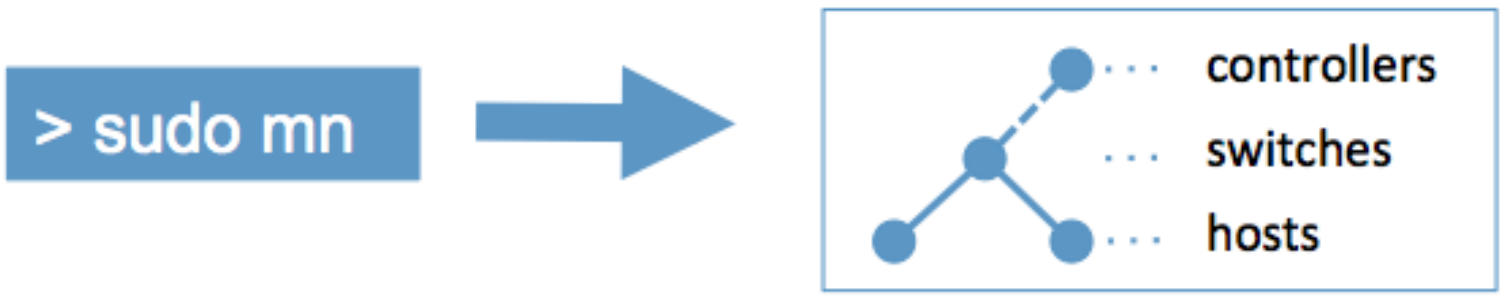
Mininet



What is Mininet?

- A **virtual network environment** that can run on a single PC
- Runs real kernel, switch, and application code on a single machine
  - Command-line, UI, Python interfaces
- Many **OpenFlow features** are built-in
  - Useful: developing, deploying, and sharing

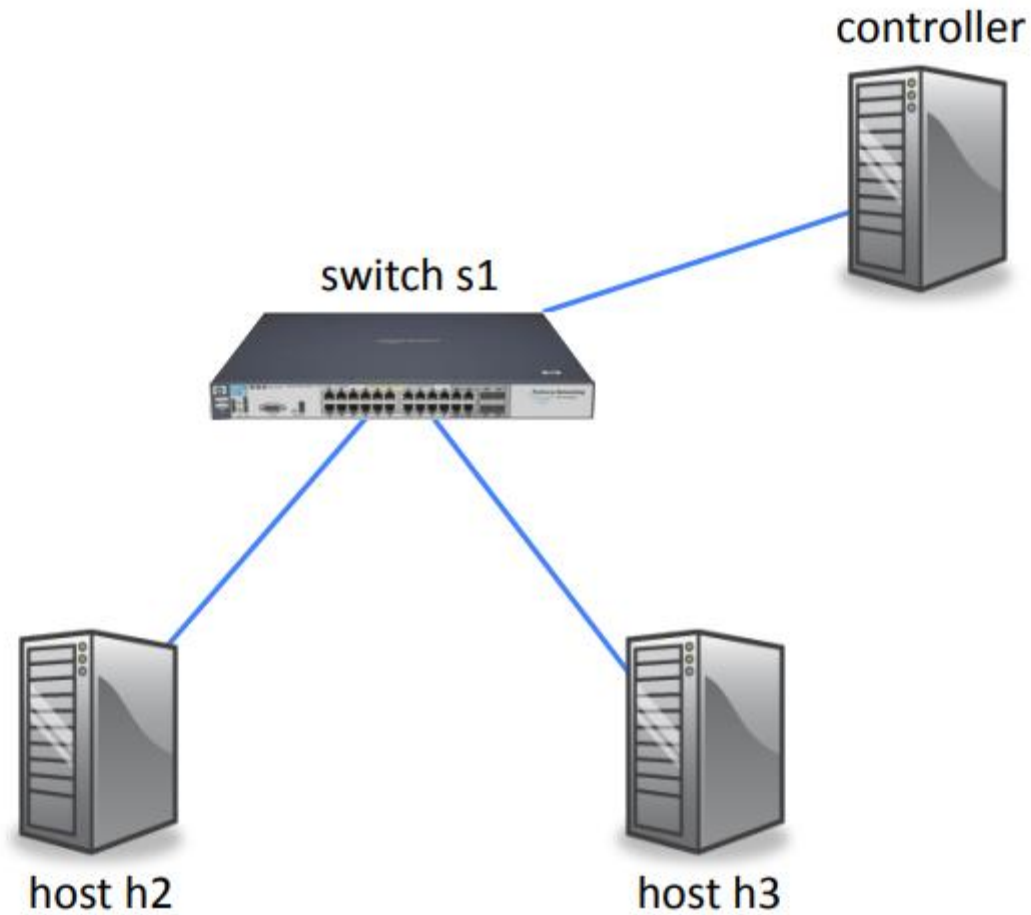
Why Use Mininet?

