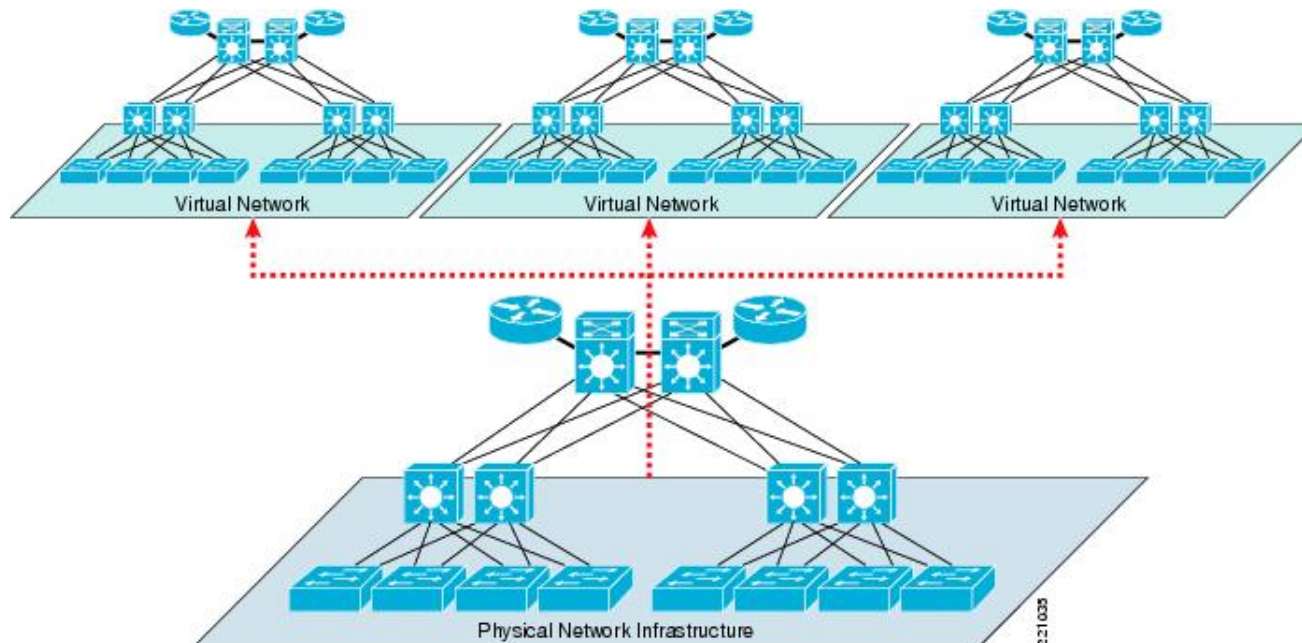# THE APPLICATIONS OF SDN

Benefits from SDN

- Network Virtualization

- Switch based Firewall

- Multipath Forwarding

- Congestion Control

- Identify bugs

Network Virtualization in SDN

- The process of combining hardware and software network resources to be some virtual networks

3

SDN-based Network Virtualization

- Each tenant can run his virtual network with controller in SDN.

