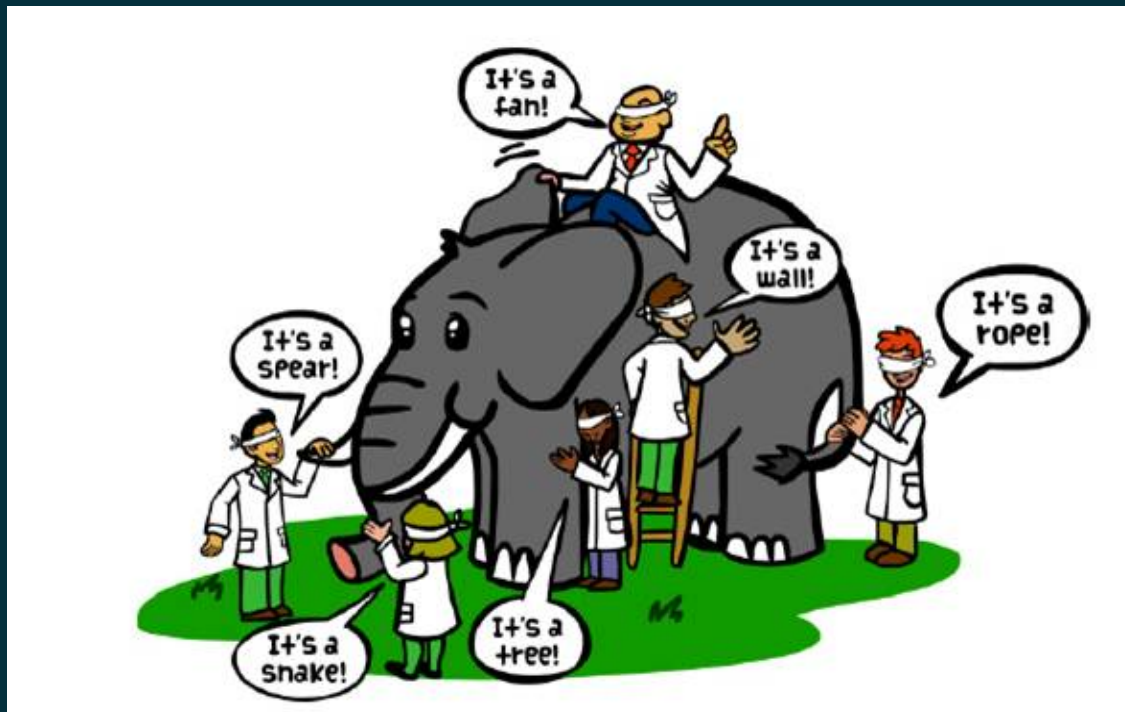# Router Virtualizations – Industry Trends and Use Cases

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October, 15 2013

What is Router Virtualization?

Router Virtualizations

- Device Multi Tenancy for traffic segregation (e.g. MPLS-VPN PE)

- Device Separation into Virtual Device Contexts

- Virtual Routing by hardware abstraction

- Service consolidation over a routing platform

- Router Virtualization and SDN

Router Virtualizations

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- **Virtual Routing by hardware abstraction**

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# Cisco Virtual Routing by Hardware Abstraction

