MARIST
INFORMATION TECHNOLOGY

Creation of Enterprise-Class Software-defined networks

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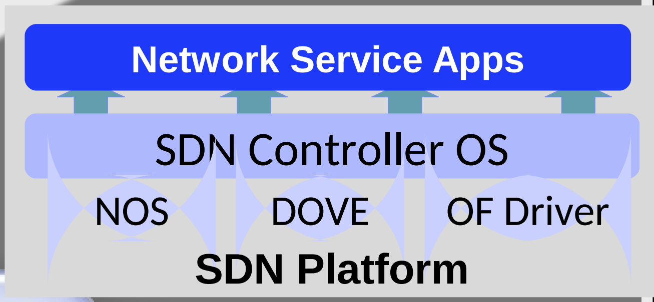
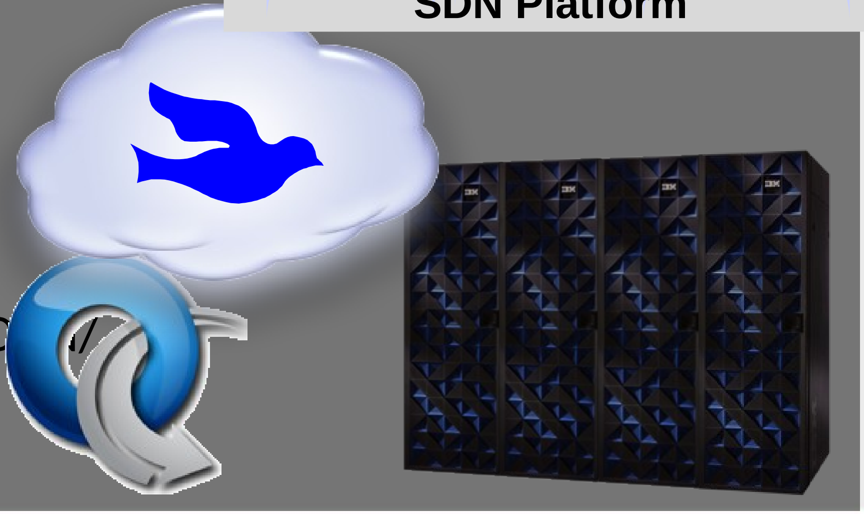
https://www-304.ibm.com/connections/blogs/D





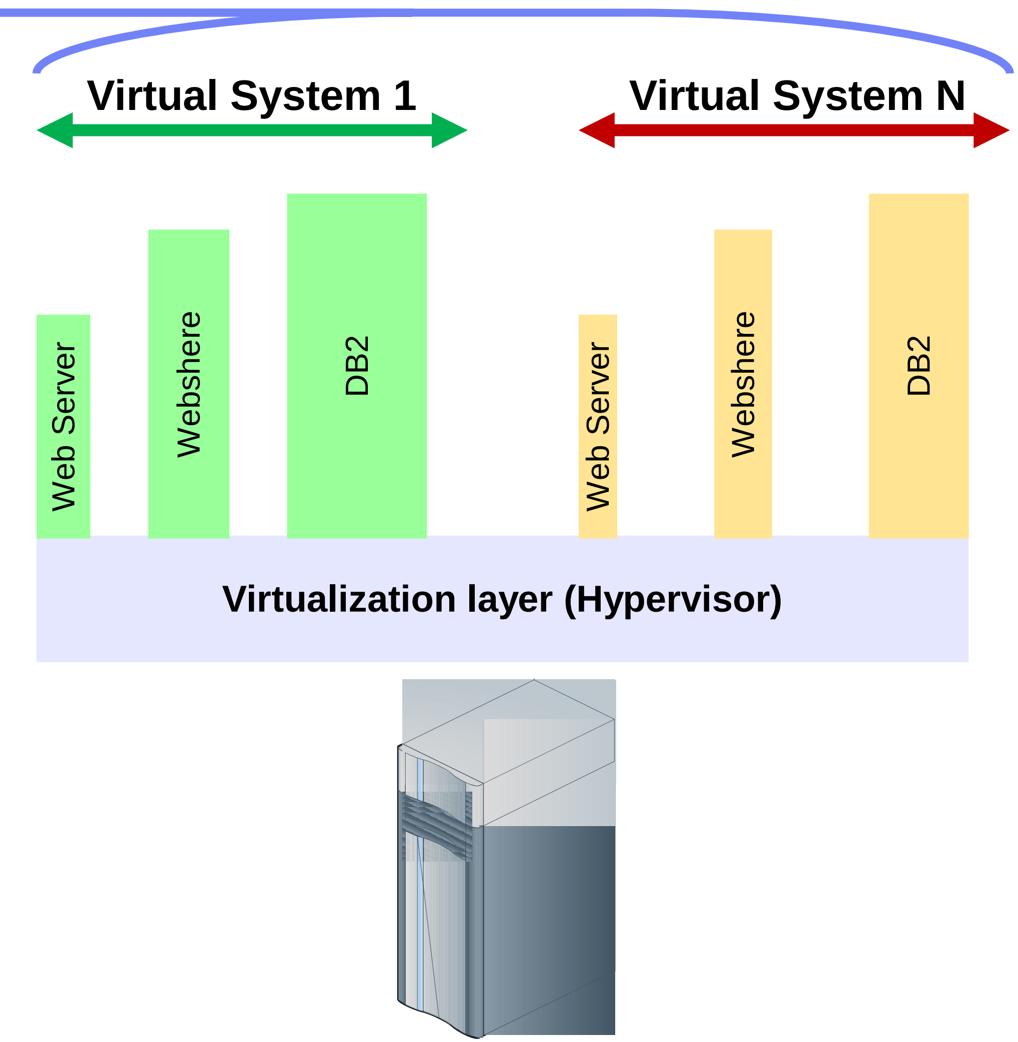
Tough reality: Life is not fair

…for Networking Professionals

Life for the Server Administrator

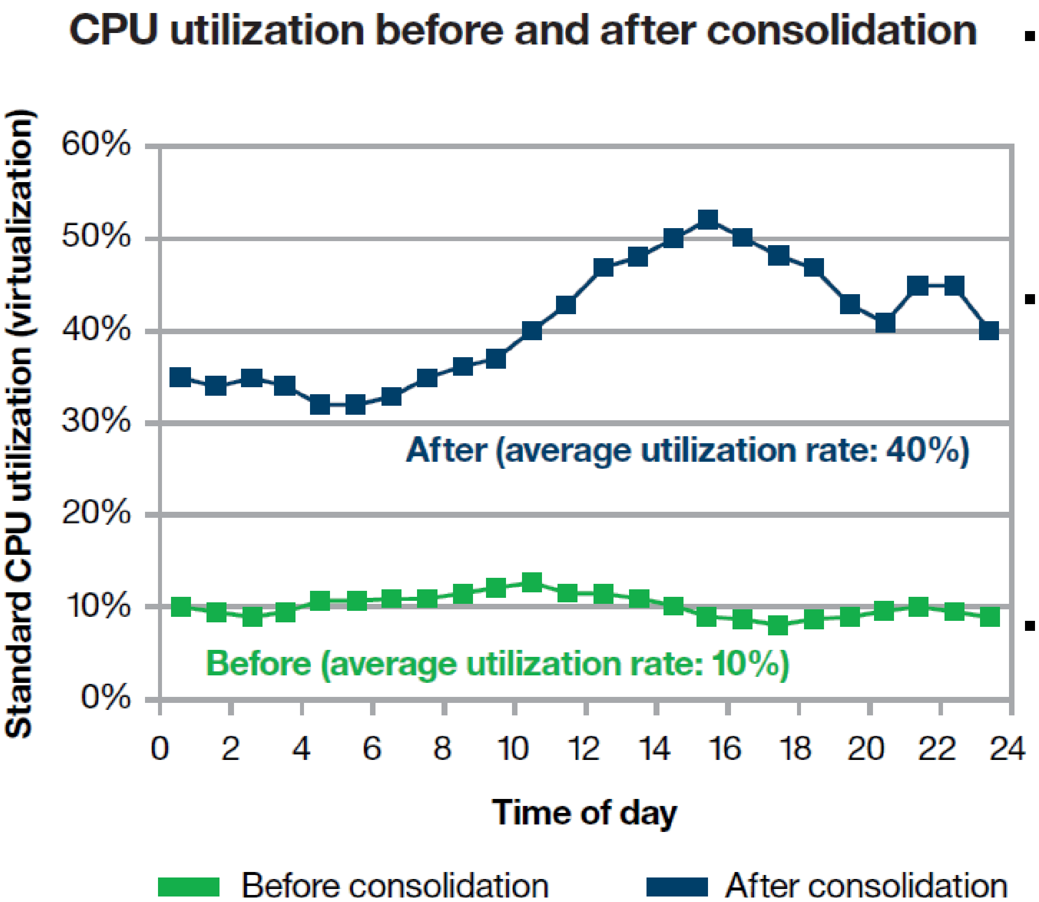
Orchestration Application

Programmable by orchestration application



- Dynamically provisioned
- Scalable capacity
- Abstracted HW complexity
- Highly utilized servers

Example Impact of Automated, Programmable Service Orchestration



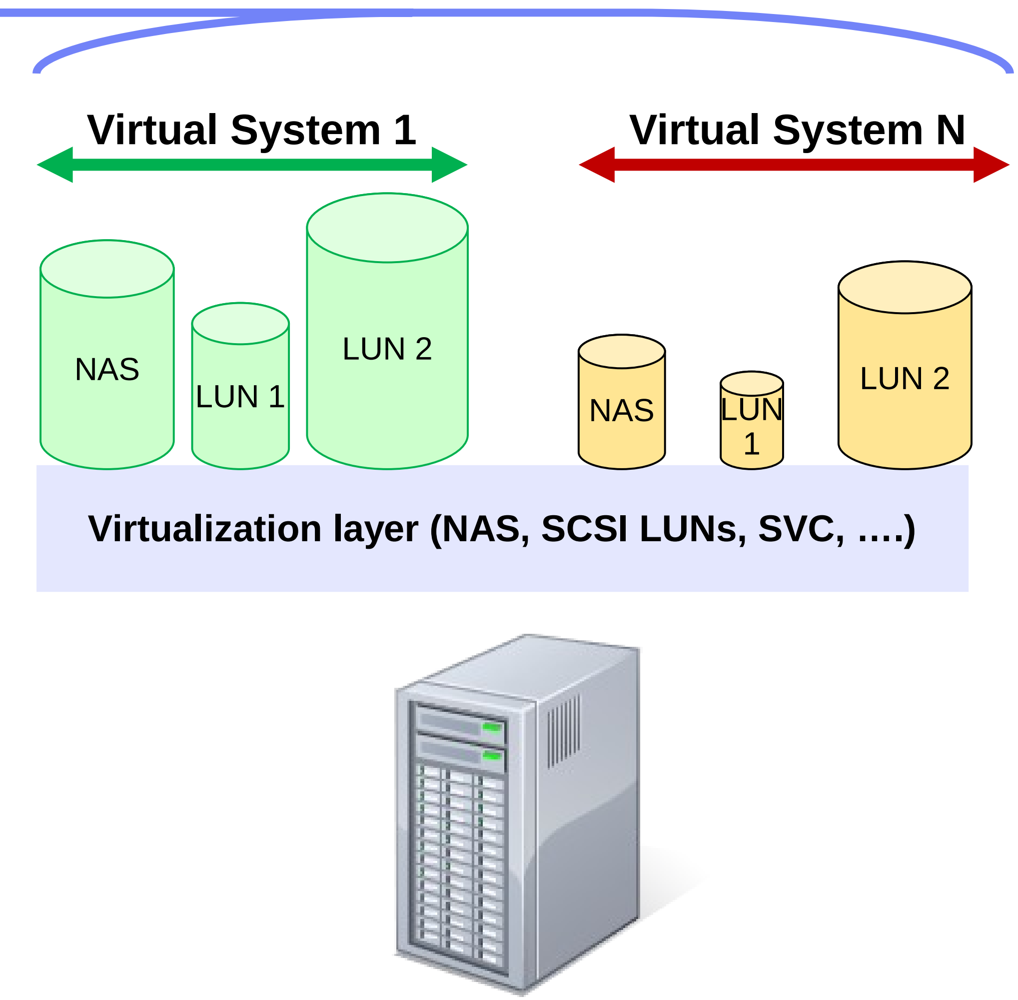
- Financial services client
  - Analyzed 30 workload variables
- Policy based automation
  - Analytics modeled current & future server workload demand
- Quadrupled utilization
  - Reduced servers by 90% and operating costs by 45%
  - Total $4M in 1st year savings