- OpenFlow network removes limitations, allowing administrators to create a flow-based virtual network abstraction.
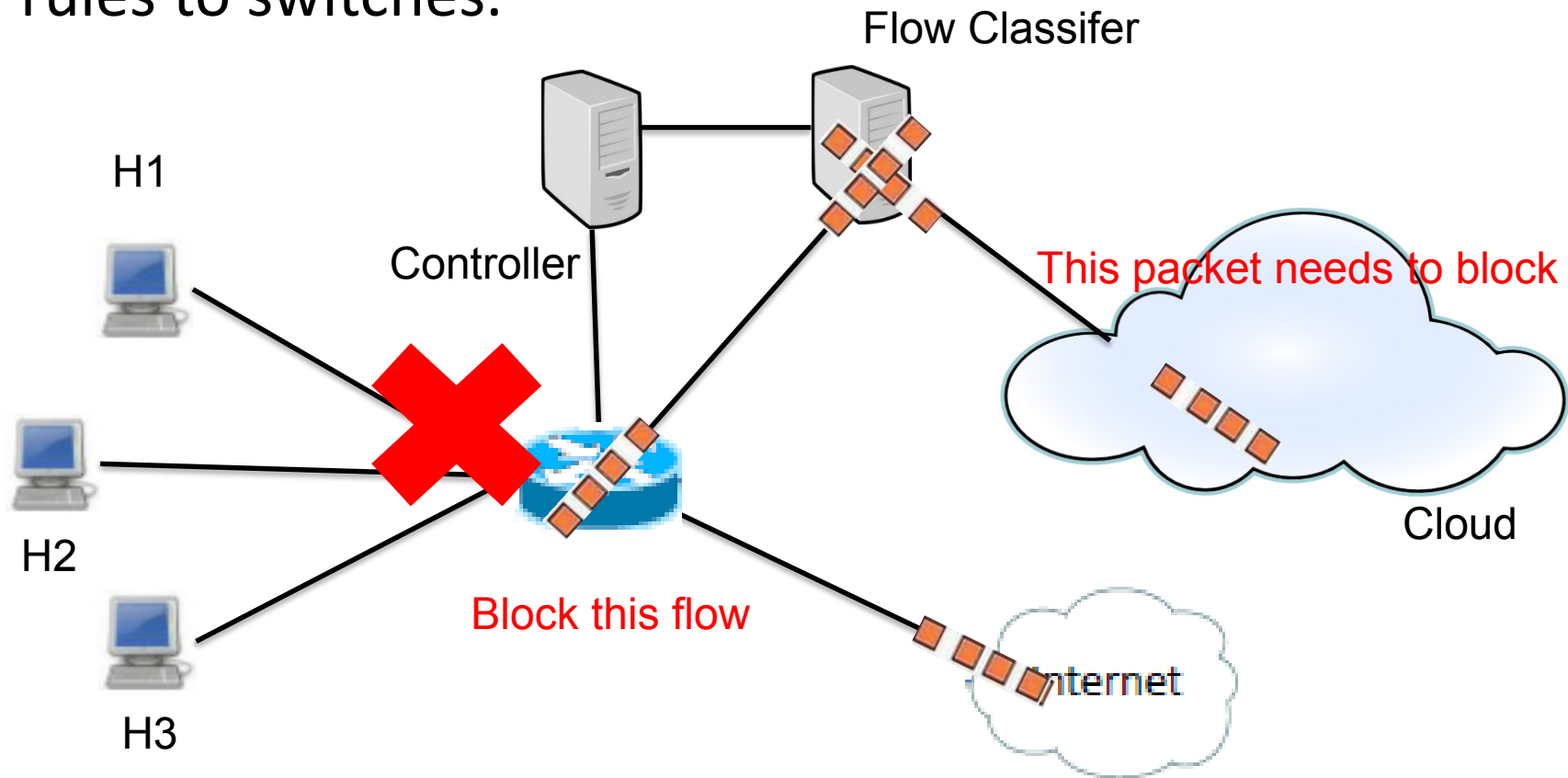