Cisco ASR 1000 Architecture
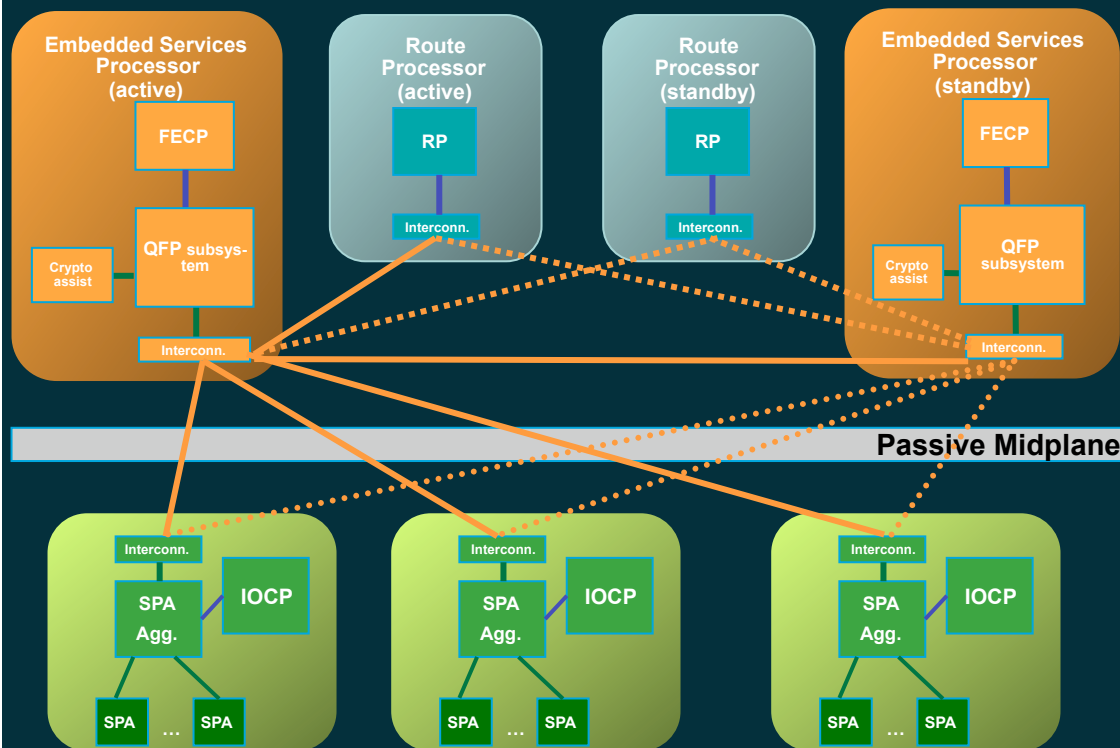
- **RP (Route Processor)**
  - Handles control plane traffic
  - Manages system

- **ESP**
  - Handles forwarding plane traffic

- **SPA Interface Processor**
  - Shared Port Adapters provide interface connectivity

- **Centralized Forwarding Architecture**
  - All traffic flows through the active ESP, standby is synchronized with all flow state with a dedicated 10Gbps link

- **Distributed Control Architecture**
  - All major system components have a powerful control processor dedicated for control and management planes

