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# Software Defined Networking



*In this course, you will learn about software defined networking and how it is changing the way communications networks are managed, maintained, and secured.*

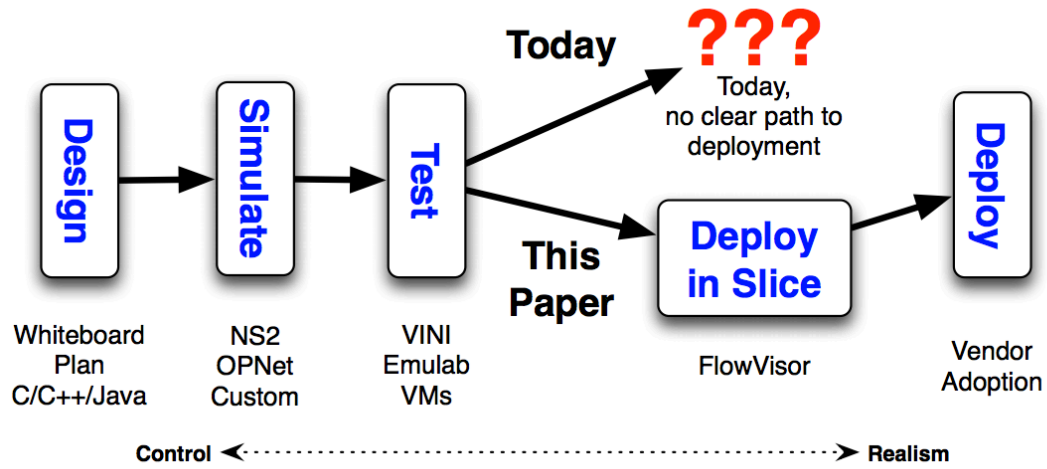
# This Module: Network Virtualization

- ⦿ Three Lessons
  - What is network virtualization and how is it implemented?
  - **Examples of network virtualization and applications**
  - Virtual networking in Mininet
- ⦿ Quiz
- ⦿ Hands-on in Mininet

# Applications of Virtual Networking

- ⦿ Experimentation on production networks
  - Can run (virtual) experimental infrastructure in parallel with production
- ⦿ Rapid deployment and development
  - Can deploy services independently from underlying vendor hardware
- ⦿ Dynamic scaling of resources
  - Can allocate from “pool” of resources

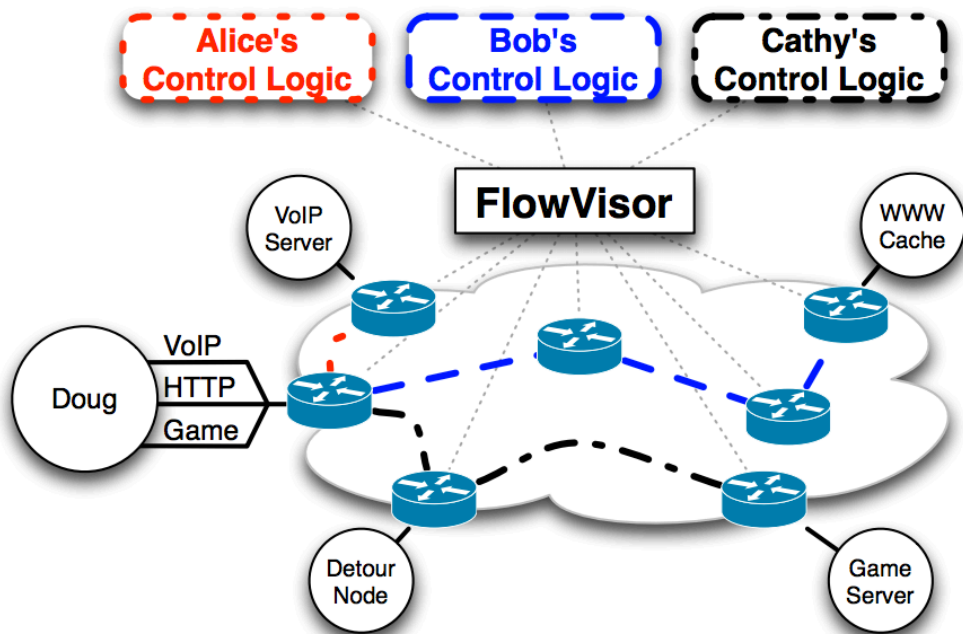
# Experimentation on Production Networks



- ⦿ How to test and deploy a “paper design”?
- ⦿ **Goal:** Realism
- ⦿ **Ideally:** Deploy in parallel in production

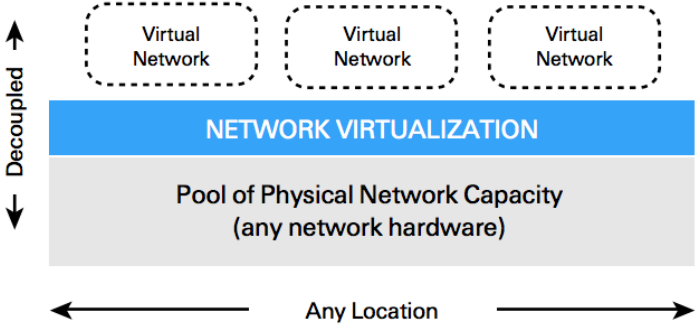
# FlowVisor: Virtualizing Network Control

- User (“Doug”) can let different flows be controlled by different groups of researchers
- Virtualization of control based on “flow space” (IP address, port, etc.)