Computer virtualization

Network Virtualization

4
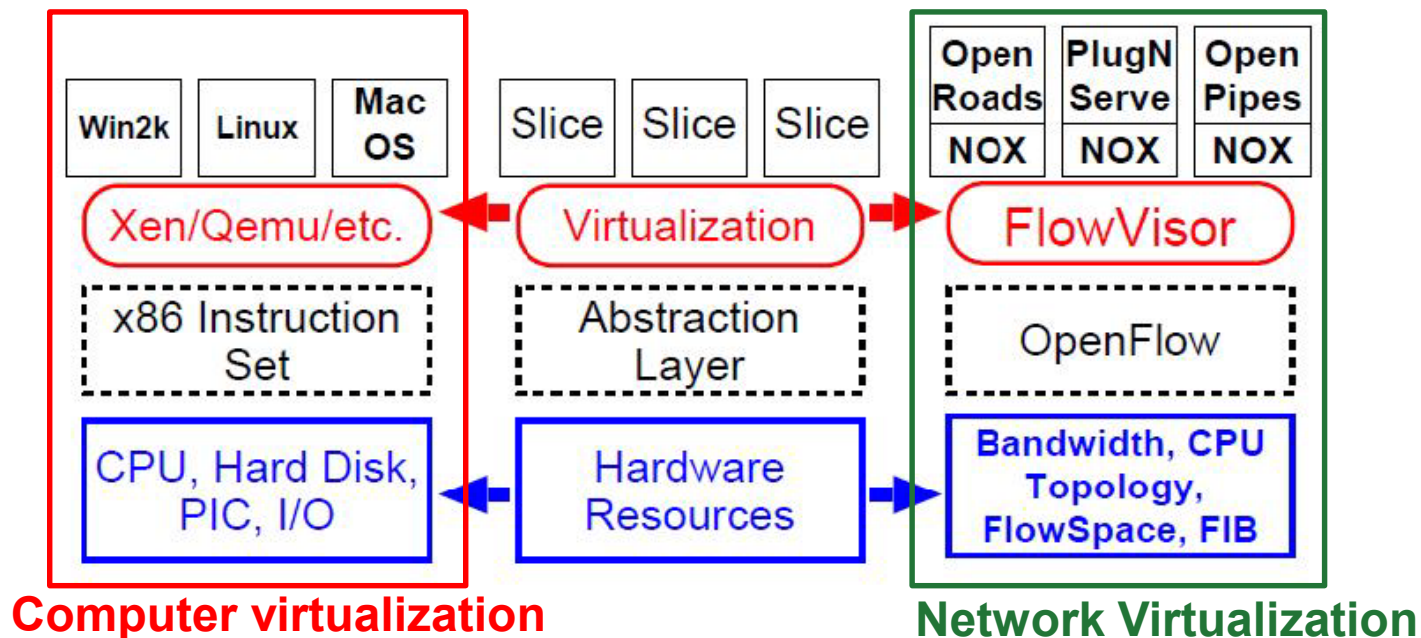
