Software Defined Networking and Use Cases

BRKARC-2663

TOMORROW
starts here.

Abstract

- Today, with the emergence of uber-trends like cloud, mobility/BYOD, virtualisation, video and the resulting data deluge, the role of the network is all the more strategic in customer environments. Organisations want the network to evolve into business and application enablers - contributing to business agility, simplifying operations and providing accelerated monetisation/revenue generation opportunities. Enter Open Network Environment (ONE). This session articulates Cisco's approach to these trends via Cisco ONE. While there is a lot of buzz in the market place around emerging concepts like Software-defined Networking (SDN), Cisco's approach will help put these things in perspective, articulate a use case driven framework for SDN & Programmability, and detail out how customers can harness the intelligence and value that we embed into our network infrastructure. With better tie-in to analytics, policy engines and with the concept of multi-layer programmability, Cisco allows customers to choose an evolutionary and pragmatic approach to addressing the uber-trends of today.

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Related Sessions

Session ID	Title	Presenter
BRKSPG-2662	Software Defined Networking (SDN) Architectures and Implications	Dave Ward, VP SP Chief Architect & CTO, Cisco
PNLRST-4601	Delivering Real Software Defined Networking (SDN) Solutions without the Hype	Panel Session
BRKARC-2662	Software Defined Networking and Use Cases	Ken Hook, Sr. Product Manager, ONE/SDN Marketing, Cisco

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Agenda

- SDN Landscape Summary
- Categories of Programmability
- Cisco ONE Strategy
- Use Case Overview

SDN Landscape Summary

"…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…"

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

"A way to optimise link utilisation in my network enhanced, application driven routing"

"An open solution for customised flow forwarding control in and between Data Centres"

"A platform for developing new control planes"

"An open solution for VM mobility in the Data-Centre"

"Develop solutions at software speeds: I don't want to work with my network vendor or go through lengthy standardisation."

"A solution to automated *network* configuration and control"

"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 behaviour"

Diverse Drivers
Common Concepts
Different Execution Paths

"A means to scale my fixed/mobile gateways and optimise their placement"

"A way to scale my firewalls and load balancers"

"A way to optimise broadcast TV delivery by optimising cache placement and cache selection"

"A way to build my own security/encryption solution"

"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"

## Simplified Operations – Enhanced Agility – New Business Opportunities

Divergent Customer Ask via SDN

"Common Theme Programmability/Automation"

Research/ Academia	Massively Scalable Data Centre	Cloud	Service Providers	Enterprise
▪ Experimental OpenFlow/SDN components for production networks	▪ Customise with Programmatic APIs to provide deep insight into network traffic	▪ Automated provisioning and programmable overlay, OpenStack	▪ Policy-based control and analytics to optimise and monetise service delivery	▪ Virtual workloads, VDI, Orchestration of security profiles
Network "Slicing"	Network Flow Management	Scalable Multi-Tenancy	Agile Service Delivery	Private Cloud Automation

Diverse Programmability Requirements Across Segments
Most Requirements are for Automation & Programmability

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Network Programmability Models
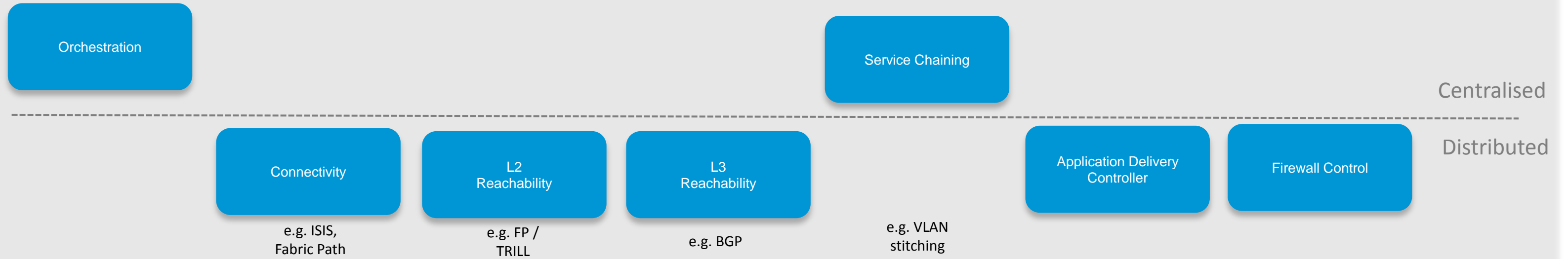## Implementation Perspective: Evolve the Control-Plane Architecture
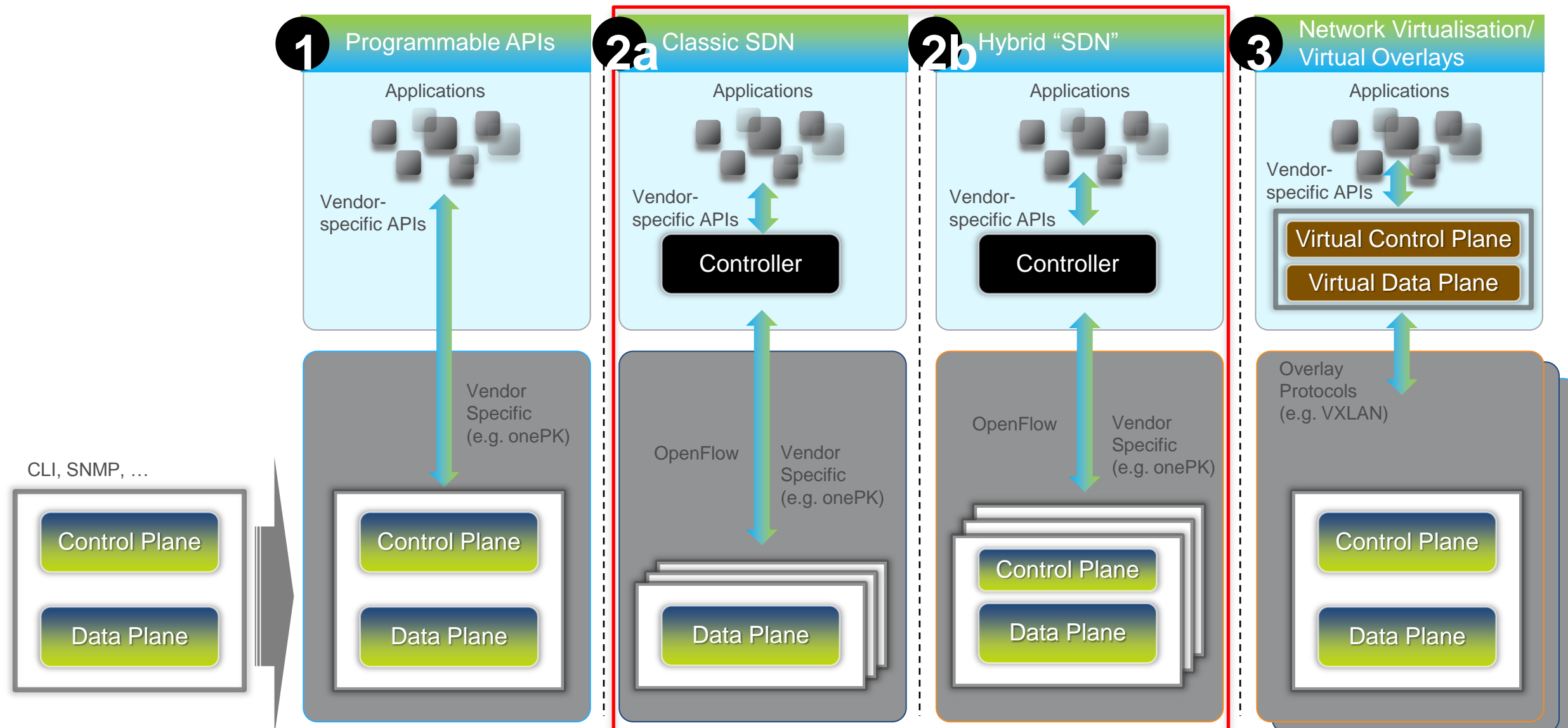
Openstack and Network Overlays Apply to All Models (Physical/Virtual)
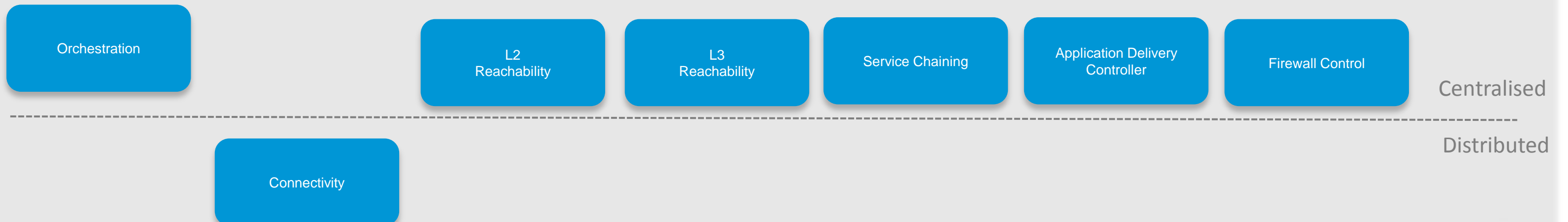Custom Features Can Be Built
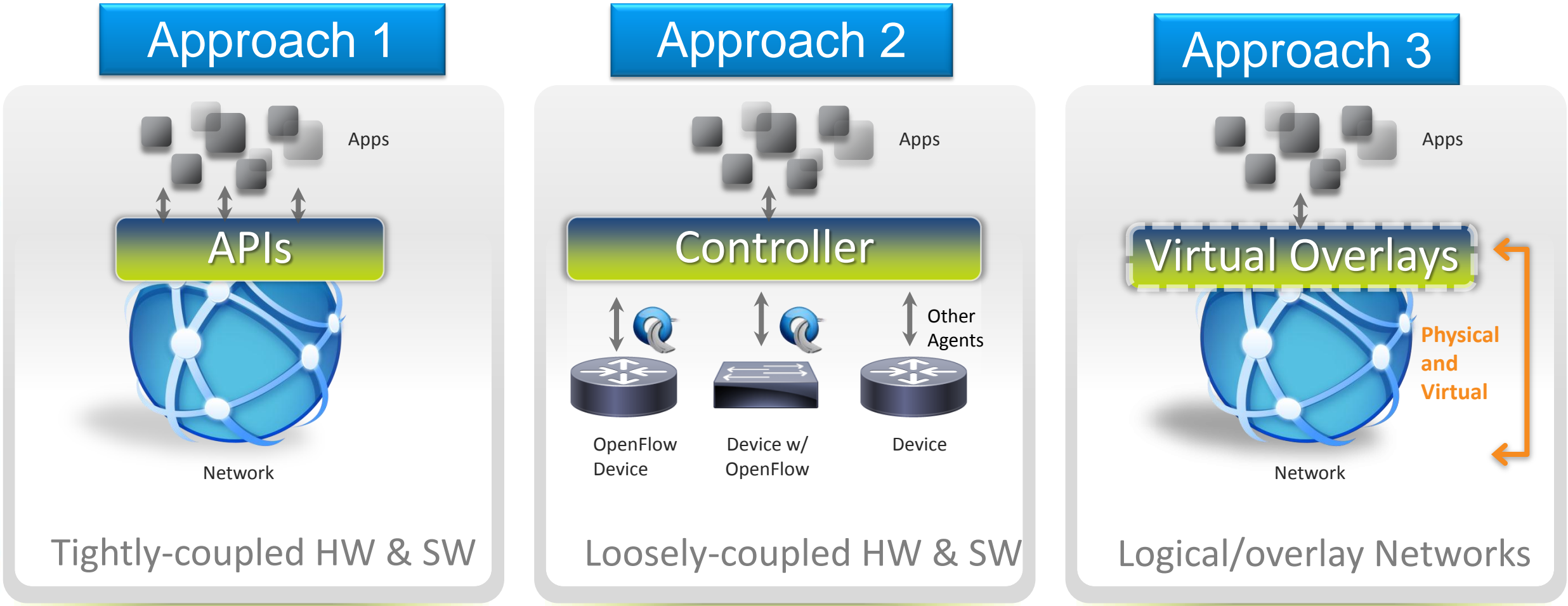
Today's Networking
Versus Classical SDN Concept