Source: 2012 IBM Data Center Study: http://www.ibm.com/data-center/study

Life for the Storage Administrator

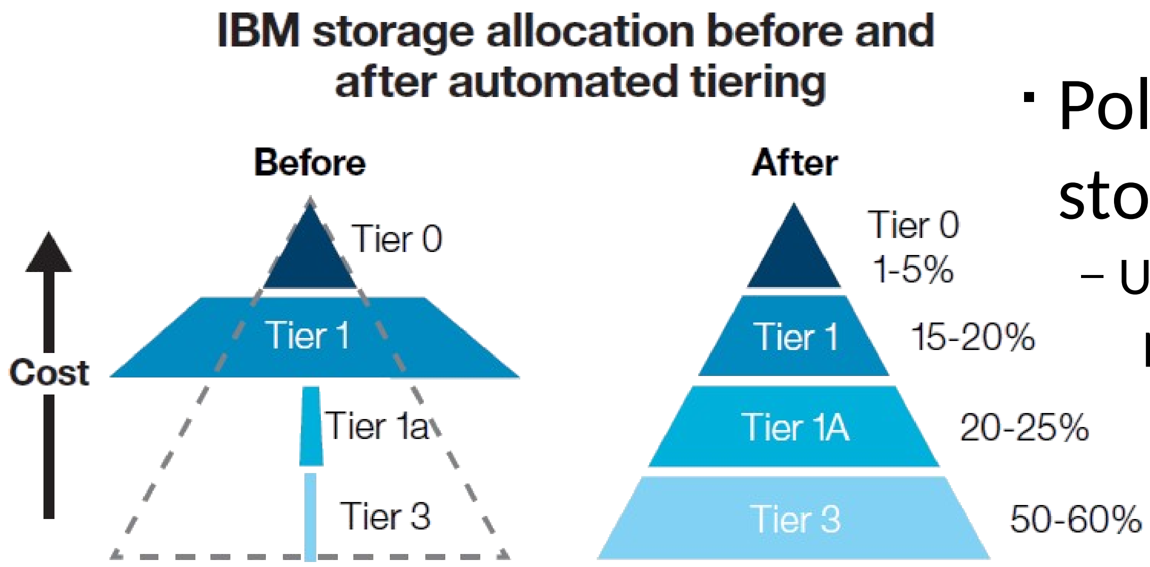
Orchestration Application

Programmable by orchestration application



- Dynamically provisioned
- Scalable capacity
- Abstracted HW complexity
- Highly utilized **storage**

Examples of the Impact of Automated, Programmable Intelligent Data Placement



- Policy based storage automation
  - Uses analytics and policy-driven automation to balance storage performance and cost over data life cycle.
  - Reduced storage management time from 235 hours to 6

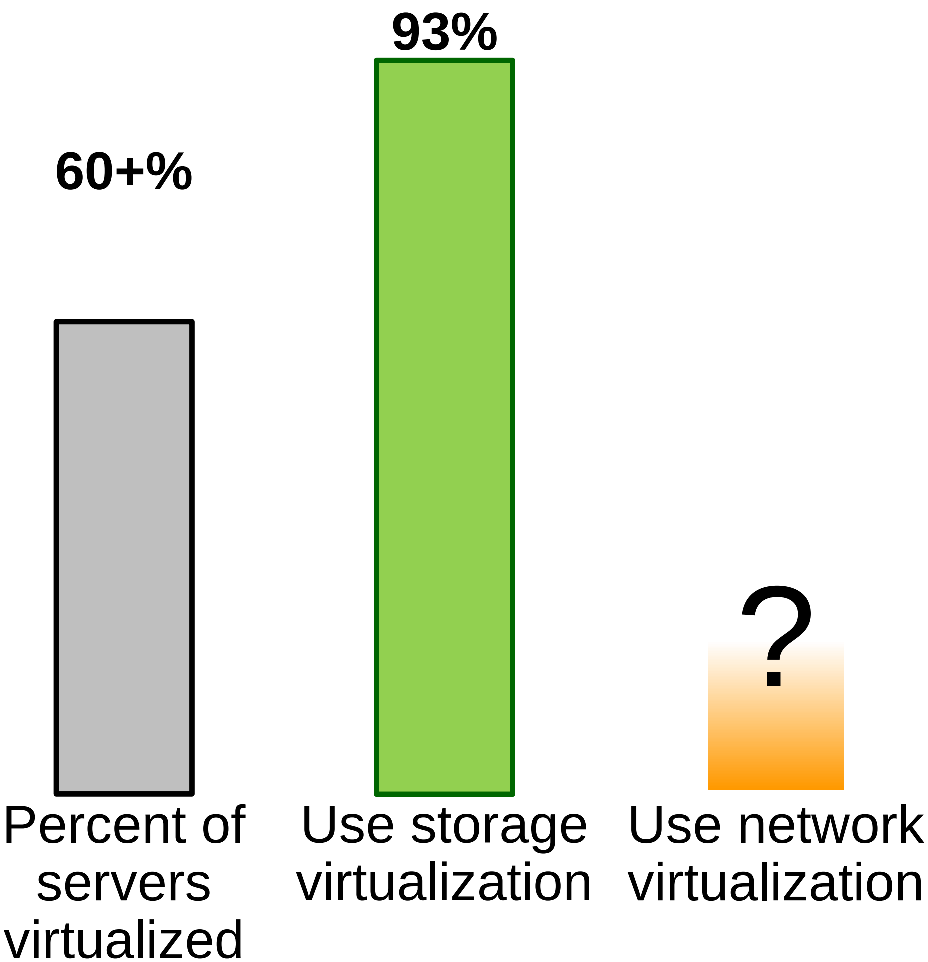
- Sprint network used storage virtualization to:
  - Increase storage utilization 100%
  - Reduce maintenance costs 57%

Source: 2012 IBM Data Center Study: http://www.ibm.com/data-center/study

Lack of Automated, Programmable Network

IBM

- Today: VM on-boarding is measured in minutes

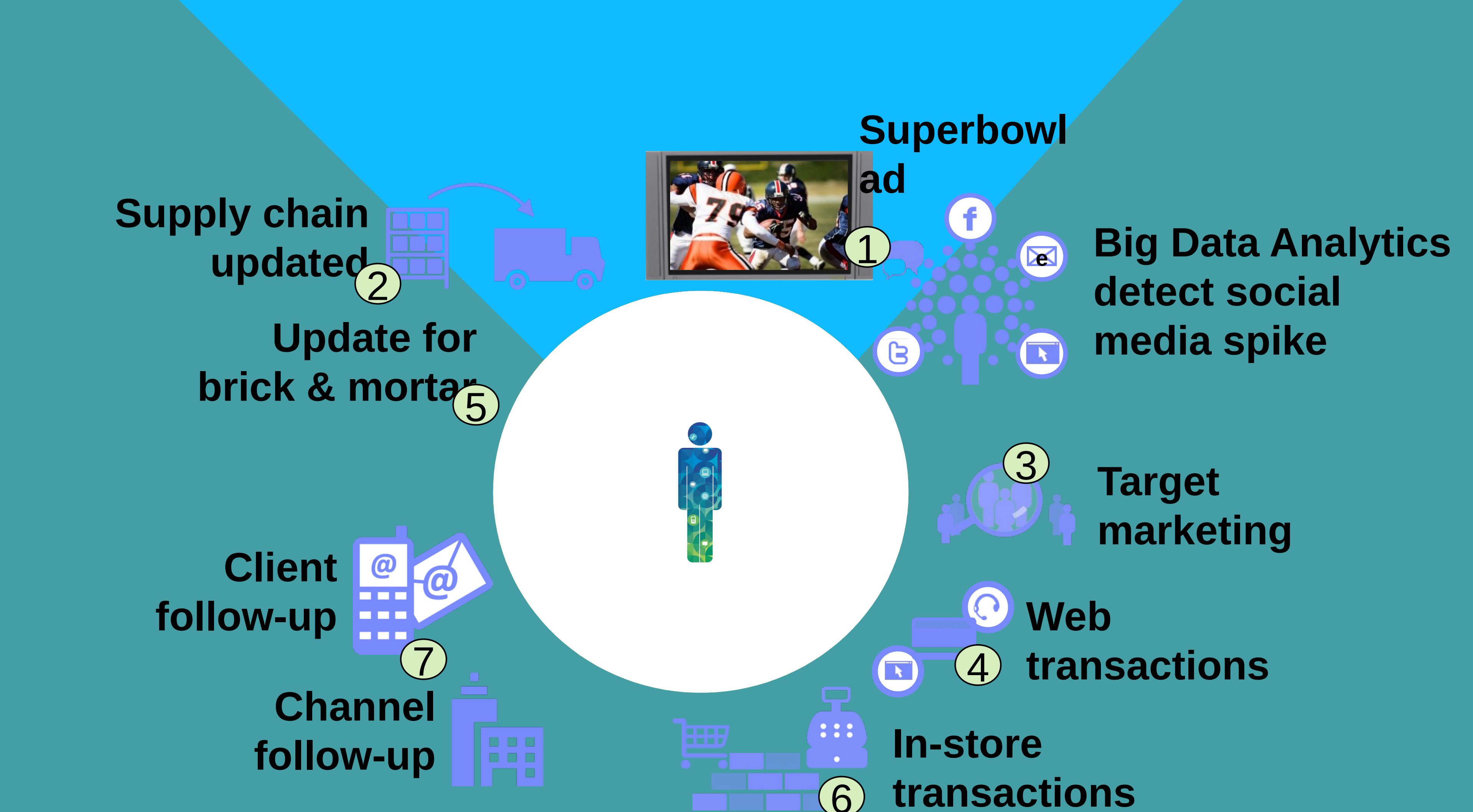


Source: 2012 IBM Data Center Study: http://www.ibm.com/data-center/study

But… **today**: multi-tier virtual-system connectivity is measured in **days**.

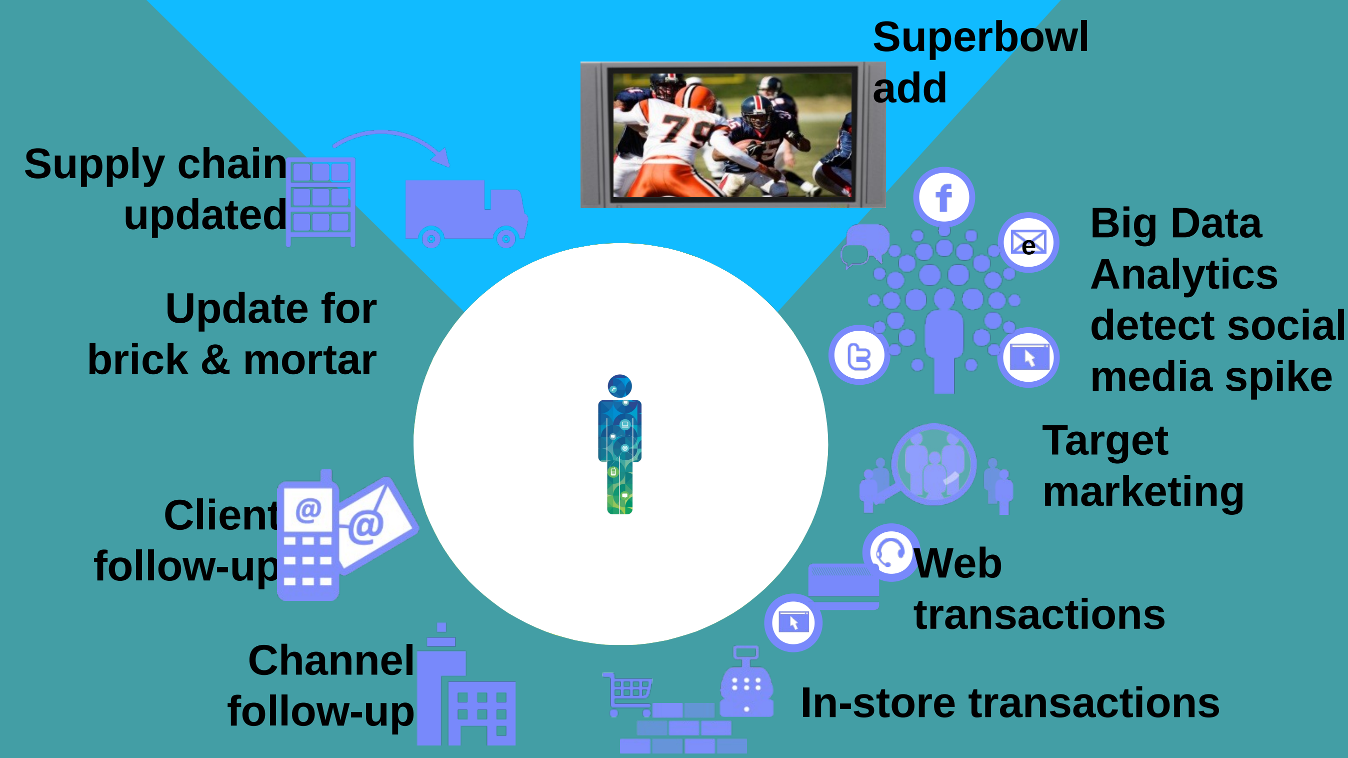
> John Manville, Cisco IT; The Power of a Programmable Cloud, OFC 2013 (OM2D.2): “It takes about 5 days from an end-end point of view to provision something like that (a multi-tier system).” Goal is to “get at least to sub-one day.”