SDN-based Network Virtualization
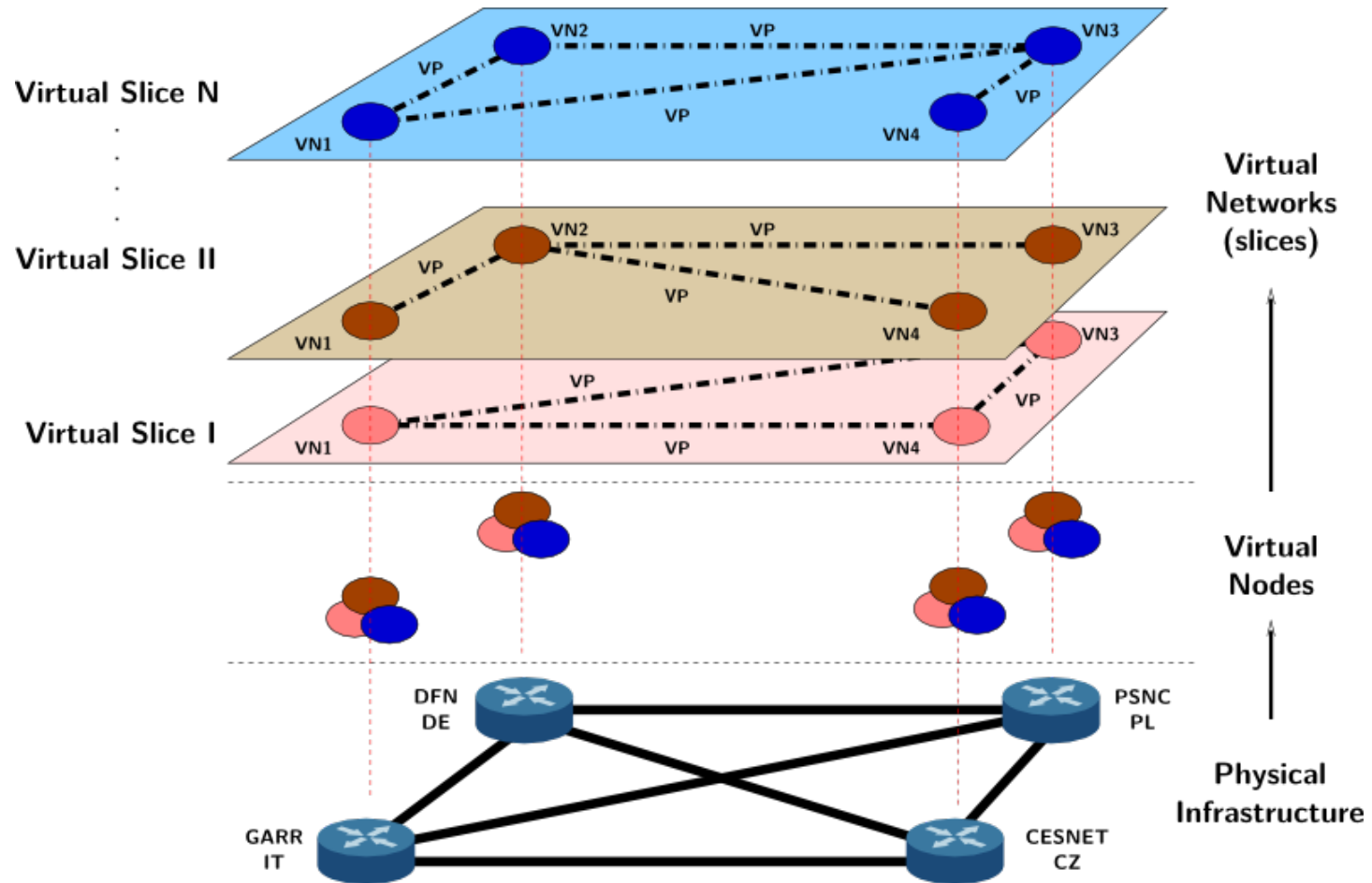
Switch based Firewall in SDN

