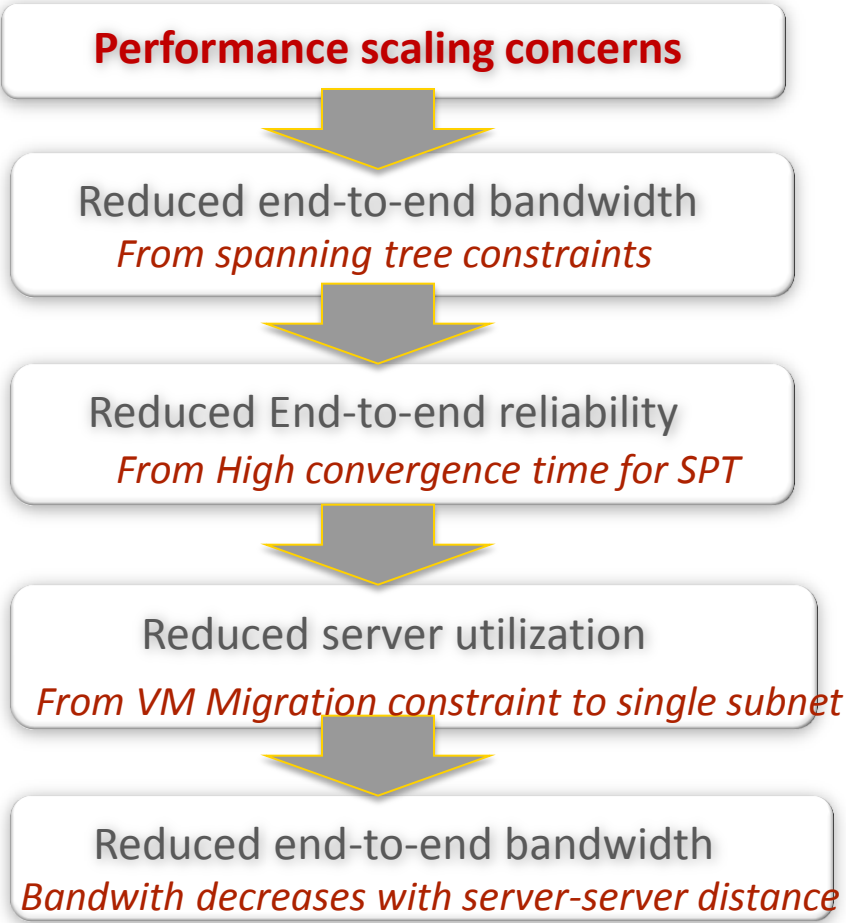# ProgrammableFlow for
Open Virtualized Data Center Network
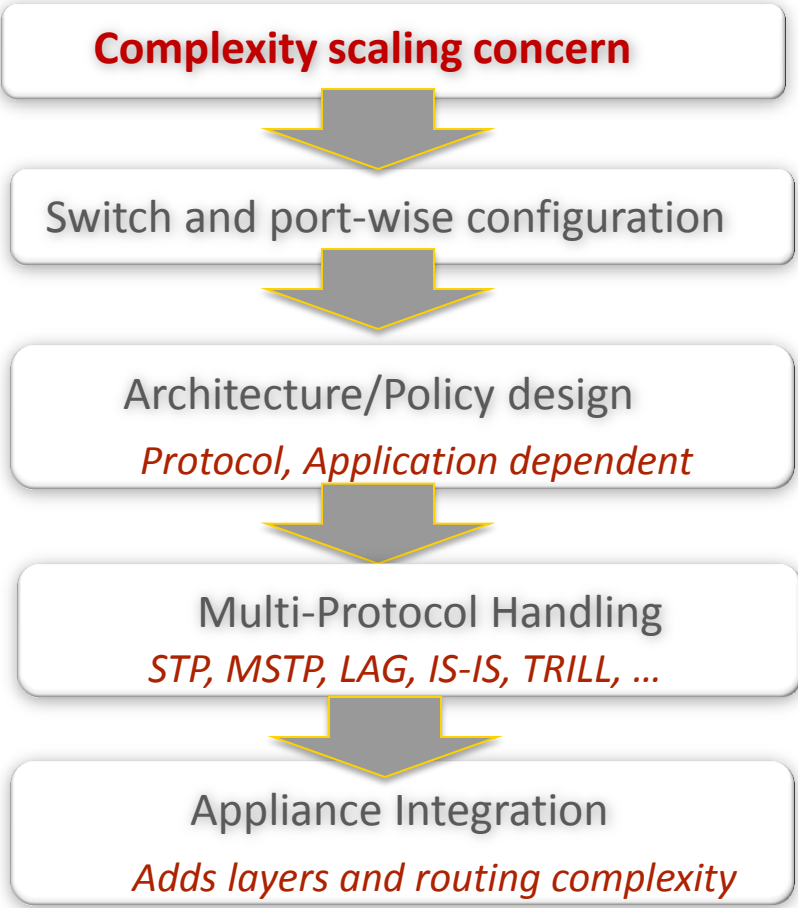
Samrat Ganguly