- Fast
- Possible to create custom topologies
- Can run real programs (anything that can run on Linux can run on a Mininet host)
- Programmable OpenFlow switches
- Easy to use
- Open source

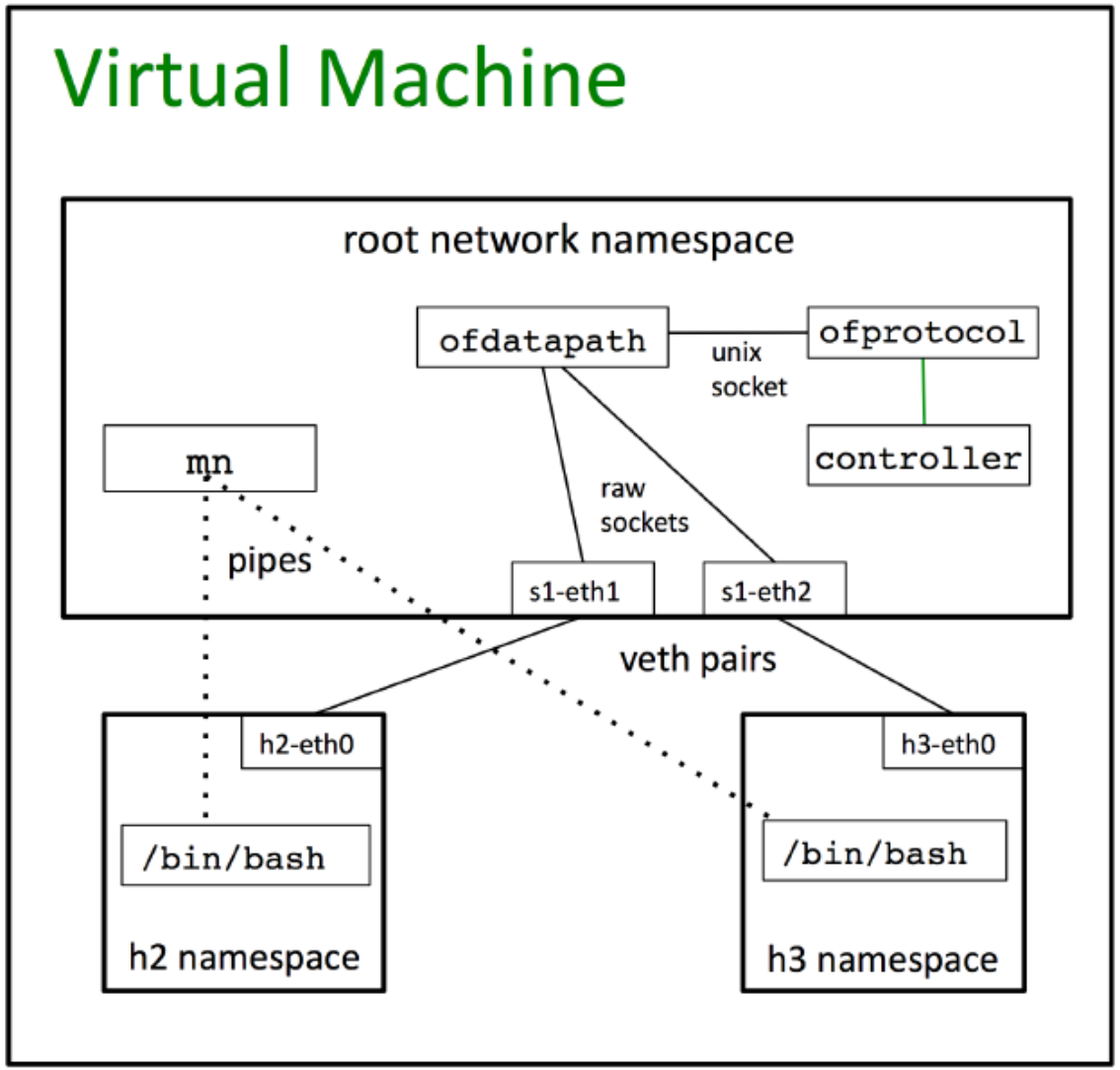
Alternatives

- **Real system:** Pain to configure
- **Networked VMs:** Scalability