VMDC Architecture

Orchestration

Service Chaining

Centralised

Distributed

Connectivity

L2 Reachability

L3 Reachability

Application Delivery Controller

Firewall Control

e.g. ISIS, Fabric Path

e.g. FP / TRILL

e.g. BGP

e.g. VLAN stitching

SDN / OF: Conceptual Only

Orchestration

L2 Reachability

L3 Reachability

Service Chaining

Application Delivery Controller

Firewall Control

Centralised

Distributed

Connectivity

Implementing Customer Use Cases

Approach 1
APIs

Apps

Network

Tightly-coupled HW & SW

Approach 2
Controller

Apps

Other Agents

OpenFlow Device

Device w/ OpenFlow

Device

Loosely-coupled HW & SW

Approach 3
Virtual Overlays

Apps

Physical and Virtual

Network

Logical/overlay Networks
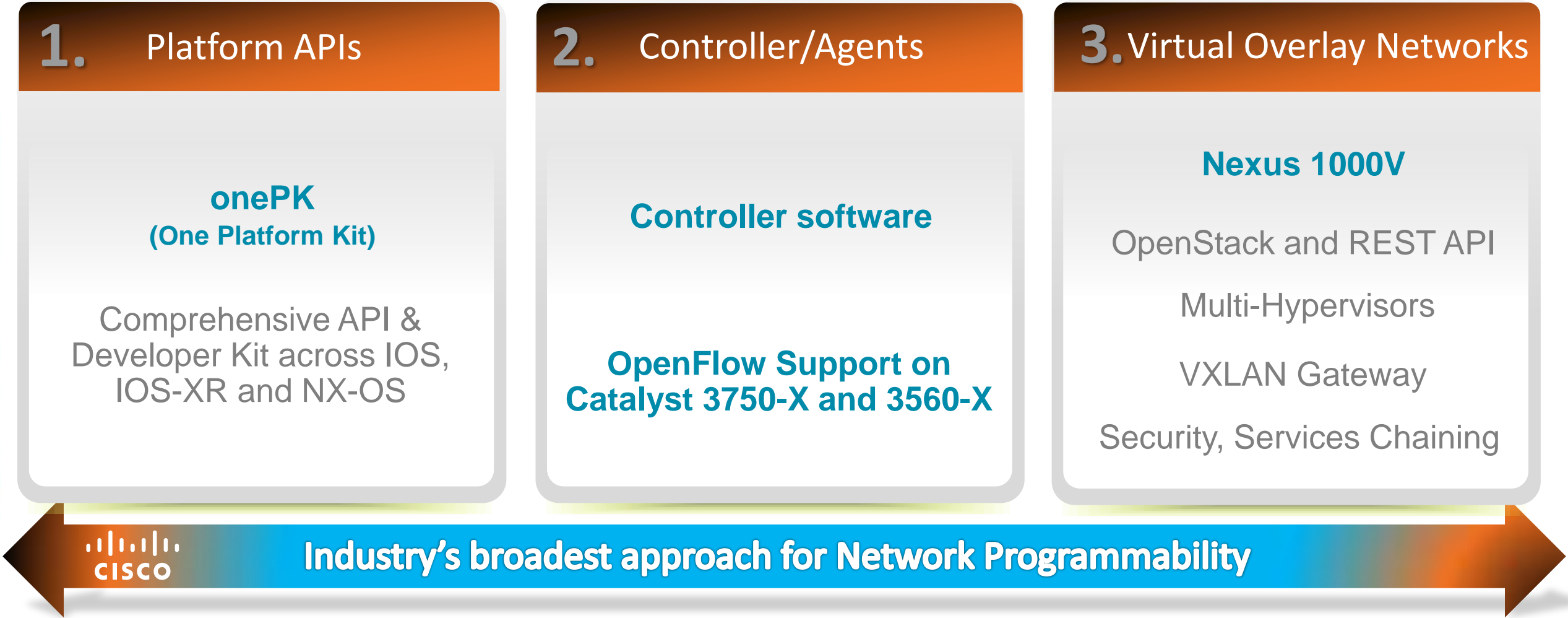
Cisco Approach: Flexibility to Choose—The Power of "AND"

Cisco Open Networking Environment

Phased availability and customer trials from Q4 CY 2012

1. Platform APIs
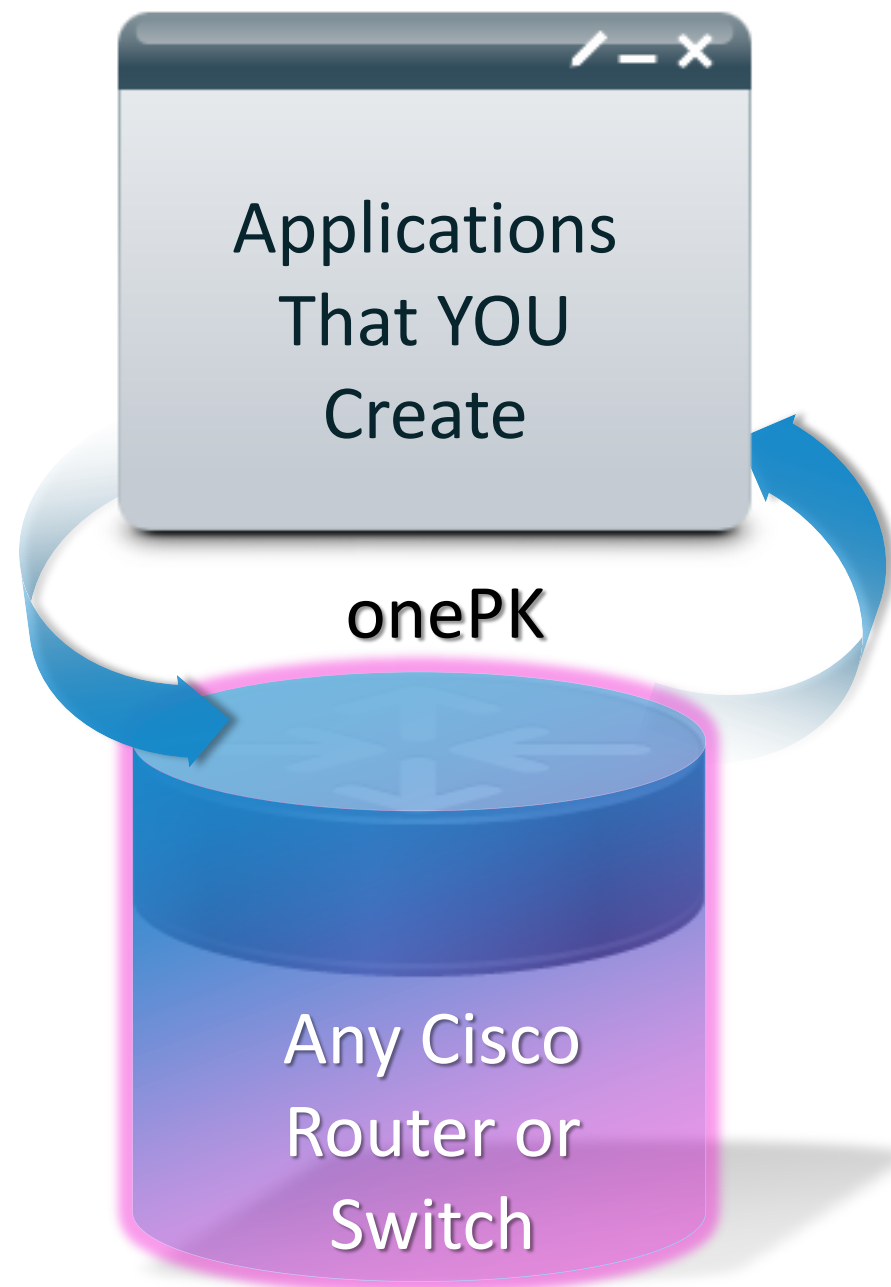
onePK
(One Platform Kit)

Comprehensive API &
Developer Kit across IOS,
IOS-XR and NX-OS

2. Controller/Agents

Controller software

**OpenFlow Support on
Catalyst 3750-X and 3560-X**

3. Virtual Overlay Networks

Nexus 1000V

OpenStack and REST API

Multi-Hypervisors

VXLAN Gateway

Security, Services Chaining

CISCO **Industry's broadest approach for Network Programmability**

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Compartmentalising Use Cases

- Network Programmability via APIs
- Leveraging Controller & Agents
- Automated Provisioning of network/virtual overlays

Programmatic APIs
Use Cass Examples

Programmatic
APIs

APIs make Abstractions available to Programmers

Example: Cisco's onePK (one Programming Kit) – Get your build on!

Applications That YOU Create

onePK

Any Cisco Router or Switch

Flexible development environment to:

- Innovate

- Extend

- Automate

- Customise

- Enhance

- Modify

onePK

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onePK Architecture

C, JAVA Program

onePK API Presentation

onePK API Infrastructure

IOS / XE
(Catalyst, ISR, ASR1K)

NXOS
(Nexus Platforms)

IOS XR
(ASR 9K, CRS)

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onePK Application Hosting Options

