SDN Software Stack

COS 597E: Software Defined Networking

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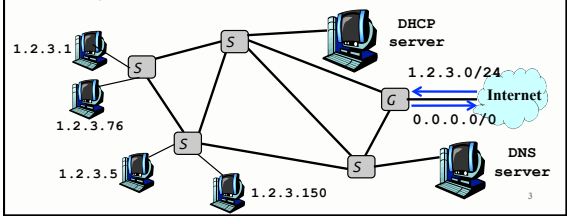
MW 11:00am-12:20pm

Background: Enterprise Networks and VLANs

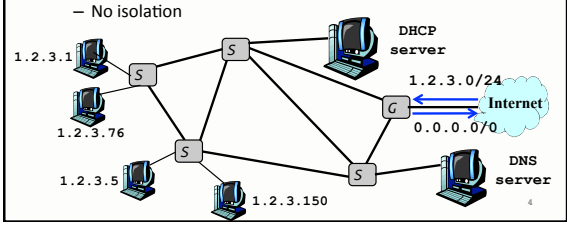
Simple Enterprise Design

- Single layer-two subnet
  - Hubs and switches
  - Gateway to the Internet
  - Single IP address block
- Local services
  - DHCP
  - DNS

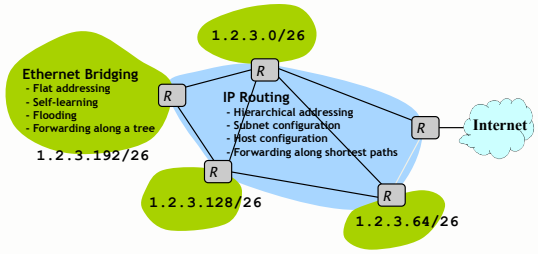


Limitations of Simple Design

- Performance
  - Spanning tree
- Security
  - No access control
  - No isolation
- Scalability
  - Large switch tables
  - Flooding overhead
  - Broadcast (ARP, DHCP)



Hybrid of Switches and Routers

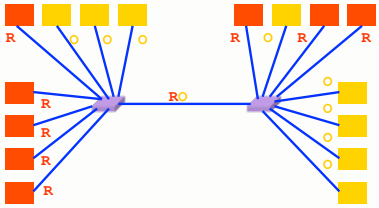


Virtual Local Area Networks

- Group related hosts
  - Same company
  - Same role (e.g., faculty vs. students)
  - All WiFi users
- Treat them as a single LAN
  - Single IP address block
  - Single broadcast domain
  - No access control
- Independent of their location

Rewire the network in software!

Example: Two VLANs



Red VLAN and Orange VLAN
Switches forward traffic as needed

7

Making VLANs Work

- Changing the Ethernet header
  - Adding a field for a VLAN tag
  - Implemented on the bridges/switches
  - … but can interoperate with old Ethernet cards
- Bridges/switches trunk links
  - Say which VLANs are accessible via which interfaces
- Approaches to mapping access links to VLANs
  - Each interface has a VLAN "color"
  - Each MAC address has a VLAN "color"

8

VLANs in SDN

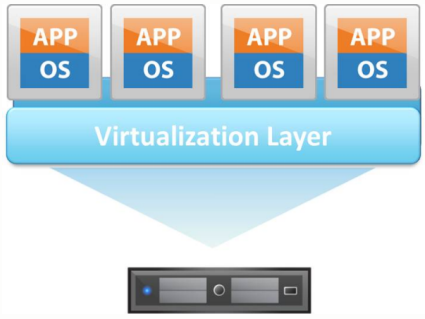
- Hybrid deployment
  - VLAN for SDN adopters
  - Remaining traffic using legacy protocols
- Switch-controller communication
  - Separate VLAN
  - Using legacy protocols
- Tagging of packets
  - VLAN header as a virtual "tag" on packets

9

Server Virtualization and Virtual Switches

10

Virtual Machines (VMs)



11

Virtual Machine (VM)

- Virtual machine
  - Software implementation of a computer
  - With interface identical to bare hardware
  - Devices, interrupts, memory, page tables, etc.
- Hypervisor (virtual machine monitor)
  - Creates and runs virtual machines
  - Manages execution of the guest OSes
  - Subdivides the hardware resources
  - Executes privileged instructions

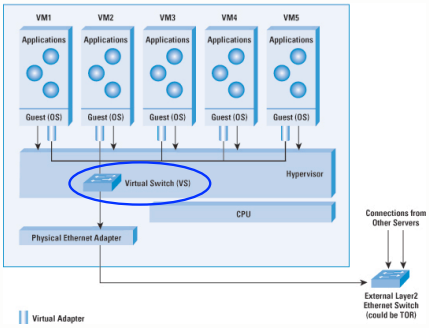
12

Motivations for VMs

- Diverse operating systems
  - Running software for obsolete platforms
  - Research, experimentation, and testing
- Sharing a single host
  - Server consolidation (lower cost, energy)
  - Isolation of applications or customers/tenants
- Fast provisioning of new servers
- Snapshotting system state
  - Backup and redeployment
  - Migrating a VM to a different host machine
- VM introspection
  - Track configuration settings
  - Identify configuration mistakes or compromises

13

Virtual Switches



14

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15

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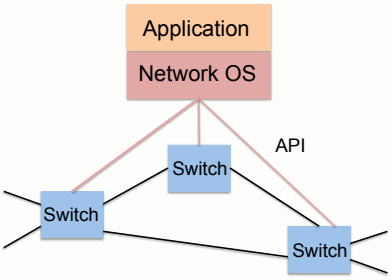

16

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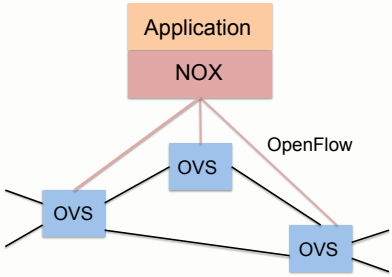

17

Discussion

- What is a good “division of labor”?
- Good design for the protocol?
- Good abstractions for the NOS?
- How apt is the “operating system” analogy?
- What parts of the system need standards?
- What are interesting SDN applications?

18