- **Simulator:** No path to hardware deployment

The Mininet VM in a Nutshell



The Mininet VM in a Nutshell



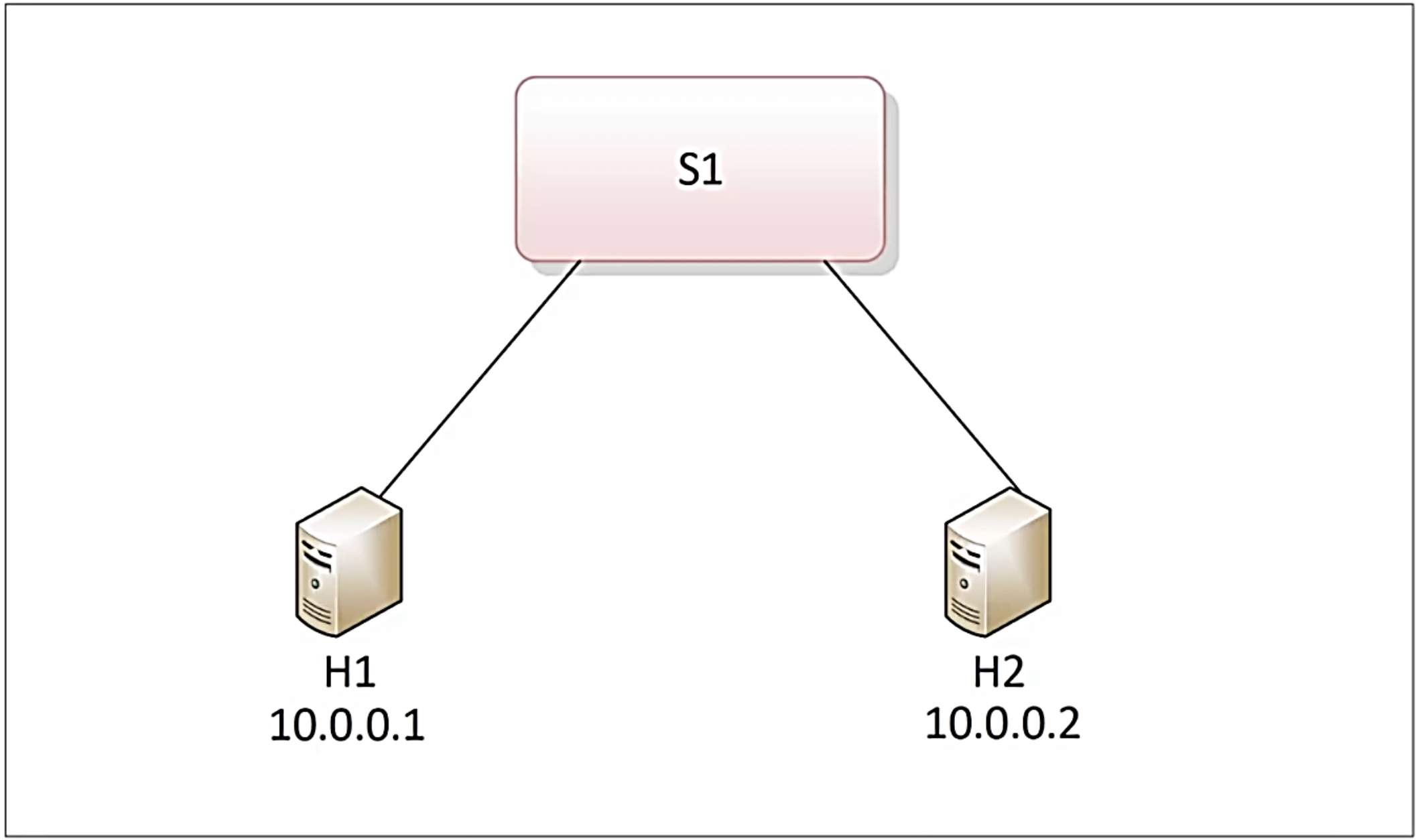
- Launch mininet process
- Per host
  - Bash process
  - Network namespace
- Create veth pairs and assign to namespaces
- Create OpenFlow switch to connect hosts
- Create OpenFlow controller