Process Hosting

Network OS

Container

onePK Apps

Blade Hosting

Network OS

Blade

Container

onePK Apps

End-Point Hosting

Network OS

External Server

onePK Apps
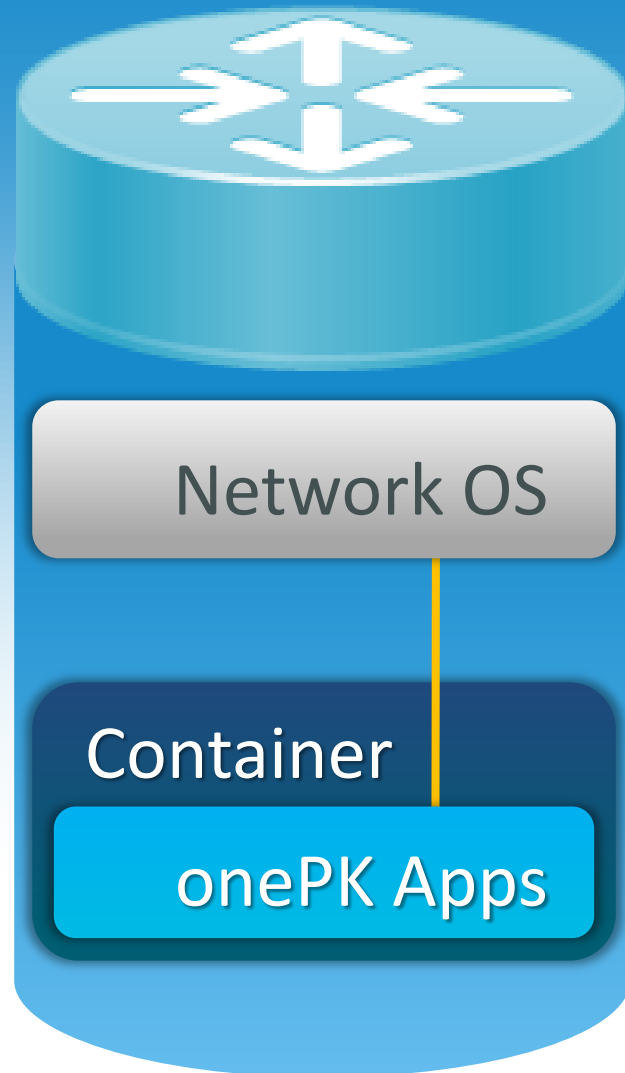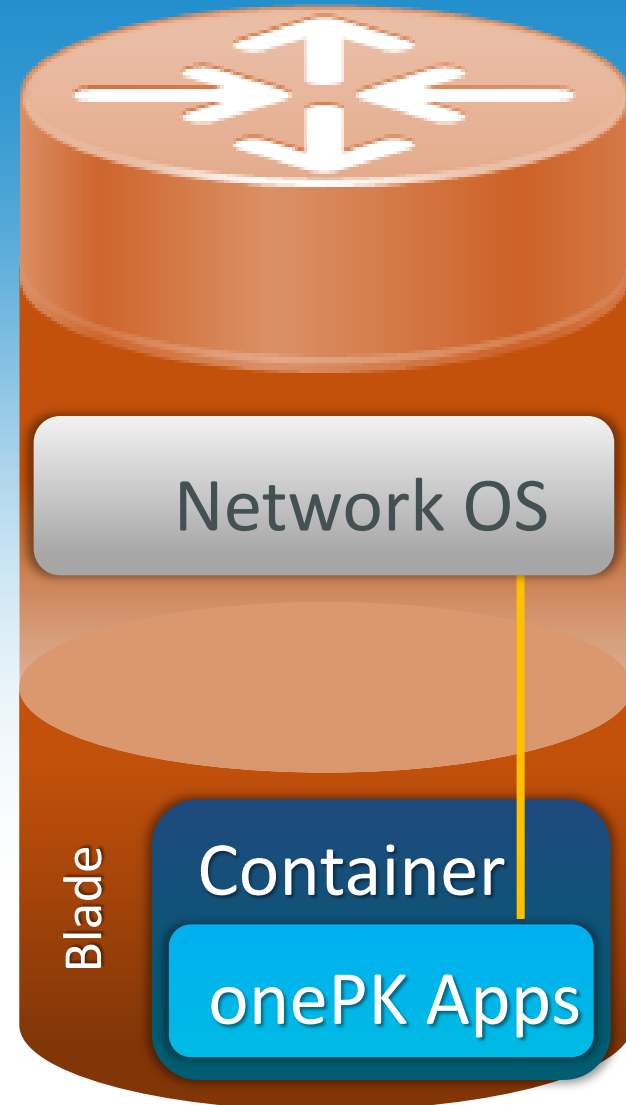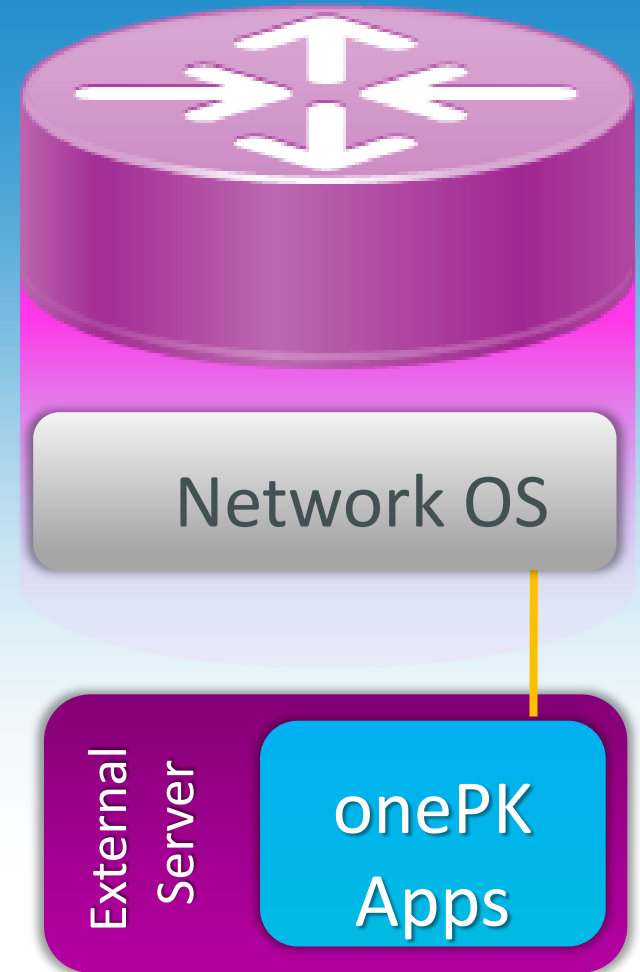
Write Once, Run Anywhere

Evolving How We Interact With The Network Operating System

Traditional Approach

IOS

- Monitoring
- Policy
- Interface
- Discovery
- Routing
- Data Plane

Events

Actions

App EEM (TCL)

CLI
SNMP
HTML
XML
AAA
CDP
Syslog
Netflow
Routing Protocols
Span

Evolution

App

C

Java

...

Anything you can think of

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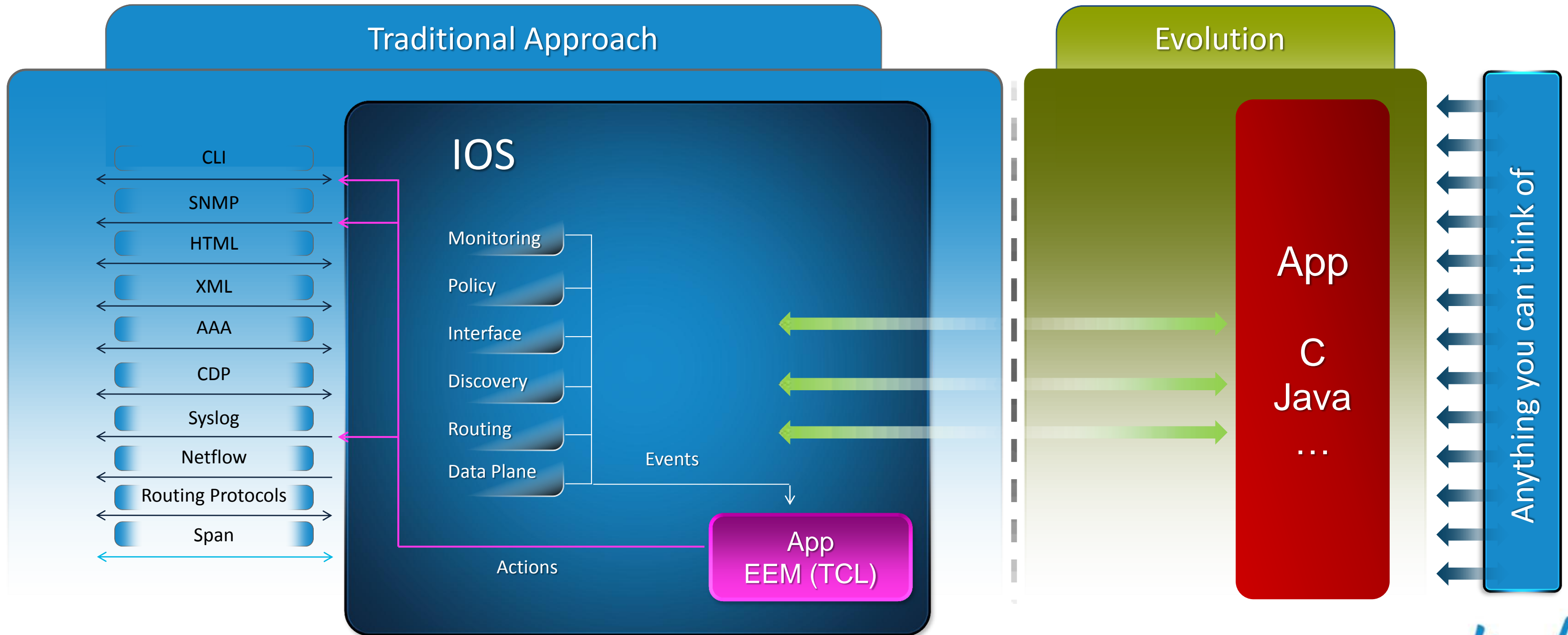
Cisco Cloud Services Router (CSR)
Extending Enterprise WAN to Cloud

BEST OF SHOW AWARD
INTEROP
TOKYO | 12 – 15 JUNE, 2012
Grand Prix

Data Centre

Cloud

ASR

VPC/ vDC

CSR

VPC/ vDC

INTERNET/ MPLS WAN

ISR

Branch

ISR

Branch

ISR
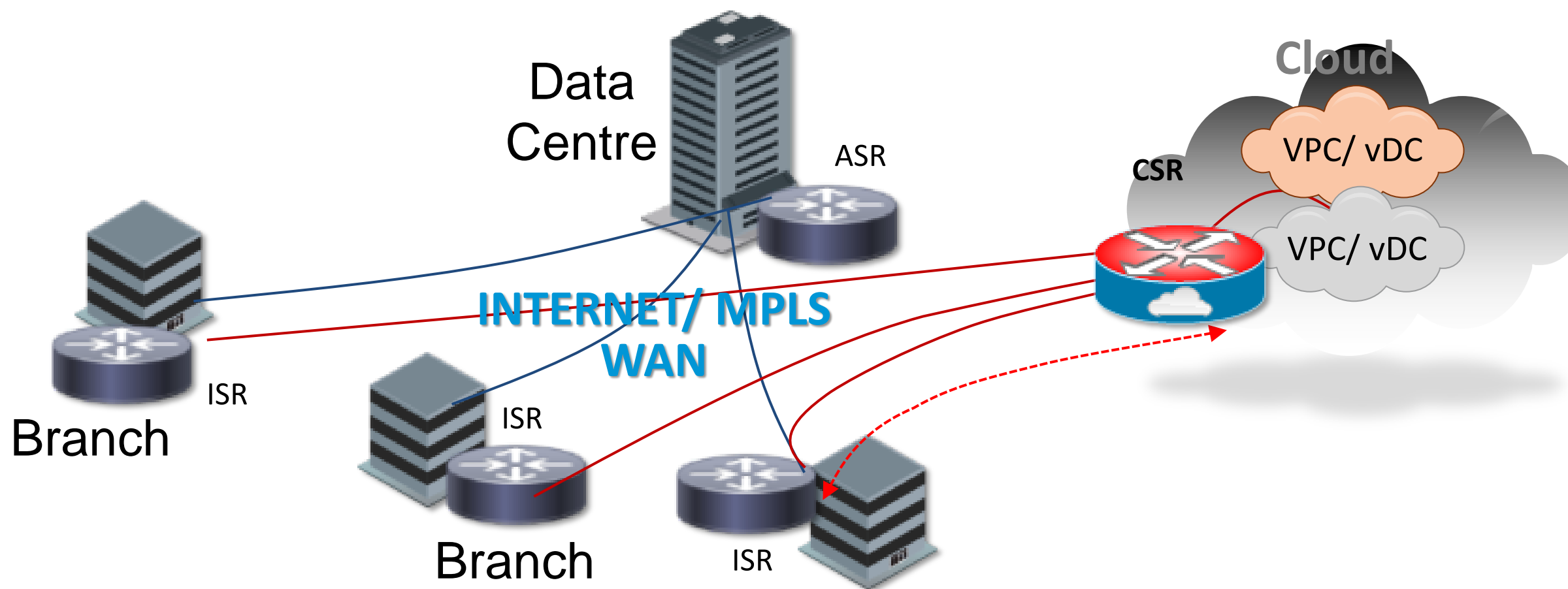
Key FCS Dates	
•	Controlled Availability **Dec 2012 - March 2013**
•	General Availability **March 2013**

Secure Connectivity	**Tenant Scalability**	**Network Consistency**	**Traffic Control**
• Globally Uniform VPN Policies	• Reduced VLAN Dependence	• Data Centre to Cloud IP Mobility	• Shortest Path from any Location
• Scalable and Reliable VPNs	• End-to-end MPLS WAN	• Full range of Network Services	• Redirection and Prioritisation
• Automatic Topology Updates	• Single-tenant Networking	• Familiar Management Tools	• End-to-End Managed SLAs

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onePK use case: Provisioning & Automation