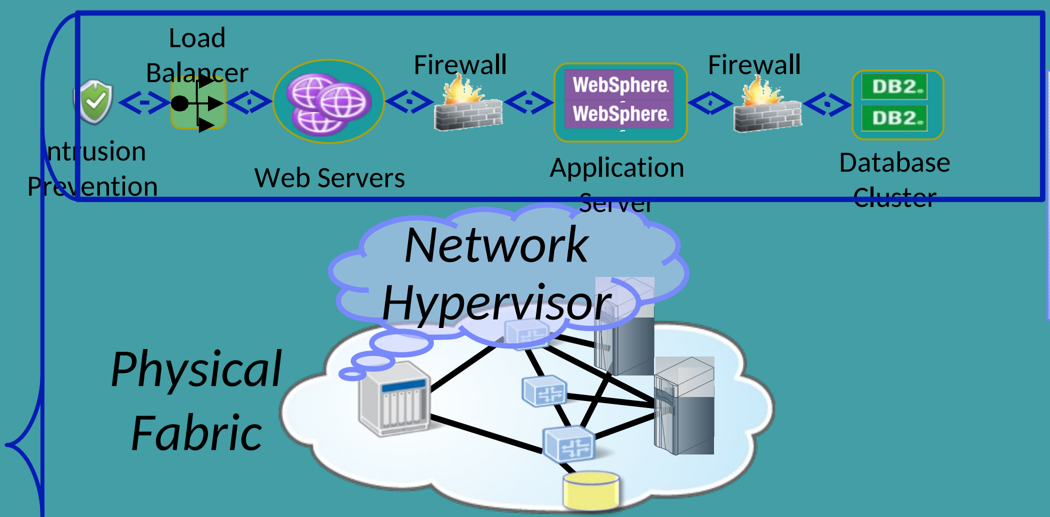
Networks are: Statically provisioned, under utilized, & require special skills



86% of clients stop doing business with a company due to bad experience.

60% of clients are willing to pay more for a better experience





Clients require a fast way to respond to their market demand

- For this example to be possible, 5 days needs to be minutes.

Today's Data Center Network

often gets in the way of client trends

Cloud needs elasticity and **multi-tenancy**

But…. Today's protocols make multi-tenancy complex. Box-level services & discrete physical infrastructure prevent true elasticity.

DC Virtualization needs agility of a **<u>fully</u> virtualized environment**

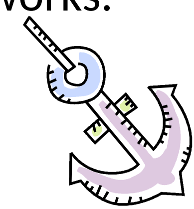
But…. Network virtualization is lagging other parts of DC Infrastructure. Complexities of physical network (box-type, SW version; capabilities; vendor inconsistencies) drag agility.

Mobility needs guaranteed **end-to-end SLA**

But…. Box-by-box protocols and behavior prevent anything end-to-end and results in error-prone security and QoS

Big Data & Analytics needs Application controlled, **optimized fabrics**

But…. Closed networks cannot be programmed via business applications, resulting in under-utilized networks.



Why is the **<u>Network</u>** usually a boat anchor in today's data center?


Clients seek smarter System Networking
Clients seek to shine a light on a part of the Data Center that has been in the dark to Application developers for too long – the Network

What is Software-Defined Networking (SDN)?

What is Software-Defined Networking ?

IBM

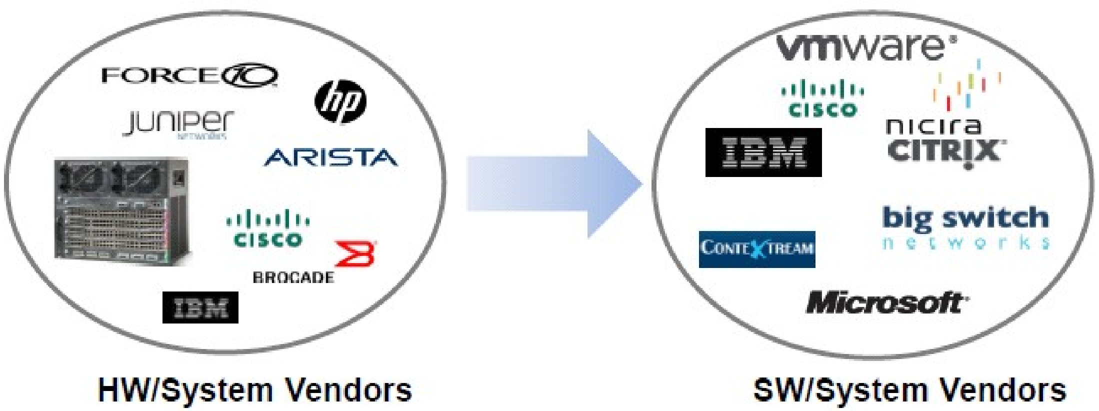
- **“I …discovered no one really knows what SDN is”** – Bob Metcalfe, inventor of Ethernet, January 2013 (http://www.eetimes.com//electronics-news/4406173/Metcalfe-seeks-peace-between-warring-comms-camps?cid=NL_EETimesDaily)
  - Everyone seems to have their own opinion (enterprises, telcos, supercomputers, cloud service providers…)

SDN is A Disruptive Force in the networking industry

An innovation that helps create a new market & value chain, and eventually displaces an existing technology

Chemical vs digital photography, cell phones vs land lines

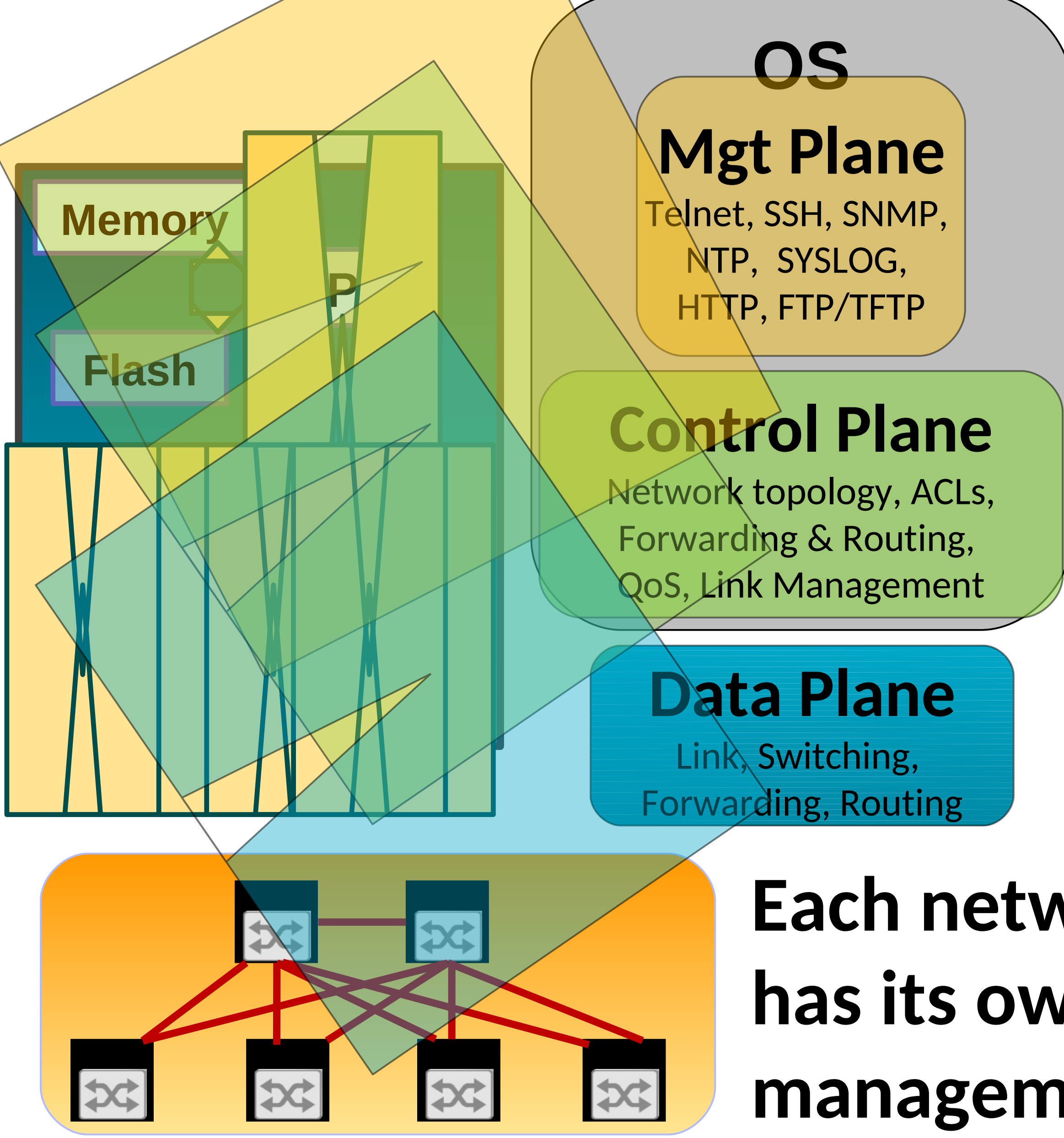
Network Virtualization is The Next Big Thing for data center design



SDN should be based on Open industry Standards & an Open Development Community

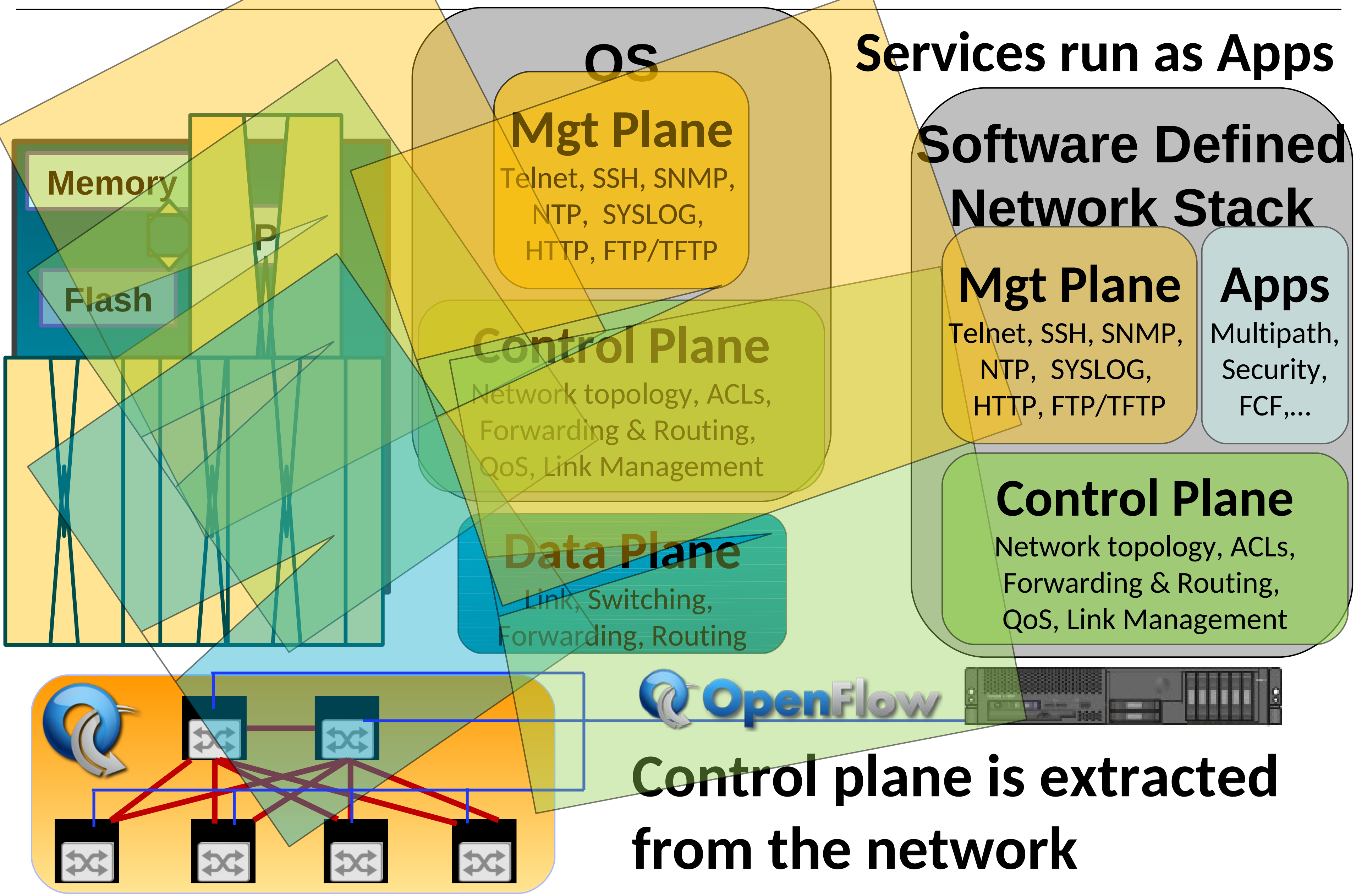
IETF incits INFINIBAND TRADE ASSOCIATION IEEE ONF