NEC Corporation of America

Challenges in Today's Data Center and Cloud Networks

Performance scaling concerns

Reduced end-to-end bandwidth
From spanning tree constraints

Reduced End-to-end reliability
From High convergence time for SPT

Reduced server utilization
From VM Migration constraint to single subnet

Reduced end-to-end bandwidth
Bandwith decreases with server-server distance

Difficult to Scale Out and high Capex

Complexity scaling concern

Switch and port-wise configuration

Architecture/Policy design
Protocol, Application dependent

Multi-Protocol Handling
STP, MSTP, LAG, IS-IS, TRILL, …

Appliance Integration
Adds layers and routing complexity

Difficult to Automate and high Opex

Can Network Virtualization solve the challenges

Open Networking Summit 2011

Empowered by Innovation **NEC**

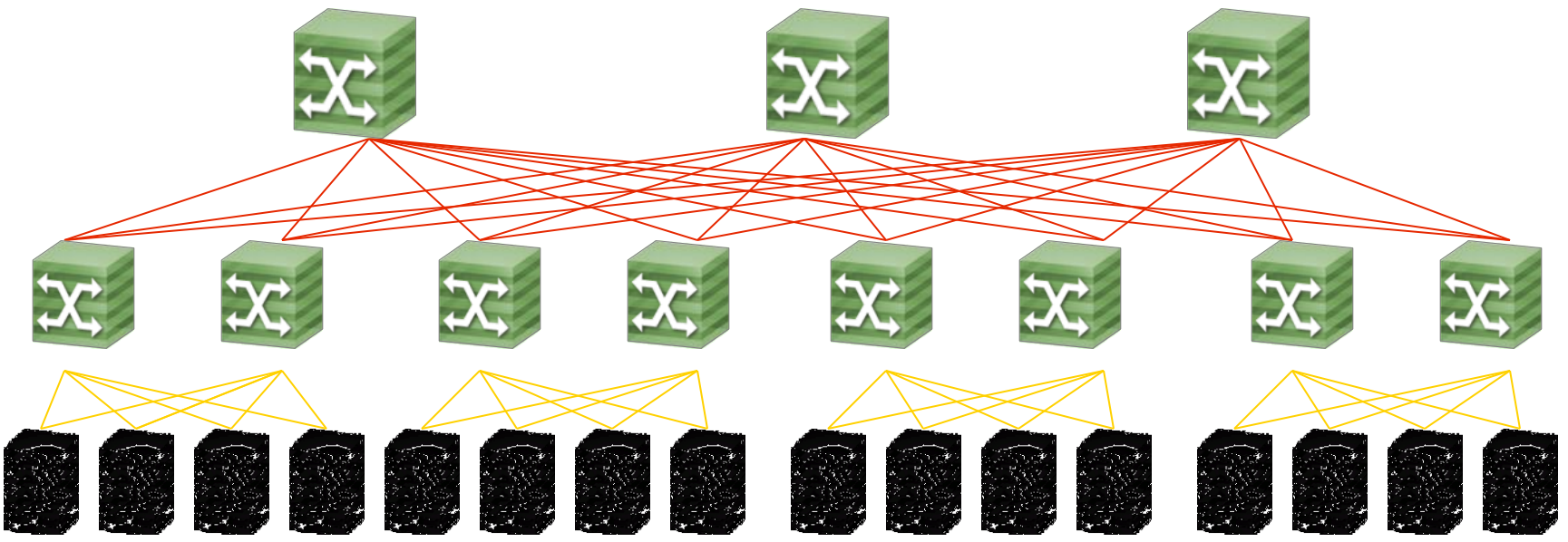# NEC ProgrammableFlow Defining Network Virtualization

