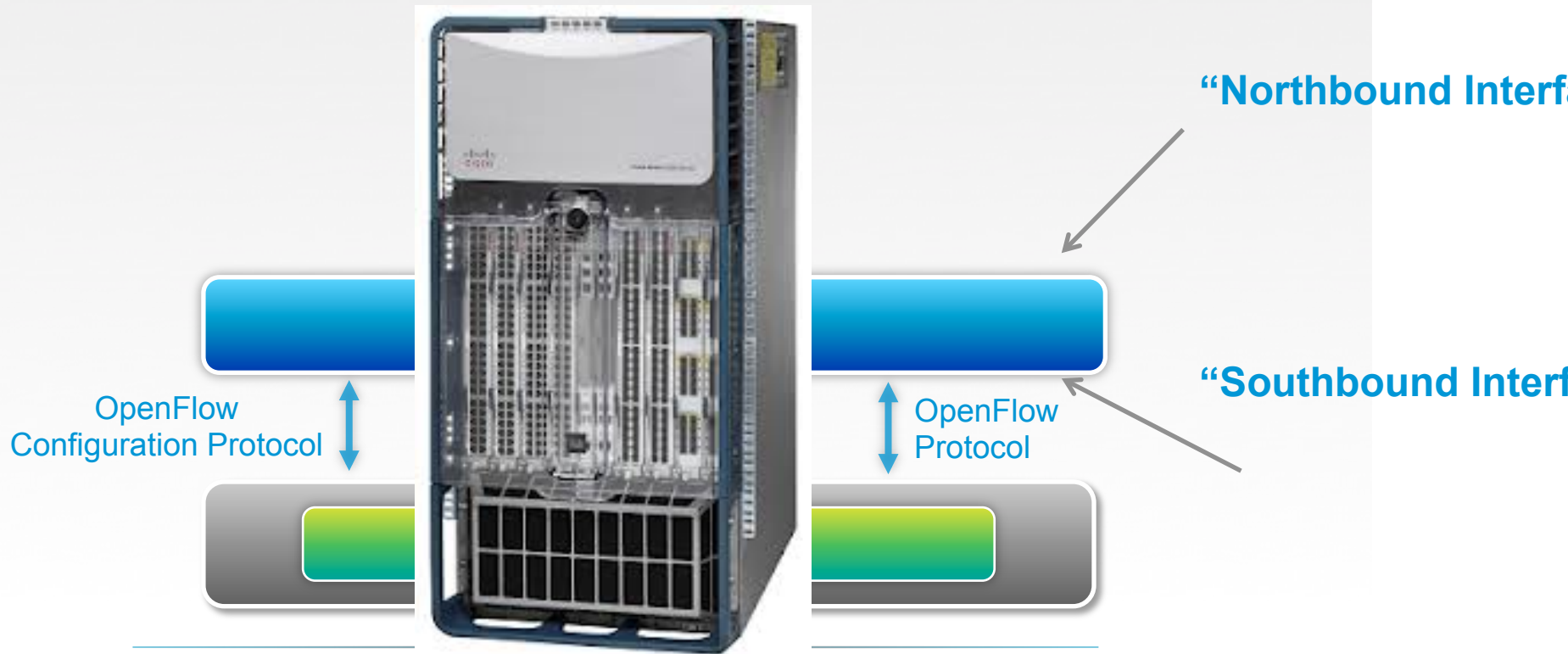
IDR, IS-IS, OSPF, MPLS, CCAMP, BFD

New working group:

I2RS – Interface to the Routing System

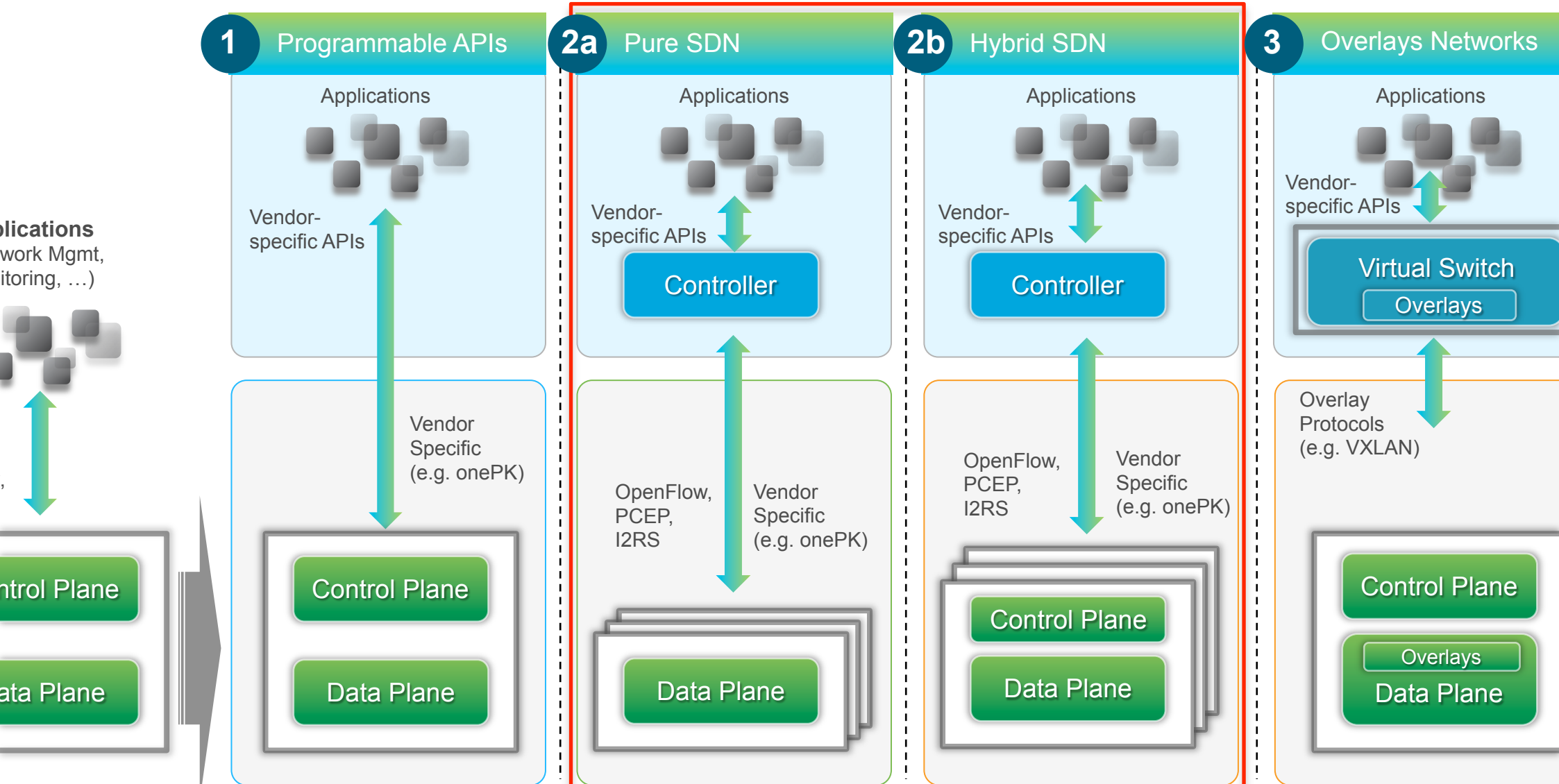
SDN: The Basic Concept

Eg: OpenFlow Approach



Simpler Provisioning, Topology Abstraction

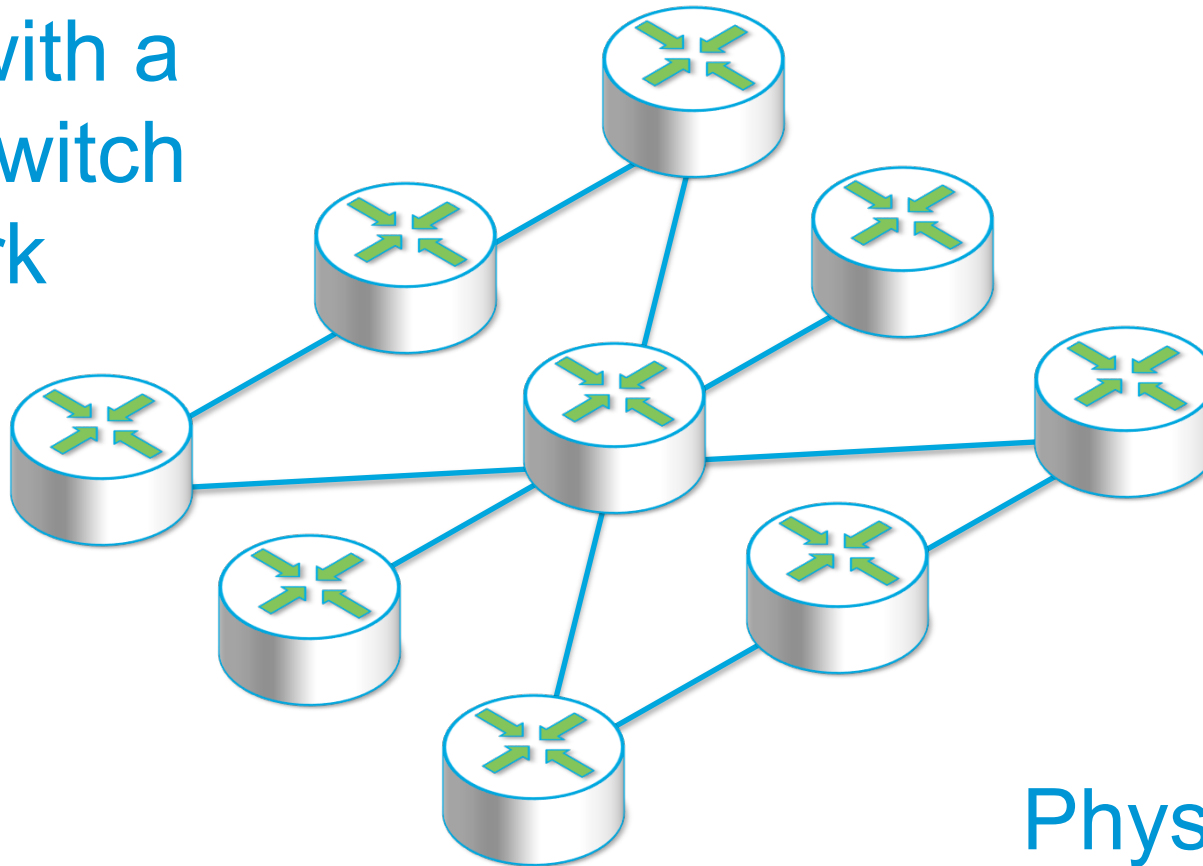
Network Programmability Models



Openstack and Network Overlays Apply to All Models (Physical/Virtual)
Custom Features Can Be Built