Puppet, Chef, OMI…
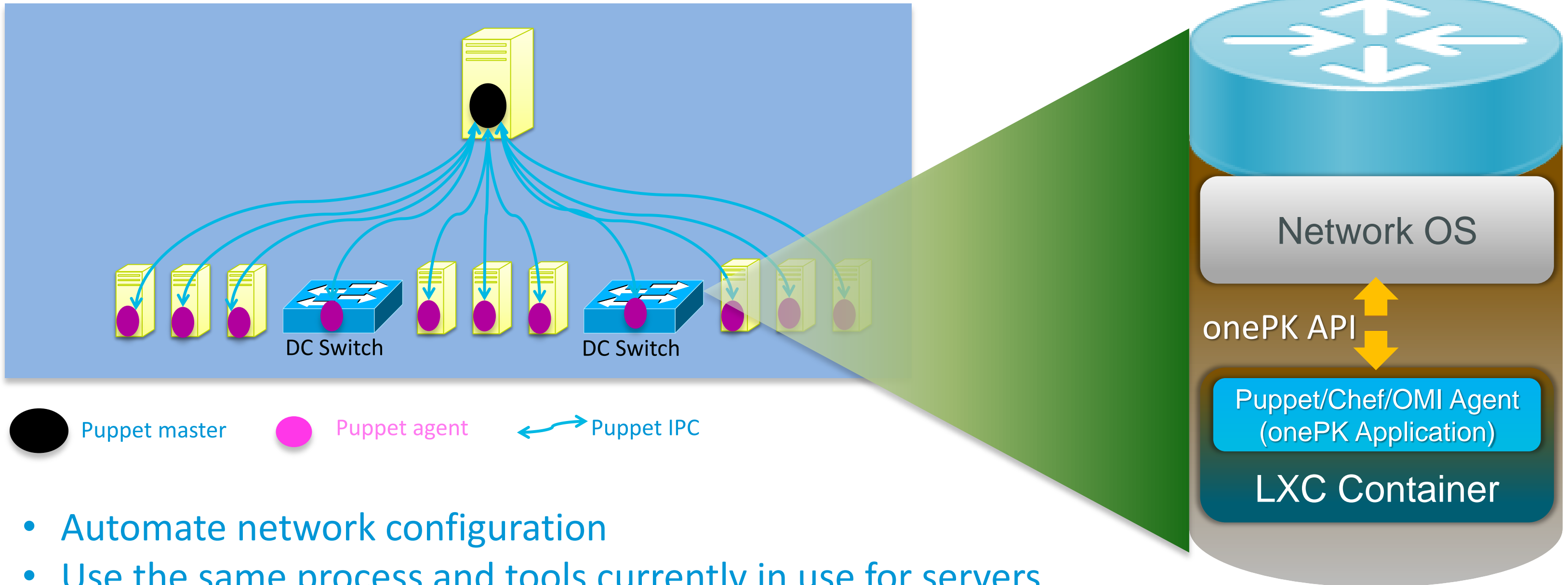
Puppet master   Puppet agent   Puppet IPC

DC Switch   DC Switch

Network OS

onePK API

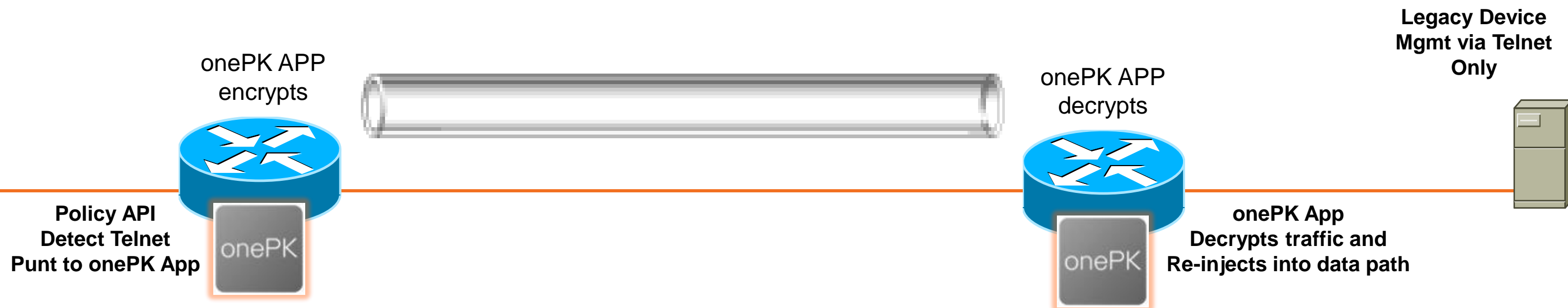Puppet/Chef/OMI Agent
(onePK Application)

LXC Container

- Automate network configuration
- Use the same process and tools currently in use for servers
  - Cross pollination of server concepts into network
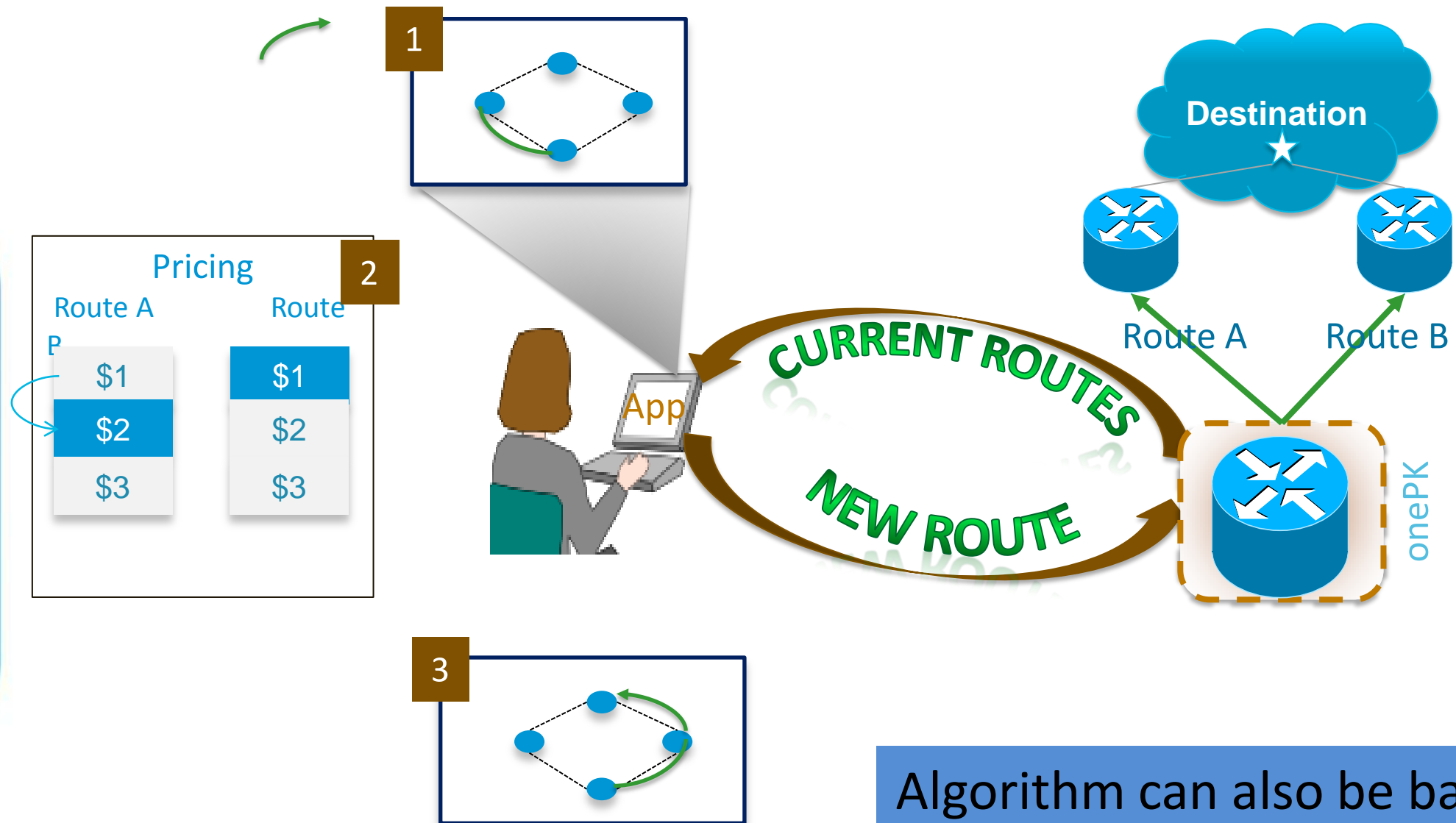
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onePK: Data Path Manipulation
Custom Encryption Example

Problem: Customers want custom encryption on specific traffic types
Value proposition: Punt traffic of interest, encrypt, and re-inject.

What can you do with

onePK

Legacy Device
Mgmt via Telnet
Only

onePK APP
encrypts

onePK APP
decrypts

**Policy API
Detect Telnet
Punt to onePK App**

**onePK App
Decrypts traffic and
Re-injects into data path**

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onePK Use Case: Custom Routing

Traffic Forwarding Based on a Custom Algorithm

Destination

Route A   Route B

CURRENT ROUTES

NEW ROUTE

App

onePK

Pricing

Route A   Route B

$1	$1
$2	$2
$3	$3

Algorithm can also be based on network conditions like latency or bandwidth utilisation or congestion

Custom Routing – Use Case Example

Initial Setup: Default routing using EIGRP
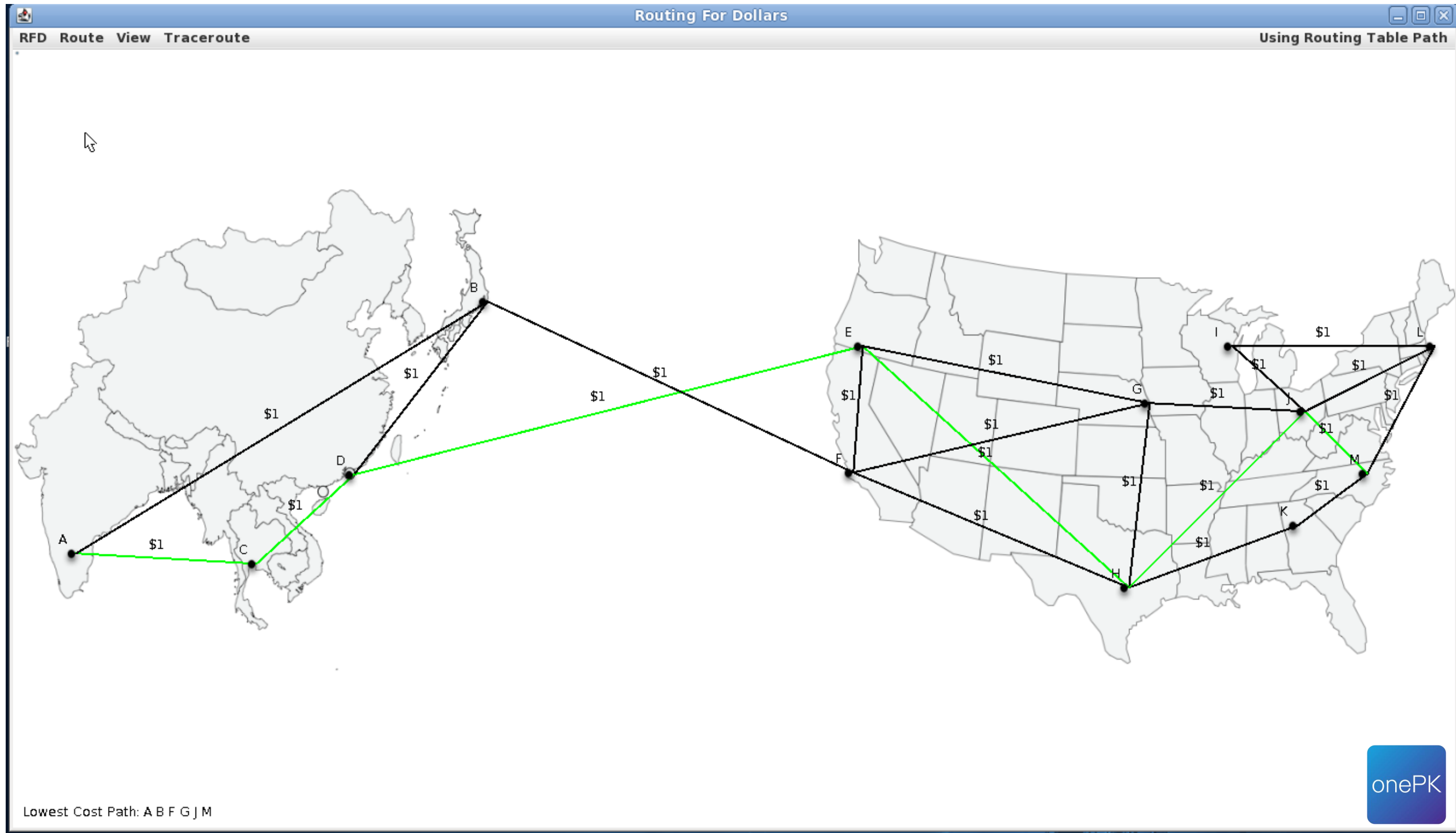
Custom Routing – Use Case Example