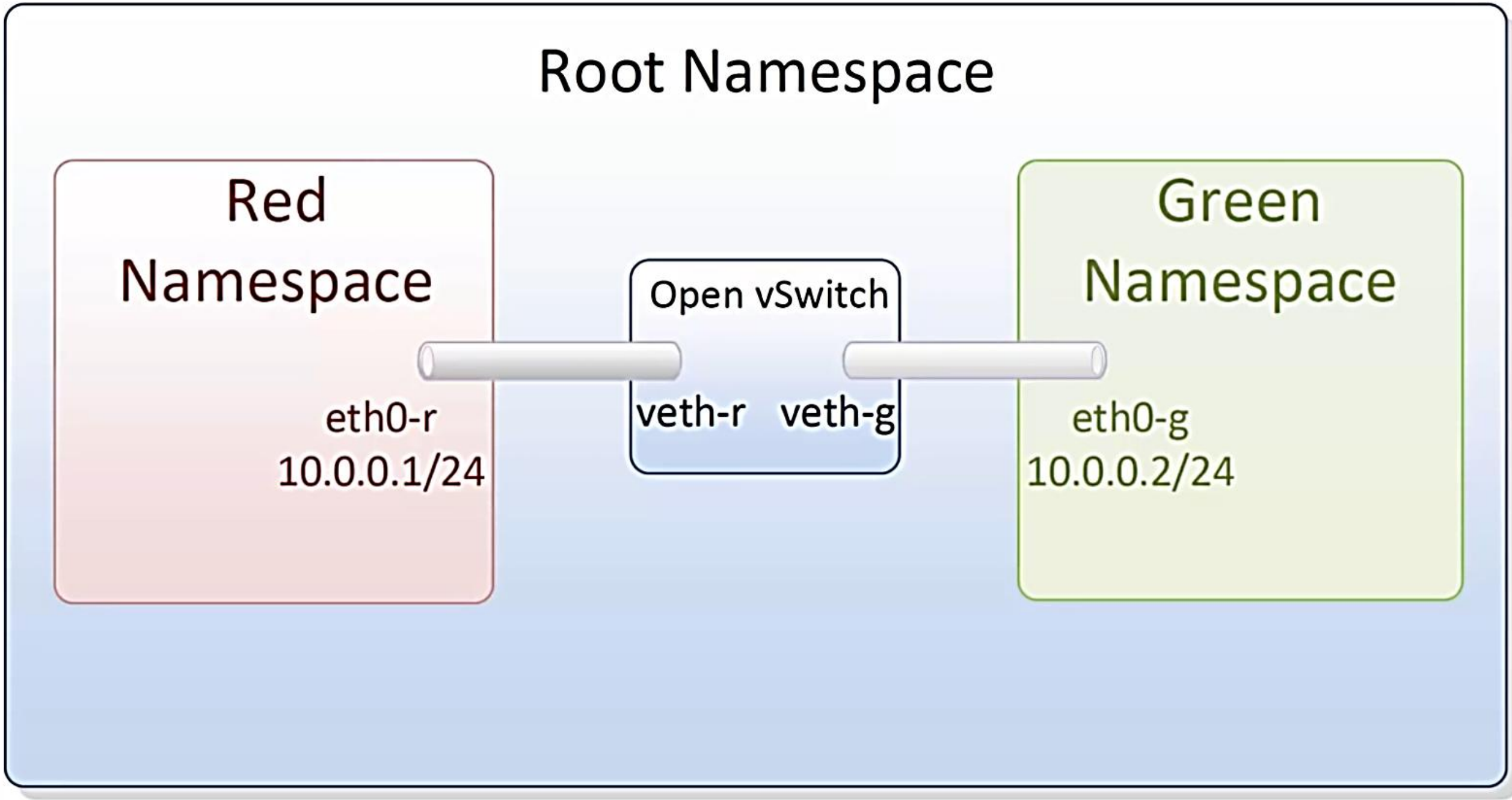
https://github.com/mininet/mininet/wiki/pdf/mininet-hotnets2010-final.pdf