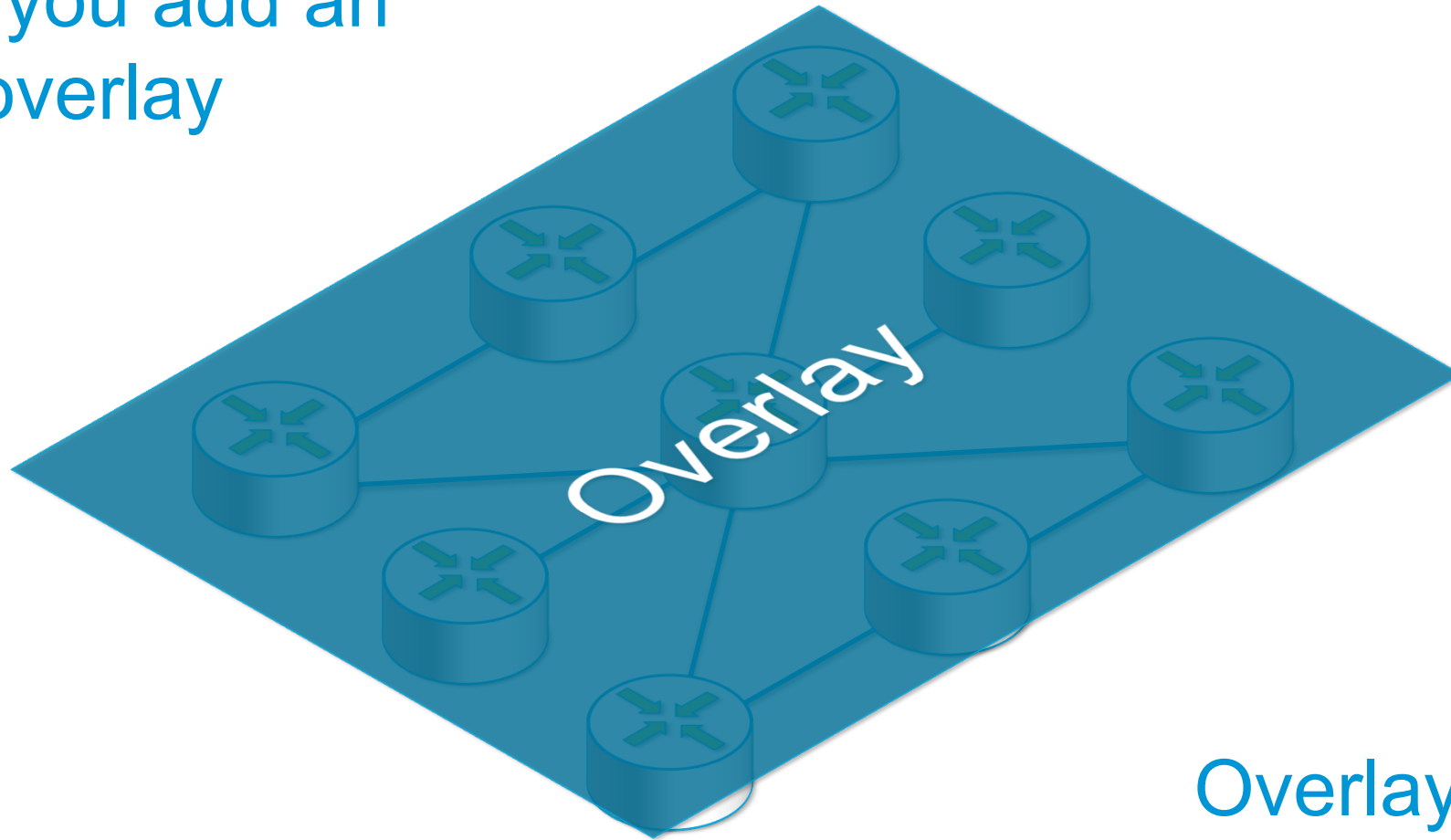
More definitions...

You start with a
Physical Switch
Network



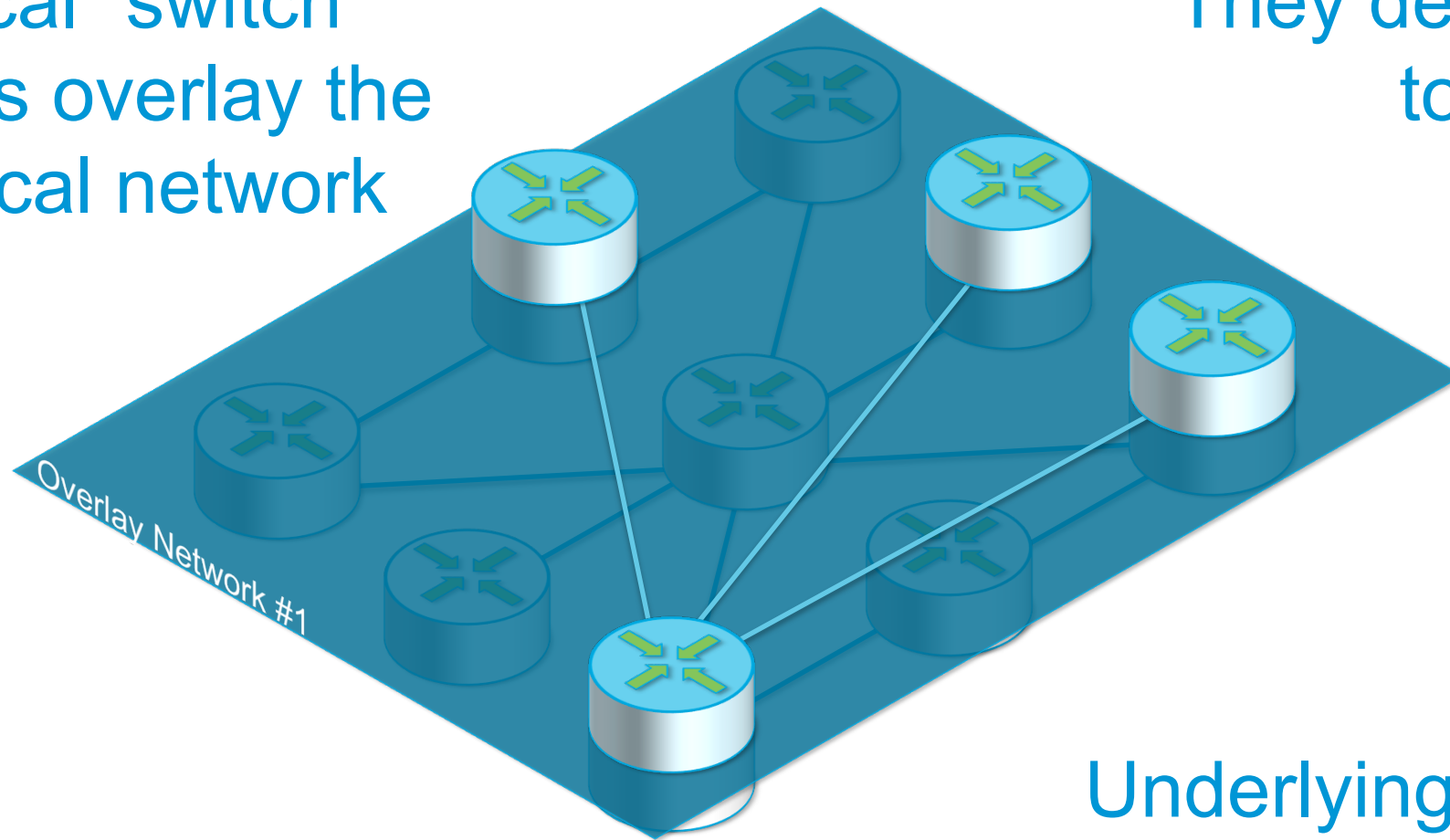
Physical Devices and
Physical Connections

Then you add an
overlay



Overlay provides
base for logical
network

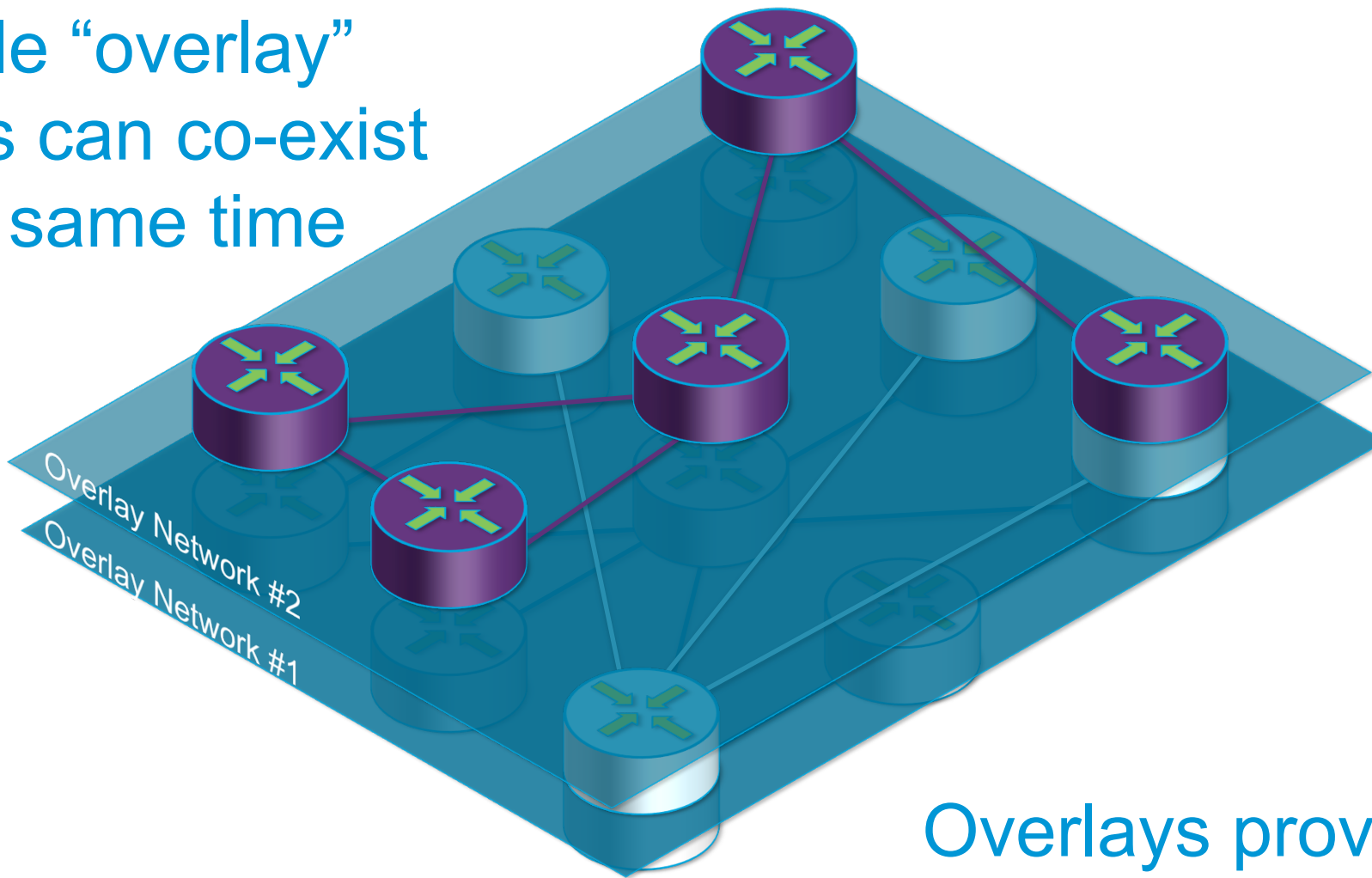
Logical “switch”
devices overlay the
physical network



