

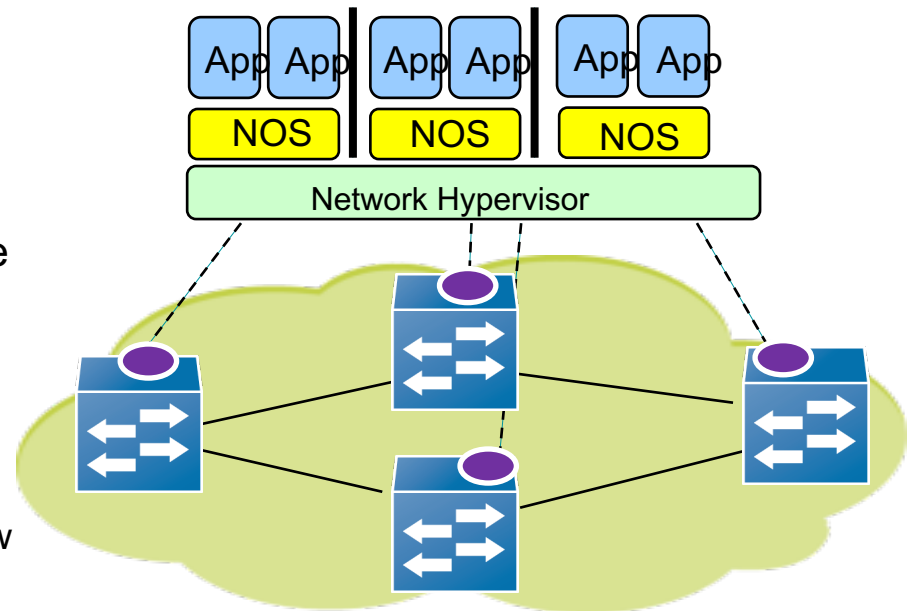
A blue circular graphic with a stylized 'X' or network symbol inside, positioned on the left side of the slide.

Comparison of Approaches to Software Defined Networking

The OpenFlow View of SDNs

- Problem being Solved
 - Inflexibility of Network Control
 - Ability to create multiple virtual networks from physical infrastructure

- Elements of Solution
 - Separate the data plane from the control plane and centralize the control plane
 - The control plane creates an abstract view of the network, which can be used by multiple applications
 - Network functions become applications on the controller
 - Use a Network Hypervisor to create multiple virtual networks



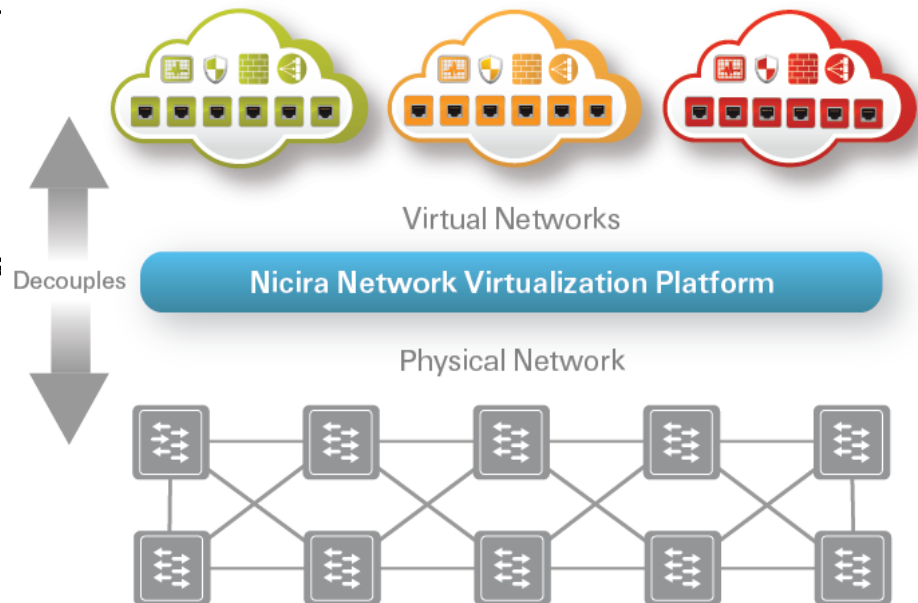
The Data Center View of SDNs

- Problem being Solved

- Ability to interconnect a very large number of VMs in a Layer 2 network
- Ability to create multiple separate virtual networks
- Ability to virtualize all networking functions on VMs

- Elements of Solution

- A central controller to manage and configure the virtual networks
- A tunneling mechanism with a Link State Protocol to interconnect all the VMs belonging to a virtual network, that advertises
 - Topology
 - Logical Network Membership