- OpenFlow switches can emulate Firewall by assigning rules to switches.

Flow Classifer

H1

Controller

This packet needs to block

H2

Block this flow

Cloud

H3

Internet

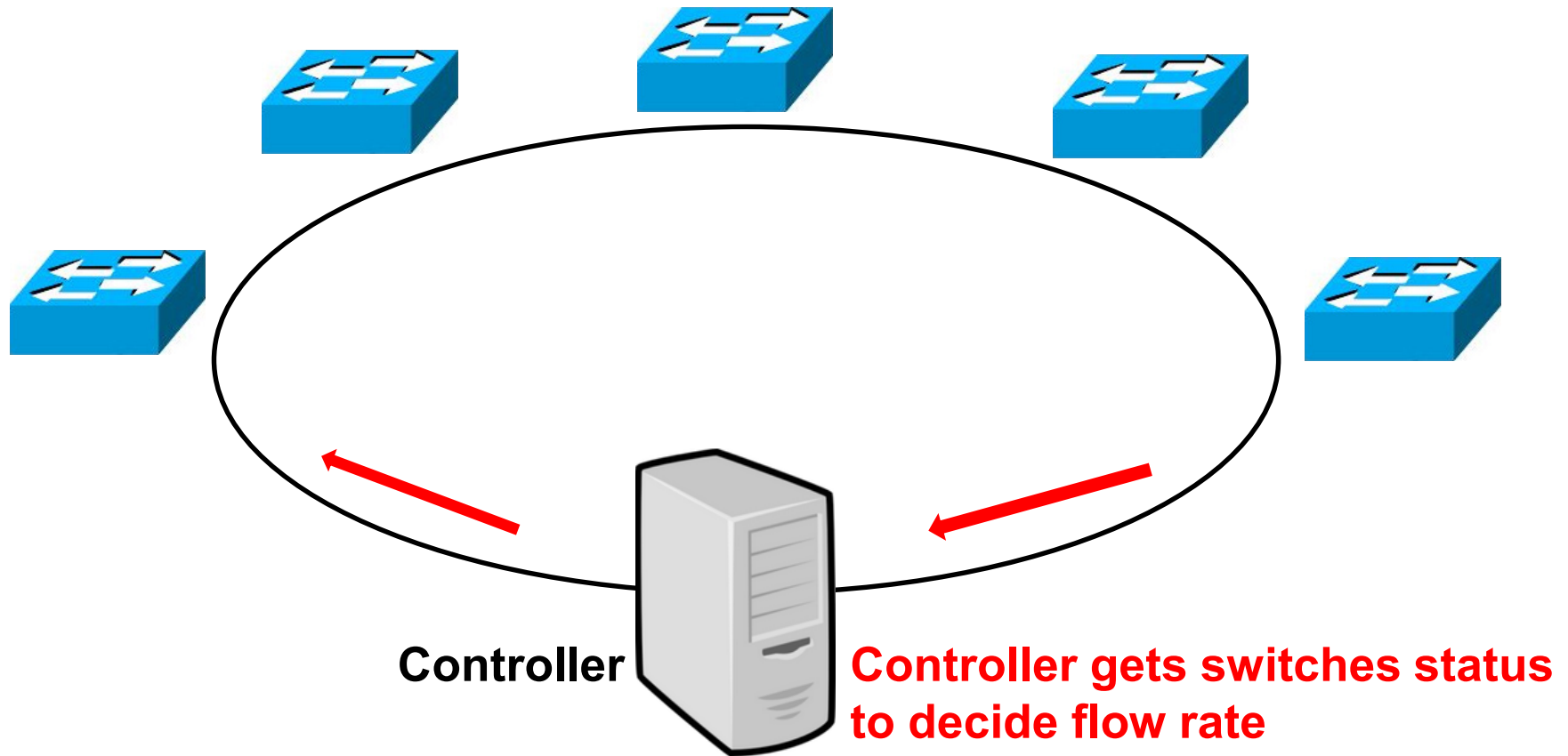# Multipath Forwarding in SDN

■ Forwarding by rule and central controller's decision.
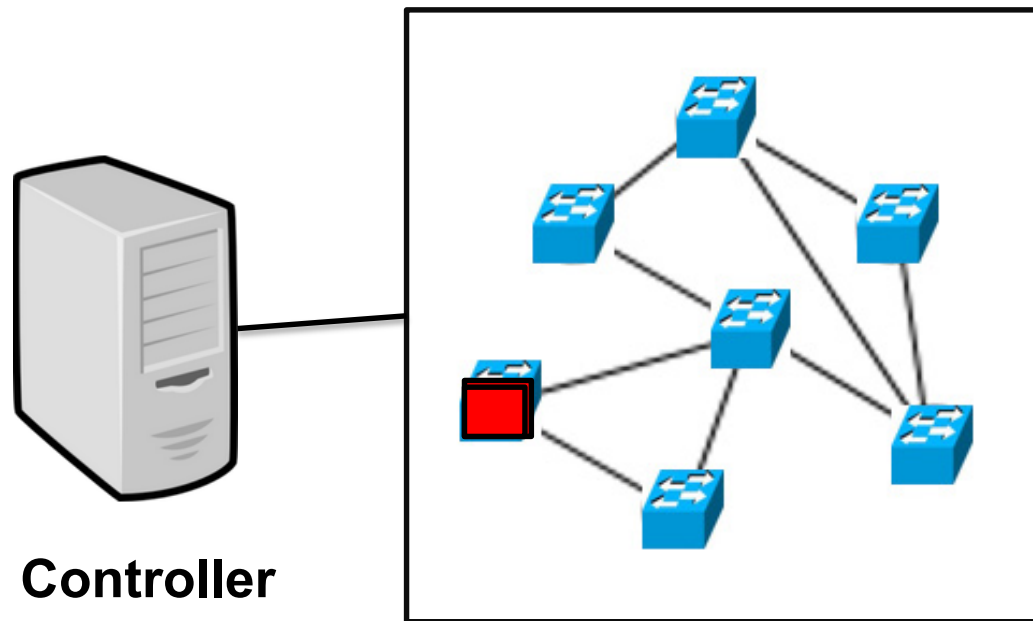
Controller

Controller can install multipath roles in SDN switches

Congestion Control by SDN

■ Controller can get SDN switches information to know if congestion happened.