Separation of Control, Management, & Data Planes



Each network element has its own control and management plane

SDN Network



OS
Mgt Plane
Telnet, SSH, SNMP, NTP, SYSLOG, HTTP, FTP/TFTP
Control Plane
Network topology, ACLs, Forwarding & Routing, QoS, Link Management
Data Plane
Link, Switching, Forwarding, Routing
Memory
Flash
P
Services run as Apps
Software Defined Network Stack
Mgt Plane
Telnet, SSH, SNMP, NTP, SYSLOG, HTTP, FTP/TFTP
Apps
Multipath, Security, FCF,...
Control Plane
Network topology, ACLs, Forwarding & Routing, QoS, Link Management
OpenFlow
Control plane is extracted from the network

SDN: Distributed or Centralized

- Ethernet topologies were built distributed

  Scalable but hard to monitor

- Openflow topologies (today) are centralized

  Control-data separation forces this model

Strengths of one approach are weaknesses of the other
Centralized is better suited to modern cloud applications

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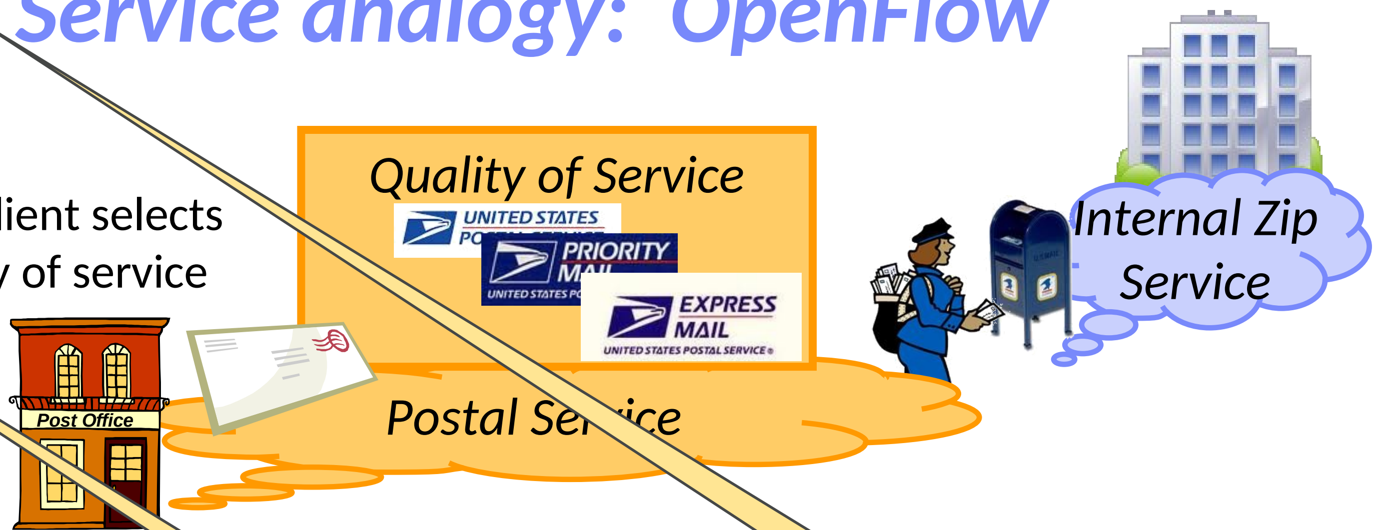
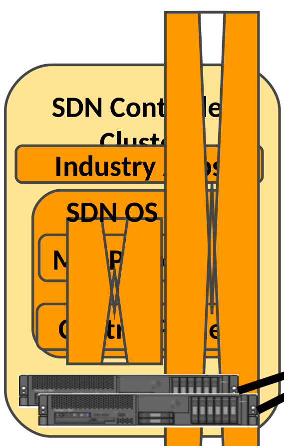
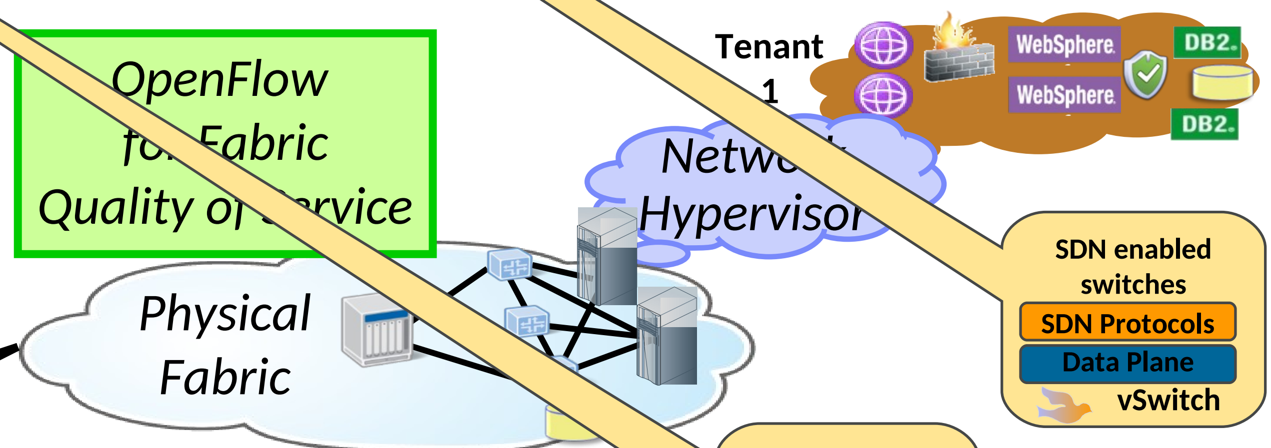
What is Software Defined Networking?

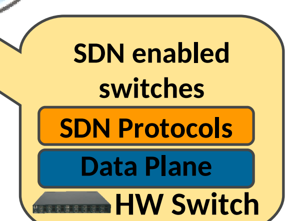
Postal Service analogy: OpenFlow

Postal client selects Quality of service









Open SDN Platform controls path packets take thru network & QoS of those paths.

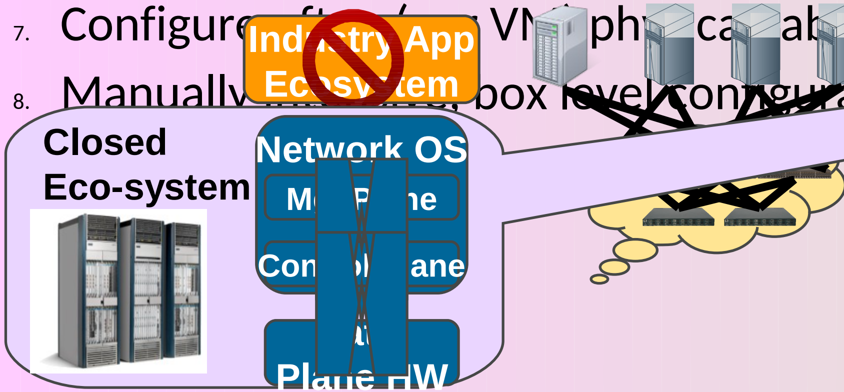
OpenFlow switches deliver packets at QoS level and thru paths set by Open SDN Platform.

Software Defined Networking

Traditional networking (w/o SDN)

Independent network switches:

1. Network OS runs on the switch
2. Switches oblivious to App requirements
3. “One size fits all” configurations & network policies
4. Poor utilization of available resources
5. Slow response to changes (load, failures…)
6. Vendor-proprietary extensions → clients locked into static, closed market
7. Configure ... VN ... ph ... ca ... ab ... c
8. Manually ... box level configurati...



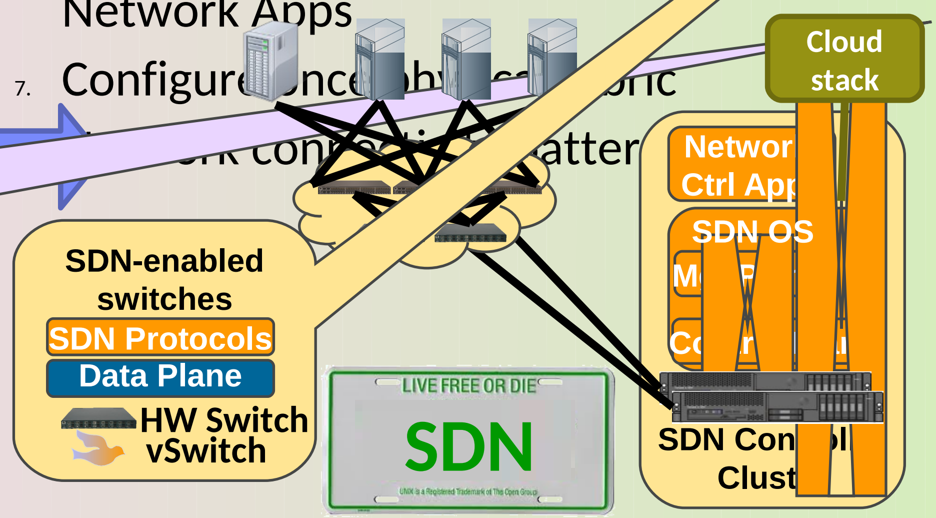
Switches:

- Run full protocol suite

Software Defined view of Network

SDN Controller programs switches:

1. Network OS runs on server cluster
2. Apps control network QoS thru SDN APIs
3. Network re-configures to match App requirements & global resource conditions
4. High network utilization
5. Responds to changes quickly and glob...lly
6. Enables innovation in SDN Contr...er & Network Apps
7. Configure ... nce ... ph ... fabric
8. ...rk conn... atter...