Comparison of Control Approaches: Cisco and Nicira

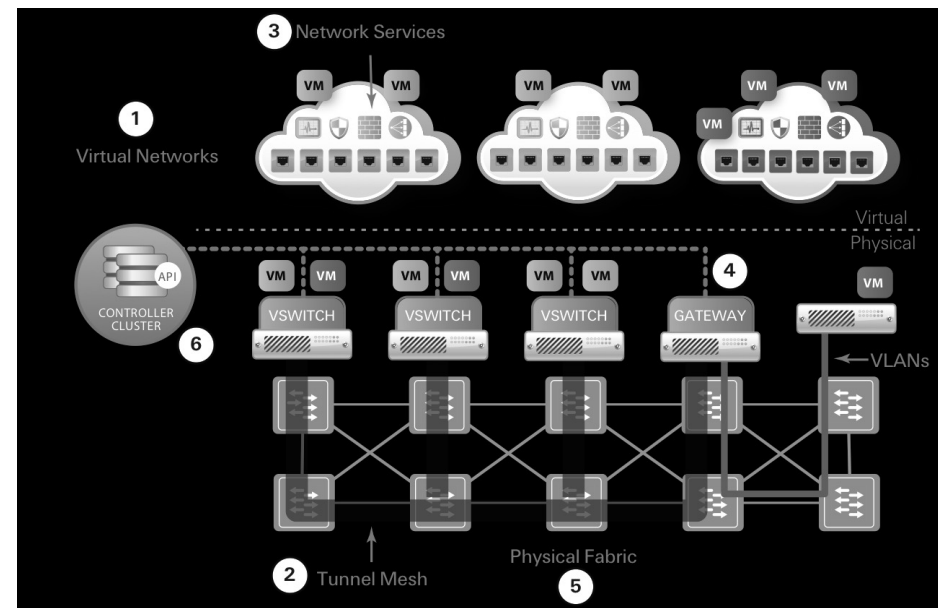
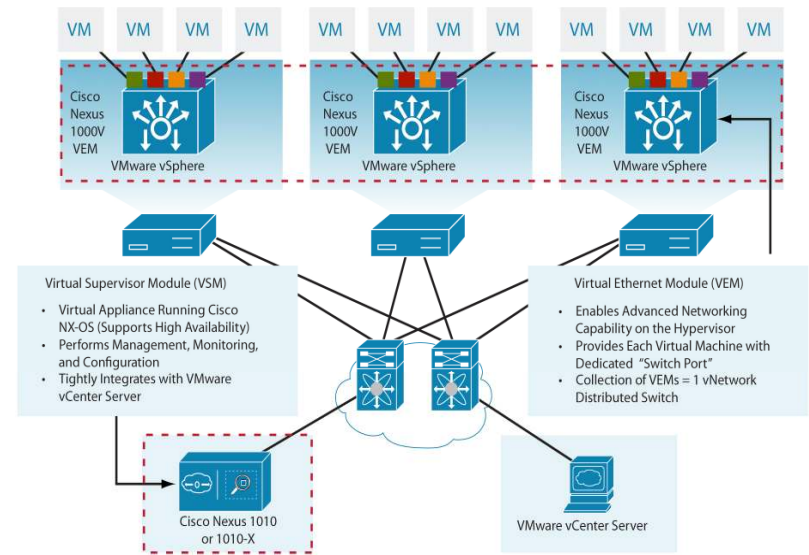
Network Control is needed to Manage and Configure the Virtual Networks.

Cisco:


- Network Control through the Virtual Supervisor Module which controls Virtual Ethernet Modules on the servers
- Protocol between the VSM and VEM is proprietary

Nicira, Dell:


- Network Control using a OpenFlow based Controller
- Controller is used to manage VSwitches (Virtual Ethernet Switches) in the servers



Comparison of Tunneling Approaches

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- VxLAN (VM Ware and Cisco)
 - Ethernet encapsulated in UDP/IP Frames
 - NVGRE (Microsoft)
 - Ethernet encapsulated in GRE Frames
 - TRILL (IETF)
 - Ethernet encapsulated in Ethernet Frames
 - Shortest Path Bridging (IEEE 802.1aq)
 - Ethernet encapsulated in Ethernet Frames

VxLAN and NvGRE (L2 in L3 Encapsulation)

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- Specification was written by VM Ware, with support from Cisco
 - Was designed as an extension of base VLAN technology for use in modern data centers
 - Has a 24 bit Identifier, leading to 16 million unique identifiers
 - Uses IP (UDP) as the transport medium, and hence is able to work with legacy switches and routers.
 - Uses IP Multicast Groups to multicast traffic within a VxLAN
 - Uses the Source Port Number as a Virtual Network Identifier
 - NvGRE is similar to VxLAN, except that it uses GRE tunnels for encapsulation and uses the GRE Key as the Virtual Network Identifier.

TRILL and SPB (L2 in L2 Encapsulation)



- TRILL was invented by Radia Perlman, who was also responsible for STP and IS-IS.
- Original objective was to come up a Layer 2 protocol that solves some of the problems with the Spanning Tree protocol, such as: Inability to use multiple paths, lack of TTL field, and slow convergence after node failure
- A new TRILL Header is appended to a Source Ethernet Frame, which is then encapsulated in another Ethernet frame, and then routed in a hop-by-hop fashion to the tunnel destination
- SPB is being developed by the IEEE 802.1 Group. Was developed after TRILL, hence took addressing requirements created by SDNs into account.
 - SPB was designed to reuse existing ASICs and OA&M procedures