Routing for Dollars: Application driven routes installed in network

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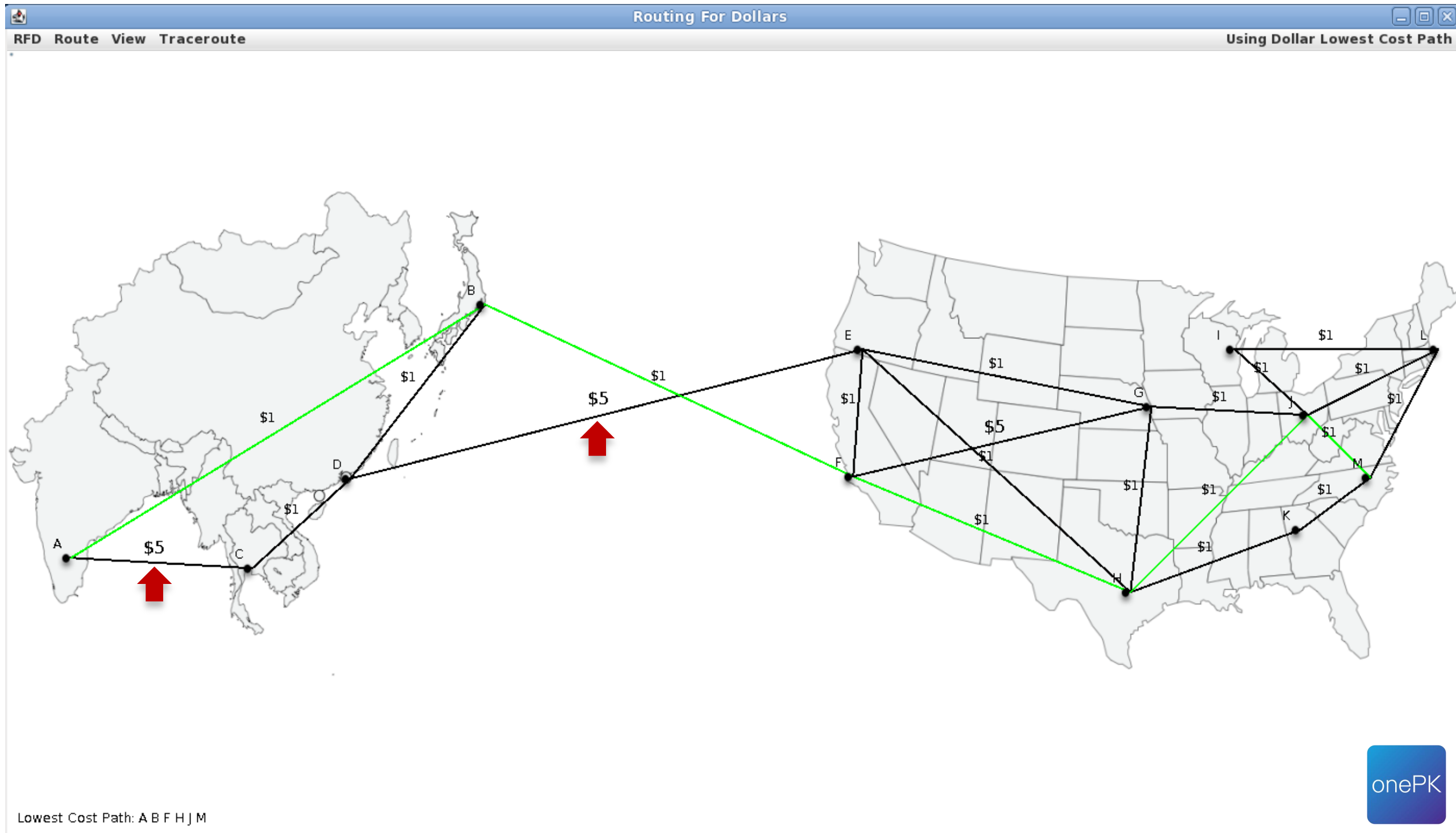
Custom Routing – Use Case Example

Tracing the application installed route – using the developer and element services

Yes, it is secure
Security Five Ways

App Security

Digital Signing
Certification Process

Code Isolation
Strong Typing

Code Security

Admin Security

CLI Control
Resource Allocation

onePK

AAA (PKI)
Encryption (TLS)

Runtime Security

Container Security

Isolation
Resource Consumption

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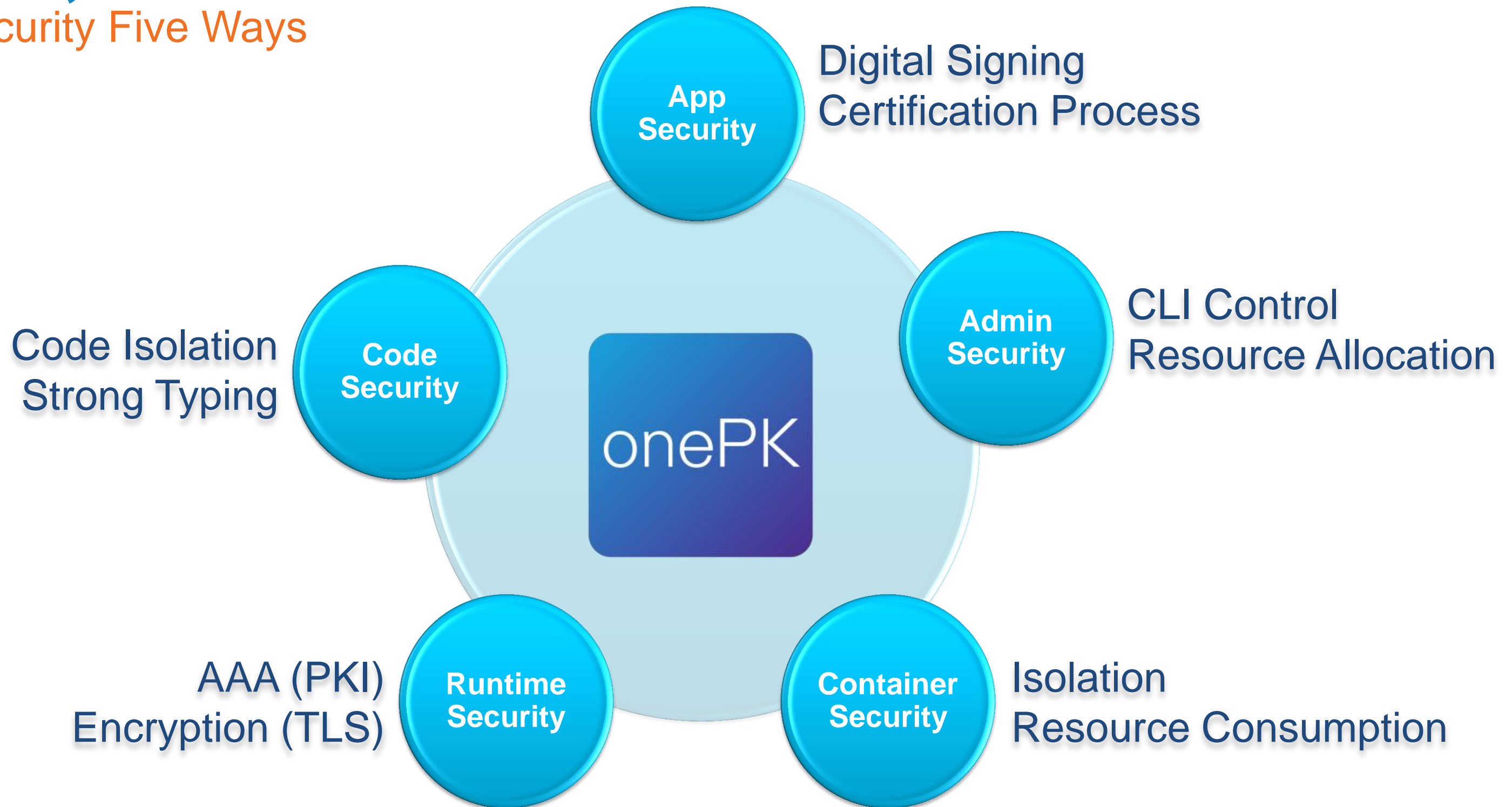
Controller & Agent Use Case Examples

Controller/Agent

Orchestration & Control

Cisco "ONE Controller"

- 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

| Applications (Cisco) | Applications (Customer) | Applications (3rd party) |

Apps/Applications

Northbound API

| Network Slicing | Network Troubleshooting | Custom Routing |

Controller built-in Applications

| Flow Management | Forwarding Logic | Device Management |

Controller Core Infrastructure

onePK API | **OpenFlow 1.x Protocol**

Southbound APIs (onePK, OneFlow,…)

Built-in GUI for Management

onePK onePK OpenFlow OpenFlow

Transit Selection (PoC on N3K)