Switches:

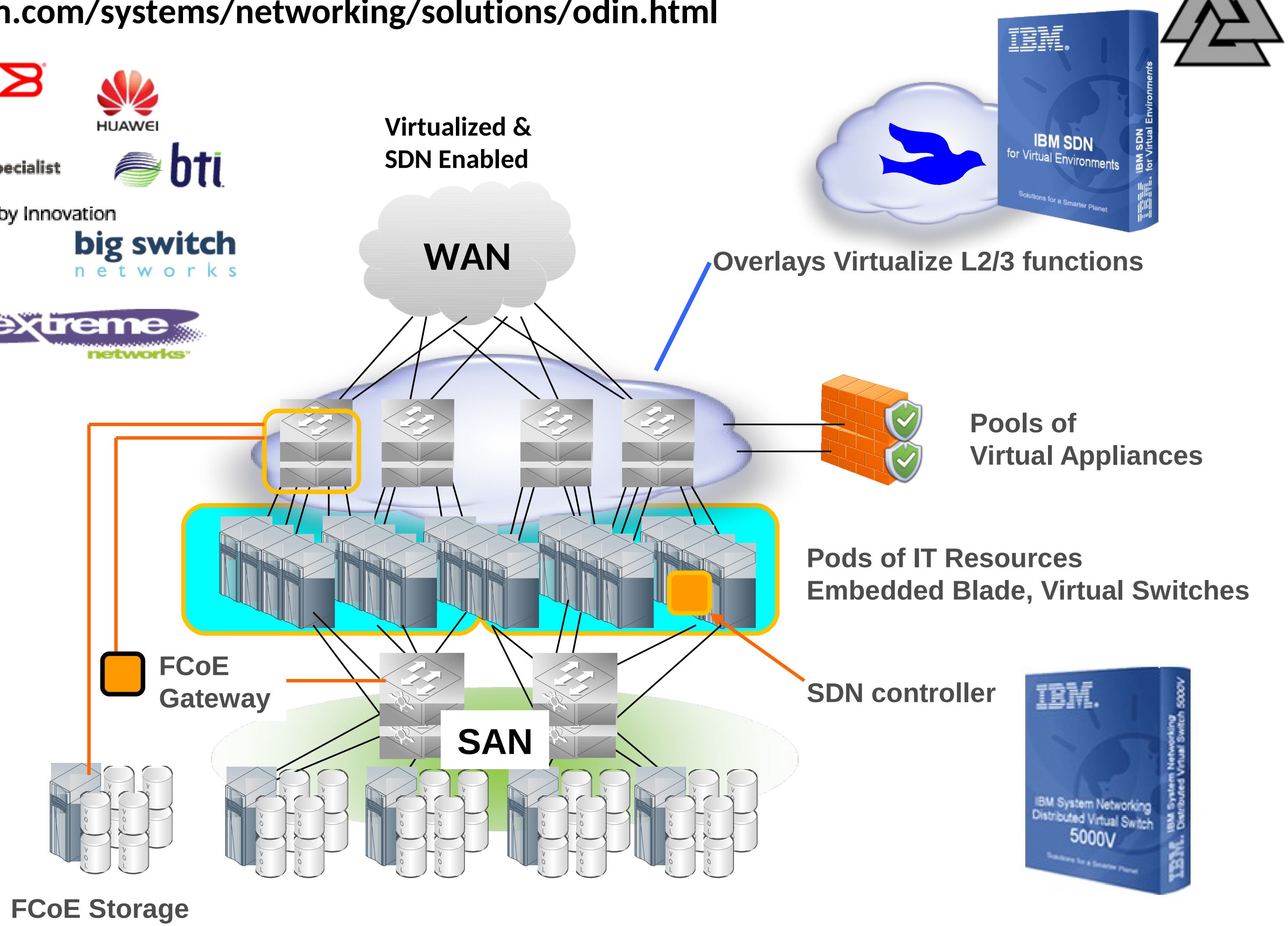
- Implements policies from

ODIN – The Open Datacenter Interoperable Network

An industry standard point of view on SDN & network virtualization

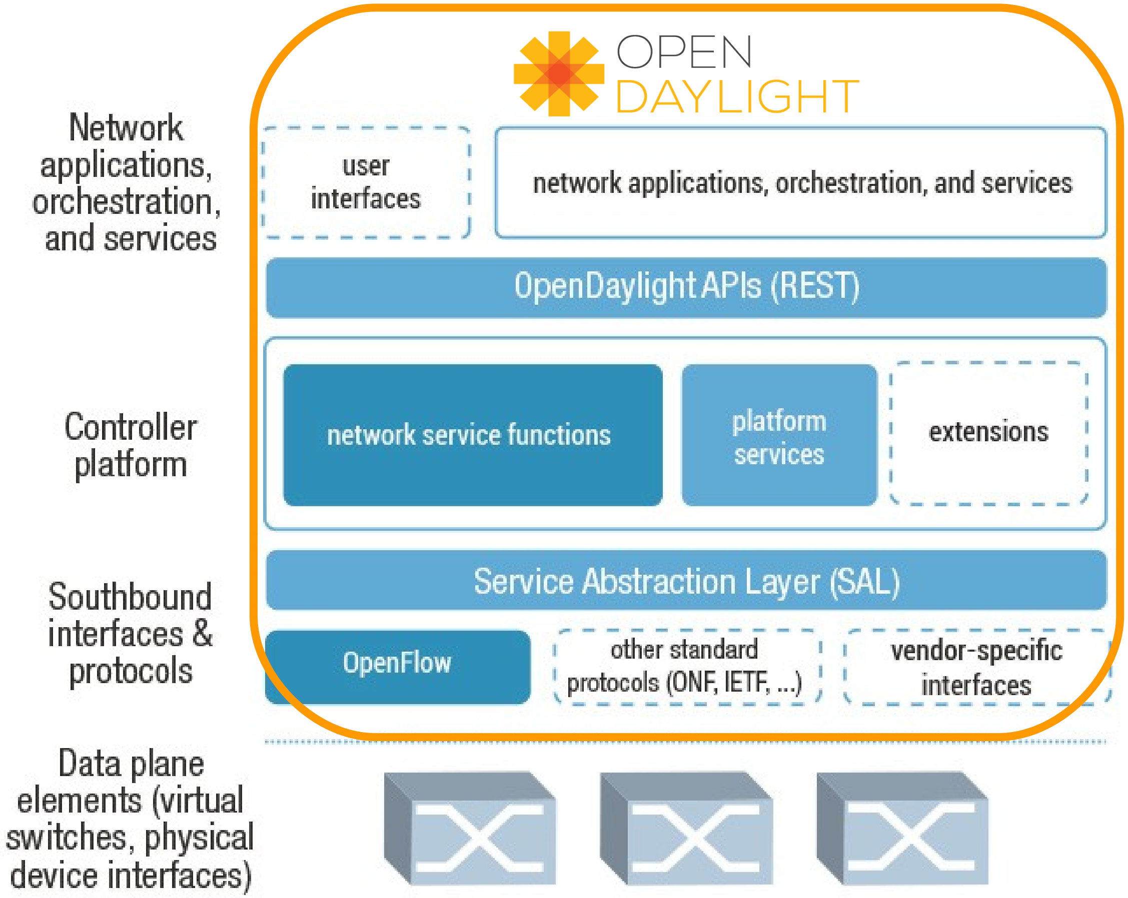
http://www-03.ibm.com/systems/networking/solutions/odin.html

stacked switches
lossless Ethernet
FCoE, TRILL, & more



Project Open Daylight

Open Daylight is an open source project under the Linux Foundation
with the mutual goal of furthering SDN adoption and innovation
through the creation of a common industry supported framework
www.opendaylight.org



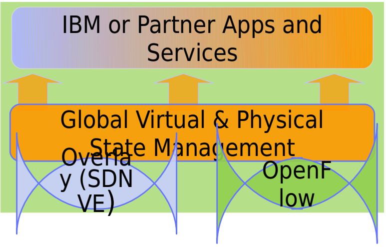
Eclipse Public License (EPL)

Members as of April 8, 2013 and growing

What can we do with SDN today?

IBM SDN Products

VMready	OpenFlow Switches	Edge Virtual Bridging	Distributed Virtual Switch	OpenFlow Controller	IBM SDN VE (DOVE)	Additional OpenFlow Switches and features	SDN Platform
Jan 2009	Oct 2011	Jan 2012	Feb 2012	Nov 2012	Mid 2013	Investment	Investment



IBM SDN: Shipping products and technology investments

Virtual Switches

OpenFlow enabled switches & controllers

Overlay Networks (DOVE)

Is SDN Ready for Primetime ?

IBM SDN Client Examples

Google also uses OpenFlow
For traffic grooming on their backbone

IBM SDN OpenFlow clients

For Global Network Services network between data centers
SDN Value: “Better network visibility & control”

SELERITY — Provider of ultra-low latency real-time financial information
SDN Value: “Policy driven content distribution & automated network configuration”

TERVELA Data in Motion — Provider of distributed data fabric for global trading & risk analysis
SDN Value: “Predictable network performance & rapid convergence”

IBM SDN Deployments in Enterprise Client Test & Development

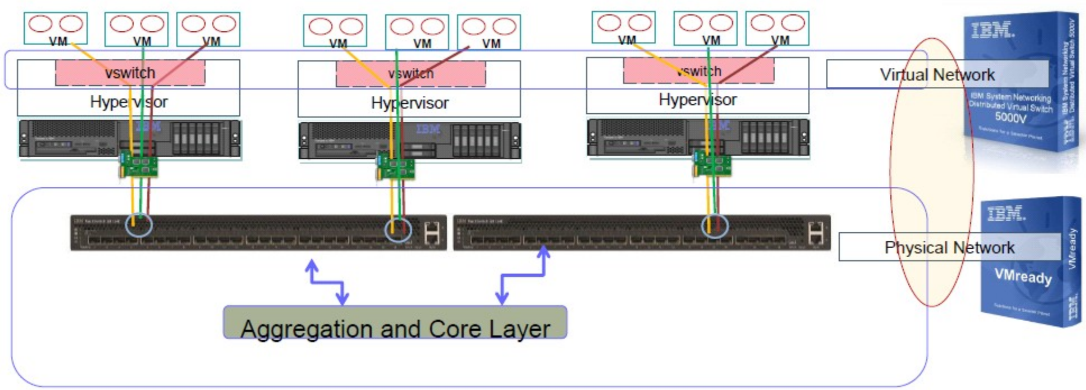
2 service providers

SDN Value:
- “Programmable hosting network”
- “Global visibility and control”

Clients Evaluating
World-wide Enterprise & Service Provider Data Centers

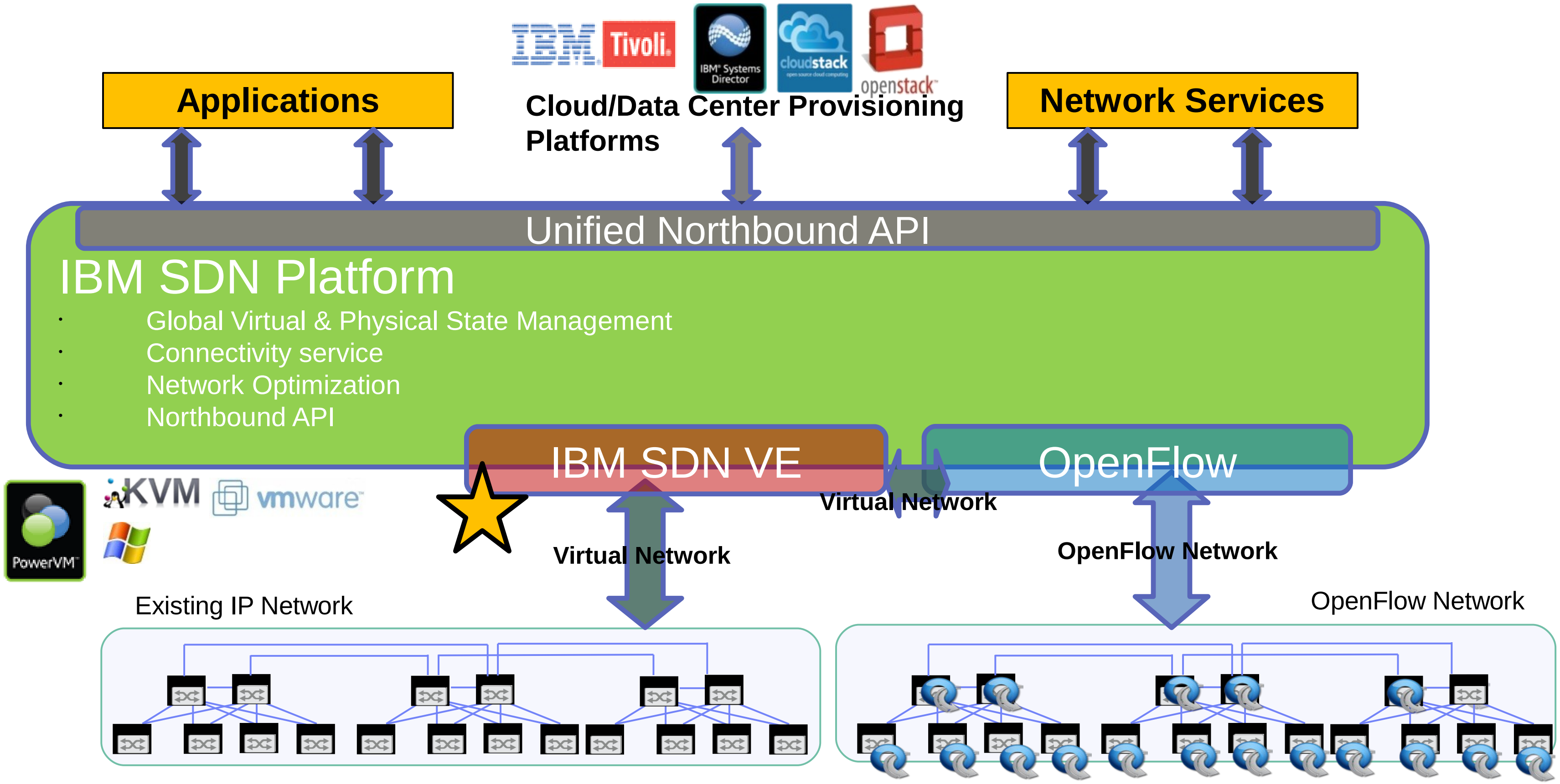
IBM Distributed Virtual Switch 5000V

- **Distributed Virtual Switch for VMware**
  - Clusters virtual switches across multiple VMware ESX Hypervisor instances
  - Seamless integration for vSphere 5.0, Advanced Layer 2 Features