They define their own
topology

Underlying physical
network carries data
traffic for overlay network

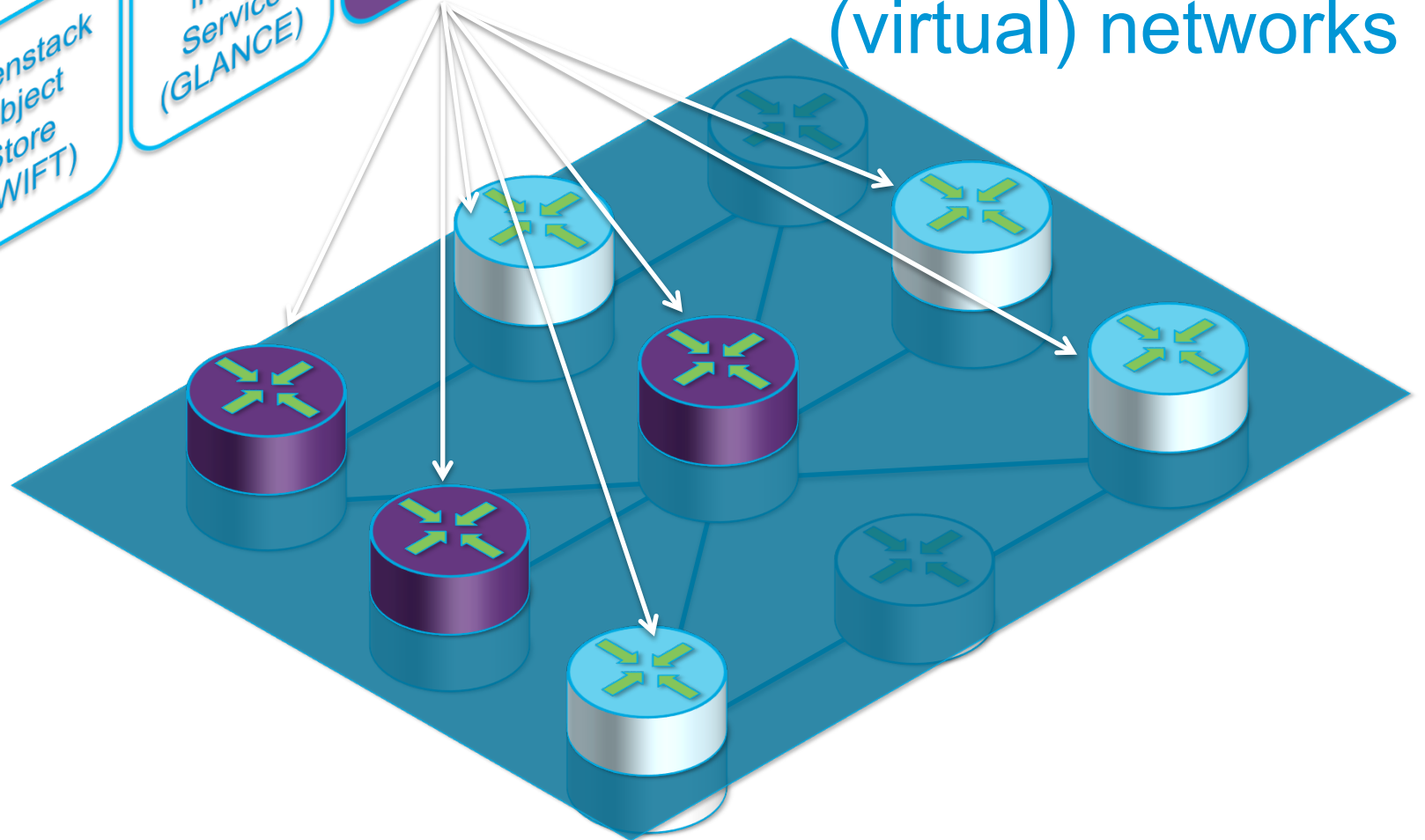
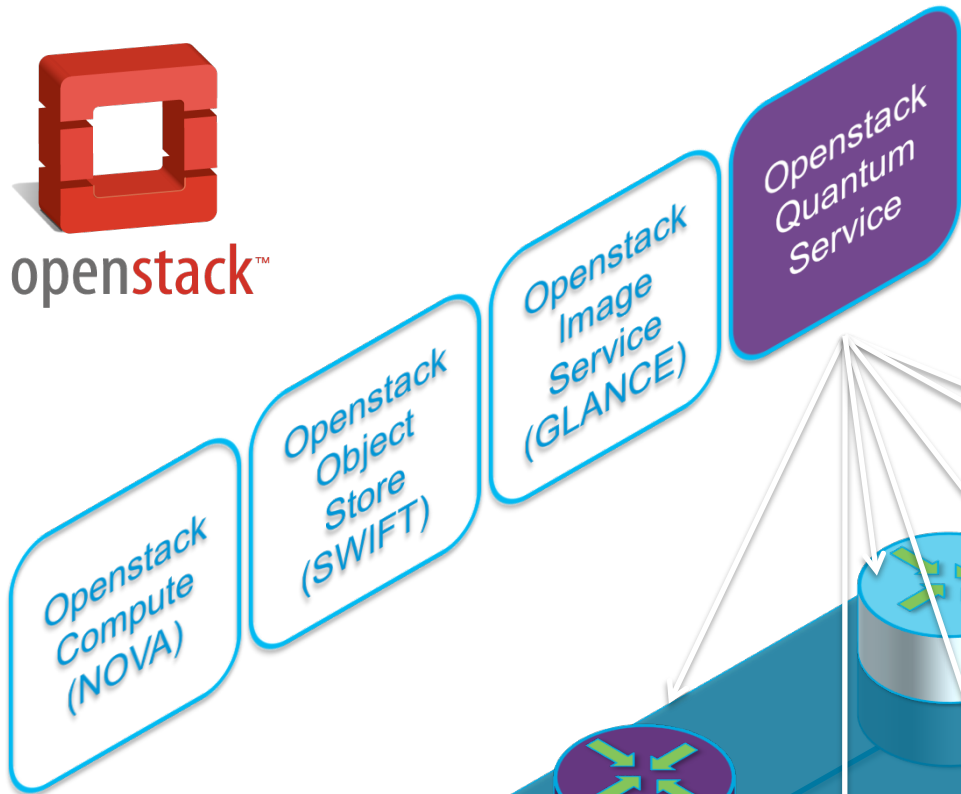
Multiple “overlay”
networks can co-exist
at the same time



Overlays provides logical
network constructs for
different tenants (customer

Main Benefit of Overlays?

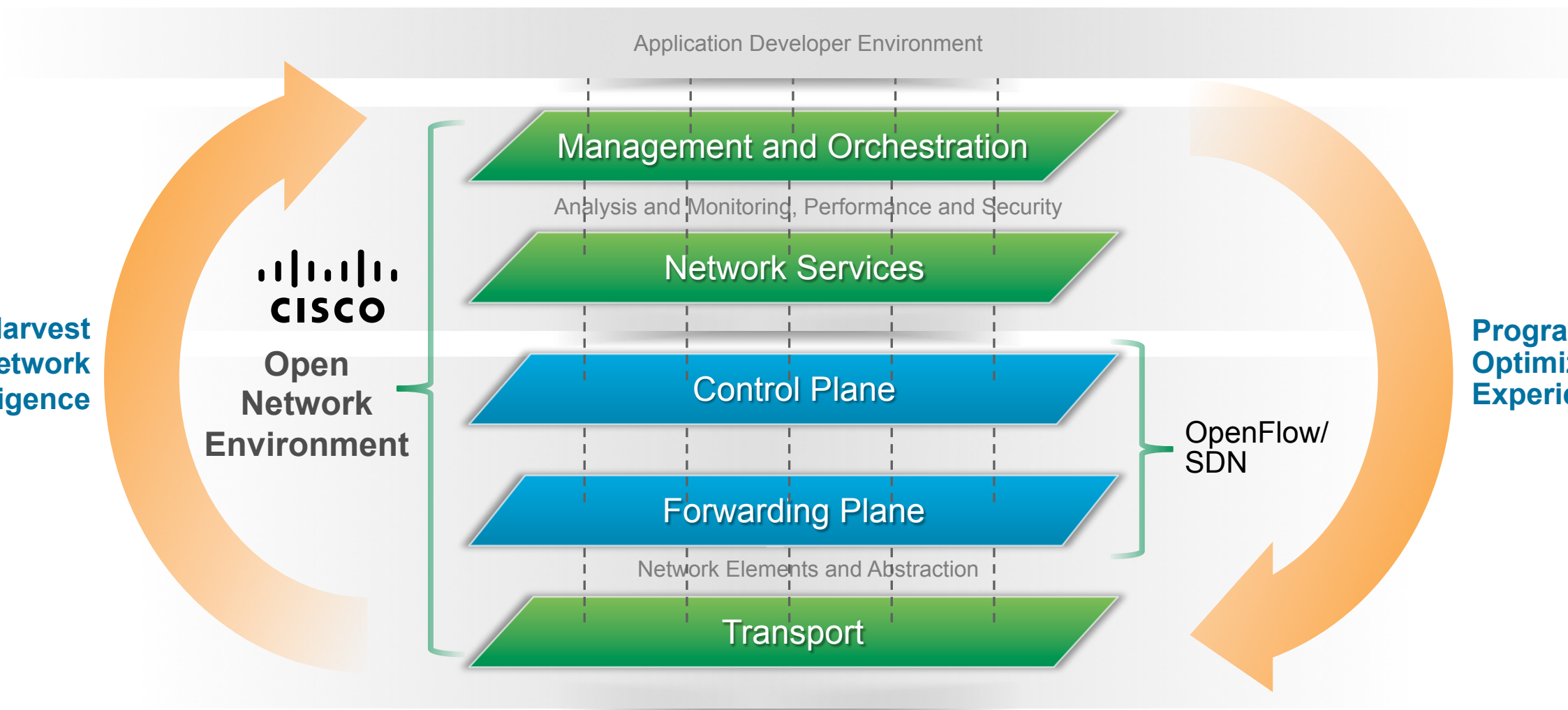
*Overlay Network can be **created and torn down** without **changing** underlying physical network*



Quantum is used to help manage the overlay (virtual) networks

Cisco Approach: Multi-layered Programmability

Flexibility in Deriving Abstractions



Cisco Open Network Environment (ONE)