Using Latency as a Parameter

Data Centre

Site-1

Site-2

Site-3

Site-4

Openflow/onePK

7 ms

3 ms

Cisco ONE Controller

2 ms
High Speed WAN

Site-5

Site-6

Site-7

Point to Point Supported
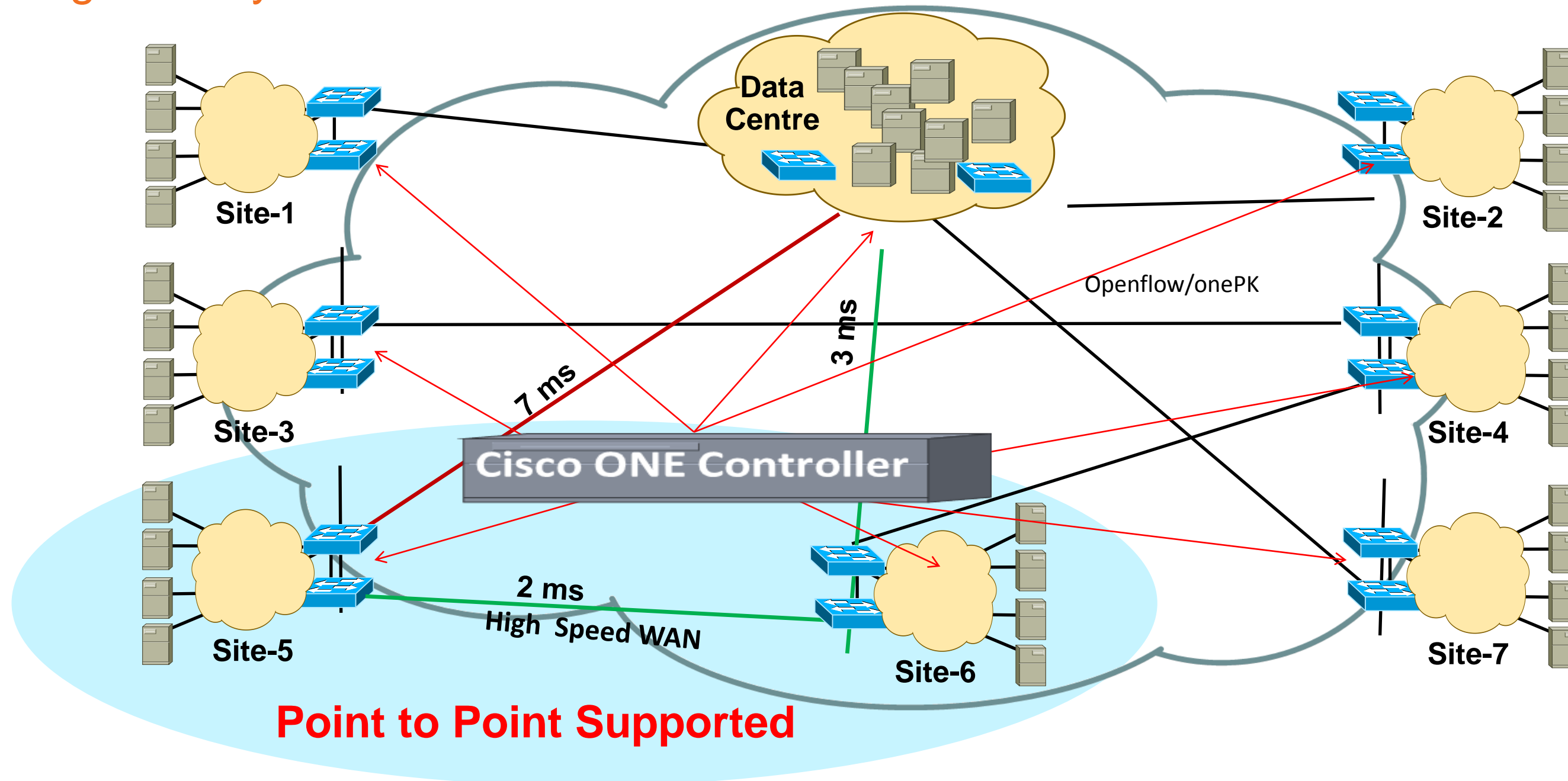
Supports Mesh or Point to Point Architectures

Custom Forwarding – Leveraging Latency

Controller Communications

- Controller determines lowest latency links

- Then programs flow tables

- Dynamically monitors link state and latency

- Adapts based on programmed thresholds
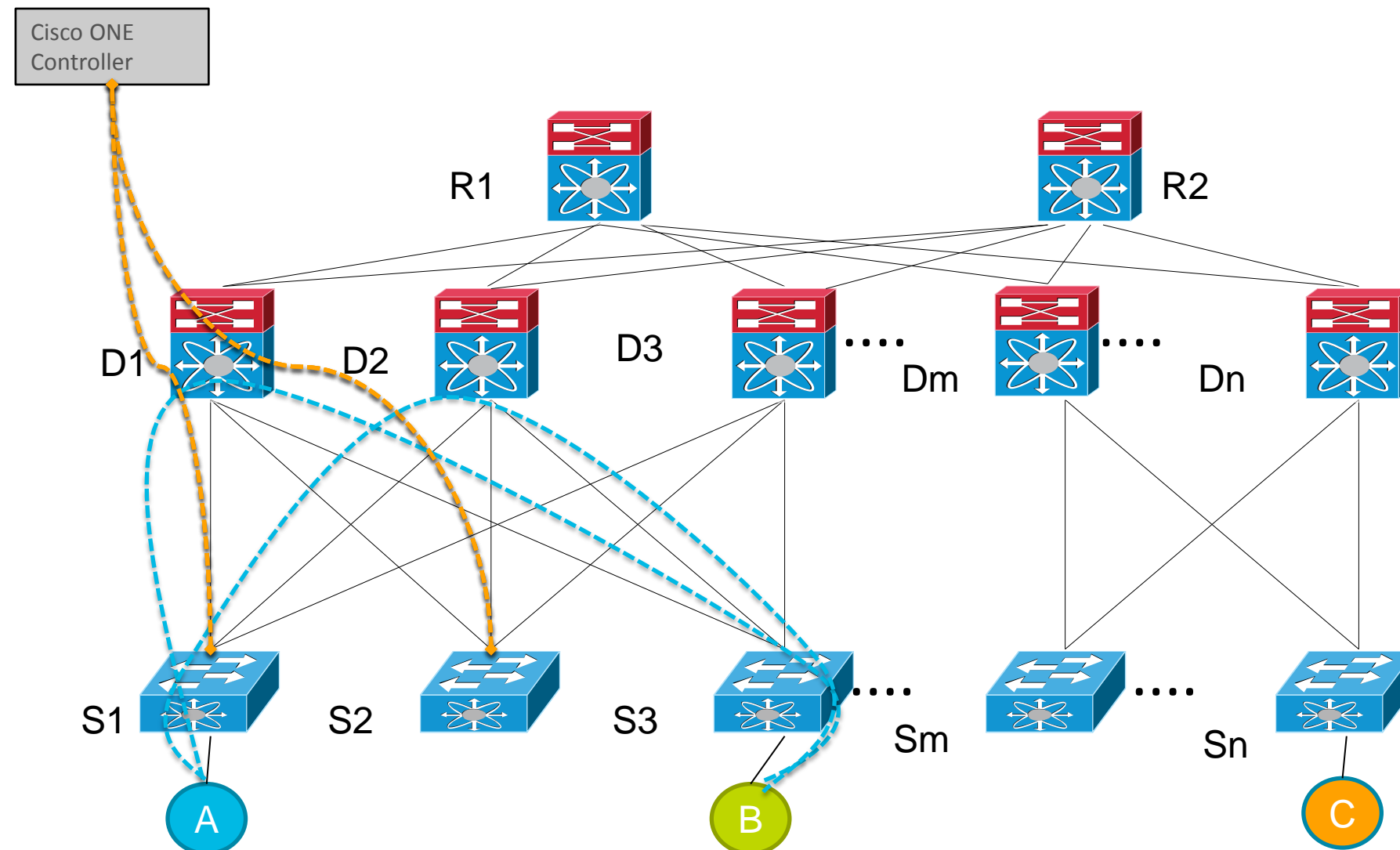

Cisco ONE Controller

R1   R2

D1   D2   D3   ....   Dm   ....   Dn

S1   S2   S3   ....   Sm   ....   Sn

A   B   C

Network Tapping (PoC on N3K)

Enterprise class OpenFlow use case

Production Network

Cisco ONE Controller

Openflow

Monitor Network

Analyser

IDS-Green

**OF Switches
(sliced)**

Tool Ports

**Network
Ports**

SPAN

Public Internet

Server A

**Optical
Tap**

Tool

Server B
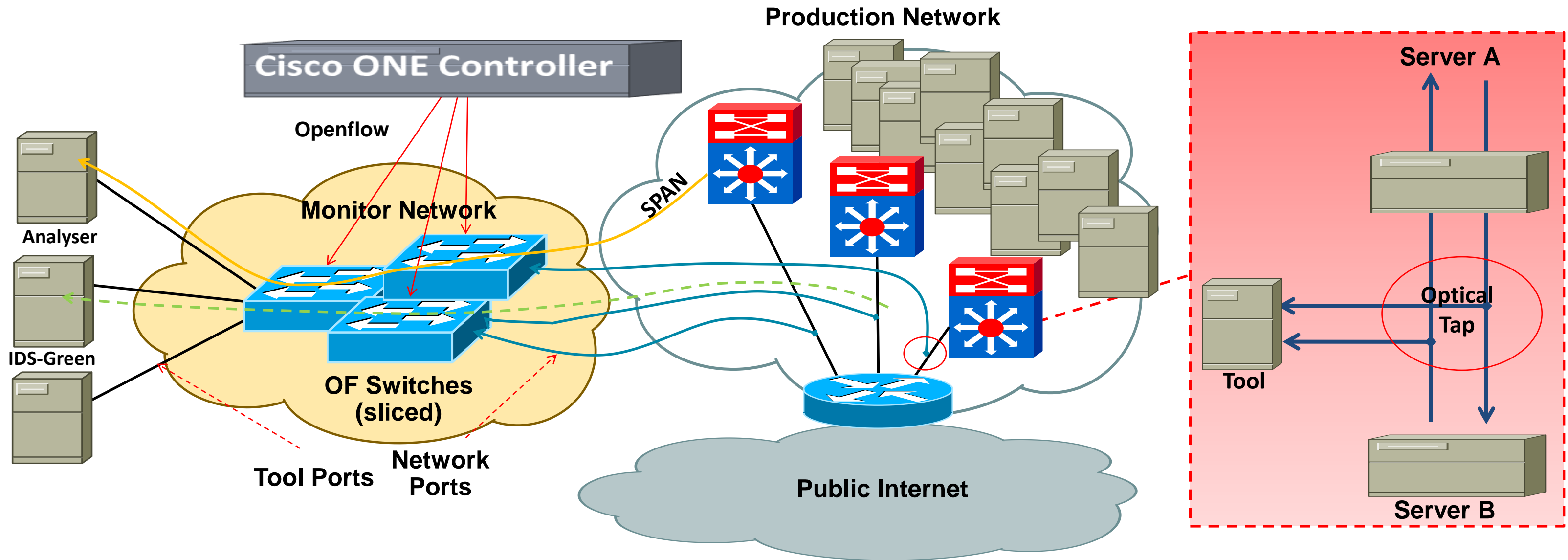
Replaces Classical Matrix Switch (i.e. Gigamon) with
Nexus 3000 switches and Tapping Application

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Cisco ONE Controller

View of the GUI

Virtual Overlay
Use Case Examples

Virtual Overlay

Physical | Virtual | Cloud Journey

PHYSICAL WORKLOAD	VIRTUAL WORKLOAD	CLOUD WORKLOAD
• One app per Server • Static • Manual provisioning	• Many apps per Server • Mobile • Dynamic provisioning	• Multi-tenant per Server • Elastic • Automated Scaling
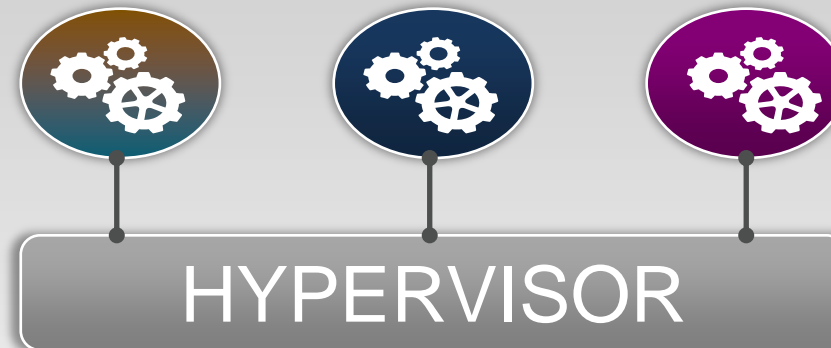
HYPERVISOR

VDC-1   VDC-2
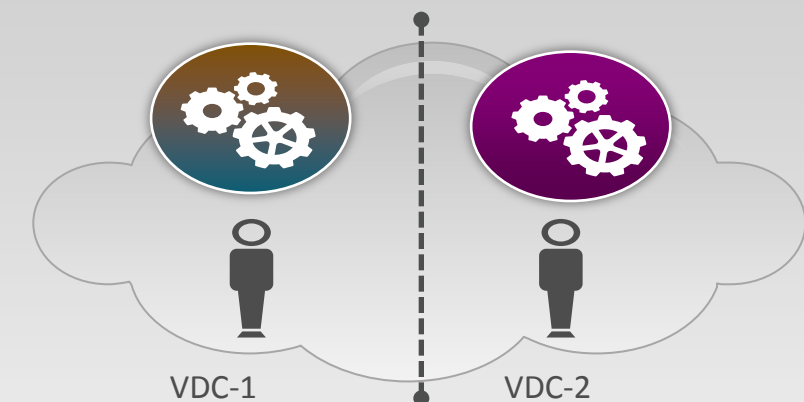
CONSISTENCY: Policy, Features, Security, Management, Separation of Duties

Switching	**Nexus 7K/5K/3K/2K**	**Nexus 1000V, VM-FEX**
Routing	**ASR, ISR**	**Cloud Services Router (CSR 1000V)**
Services	**WAAS, ASA, NAM**	**vWAAS, VSG, ASA 1000V, vNAM****
Compute	**UCS for Bare Metal**	**UCS for Virtualised Workloads**

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** 1H 2013

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Virtual Overlay
Primary Use Case Classifications

Multi-Hypervisor

Multi-Services

Multi-Cloud

Nexus 1000V

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Cisco Nexus 1000V
Network Consistency (Physical to Virtual) - Multi-Hypervisor and Multi-Orchestration

Consistent architecture, feature-set & network services ensures operational transparency across multiple hypervisors.