CISCO - CSR 1000v Architecture
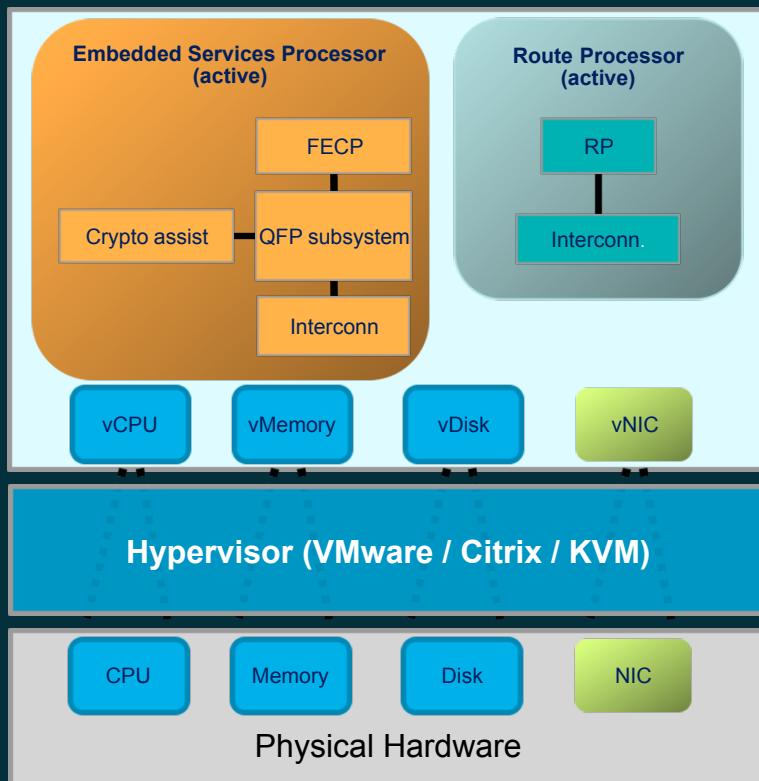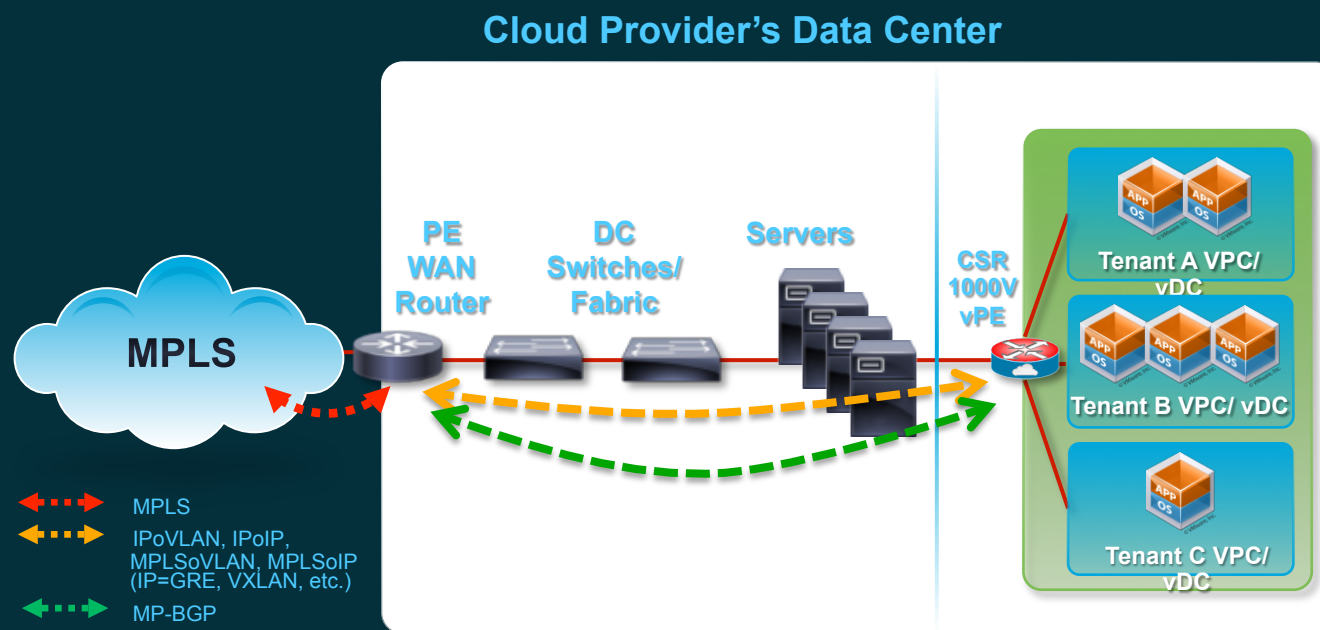

- **Virtualized IOS XE**
  - Generalized to work on any x86 system
  - Hardware specifics abstracted through a VM Layer
  - Forwarding (ESP) and Control (RP) mapped to vCPUs
  - Bootflash: NVRAM: are mapped into memory from hard disk
  - No dedicated crypto engine – we leverage the Intel AES-NI instruction set to provide crypto assist.
  - Boot loader functions implemented by GRUB

Use Case: MPLS Provider Edge (PE) Extension

Benefit: Extend SP MPLS Network into Cloud for End-to-End Managed Connectivity

Cloud Provider's Data Center

- **PE WAN Router**
- **DC Switches/ Fabric**
- **Servers**
- **CSR 1000V vPE**
- **MPLS**
- **Tenant A VPC/ vDC**
- **Tenant B VPC/ vDC**
- **Tenant C VPC/ vDC**

Legend:
- ⟵⟶ MPLS
- ⟵⟶ IPoVLAN, IPoIP, MPLSoVLAN, MPLSoIP (IP=GRE, VXLAN, etc.)
- ⟵⟶ MP-BGP

Challenges
- Mapping tenant traffic from VRFs to VLANs
- Maximum 4,096 VLANs limits scalability