Bringing the Network Closer To Applications

Hardware + Software

Physical + Virtual

Network + Compute

Applications

**OPEN NETWORK
ENVIRONMENT**

Platform
APIs

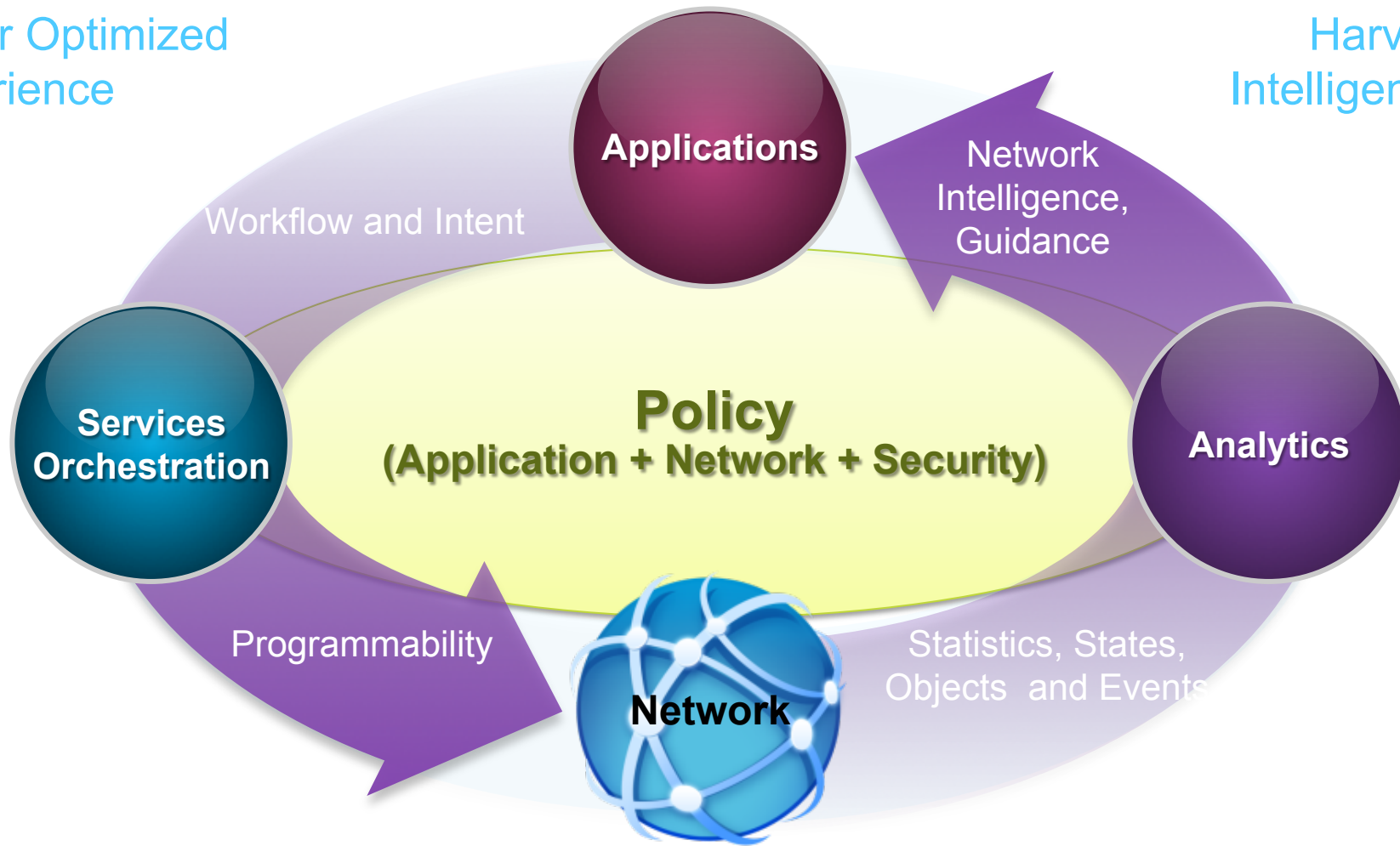
Integrated
Network
Overlays

Controllers
and Agents

Cisco ONE: Applications Define the Network

Program for Optimized Experience

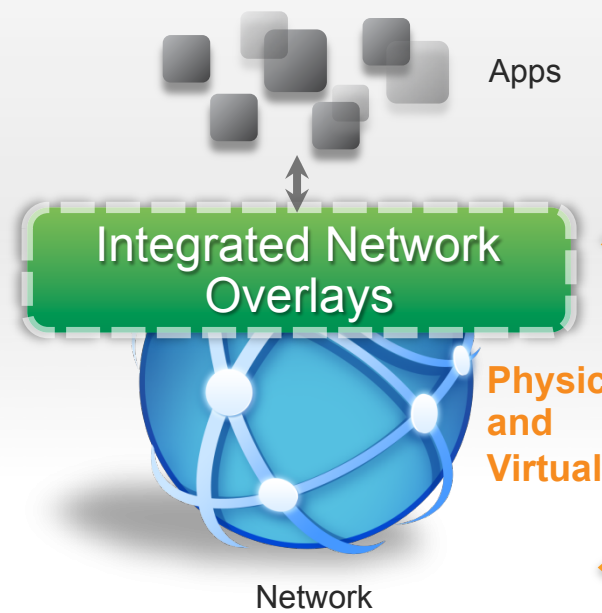
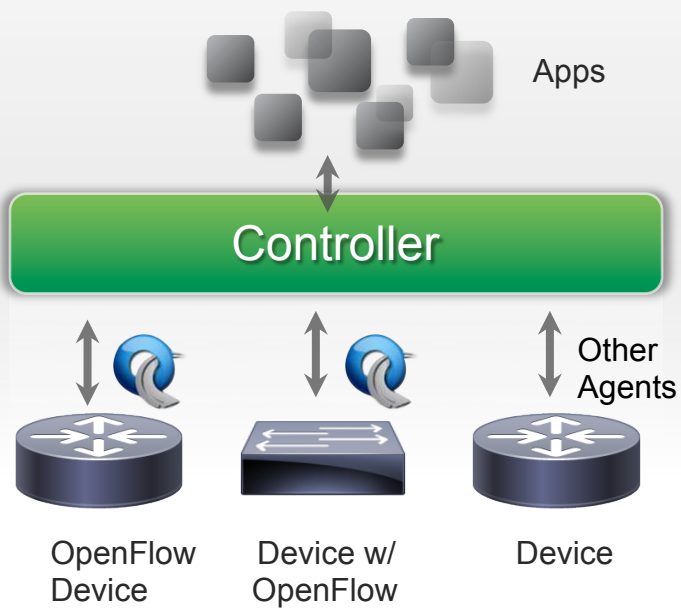
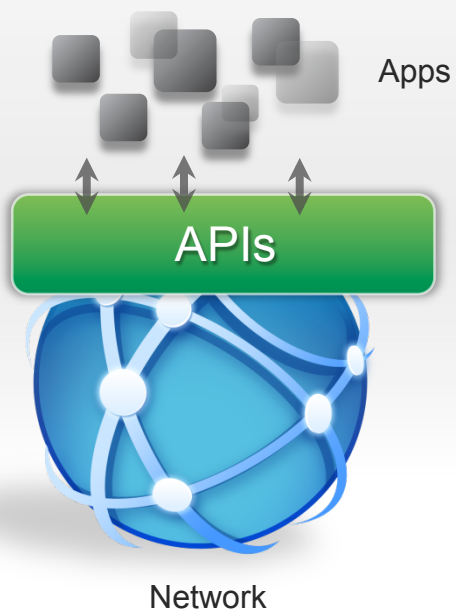
Harvest Network Intelligence and Security



Cisco Open Network Environment

The Power of "AND"

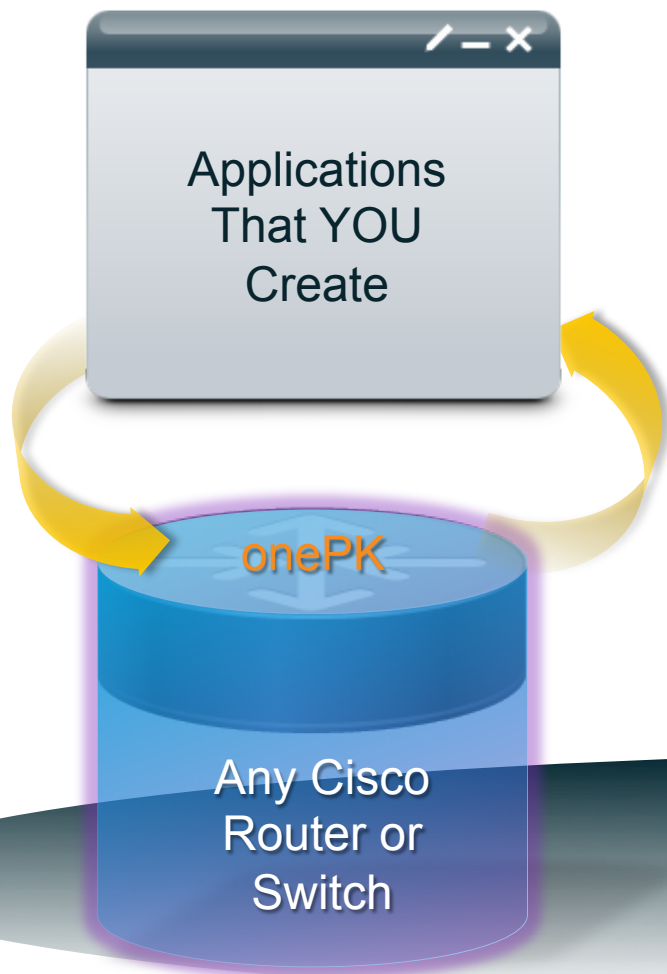
"SDN"



OnePK = One Programmable Kit

“Allows an external application to access, extend or customize the software capabilities of Cisco’s routers and switches via API’s...”

The Promise of onePK

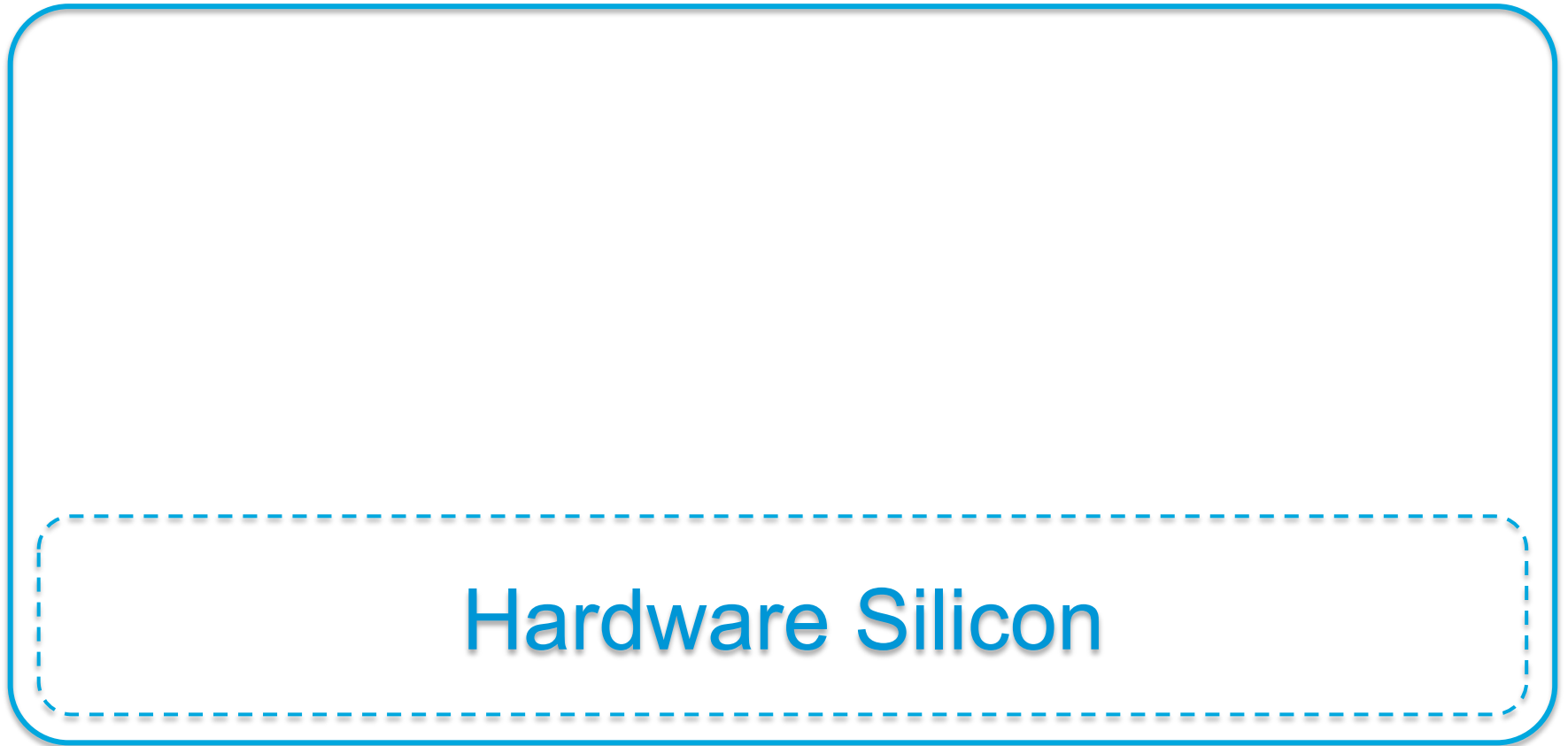


Flexible development environment to:

- Innovate
- Extend
- Automate
- Customize
- Enhance
- Modify



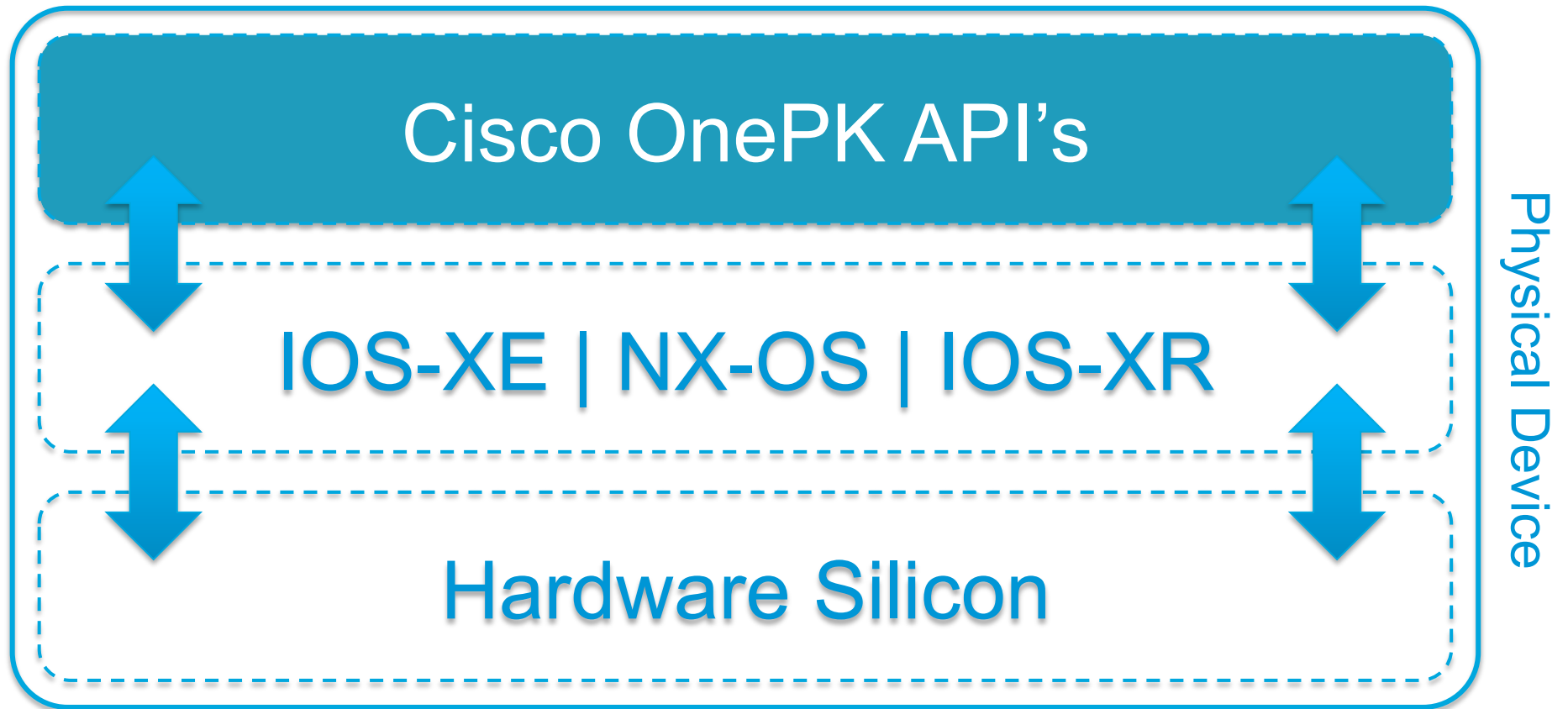
Start with the physical switch or router

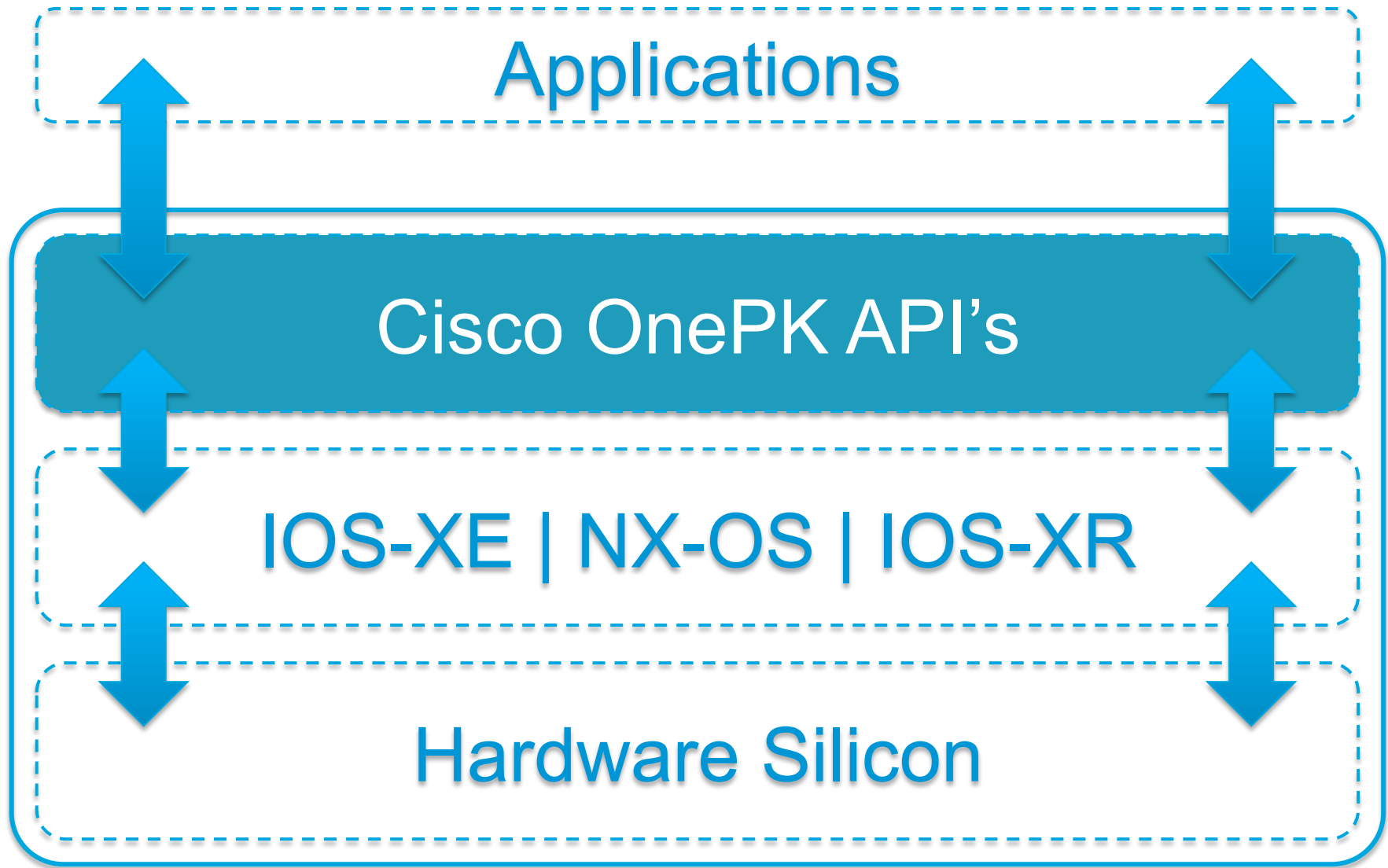


Then add the device OS



OnePK sits on top of the OS





Applications

Cisco OnePK API's

IOS-XE | NX-OS | IOS-XR

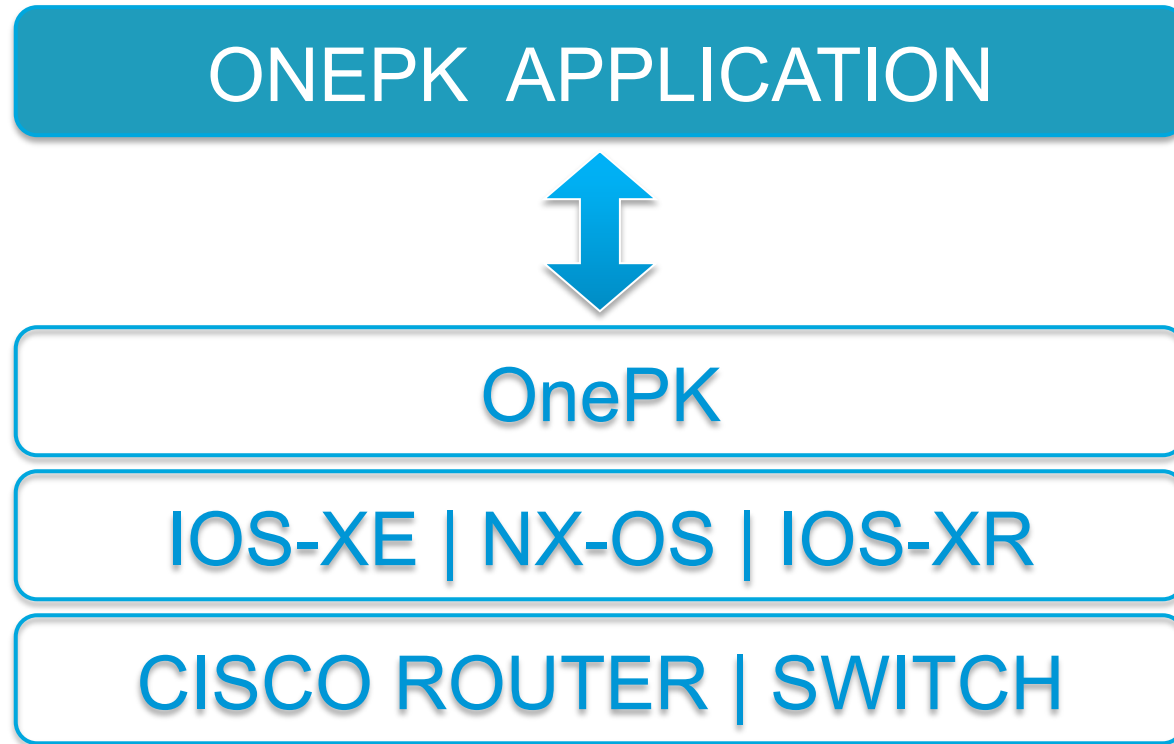
Hardware Silicon

Physical Device

Applications could be...