What are Linux Network Namespaces?

- Multiple isolated networking environments running on a single physical host or VM
- Each network namespace has its own interfaces, routing tables and forwarding tables
- Processes can be dedicated to one network namespace
- Used in OpenStack, Mininet, Docker, more...

Example




Root Namespace
Red Namespace
eth0-r
10.0.0.1/24
Open vSwitch
veth-r
veth-g
Green Namespace
eth0-g
10.0.0.2/24

Installation

VM Setup

Download the Mininet VM

Download the Mininet VM from https://github.com/mininet/mininet/wiki/Mininet-VM-Images .

Download and install a virtualization program such as: VMware Workstation for Windows or Linux, VMware Fusion for Mac, VirtualBox for any platform.

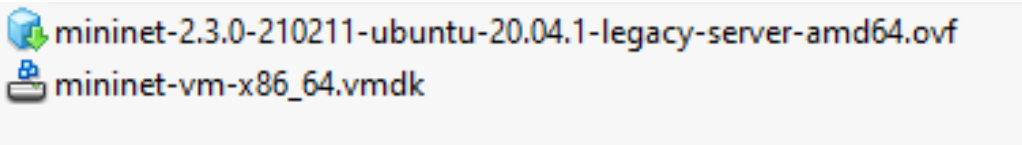
Wireshark Setup

Download the Wireshark software from https://www.wireshark.org/download.html and install it on your own system.

http://mininet.org/vm-setup-notes/

Installation

Boot VM
Add the VM and start it up, in the virtualization program of your choice:



VirtualBox:

1. Usually you can just double-click on the .ovf file and import it.
2. If you get errors importing the .ovf file, you can simply create a new VM of the appropriate type (e.g. Linux, Ubuntu 64-bit) and use the .vmdk file as the virtual hard disk for the new VM.
3. Select “settings,” and add an additional host-only network adapter that you can use log in to the VM image. Start the VM.
4. For more information on setting up networking in VirtualBox, you may wish to check out these VirtualBox specific instructions

VMware: Import the OVF file, then start the VM.

http://mininet.org/vm-setup-notes/

Log in to VM

Log in to the VM, using the following name and password:

```
mininet-vm login: mininet
Password: mininet
```

First, find the VM's IP address, which for VMware is probably in the range 192.168.x.y. In the VM console:

```
ifconfig eth0
```

Note: VirtualBox users who have set up a host-only network on ***eth1*** should use

```
sudo dhclient eth1   # make sure that eth1 has an IP address
ifconfig eth1
```

```
mininet@mininet-vm:~$ ifconfig eth0
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 10.0.2.15  netmask 255.255.255.0  broadcast 10.0.2.255
        ether 08:00:27:7e:90:69  txqueuelen 1000  (Ethernet)
        RX packets 42  bytes 5382 (5.3 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 46  bytes 4622 (4.6 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

```
mininet@mininet-vm:~$ sudo dhclient eth1
mininet@mininet-vm:~$ ifconfig eth1
eth1: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 192.168.56.101  netmask 255.255.255.0  broadcast 192.168.56.255
        ether 08:00:27:40:2a:f7  txqueuelen 1000  (Ethernet)
        RX packets 4  bytes 1300 (1.3 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 2  bytes 684 (684.0 B)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