- **VMs become the new switch entity within your server pods**
  - Allows physical access switches to be Virtual Machine aware (e.g. configure network state before VM starts-up, migrate network state before VM migration).
  - Optimizes East-West traffic between VMs in a single server and within a rack
  - Based on IEEE 802.1Qbg standard specification (KVM, PowerVM support)

IBM SDN technology overview



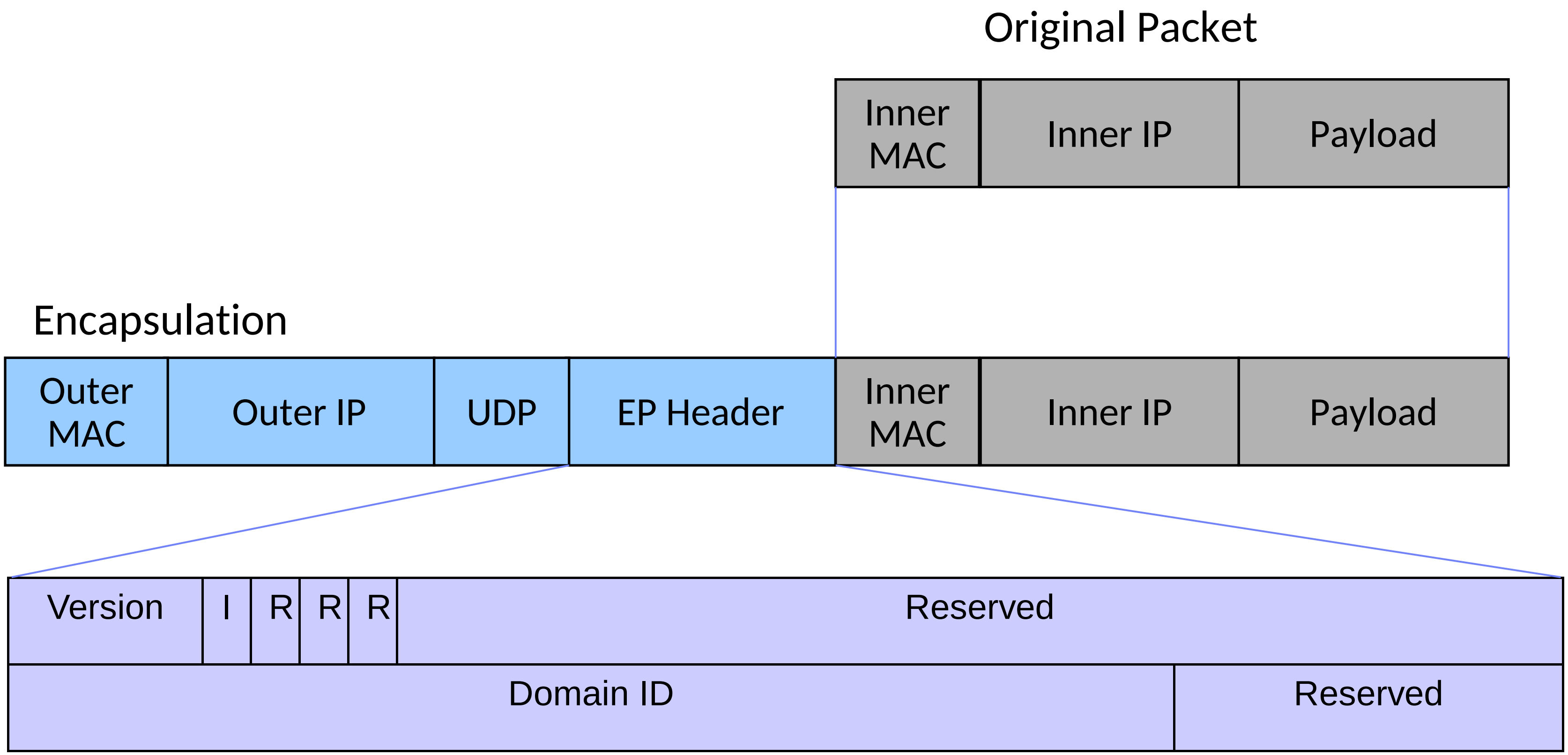
The IBM SDN Platform

- **SDN Controller** — Automates connectivity service, optimizes network
- **IBM Software Defined Environment for Virtual Environments — A network hypervisor**
- **Optimized Fabric** — Converged Ethernet and OpenFlow

Automated

DOVE Technology

VXLAN based Encapsulation Example



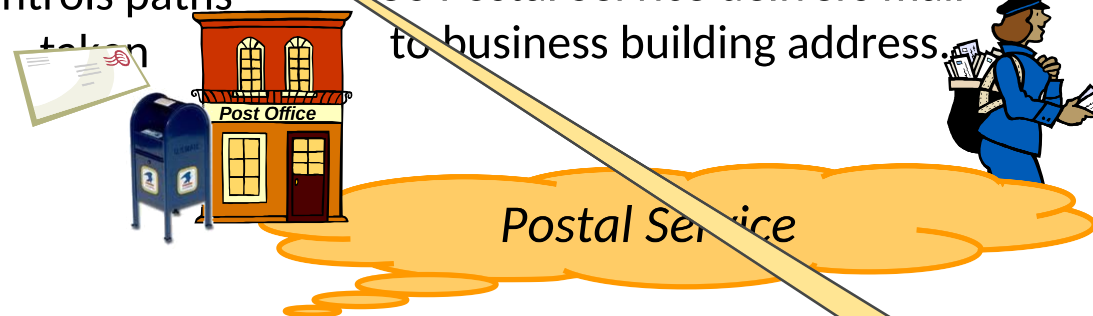
Encapsulation Protocol (EP) Header (e.g. VXLAN based)

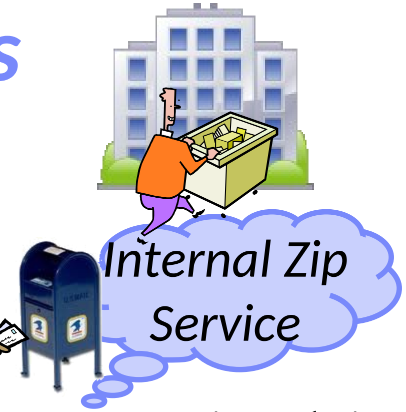
What is Software Defined Networking?

Postal service analogy: Overlays

Postal service controls paths taken

US Postal Service delivers mail to business building address.

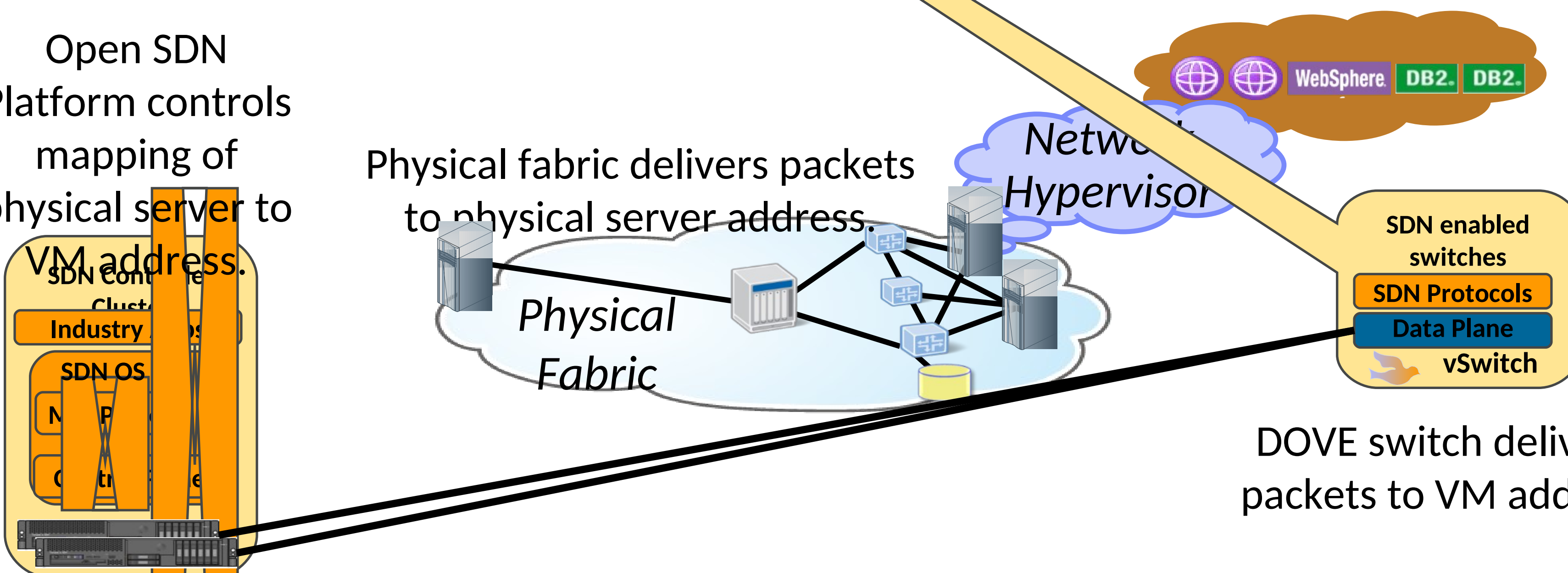




Business's internal mail service sorts & delivers mail to internal address.

Open SDN Platform controls mapping of physical server to VM address.

Physical fabric delivers packets to physical server address.



DOVE switch delivers packets to VM address.

What is Software Defined Networking?

Postal service analogy: Multicast

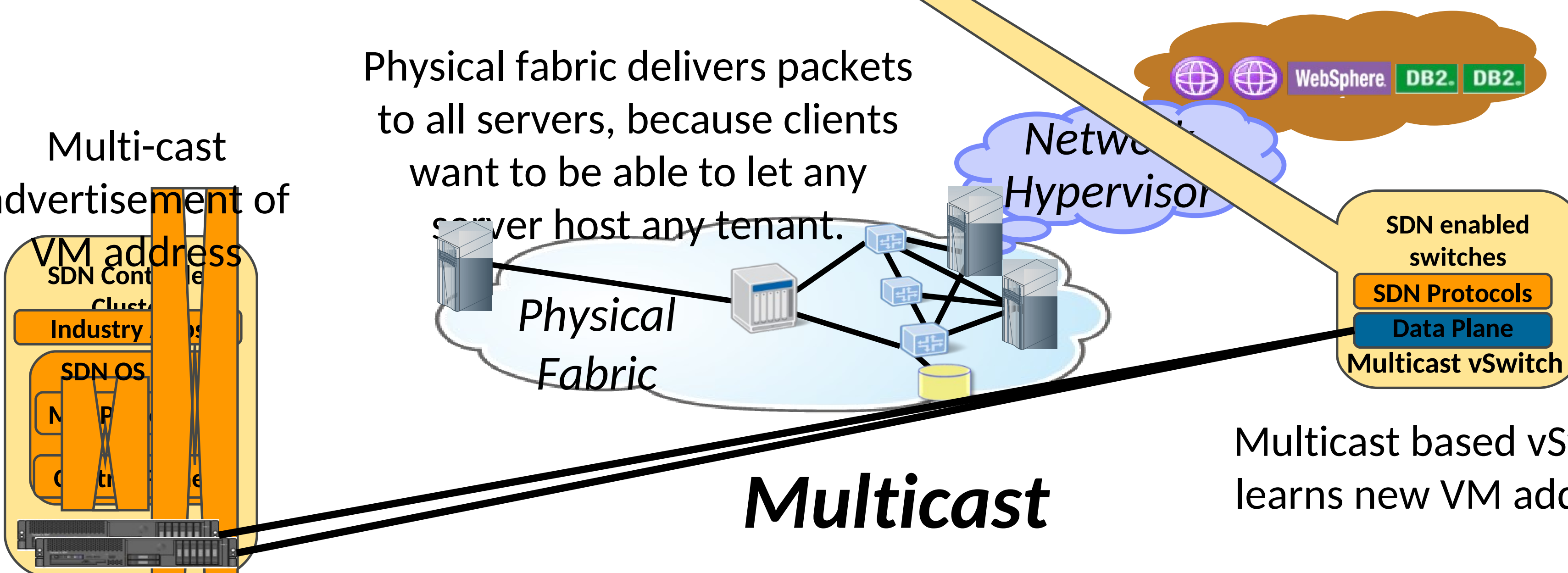
“Multi-cast” **potential** target addresses

US Postal Service delivers junk mail to all **potential**

Flood of junk to all “**potential**” target addresses

Multi-cast advertisement of VM address

Physical fabric delivers packets to all servers, because clients want to be able to let any server host any tenant.