Off the Shelf (3rd Party) or Homegrown

i.e. someone is going to have to write them



Cisco Developer Network for onePK

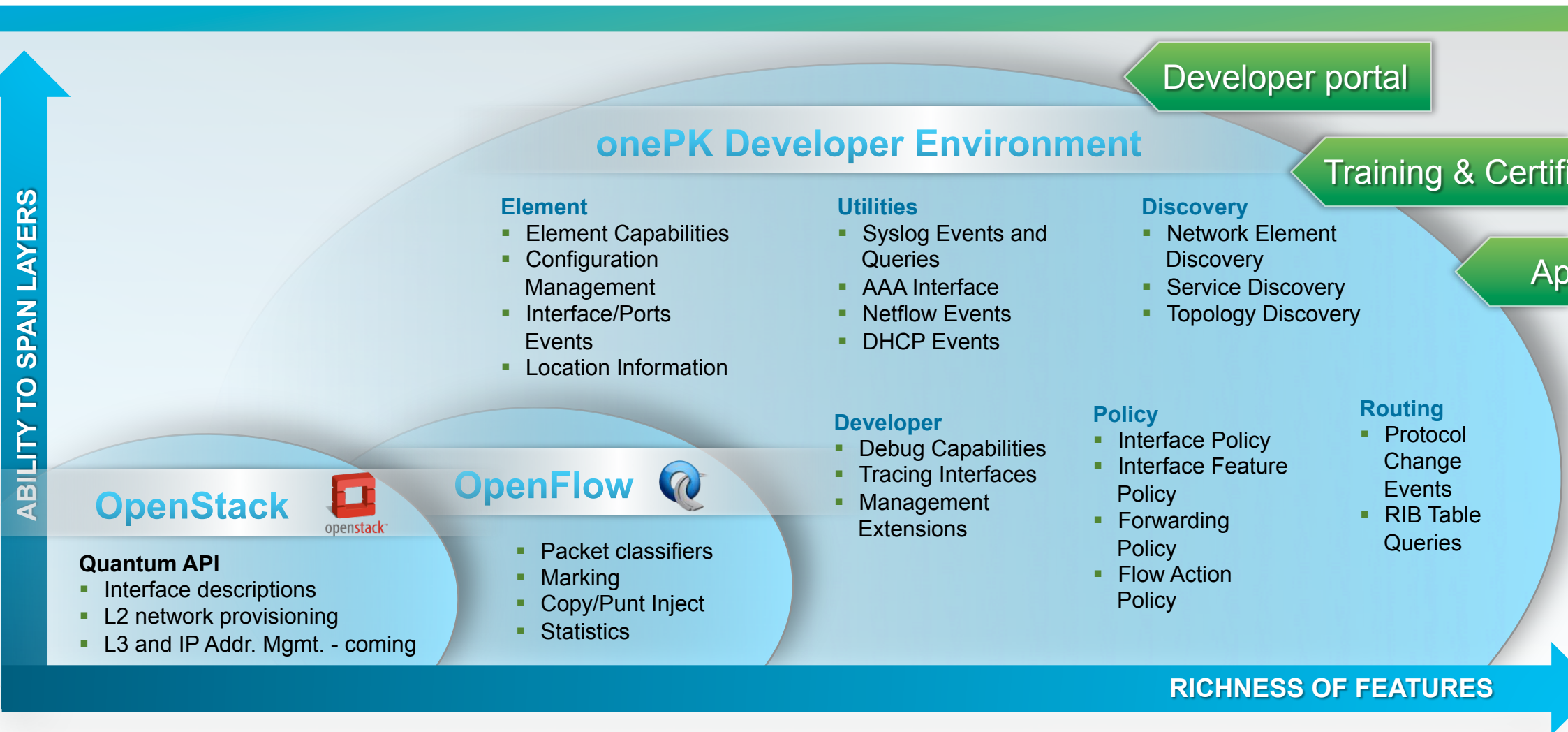
- Establishing Rich Ecosystem of Development Partners
- Tools to Help Write and Test Code
- Developer service set to help troubleshoot code
- Training Videos, sample code
- Discussion Forums

The screenshot shows the Cisco Developer Network onePK Developer Center. The page features a navigation bar with links for Home, Documentation, Media, and FAQ. Below the navigation bar, there are two main sections: "Get Started with onePK" and "Technical Overview of onePK". The "Get Started with onePK" section includes a sub-header and a paragraph: "Ramp up with onePK in no time. In a few easy steps, we'll have you up-to-speed on everything you need to know to develop with onePK". The "Technical Overview of onePK" section includes a sub-header and a paragraph: "Not sure onePK is right for you and your organization? The technical overview describes the basics: how to integrate with onePK, where it fits in the architecture, and how to install." Below these sections, there are three columns of content: "Review the Documentation" with a sub-header and a paragraph: "This guide includes overview, instructions and other information"; "Check out the Media" with a sub-header and a paragraph: "Check out Media related to onePK"; and "Sign Up for More Information" with a sub-header and a paragraph: "Sign up for the 'Get Your Build On' Monthly Newsletter, full of educational information, tips, tricks & technical insight into software at Cisco." Each column has a corresponding icon and a link to the respective content.