Virtualized Network

Create abstract layer defining virtual networks

Hide physical network and protocol details
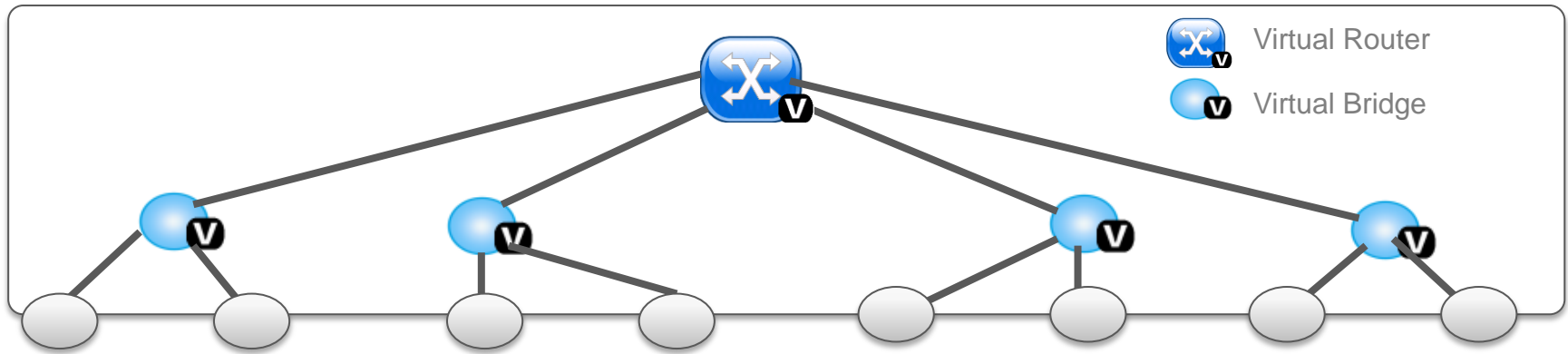
Automate network creation and deletion

Network Virtualization Plane
One aggregated network view and control

Switches\ Links

servers

Open Networking Summit 2011

Empowered by Innovation **NEC**
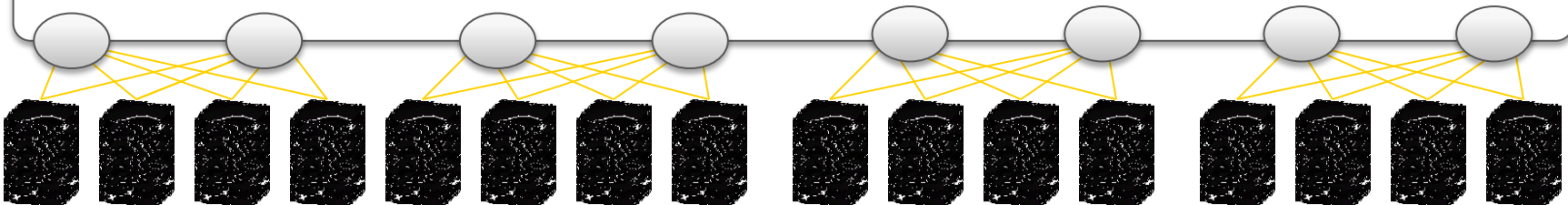
Virtual Networks