Multicast

Multicast based vSwitch learns new VM address.

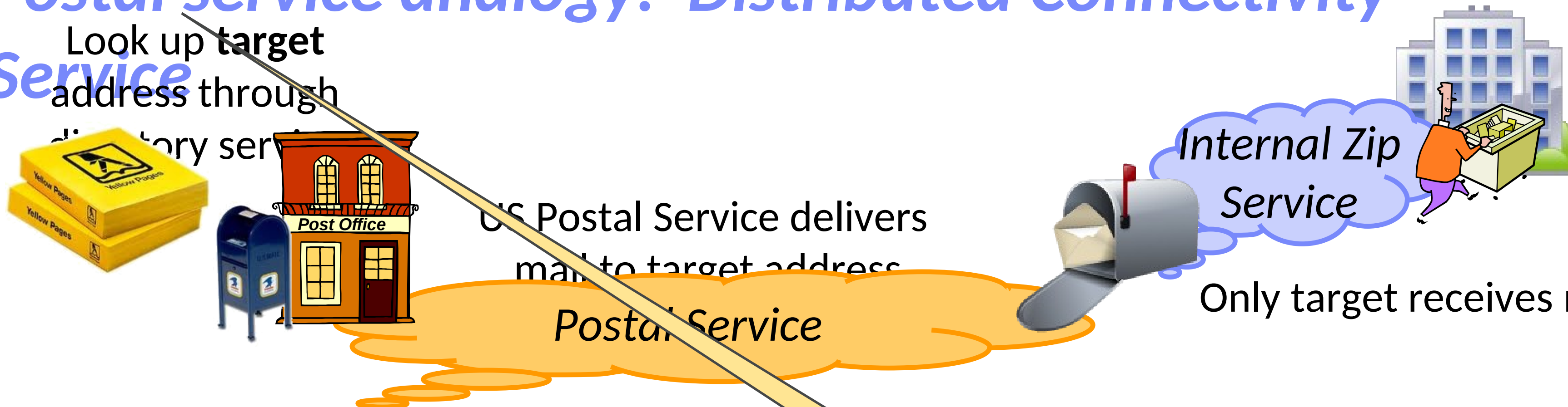
What is Software Defined Networking?

Postal service analogy: Distributed Connectivity Service

Look up **target** address through di tory ser

US Postal Service delivers mail to target address

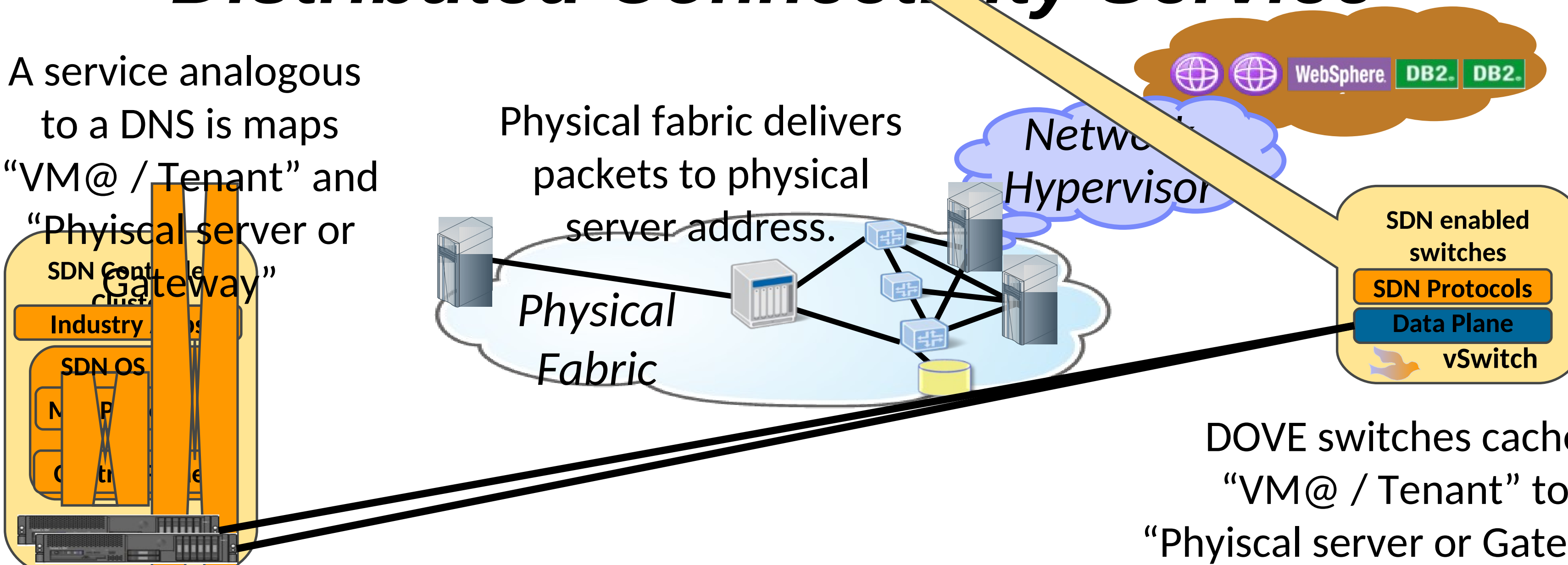
Only target receives mail



Distributed Connectivity Service

A service analogous to a DNS is maps "VM@ / Tenant" and "Phyisical server or Gateway"

Physical fabric delivers packets to physical server address.



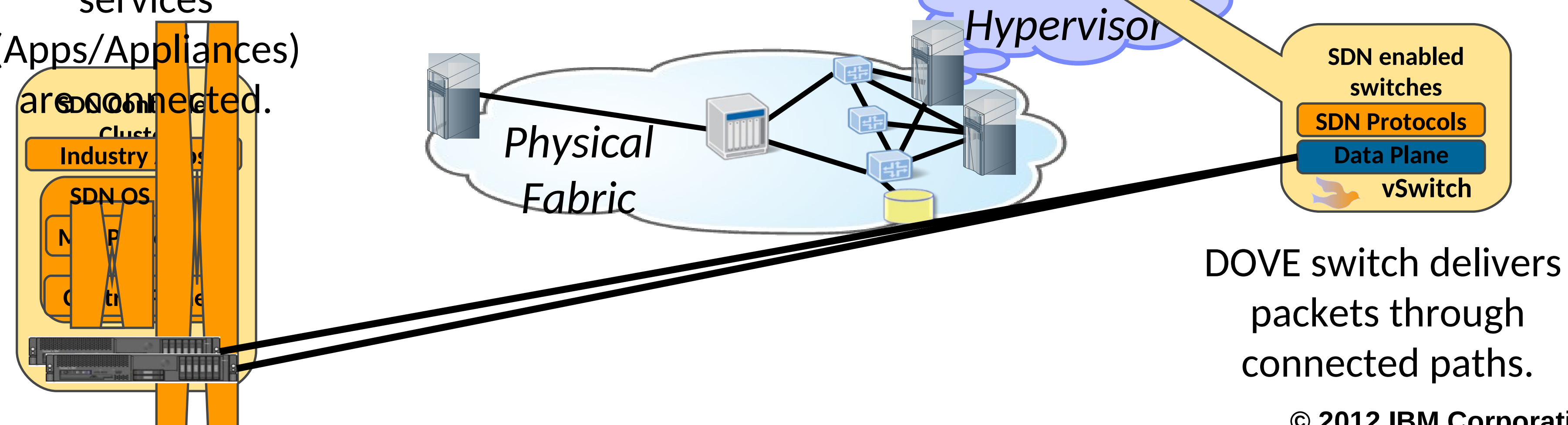
DOVE switches cache "VM@ / Tenant" to "Phyisical server or Gateway" DCS mappings

What is Software Defined Networking?

Postal service analogy: Connectivity Service Security

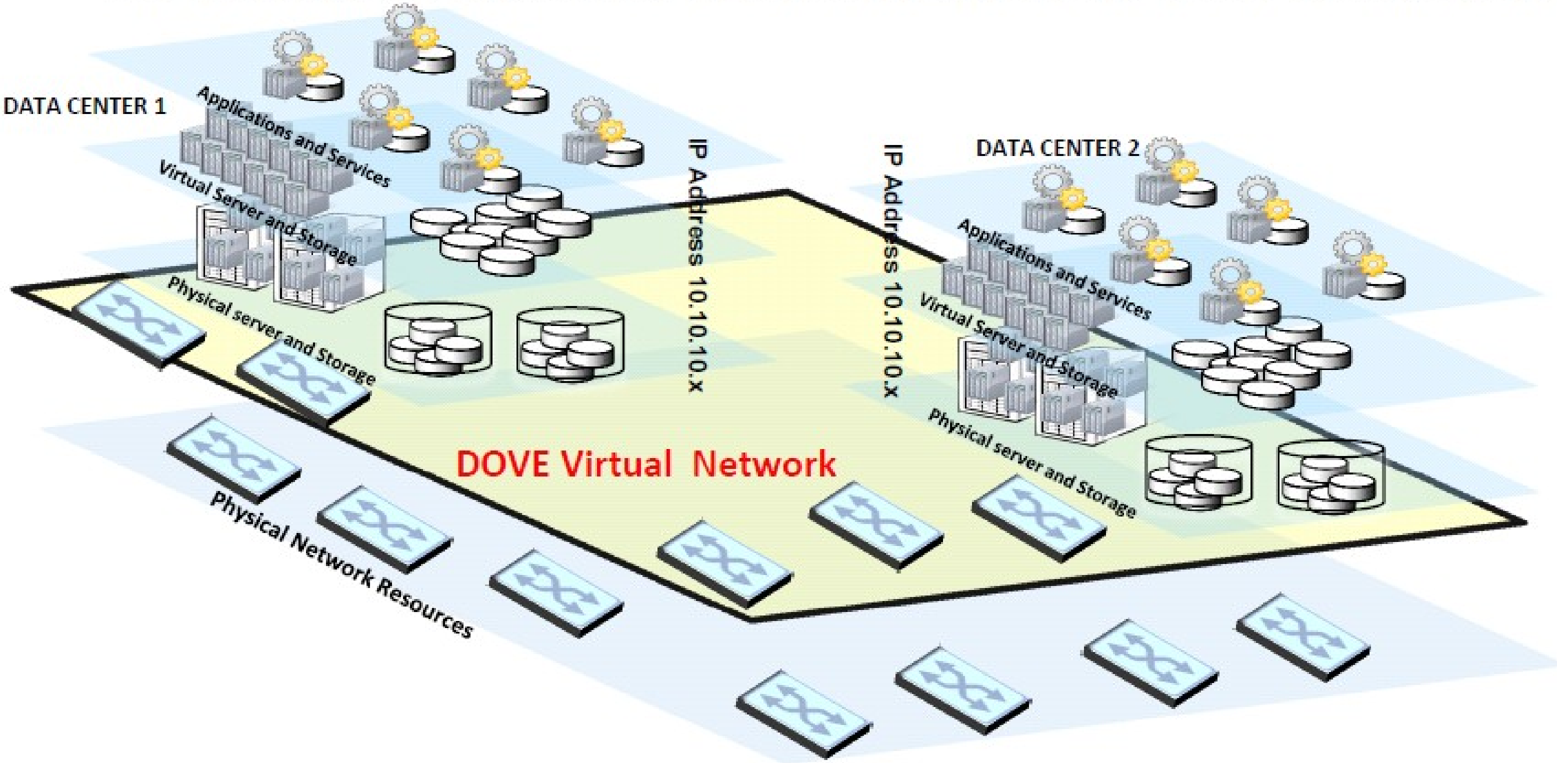
Pentagon's internal mail service assures mail flows through security checks (e.g., poison check).

Open SDN Platform controls how services (Apps/Appliances) are connected.



DOVE switch delivers packets through connected paths.