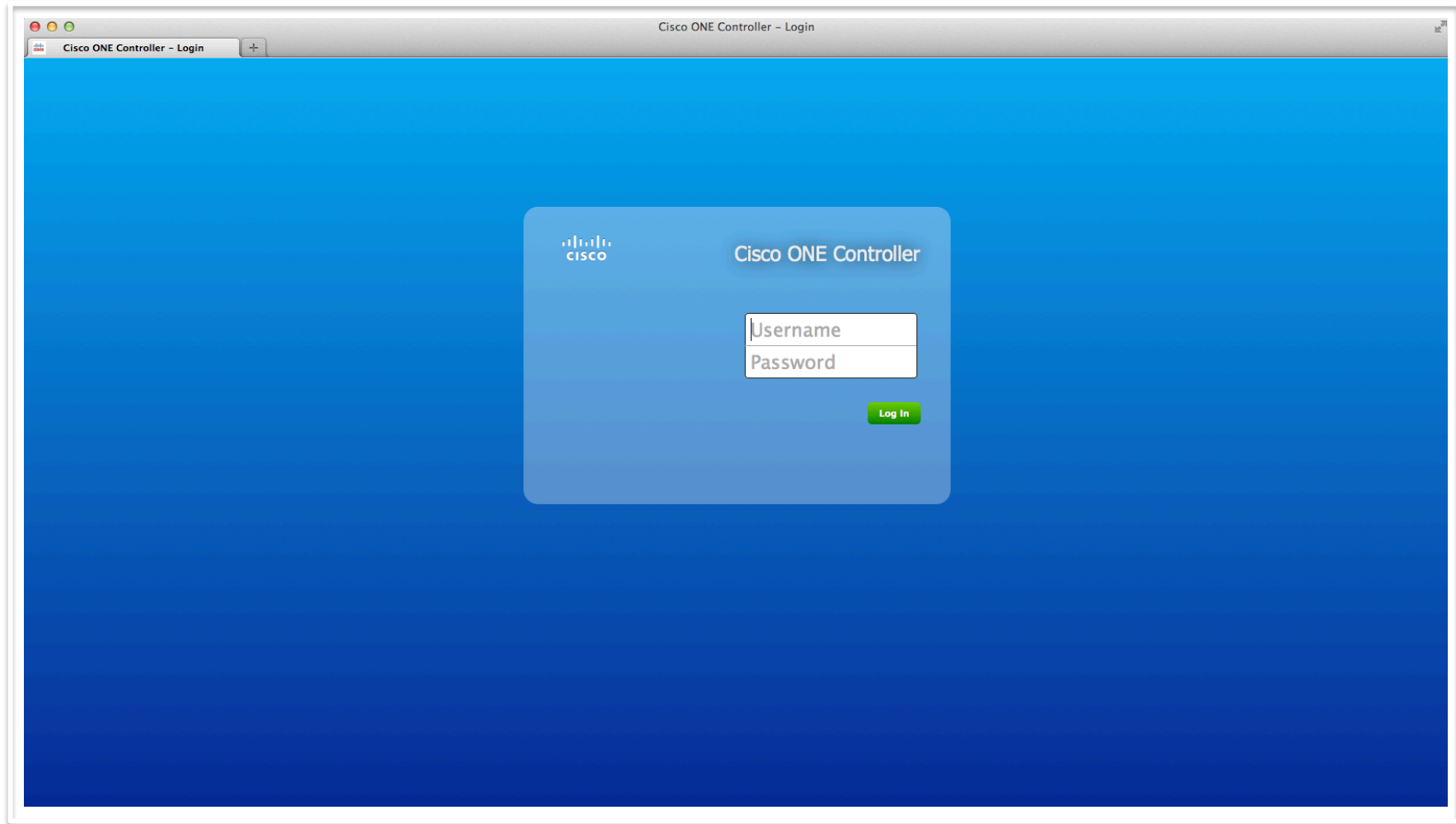
<http://developer.cisco.com/web/onepk>

Open Network Environment – Flexibility to Choose

Use-case Driven Approach



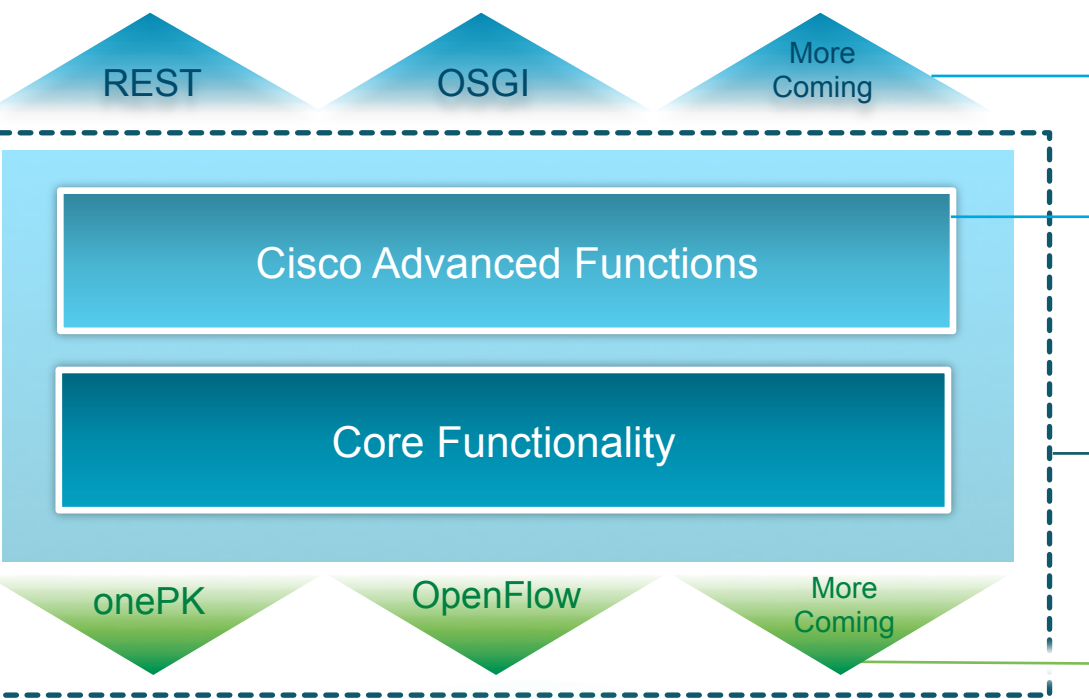
Cisco ONE Controller



Yes,... it is true
We are building a Controller

Cisco ONE Controller

Industry's Most Extensible Controller



Ex. Low Latency Routing, Network Tap

Northbound: Published open APIs with more to follow

Ex. Network Slicing

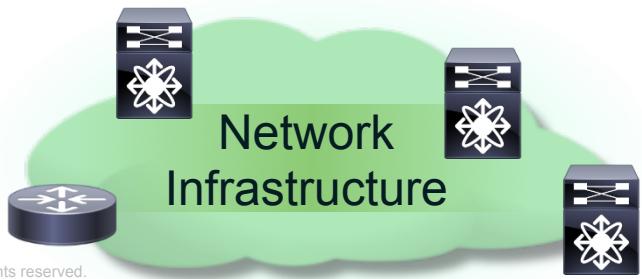
Scale-out architecture

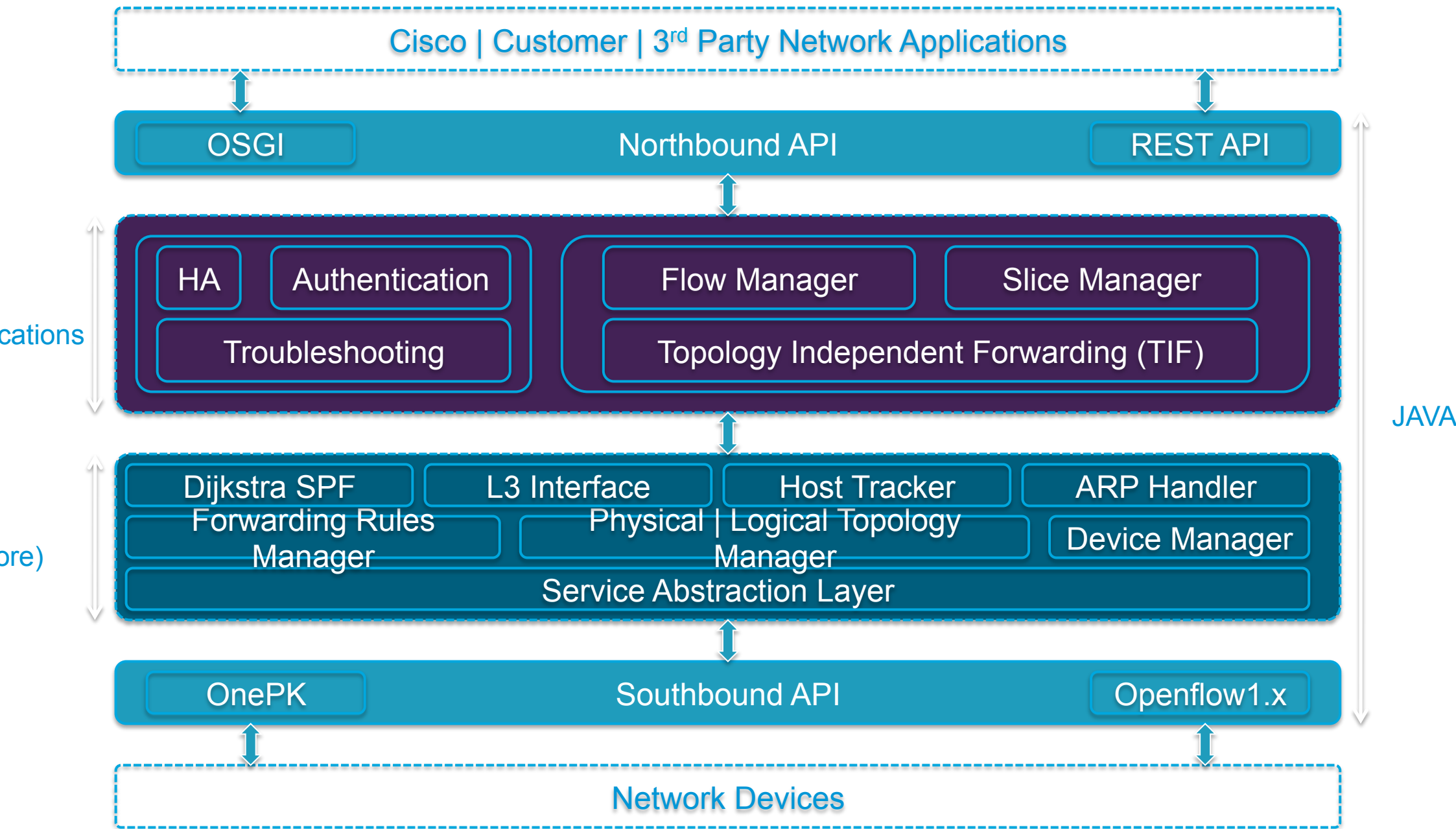
Highly Available

Consistent management, troubleshooting and security

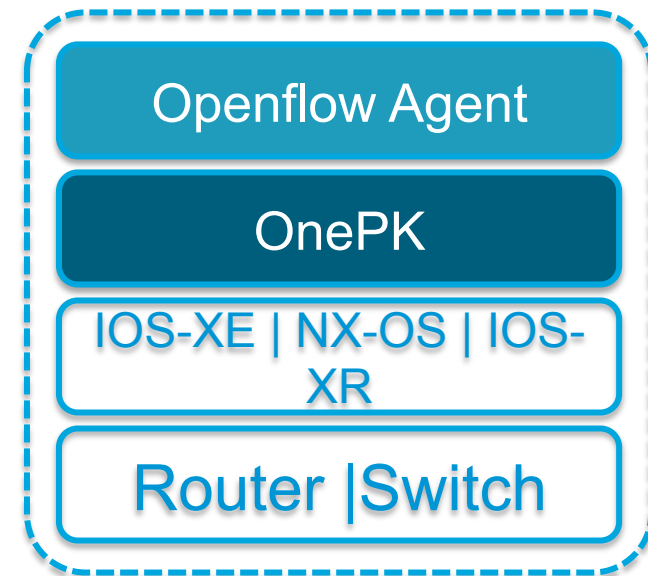
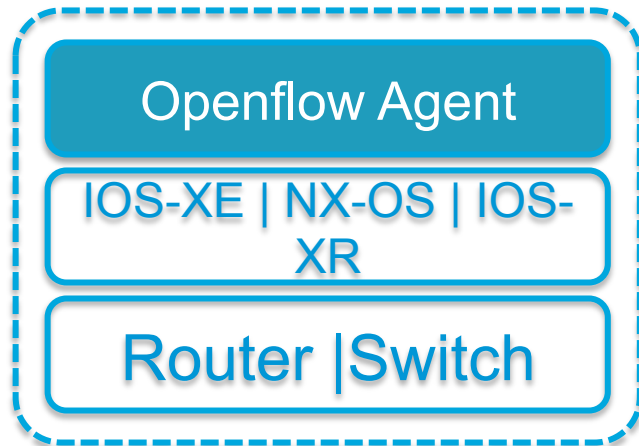
Modular functionality via Java Framework

More Southbound interfaces to follow





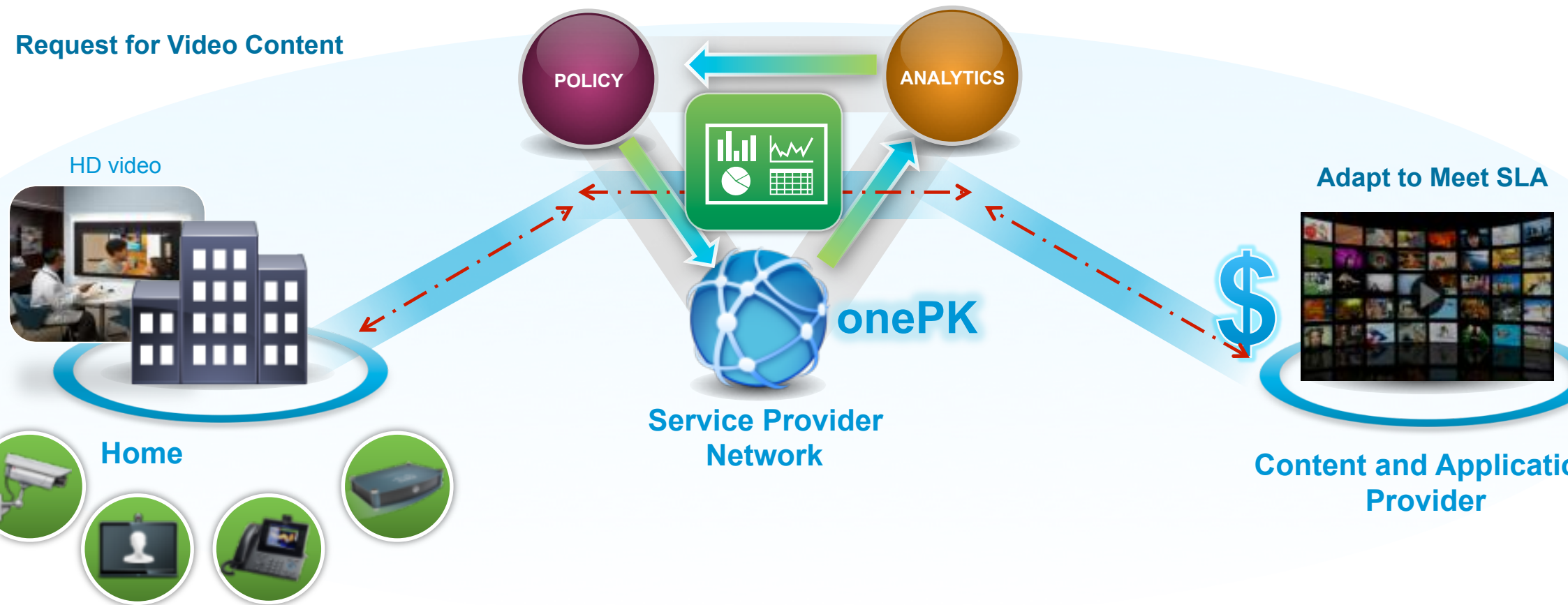
Two methods for running the O/F Agent



You will see two types of agents in the coming months

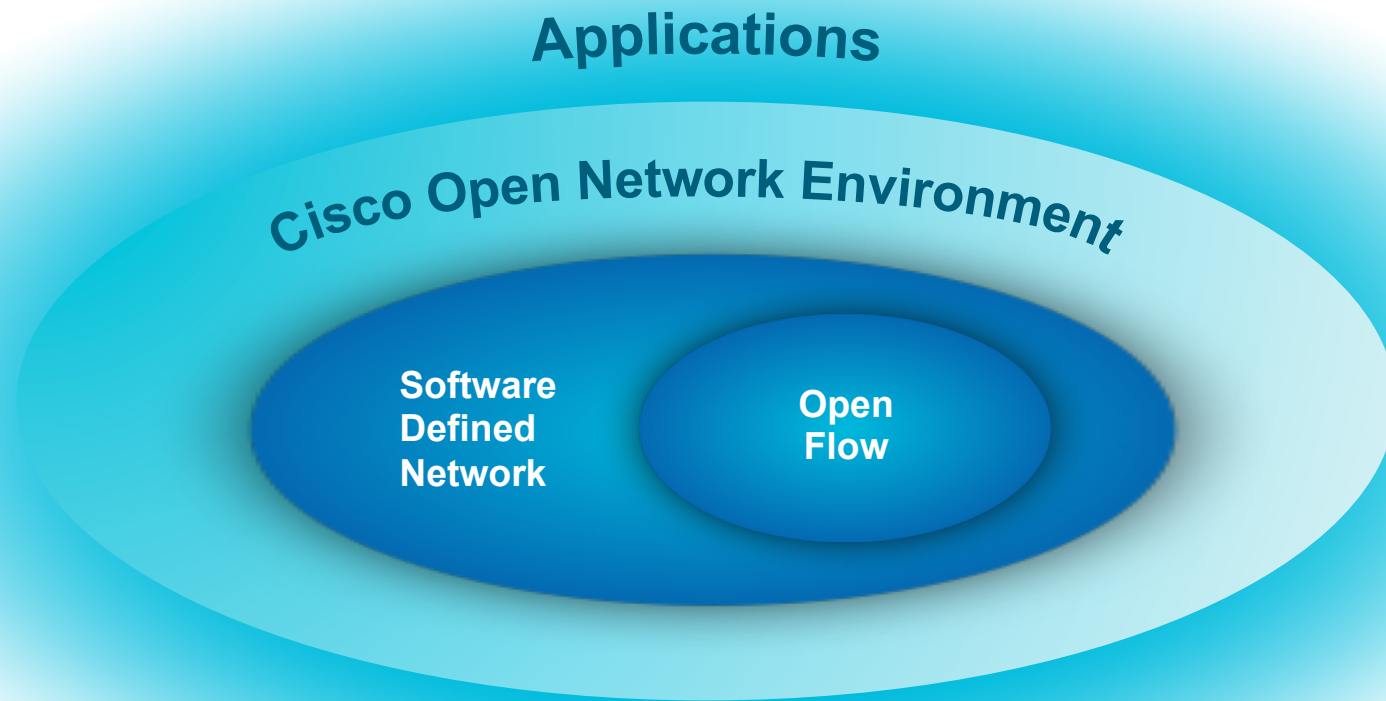
Case Case: Agile Service Delivery for Service Providers