Solutions
- MPLS Extension – PE function - into the Cloud
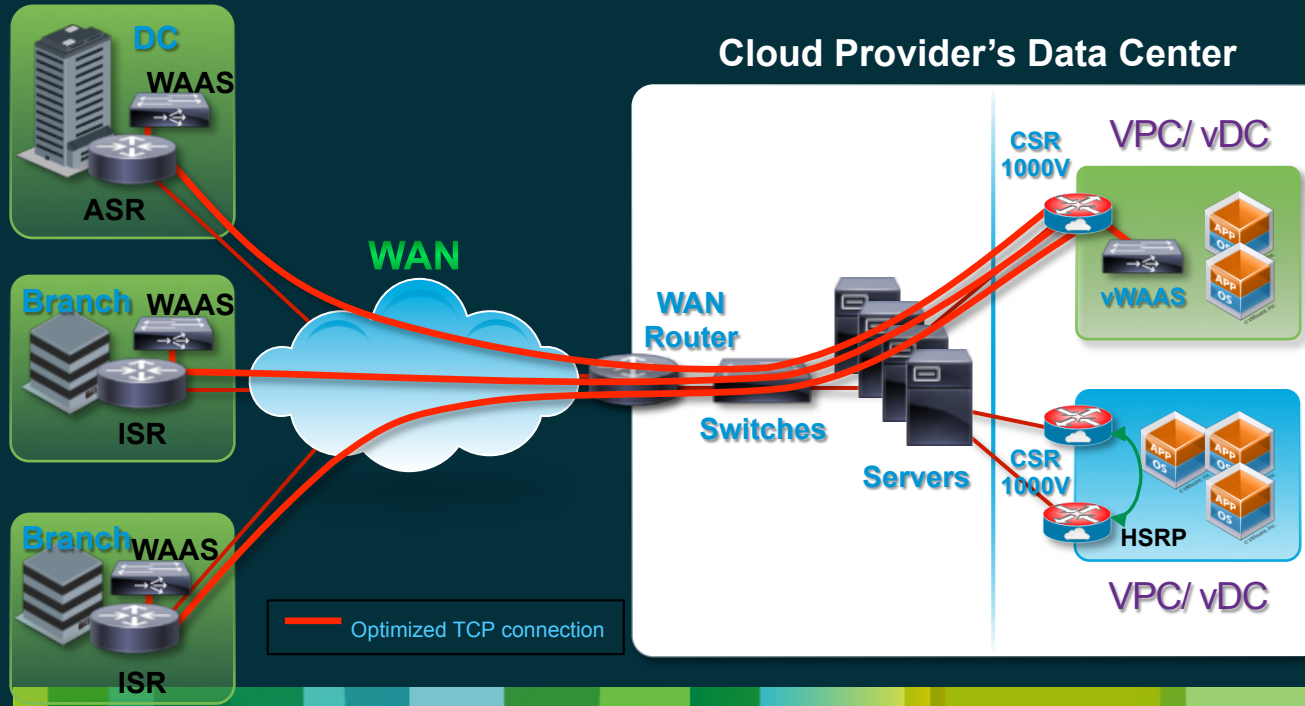- Zone based Firewall across Tenants

Benefits
- More Tenants per Physical Infrastructure
- End-to-end Managed Connectivity and SLAs

Use Case: Traffic Control and Management
Benefit: Comprehensive Networking Services Gateway in the Cloud