Virtual Overlay Networks

Use Case: Virtual Overlay Networks and Services with Nexus 1000V

- **Scalable Multi-tenancy**
  - Tens of thousands of virtual ports, L2 networks
  - Hundreds of Servers
  - Scalable segmentation: VXLAN

- **Common APIs**
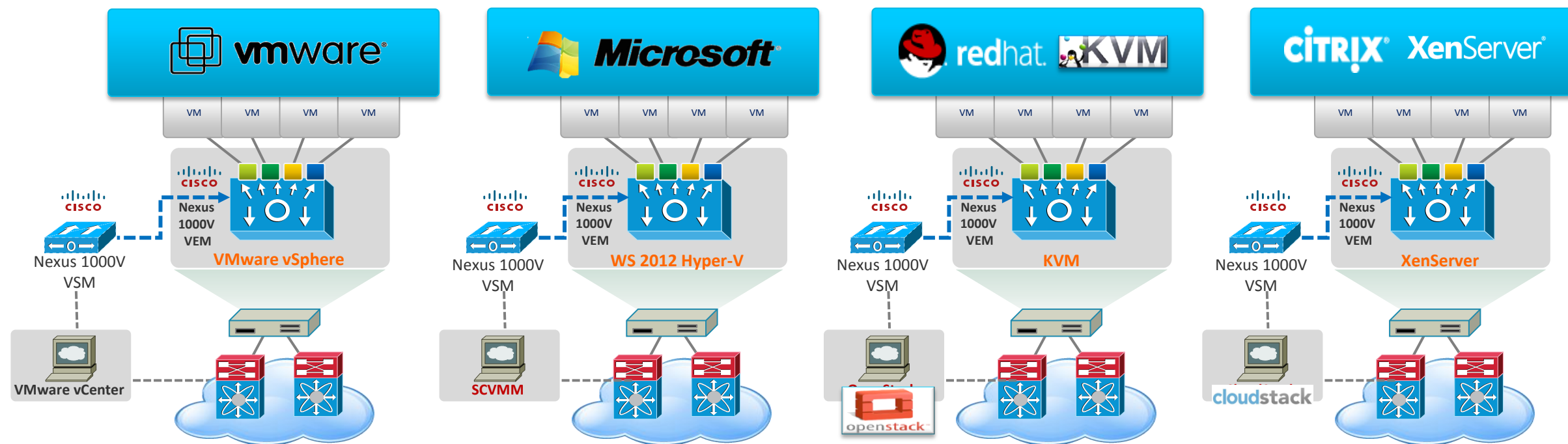 - Incl. OpenStack Quantum API's for cloud automation/orchestration

- **Virtual Services**
  - vPath for traffic steering / service chaining
  - VSG, ASA 1000V (cloud-ready security), vWAAS (application acceleration)
  - CSR 1000V (cloud router)

- **Multi-hypervisor**
  - ESX, Hyper-V, OpenSource Hypervisors (KVM/Xen)

- **Hybrid Use Cases** (Physical and Virtual)
  - VXLAN to VLAN GW

OpenStack Quantum API | REST API

Nexus 1000V

ASA 1KV | VSG

vWAAS

Virtual Services

Any Hypervisor

VXLAN Gateway

Physical (VLAN) Network

ASA 55xx

Tenant 1 | Tenant 2 | Tenant 3

Virtual Workloads

Physical Workloads
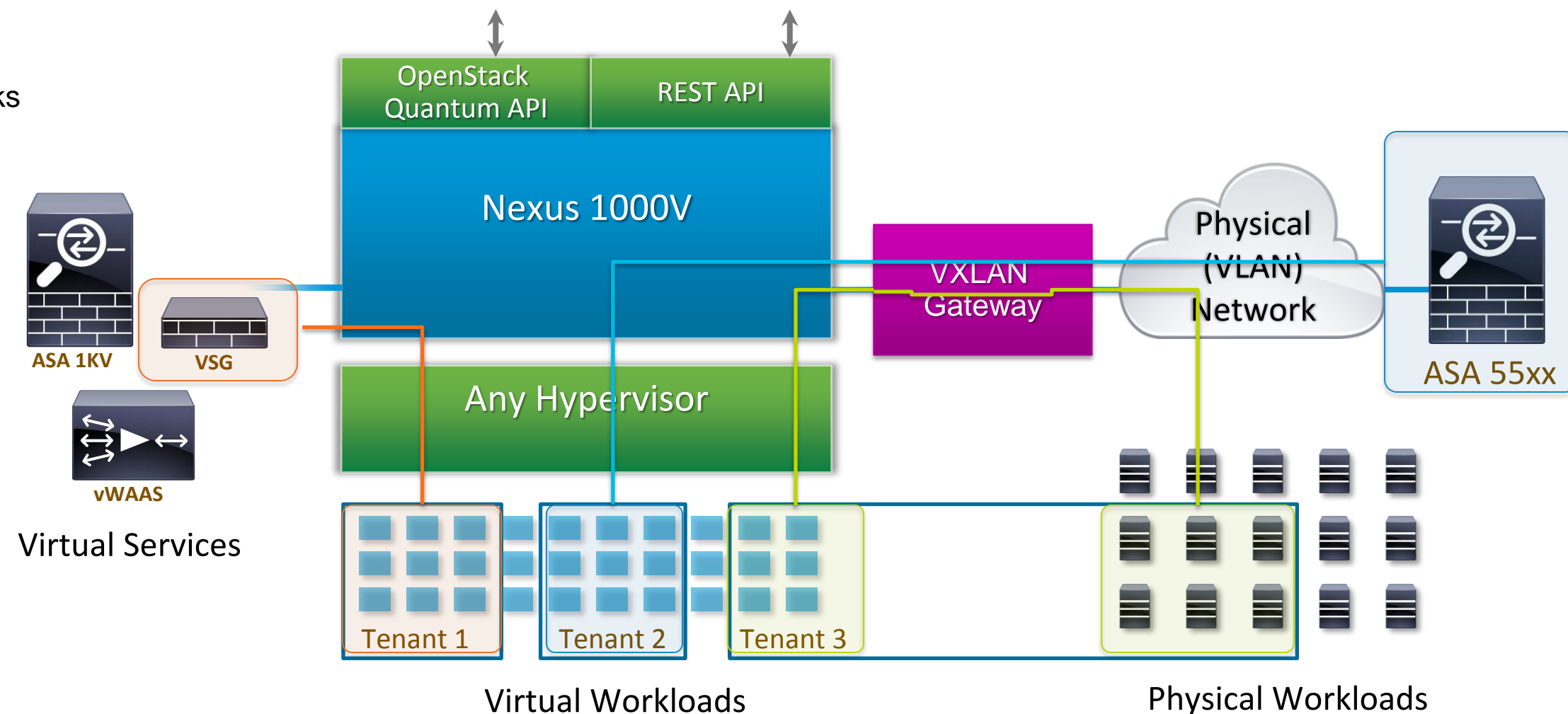
Tenant 1: virtual workloads protected by virtual firewall
Tenant 2: virtual workloads protected by physical firewall (via VXLAN GW)
Tenant 3: virtual & physical workloads in same L2 domain (via VXLAN GW

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Nexus1000V InterCloud (Project Kumo)

Securely Extend Enterprise Environment into Provider Cloud

ENTERPRISE CLOUDS
(Private / Hosted / Manged)

VNMC
InterCloud

PROVIDER CLOUDS
(Public / Utility / Community)

VM Manager Integration

Provider Cloud API Intg.

VM | VM | VM

Nexus1000V | vSwitch

Nexus 1000V InterCloud

L2 Virtual
Private Cloud

Other
Tenants

VM | VM | VM

N1KV InterCloud

Nexus Switching | IOS Routing | Network Services
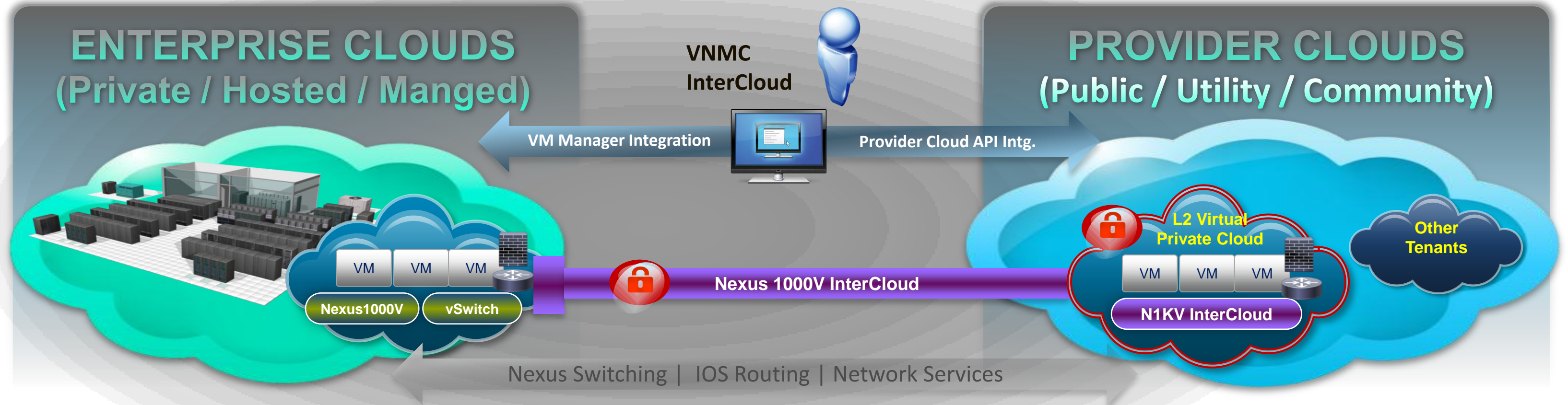
Secure	Enterprise-Grade Crypto and Firewalling within & across clouds
Simple	Transparent Application Migration; Centralised Management
Flexible	Choice of Provider Clouds and Hypervisors

Network Virtual Overlay Use Case
Examples

- Server Virtualisation w/ Logical Virtual Overlay Networks
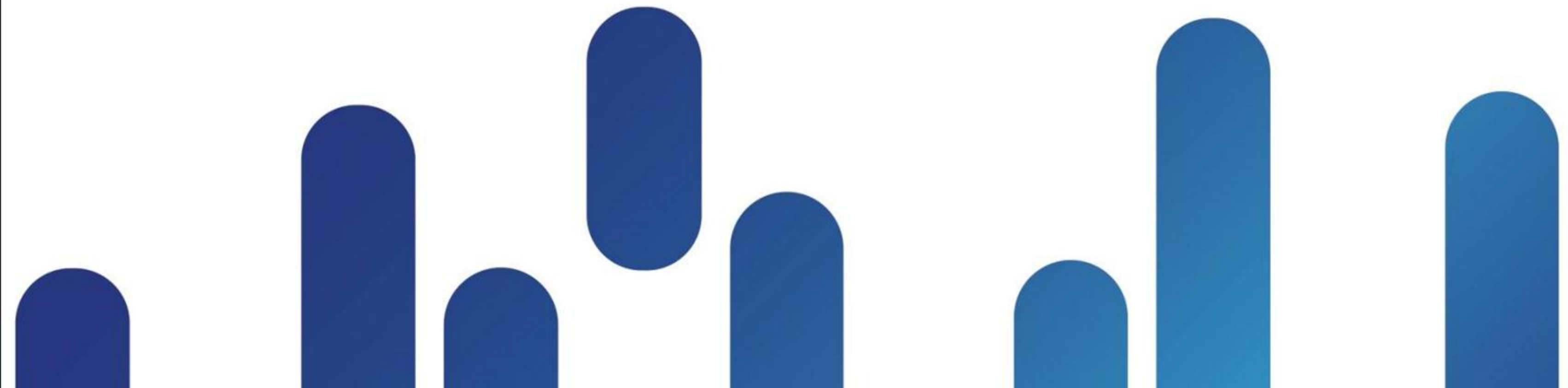- Cloud L2 & Virtual Services in a multi-hypervisor environment
- Bridging Virtual to Physical with VXLAN GW