Controller

Controller gets switches status to decide flow rate

Identify Bugs by SDN

- Identify bugs with systematically tracking down their root cause

  - When an operational network misbehaves, it is very hard to find the root cause

  - Allows users to define a Network Breakpoint

  - Capture and reconstruct the sequence of events leading to the breakpoint
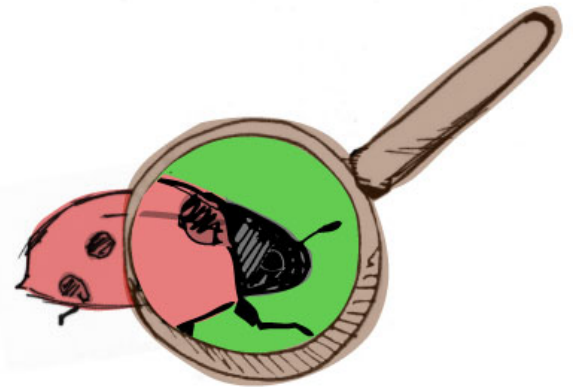
CHALLENGES

Challenges

- Complex designing solutions

- Limited TCAM size

- Controller delay and overhead

- Multi-controller working together

- Migrating from legacy to SDN

SDN - Data-Plane Challenges

- **State of Specification**
  - Maturity Concerns
  - OF 1.0 single flow table, ... OF 1.1 leverages multiple tables
- **Silicon Concerns**
  - Spec is much ahead of silicon development... OF Spec is a moving target for merchant silicon
  - Merchant silicon is not optimized for OF... supports of current networking features is a higher priority
- **Specific issues**
  - Scalability of Flow-Matches (limited by TCAM size)
  - Cost concerns

SDN – Control-Plane Challenges

- Control Plane scalability
  - Centralized vs. distributed controllers…
  - Single view of the state of the network, forwarding tables,… is this a distributed database problem?
- Interoperability
  - SDN/NON-SDN
  - Inter-Controller
  - Between different controllers
  - Orchestrating SDNs managed by different controllers
  - With Hypervisor virtual networking

SDN- Application-Environments Challenges

- **Network Resource Abstraction & Conflict Resolution**
  - Resource abstraction
  - Conflict resolution among different application actions
- **Development tools and New Application Paradigm**
  - Computing system style application…
  - New class of Network Programming
  - Languages… New tools
  - New development skills… New talents… New education curriculum…

RESEARCH RESOURCES

Research Platform for SDN

- **Mininet**
  - Network emulator
  - Designed for emulating SDN networks
  - Easy to use
  - High performance (100 nodes on a laptop)
- **Network OS for Research**
  - NOX (C++/Python)   http://noxrepo.org
  - Maestro (Rice University)
  - Helios (NEC)
  - Beacon (Java) coming soon, …
- **Network OS Commerce**
  - ONIX [OSDI 2010, Google, Nicira, NEC]
  - Expect others

OpenFlow Testbed

- Candidate controllers:
  - Nicira's Nox: C++ and python ← prototyping
  - NTT's Ryu : python ← more production level

- Candidate switches:
  - Standalone switches
    - Pica8 (3290): OpenFlow v1.1, a spin-off of Quanta
    - HP (5400zl): either OpenFlow mode or legacy mode.
    - NEC(IP8800): either OpenFlow mode or legacy mode.
    - Pronto: legacy routing stack and OpenFlow enabled features can not be support in the same VLAN
    - Brocade (CES/CER/MLX/XMR/MLXe): fully support hybrid mode
  - PC-based switches (decreasing programmability)
    - OVS (OpenVSwitch): pure software based OpenFlow enabled data path
    - Netronome: network processor PCI card
    - NetFPGA (Stanford): research oriented cards