Virtual Router

Virtual Bridge

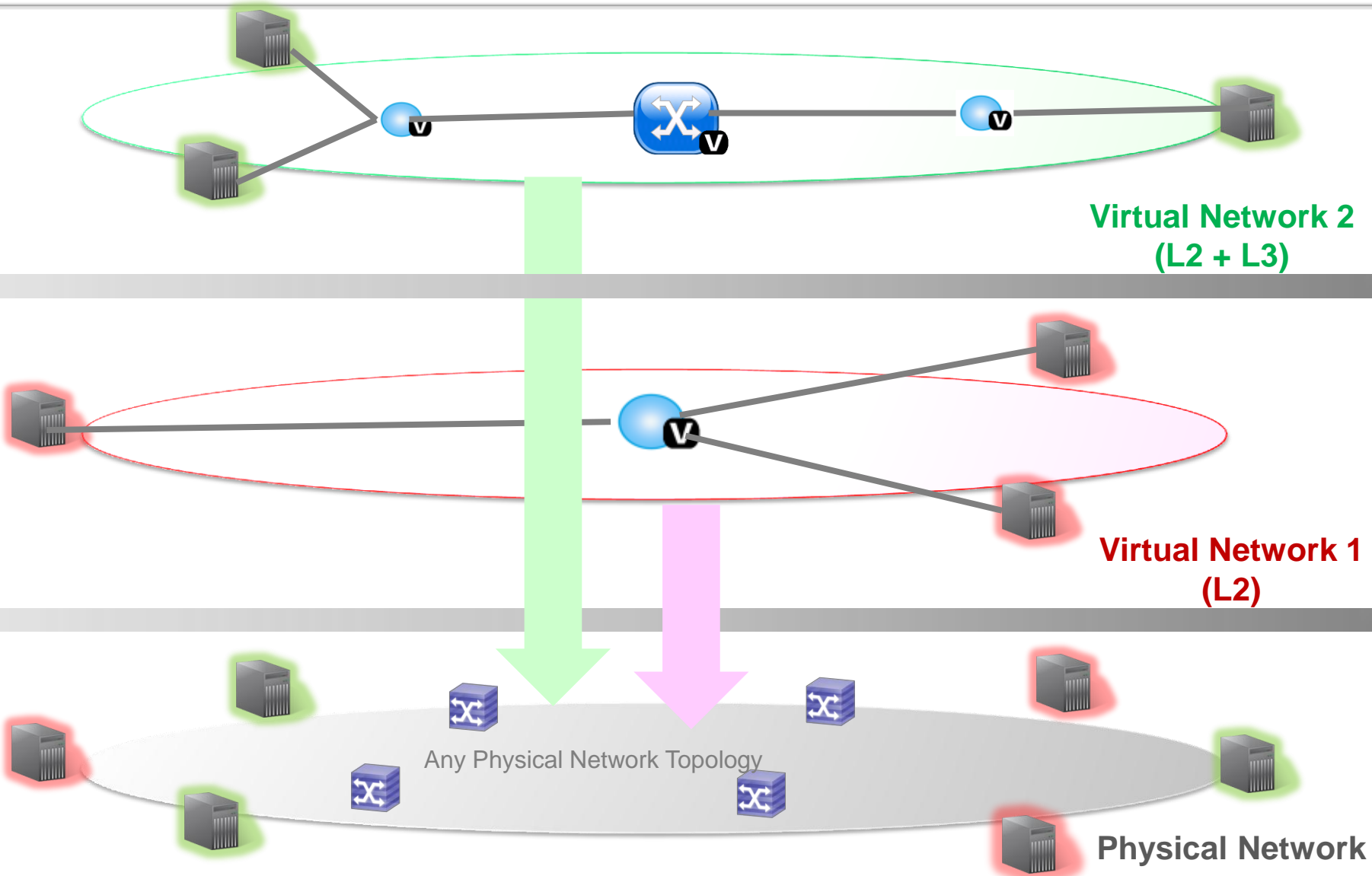Automated Deployment on Physical Network

Switches\ Links

Virtualized Physical Network

- Hides physical switches, ports, network topology, protocols
- Zero switch/port level configuration on deployment
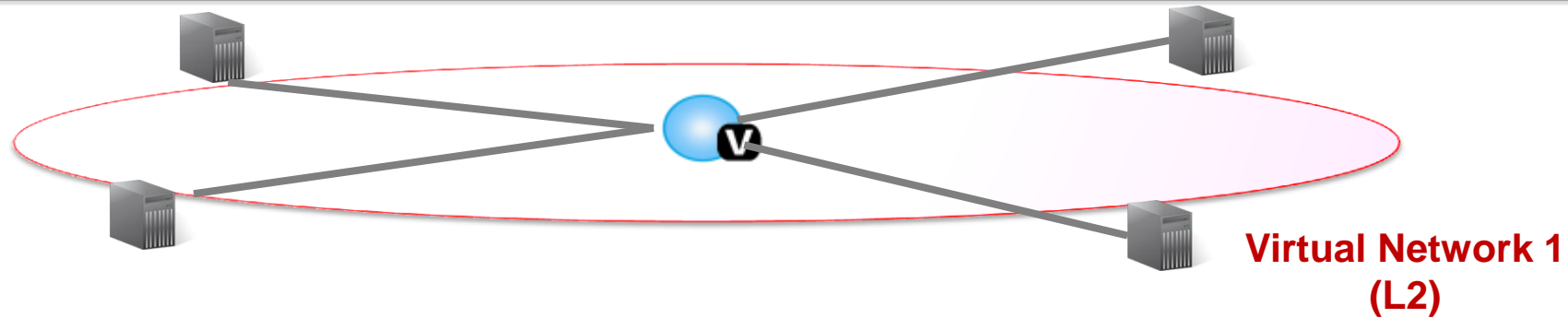- Automatically optimizes underlying network resources

servers

Open Networking Summit 2011

Empowered by Innovation

NEC