Monetize Via Real-time Network Adaptation and Maintain SLA



Adaptive Architecture Optimizes Resource Utilization

Cisco Open Network Environment Bringing the Network to Applications



Information Portals

Worldwide [change] Welcome, Nagataj Kiran Account Log Out My Cisco

Products & Services Support How to Buy Training & Events Partners

Cisco Open Network Environment

Overview In Depth Why Cisco Resource Library

A Network That Pays Attention

Build a network that listens, responds, and adapts to your apps in real time. (2:12 min)

Your Apps Talk, And the Network

LISTENS RESPONDS ADAPTS

Visit Cisco ONE Knowledge Portal

Browse the latest information on network programmability, SDN, and more.

Start Here >

The Possibility of Programmable Networks

Today, trends such as cloud, video, BYOD, and big data are poised to help you increase employee productivity and take better care of your customers. And once again, the network is playing a central role.

Cisco Open Network Environment is a portfolio of Cisco technologies and open standards that give you programmatic control of your network. You need your network and your applications to work together - and that's exactly what the Open Network Environment does for you.

- The **Cisco onePK** developer kit includes a rich set of platform APIs to allow your apps to directly control Cisco switches and routers.
- **Cisco controller and agent technology** supports emerging protocols such as OpenFlow.
- **Virtual overlay network technologies** based on the **Cisco Nexus 1000V Switch** allow your virtualized workloads to directly control their network services without forgoing the capabilities you have come to expect from your physical network.

There is no "one-size-fits-all" solution in networking, and programmability is no exception. Cisco Open Network Environment gives you a choice of technologies and lets you pick the solution that best matches your needs, from platform-level control to broader infrastructure-level solutions like the **Cisco Edition of OpenStack**.

With the Cisco Open Network Environment, the network listens to what your customers want and your employees need. Then it adapts accordingly, keeping pace with today's on-demand world.

Stay Current on Cisco ONE

Get the latest information on Cisco Open Network Environment (ONE) through news and blogs.

[Get Updates](#)

Increase Revenue and Flexibility

Cisco One Platform Kit (onePK) gives you the flexibility to build systems the way you want. (2:12 min)

[See How](#)



Knowledge Portal

Looking for whitepapers, solution briefs, and more?

[Enter the knowledge portal](#)

Cisco ONE Knowledge Portal



Newsroom Portal

Read the latest blogs, analyst and news reports.

[Visit the newsroom portal](#)

Cisco ONE Newsroom portal

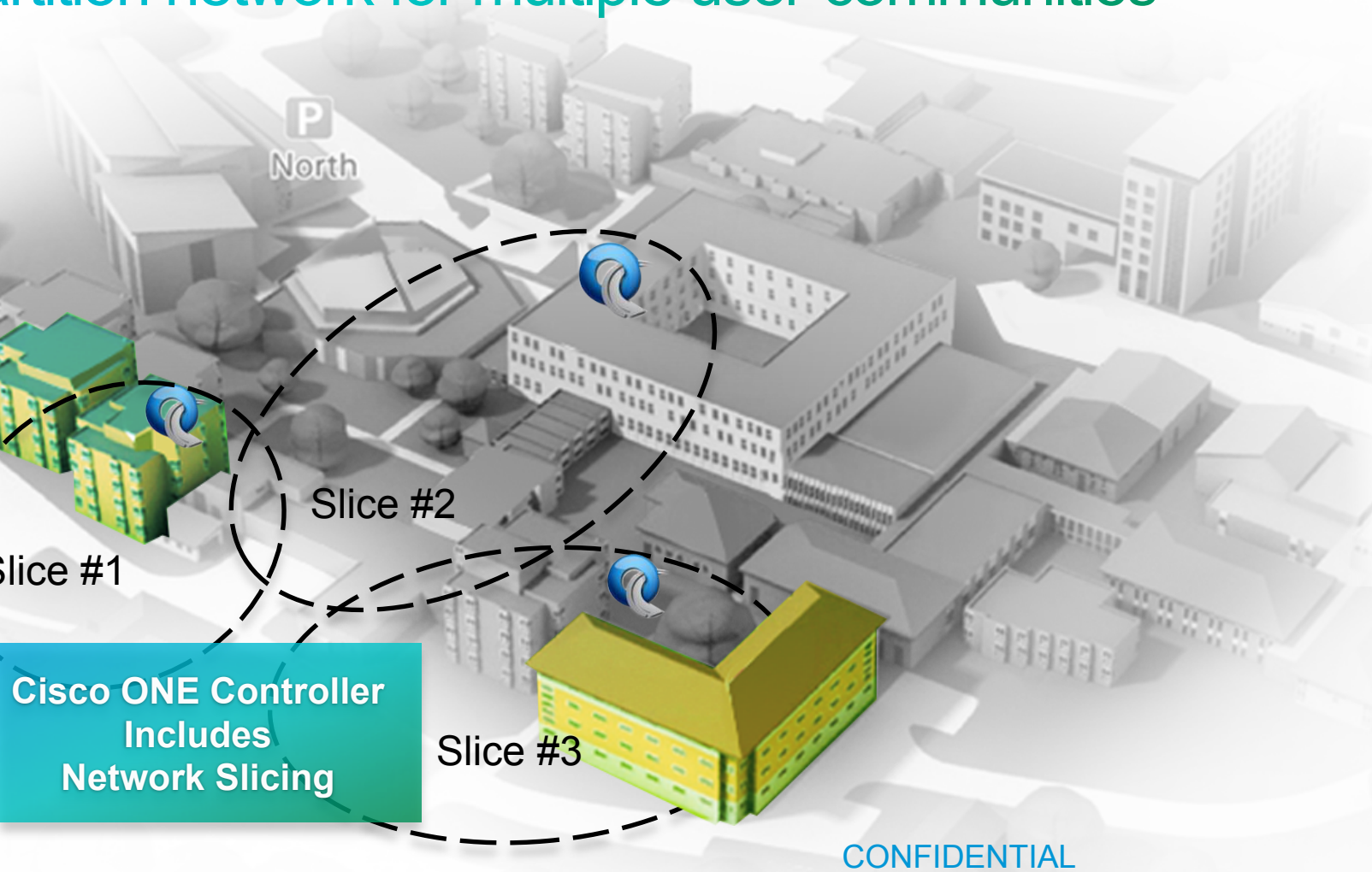
<http://www.cisco.com/go/one>

Thank you.



What is Network “Slicing”?

Partition network for multiple user-communities



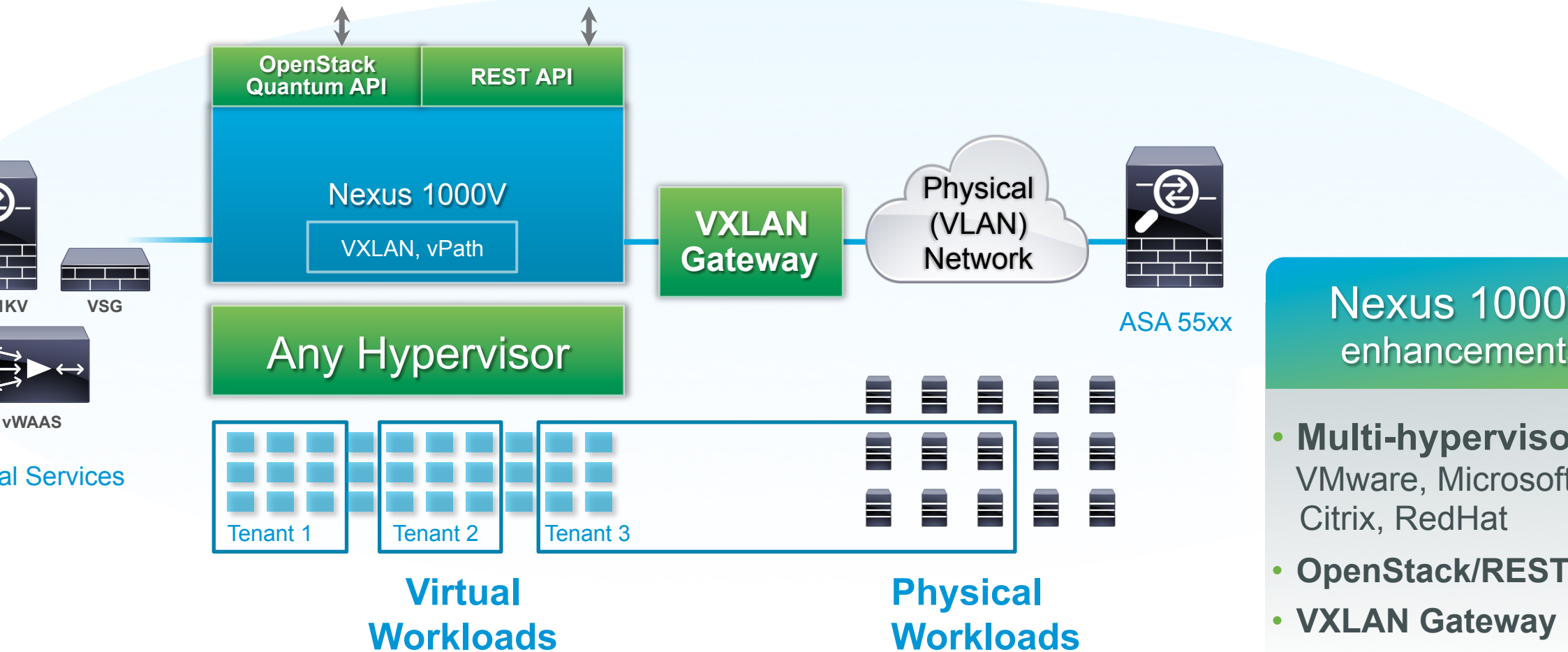
Features

- Dynamic network partitioning from “one pane of glass”
- Flowspec policy enforcement
- Production worthy slice isolation
- Seamless integration with custom forwarding
- ***No flowvisor required***

Consistent policy management for maximum flexibility and Innovation

Virtual Overlay Networks

Scalable Multi-tenant Cloud Infrastructures – foundation for Secure Hybrid cloud



Secure Consistent Experience Across Physical and Virtual Environments