Summary

Summary: Open Network Environment

Cisco Innovations Summary announced at Cisco Live San Diego 2012

onePK Developer Kit

- Complete developer's kit for multiple Cisco Platforms, Servers, Blades
- Rapidly develop test and deploy Applications.
- Phased availability across IOS, IOS-XR and NX-OS platforms

Programmatic APIs

Controllers + Agent Support

- Engage with universities & research for campus slicing use case
- OpenFlow 1.x support on select Cisco platforms
- Controller SW

Controllers and Agents

Overlay Network Solutions

- Multi-hypervisor support on Nexus 1000V (incl. OpenSource hypervisor)
- OpenStack and REST APIs on N1KV for rapid tenant provisioning
- VXLAN-VLAN gateway (for bridging traditional environments)
- Virtual or Physical Network Services

Virtual Overlays

Cisco ONE – Next Phase

Expanded Platform Support**

Platform APIs

onePK Platforms 1H13

- ISR G2 1H13
- ASR 1000 1H13
- ASR 9000*
- Nexus 3000 1H13
- Nexus 7000*

Controller/Agents

ONE Controller 1H13

OpenFlow Agents

- Catalyst 3000*
- Catalyst 6500*
- Nexus 3000 1H13
- Nexus 7000*
- ASR 9000*

Overlay Networks

CSR 1000V 1H13

Nexus 1000V Updates

- N1KV Hyper-V 1H13
- N1KV KVM*
- VXLAN Gateway 1H13
- Service Chaining vPath) (w/ *Shipping (3Q12)*

Cisco Edition of OpenStack *Shipping (4Q12)*

N1KV InterCloud 1H13

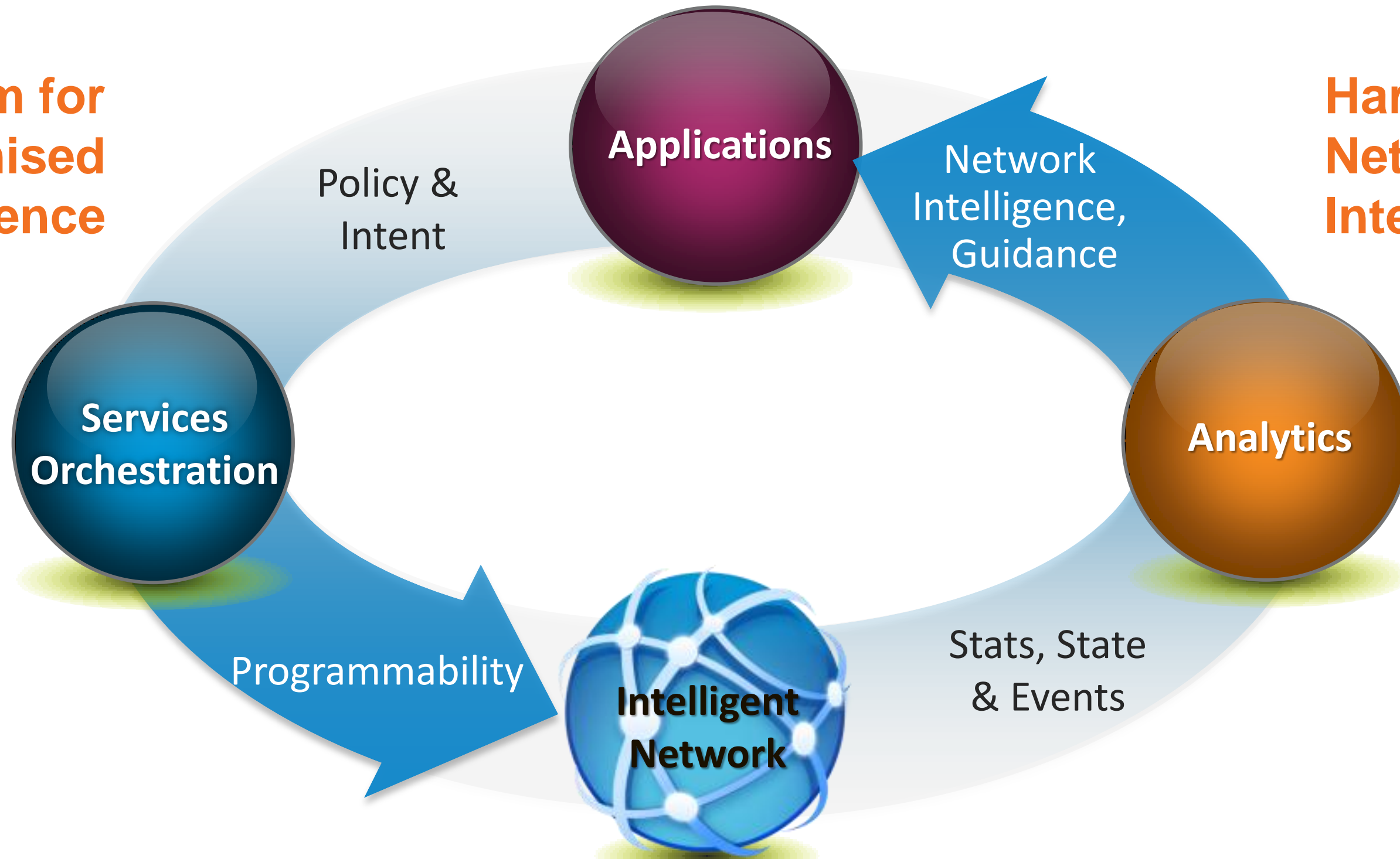**Virtual NAM (vNAM)***

*Customer PoC: on-going or in 1H13

**Timelines are subject to change

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Open Network Environment

Leverage Network Value
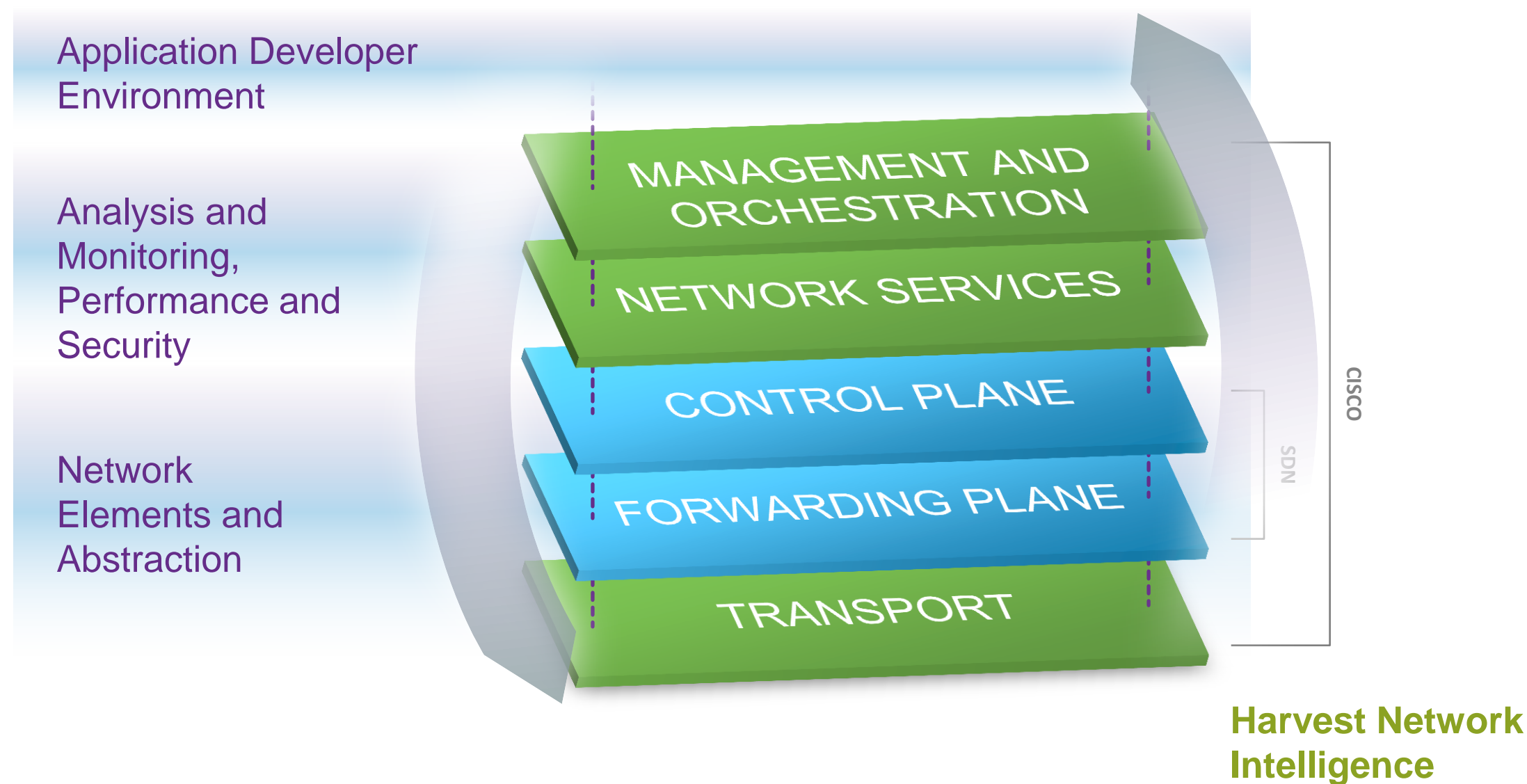
Program for Optimised Experience

Harvest Network Intelligence

Applications

Analytics

Services Orchestration

Intelligent Network

Policy & Intent

Network Intelligence, Guidance

Programmability

Stats, State & Events

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Cisco Vision: Exposing The Entire Network Value

Programmatic Control across Multiple Network Planes

Program Policies for Optimised Experience

Application Developer Environment

Analysis and Monitoring, Performance and Security

Network Elements and Abstraction

MANAGEMENT AND ORCHESTRATION

NETWORK SERVICES

CONTROL PLANE

FORWARDING PLANE

TRANSPORT

CISCO

SDN

Harvest Network Intelligence

Any Object

- Switch/Router
- ASIC
- Network Fabric
- Compute

Any Service

- Cloud
- Collaboration
- Video
- Security
- Mobility

Any Layer

- L1-7
- Control/Data Plane
- Hardware/Software
- ASICs/OS

Ciscolive!

Open Network Environment – Summary
The Industry's Broadest Approach to Programmatic Access to the Network

- Evolutionary step for networking:
  - Complement/evolve the Network Control Plane where needed

- Centred around delivering open, programmable environment for real-world use cases
  - No one-size-fits-all
  - Cisco will support Network Virtualisation, APIs and Agents/Controllers
  - Joint evolution with industry and academia

- Technology-agnostic
  - Not predicated on a particular technology or standard
  - Draw from Cisco technologies and industry standards

- Delivered as incremental functionality
  - Many customers will use hybrid implementations
  - Build upon existing infrastructure with investment protection

Open Network Environment
www.cisco.com/go/one

onePK
www.cisco.com/go/onepk
www.cisco.com/go/getyourbuildon

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