Multi-tenant Virtual Networks on one Physical Network

Virtual Network 2 (L2 + L3)

Virtual Network 1 (L2)

Any Physical Network Topology

Physical Network

Open Networking Summit 2011

Empowered by Innovation   **NEC**

Optimizing the physical network
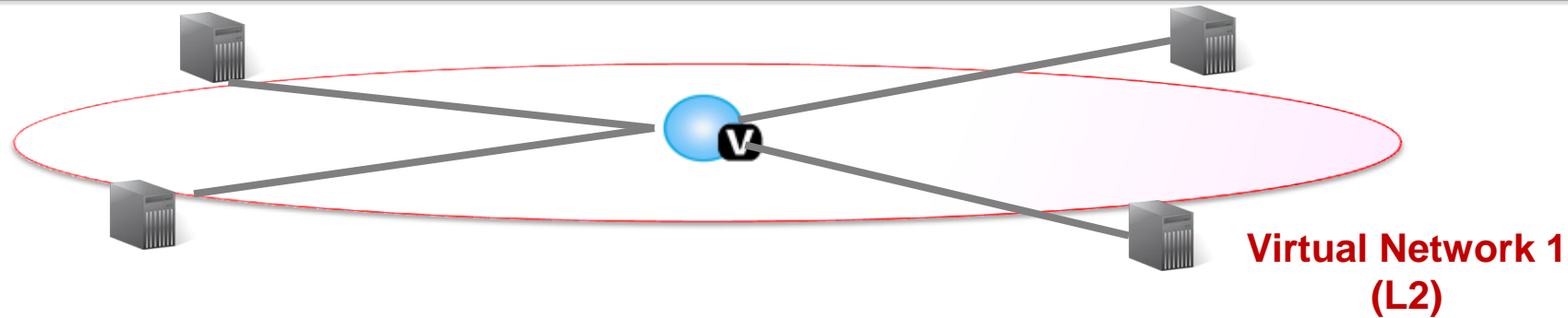

Virtual Network 1 (L2)

- Automatically discovers multiple paths
- Automatically avoids loops
- Automatically balances flows across paths
- No route flapping