Enterprise

DC
WAAS
ASR

Branch
WAAS
ISR

Branch
WAAS
ISR

WAN

— Optimized TCP connection

Cloud Provider's Data Center

WAN
Router

Switches

Servers

CSR
1000V

VPC/ vDC

vWAAS

CSR
1000V

HSRP

VPC/ vDC

Challenges
- Response Time of Apps
- Resource Guarantees
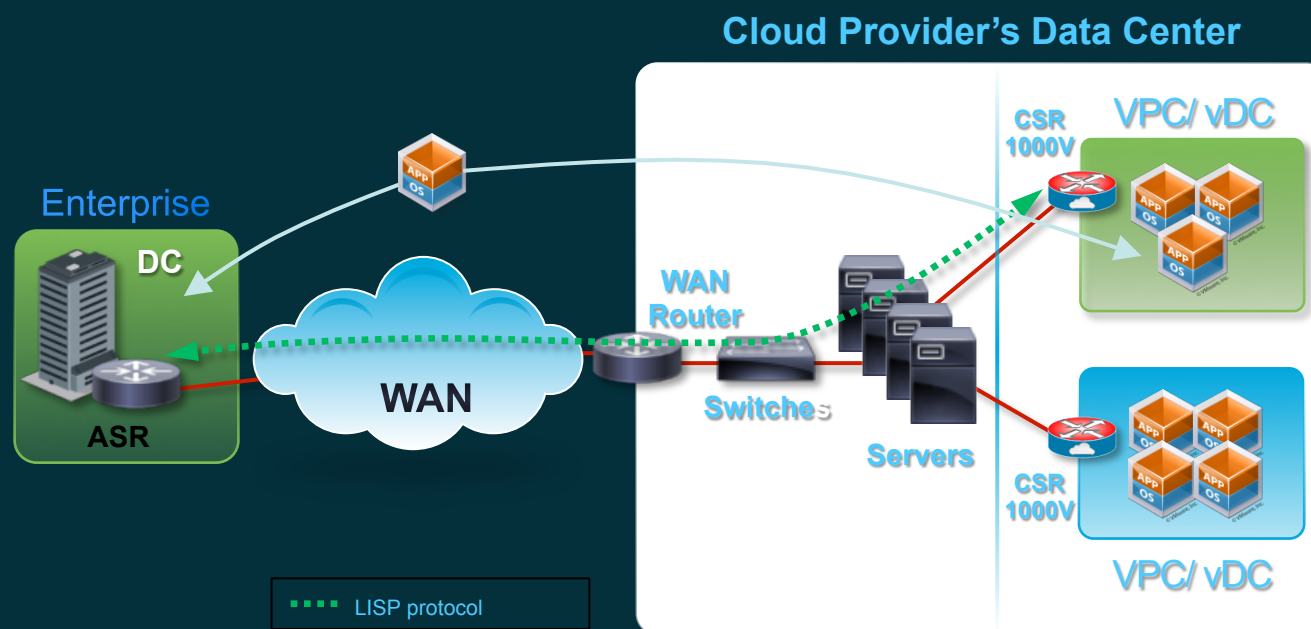- Resilient Connectivity

Solutions
- AppNav for WAAS
- QoS Prioritization
- HSRP VPN Failover

Benefits
- Rich Portfolio of Network Features and Services
- Single Point of Control

Use Case: DC to Cloud IP Mobility
Benefit: Simplified Application Deployment to the Cloud