- Data Center Consolidation improves efficiency
- Site consolidation and M&A activities necessitates Data Center Consolidation



Overlapping Network addresses is a big challenge to Data Center Consolidation

Many Application licensing tied to IP addresses which makes server consolidation a big challenge
Physical Networks make it impossible to share same IP addresses which makes Data Center consolidation complex

Efficient Data Center consolidation with DOVE enabled servers

Integrated

IBM SmartCloud Foundations & OpenStack

IBM

Supporting both Vertically Integrated and Horizontal solutions

- **Simple 3 tier structure**, with increased Client Value at each tier
- Using **open, common, standards based architecture** providing choice, flexibility, interoperability, portability
- **Clean upgrade paths** with **progression** to fully integrated and factory optimized PureApplication System
- **Significant customer benefits above and beyond base OpenStack**

Related Standards & Organizations

ISO International Organization for Standardization
CCRA
OSLC
Cloud Standards Customer Council
THE Open GROUP
TOSCA
OASIS STANDARD
openstack CLOUD SOFTWARE
DMTF
CIMI & OVF
OPEN DAYLIGHT

SmartCloud Orchestration

Orchestrate Services across multiple environments and domains

Key: Common Cloud Stack | Factory Integrated | Bundle Option

SmartCloud Provisioning
Automate Optimized Workloads

SmartCloud Entry
Automate IT Delivery

Customer integrated hardware

SmartCloud Provisioning
Automate Optimized Workloads

SmartCloud Entry
Automate IT Delivery

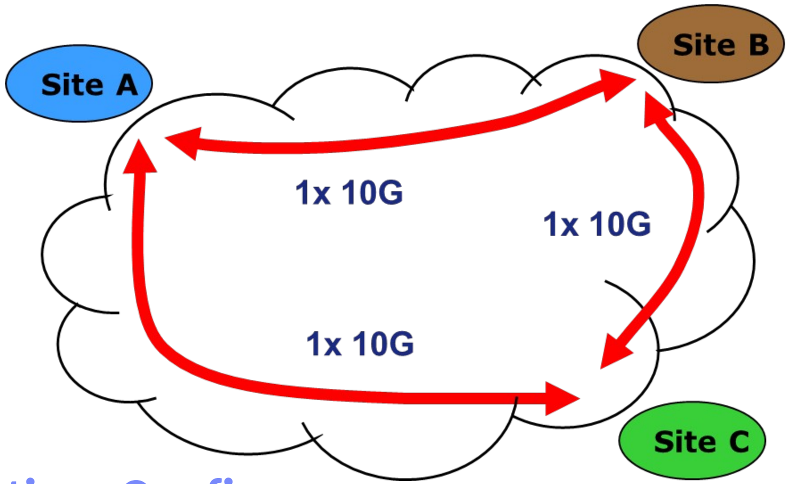
PureFlex System

Automate Optimized Workloads

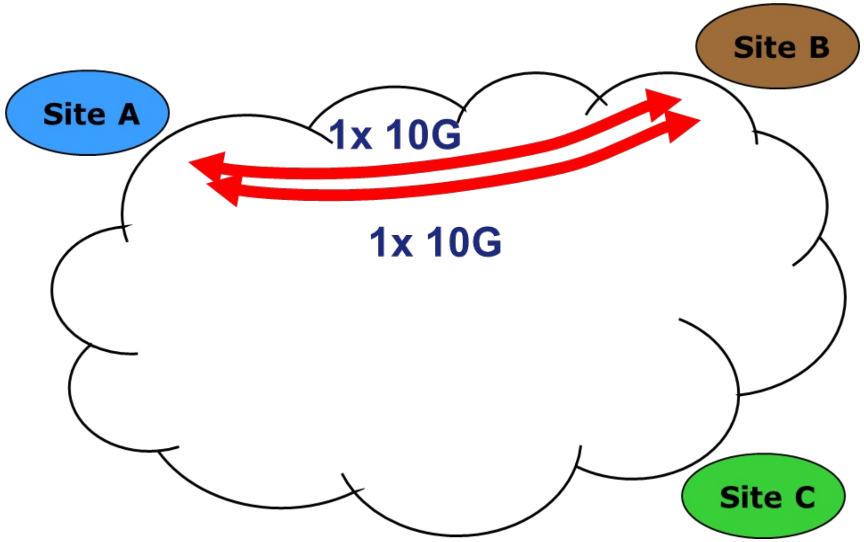
PureApplication System

Application Aware Network Orchestration

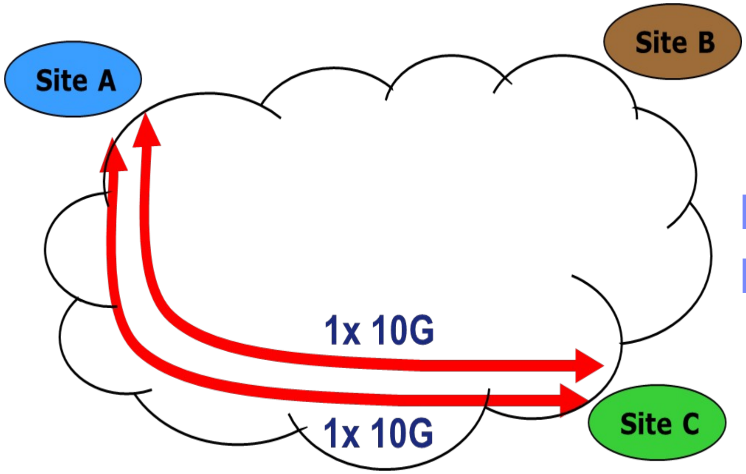
IBM



Daytime Config:
Workload balanced across sites



Nighttime Config:
Backup jobs between selected sites



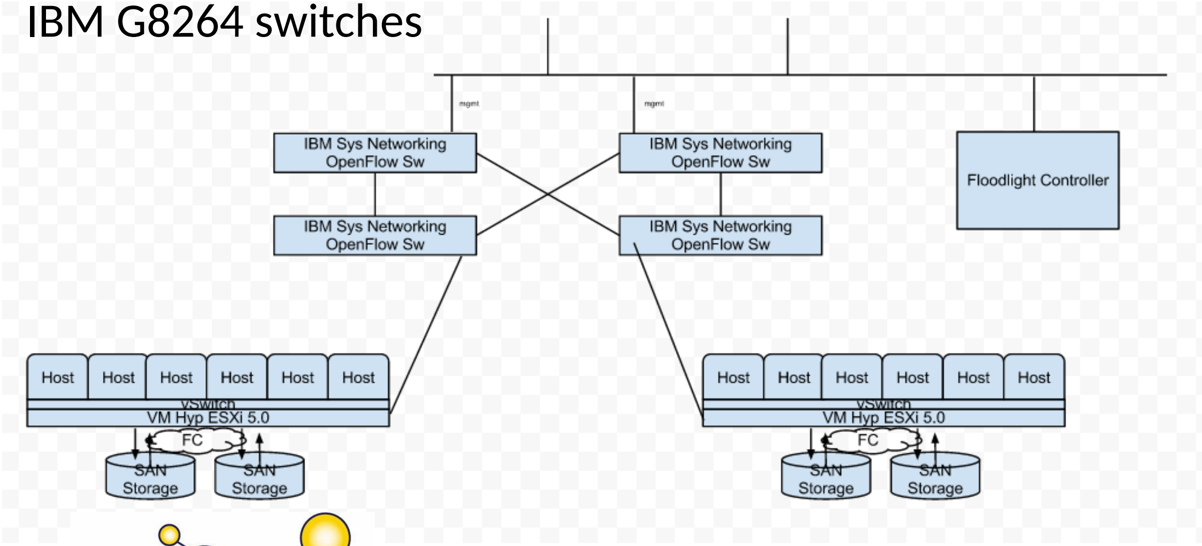
Disaster Alert !
Emergency Recovery between sites

C. DeCusatis, T. Bundy, R. Cannistra, "Dynamic software-defined networking (SDN) testbed", Proc. 2013 Internet2 Annual Meeting, Arlington, VA (April 2013)

INTERNET 2

N.Y. State Center for Cloud Computing & Analytics

IBM G8264 switches



OpenFlow

First OpenFlow demo using System Z

Successfully loaded a FloodLight controller on a blade in Z Hybrid

FloodLight

Port Down Reconciliation Released to FloodLight distro

SDN lab partnership

Sold-out 90 minute tutorial, TIP 2013

IBM TechConnect Award Winner

Avior, an open source FloodLight administrative control panel

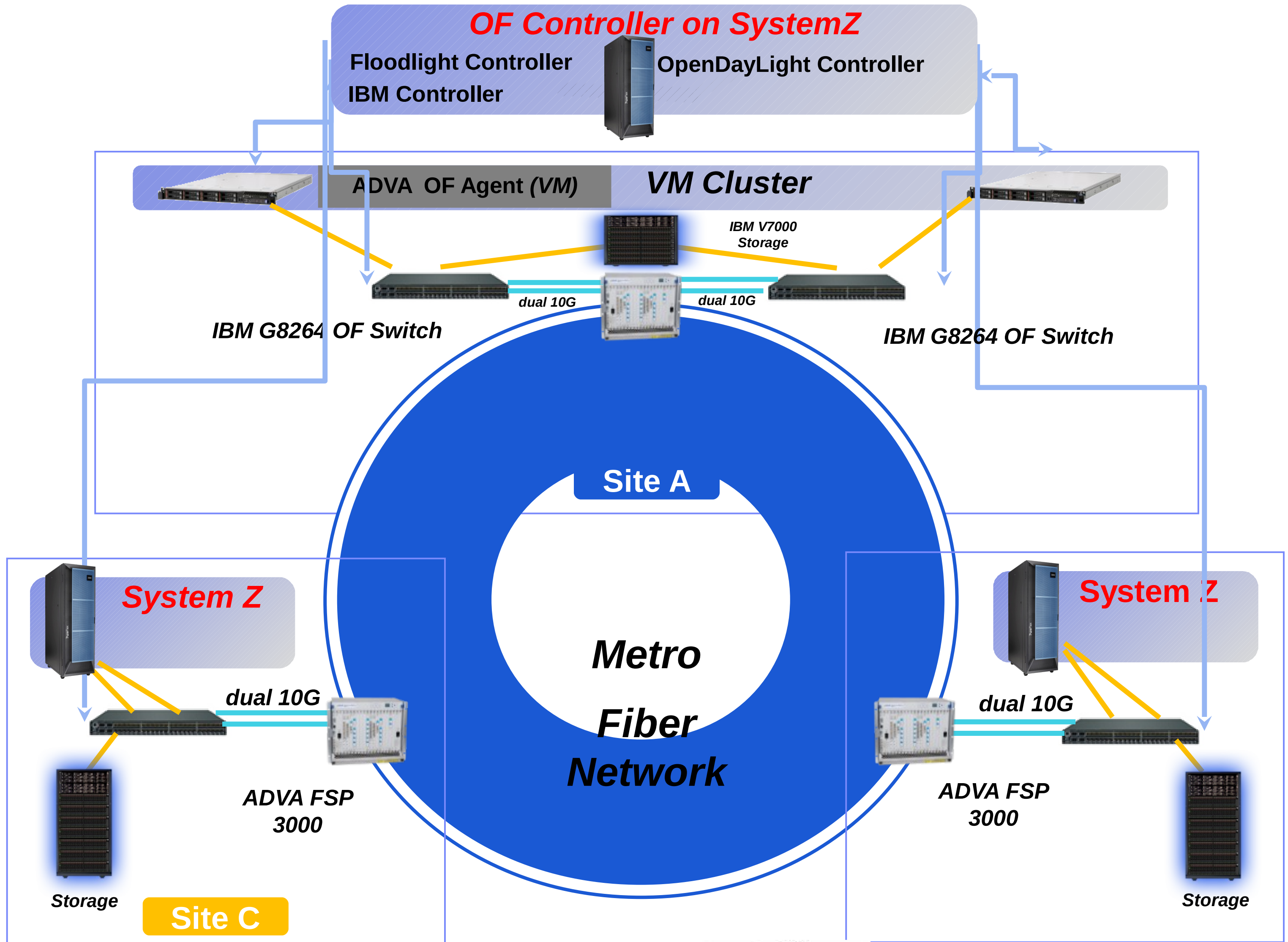
- Eliminates need to write Python script, reducing management complexity
  provisions QoS and routing of Layer 2 & 3 VLANs
  manipulation of firewall ACLs

ADVA Optical Networking

big switch networks

NEC Empowered by Innovation

N.Y. State Center for Cloud Computing & Analytics – Dynamic Infrastructure Test Bed with IBM System Z



Questions ?

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