Physical Network

Open Networking Summit 2011

Empowered by Innovation   **NEC**
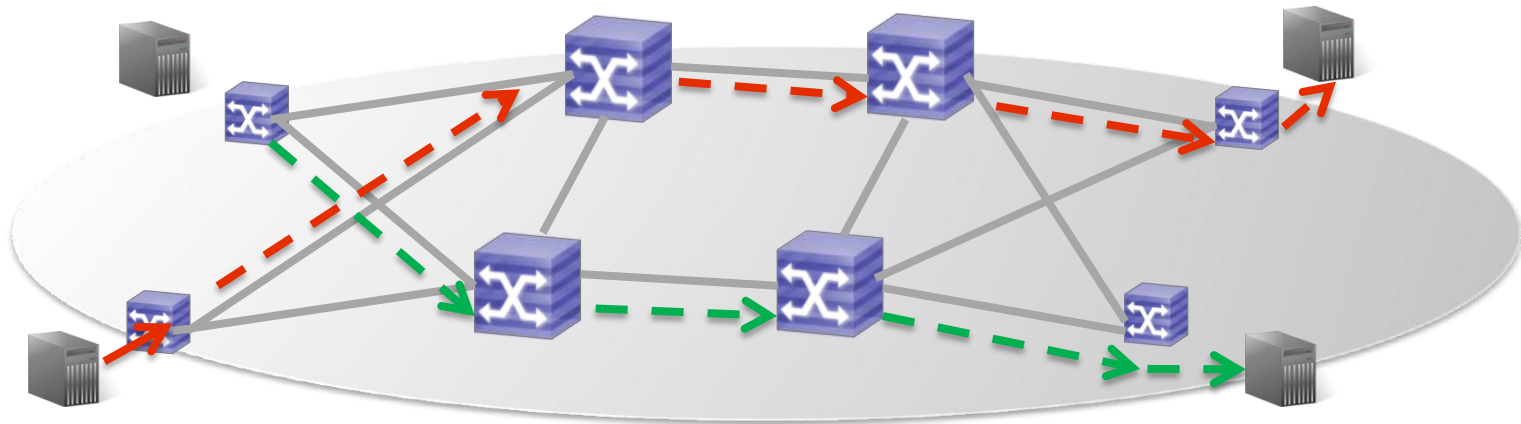
Adding End-to-End Reliability

Virtual Network 1 (L2)

- Automated monitoring of switch/link status
- Automatically re-recomputed alternate path
- Automatically shifts flows to alternate path
- Fast due to avoiding convergence time as in STP

Physical Network

Open Networking Summit 2011

Empowered by Innovation **NEC**
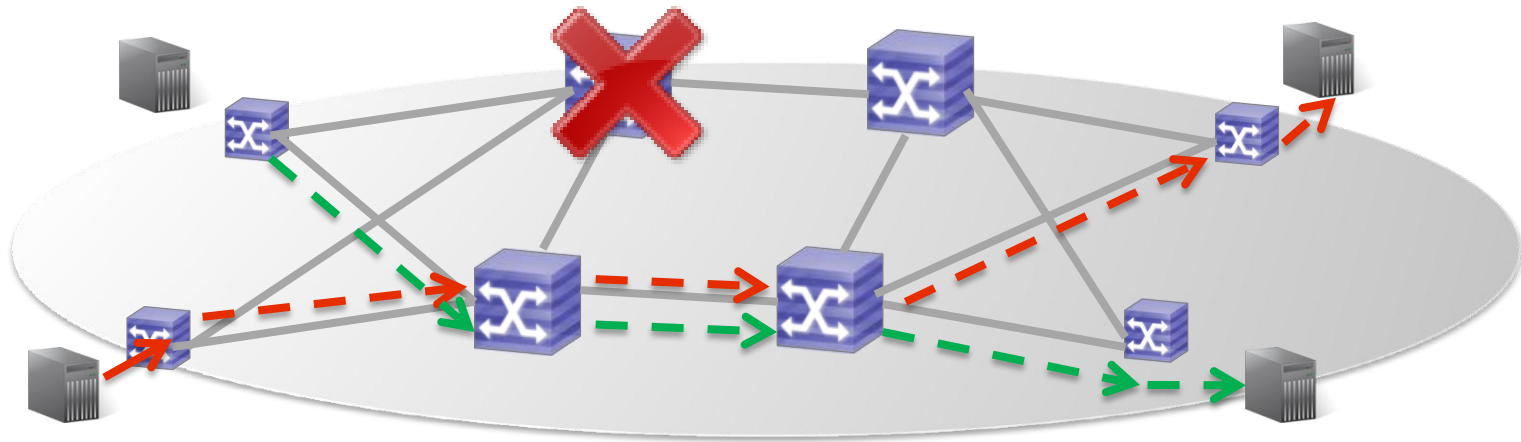
High Level Virtualization Architecture

NEC Products (GA)

Virtual Network **1**

Virtual Network **2**

Virtual Network **3**

Network Virtualization Plane

NEC ProgrammableFlow Controller

OpenFlow

OpenFlow Control

Any interconnection topology

NEC ProgrammableFlow Switch
-48 port 10G / 4 port 40G
-48 port 1G / 4 port 10G

OpenFlow Enabled Switch | From Any vendor

Empowered by Innovation **NEC**

NEC Network Virtualization Stack Controller

CLI | API | Management console

Virtual Network Construction framework

vBridges, vRouters, vLink, vFilters, vRedirects

Multi Virtual Tenant Network Provisioning

Multiple independent virtual networks and policies

Network Knowledge Plane
Auto-discover switch,
Ports, interconnects

Virtual Network Translation
Auto-translation to Physical
Network forwarding tables