Cloud Provider's Data Center

CSR 1000V

VPC/ vDC

Enterprise

DC

ASR

WAN

WAN Router

Switches

Servers

CSR 1000V

VPC/ vDC

LISP protocol

Challenges

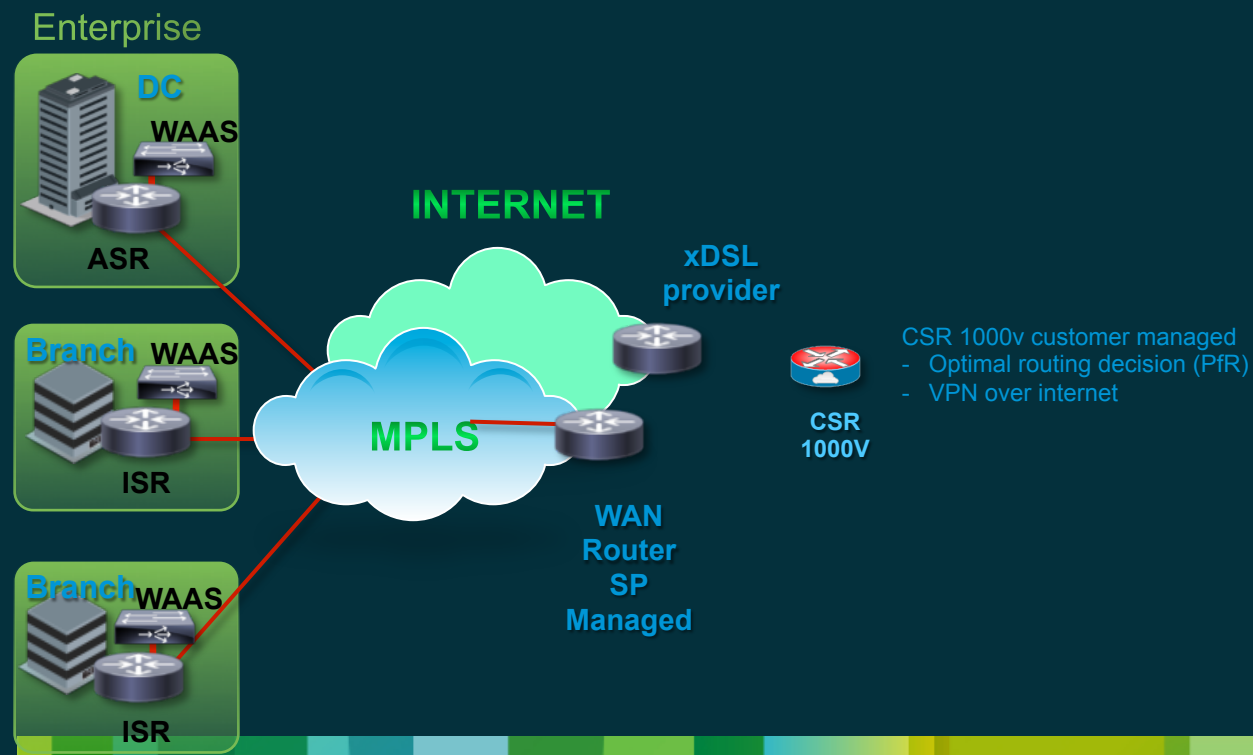- Simple, Fast, Transparent Application Onboarding
- Consistency with DC Network Fault

Solutions

- LISP for VM Mobility
- Routing
- NAT, DHCP

Benefits

- Simpler App Integration
- Dynamic infrastructure
- Consistent Management

Use Case: Traffic Control and Management in Managed Service WAN

Enterprise

DC

WAAS

ASR

Branch WAAS

ISR

Branch WAAS

ISR

INTERNET

MPLS

xDSL provider

WAN Router SP Managed

CSR 1000V

CSR 1000v customer managed
- Optimal routing decision (PfR)
- VPN over internet

Challenges
- Response Time of Apps
- Resource Guarantees
- Resilient Connectivity

Solutions
- AppNav for WAAS
- QoS Prioritization
- HSRP VPN Failover

Benefits
- Rich Portfolio of Network Features and Services
- Single Point of Control

Service Consolidation over a Routing Platform

UCS-E Series – Consolidating Services
What are we trying to achieve

Server Virtualization

- Consolidate multiple physical servers to reduce costs
- Improve application uptime and failure recovery time
- Shorten time-to-deployment for new applications

Blade Form Factor

- Eliminate wires, components and space to reduce costs
- Rapidly provision hardware with plug-and-play modularity
- Right-size hardware profile for the lean branch office

All-in-one Device

- Integrate all branch devices into one box to reduce costs
- Simplify infrastructure to reduce operational burden
- Improve IT responsiveness with on-demand services

Service Virtualization
Borderless Services Without Infrastructure Changes

Cisco Services Ready Engine Modules

o Centralized deployment and management model with flexibility to move services without on-site visits

o Multi-purpose router blades for appliance, compute, and storage services

o Range of virtualized branch services and applications in a compact, router-integrated footprint