Sherwood, Rob, et al. "Can the production network be the testbed." *Proceedings of the 9th USENIX conference on Operating systems design and implementation*. USENIX Association, 2010.

# Rapid Deployment of Services: Nicira Network Virtualization Platform



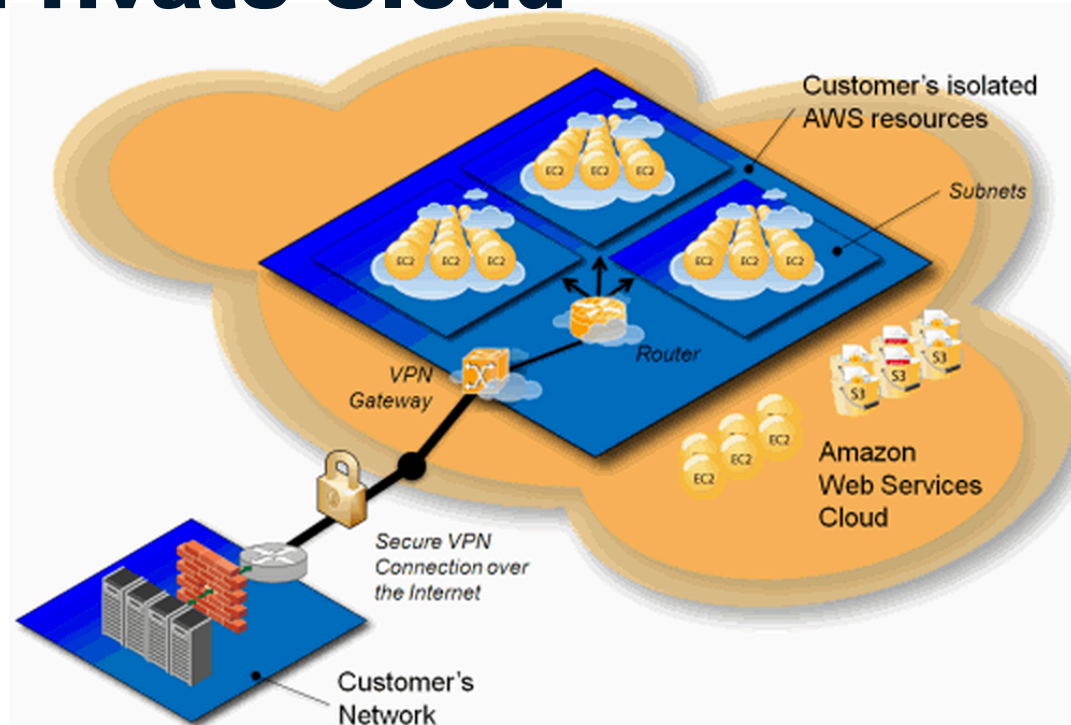
- Abstraction layer between hosts & underlying network
- Open vSwitch in host hypervisors: abstraction layer
- Managed by distributed controller

# Nicira NVP: Applications

- ⦿ Dynamic workload placement
  - Multi-tenant data centers
  - Creation of isolated virtual networks for each tenant
  
- ⦿ Dynamic security
  - Central management of security policies
  - Enforcement per virtual network
  - Independence from VLAN limits

# Dynamic Scaling of Resources: Amazon Virtual Private Cloud

- Connect logically isolated VM instances to existing network
- Connection to existing infrastructure via VPN





# Amazon Virtual Private Cloud

- ⦿ Allows customers to define their own network, address space, etc.
- ⦿ Extend existing enterprise data center
  - VPN between Amazon VPC and data center
- ⦿ Applications/Benefits
  - Dynamic scaling
  - Disaster recovery
  - Manageability

# Many Other Examples of Virtualization

- Wide-Area Virtual Networks
  - Experimental infrastructure: VINI, GENI
  - Value-added services: CABO
  - Multiple control infrastructures: Tempest
- Virtual “Network in a Box”
  - Open vSwitch, Citrix, Vyatta, OpenSolaris, Microsoft Virtual Server
- Network functions virtualization

# Summary:

## Applications of Virtual Networking

- ⦿ Experimental deployments
- ⦿ Isolation on shared infrastructure
- ⦿ Reuse of resource pool
- ⦿ Dynamic scaling
- ⦿ Easier management of “logical” resources