OpenFlow Network Control
Dynamic Configuration of Switch Forwarding table | Statistics

OpenFlow Control Protocol

OpenFlow Switches

Open Networking Summit 2011

Empowered by Innovation

NEC

Why Virtualize? – Key Benefits

- Ability to hide physical network complexity
- Ability to create, edit, delete virtual network on-demand
- Ability to create and operate independent virtual networks
- Automation through APIs
- Automated multipath scaling
- Automated end-to-end reliability
- Zero switch/port configuration while in operation
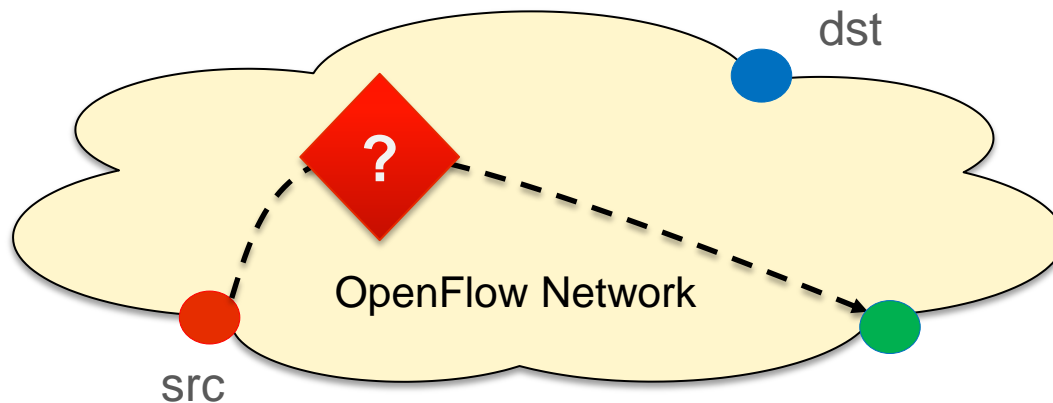- Easy to change physical network while in operation

Open Networking Summit 2011

Empowered by Innovation **NEC**

Conditional Routing

Destination-based routing
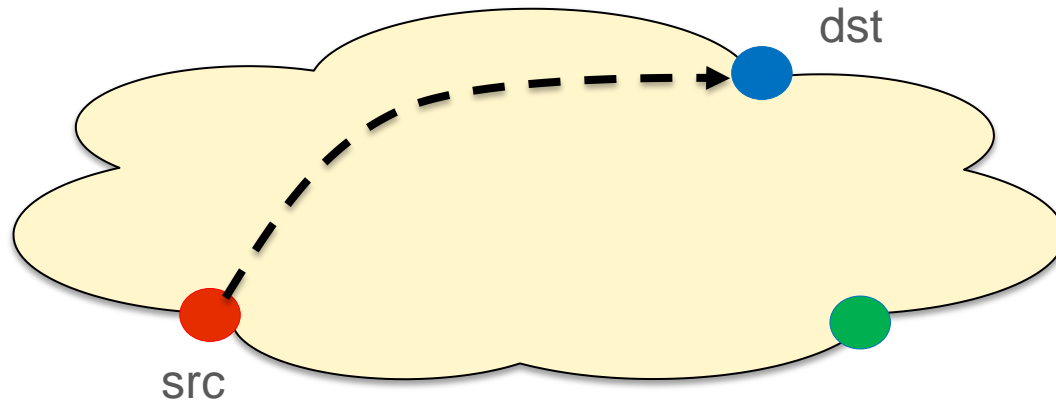
Network forwards packet
based on destination

Conditional Flow (Routing using Pflow vFilter+vRedirect)

OpenFlow Network

Network forwards flow packets
based on matching condition

If (Condition matched)
Route to *egress port/switch*

Open Networking Summit 2011

Empowered by Innovation   **NEC**

Appliance Networking: Composing Conditional Flow

WAN
To Internet

Empowered by Innovation

NEC