Any Service, Any Branch, Any Time

Simplify

o Consolidate all branch services into single device

o One hardware platform for wide range of applications

o Multi-application hosting for smaller hardware footprint

Grow

o Install new/replace existing application when needed

o No architecture redesign to deploy a different application

o Select from portfolio of Cisco and third-party applications

Save

o Lower on-site application installation/replacement cost

o Lower energy bills

o Lower hardware support cost

o Lower administration cost

Range of Branch Services

Network and Security Services		Collaboration Services	Compute Services and Applications	
Network Services	**Network and Physical Security**	**Unified Communications**	**Application Infrastructure**	**Industry Applications**
Control, Accelerate, Analyze	Secure, Protect, Compliance	Reach, Communicate, Collaborate	Consolidate, Simplify, Future-proof	Deliver Value-add Custom Solutions
▪ Wireless LAN Controller (WLC) ▪ Network Analysis Monitoring (NAM) ▪ Wide Area Application Services (WAAS) ▪ Application Performance Monitoring (NetScout and Visual Networks) ▪ IP Address Management (Infoblox and BlueCat) ▪ Log Management (LogLogic) ▪ Managed Print (Xerox)	▪ Video Surveillance (VSM) ▪ Voice Policy Firewall (SecureLogix) ▪ POS Analytics (Agilence)	▪ Cisco Unity Express (CUE) ▪ Unified SIP Proxy (CUSP) ▪ Unified Messaging Gateway (UMG) ▪ Survivable Remote Site Voicemail (SRSV) ▪ Cisco Unified Communications Manager (CUCM) ▪ Fax over IP (Sagemcom and OpenText) ▪ Paging over IP (Singlewire)	▪ Services Ready Engine Virtualization (SRE–V) ▪ Microsoft Windows Server on SRE-V ▪ Cloud Storage (CTERA) ▪ Digital Media Management (Industry Weapon)	▪ Cisco Medical Data Exchange Solution (Tiani Spirit) ▪ OSIsoft PI

▪ Cisco App   ▪ Partner App   15

Router Virtualization and SDN

Architectural Models for Networking Elements

Current switch/router

Vendor-specific APIs

Control Plane

Data Plane

Resilient and scalable, but decentralized

"SDN" Approach

Vendor-specific APIs

Central/Less to manage Feature poor

"Overlay" Approach

Vendor-specific APIs

Still requires resilient traditional network

Emerging: Hybrid Model

Standards-based APIs

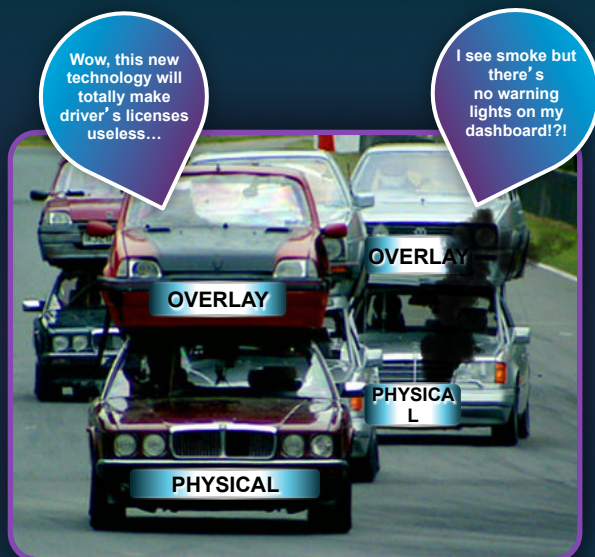**Control Plane**

OpenFlow or Vendor-specific CLI/SNMP

Control Plane

Data Plane

Cisco's ONE(one PK) Appro
Best of both worlds

Software-Overlay Only Approach: The Real Story

Perspective of an Overlay Startup Vendor

Wow, this new technology will totally make driver's licenses useless…

I see smoke but there's no warning lights on my dashboard!?!

OVERLAY

OVERLAY

PHYSICAL

PHYSICAL

Network Visibility of Your Apps Today

Network Visibility of Your Apps on an **Software Overlay**

REDUCED VISIBILITY

DIFFICULT TO TROUBLESHOOT

SECURITY CHALLENGES AND LACK OF COMPLIANCE

Where Do onePK Applications Run?

On An External Server
- Plentiful memory/compute
- Higher latency and delay
- Supported on by all platforms

"End-Node"

On A Hardware Blade
- Dedicated memory/compute
- Low latency and delay
- Requires modular hardware blade

"Blade"

Blade

On the Router
- Shared memory/compute
- Very low latency and delay
- Requires modular software architecture

"Process"

Adding a 'Slice' – Workflow Example

Slice Overview

What is a slice?

You can think as reserving a physical and logical switch resources.
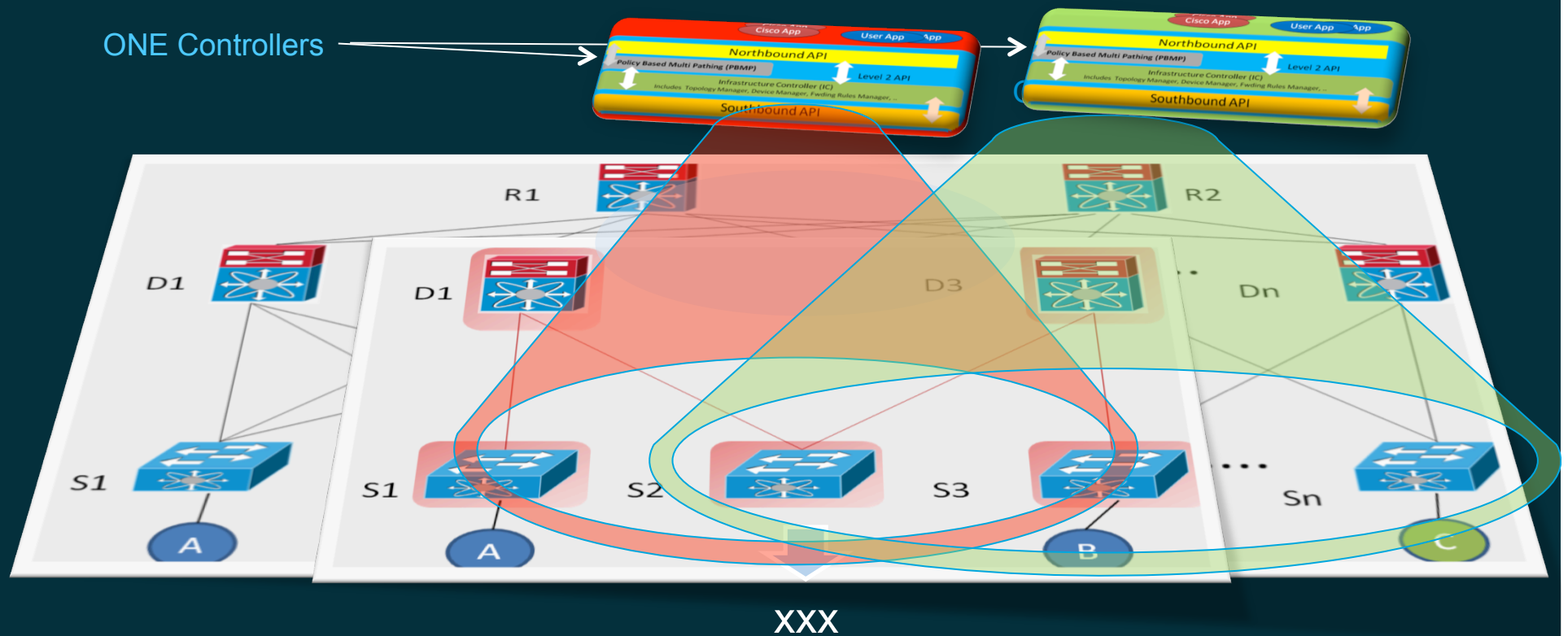It is very much analogous to N7K Virtual Device Context.

For Physical Resource:
Add physical ports/switches to a slice

For Logical Resource:
Add what Traffic (FlowSpec) to run on the slice

Flexible Slicing Instantiations WHILE Maintaining Policy Consistency

ONE Controllers

XXX

Router Virtualizations

- There are several device virtualizations

- Two main goals:
    Maximize resource utilization
    Provide IT agility

- They all face the same big challenge: Robustness (defined as "the ability of a system to resist change without adapting its initial stable configuration")

A Few References

- Cisco Virtual Router CSR1000v:
  http://www.cisco.com/en/US/products/ps12559/index.html

- Cisco SDN ONE strategy: http://www.cisco.com/go/one

- Cisco ONE/Pk developer network: http://developer.cisco.com/web/onepk

- Cisco VIRL ambiente per simulazioni di rete:
  http://www.cisco.com/web/solutions/netsys/CiscoLive/virl/index.html

Thank you.

CISCO