Intro to VBOx Networking Modes

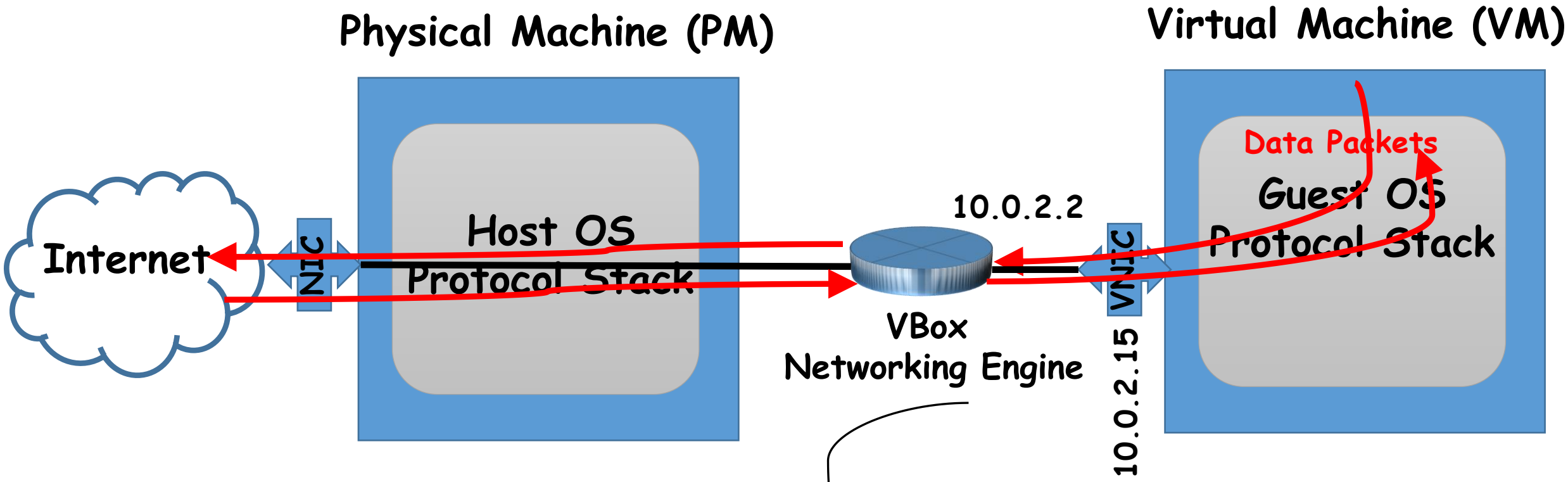
VBox Networking Modes

- **Not attached**
  - In this mode, VirtualBox reports to the guest that a network card is present, but that there is no connection -- as if no Ethernet cable was plugged into the card.
- **Network Address Translation (NAT)**
  - If all you want is to browse the Web, download files and view e-mail inside the guest, then this default mode should be sufficient for you.
- **Bridged Networking**
  - This is for more advanced networking needs such as network simulations and running servers in a guest. When enabled, VirtualBox connects to one of your installed network cards and exchanges network packets directly, circumventing your host operating system's network stack.
- **Host-Only Networking**
  - This can be used to create a network containing the host and a set of virtual machines, without the need for the host's physical network interface. Instead, a virtual network interface (similar to a loopback interface) is created on the host, providing connectivity among virtual machines and the host.

Network Address Translation (NAT) Mode

- Network Address Translation (NAT) is the simplest way of accessing an external network from a virtual machine.
  - Usually, it does not require any configuration on the host network and guest system.
    - For this reason, it is the default networking mode in VirtualBox.
- A virtual machine with NAT enabled acts much like a real computer that connects to the Internet through a router.
  - The "router", in this case, is the **VirtualBox networking engine**, which maps traffic from and to the virtual machine transparently.
  - In VirtualBox this router is placed between each virtual machine and the host.
  - This separation maximizes security since by default virtual machines cannot talk to each other.

Vbox NAT Mode



- Acts as a NAT router and
- Runs a DHCP server

NAT Mode (Cont'd)

- The disadvantage of NAT mode is that much like a private network behind a router, the virtual machine is invisible and unreachable from the outside internet; you cannot run a server this way unless you set up port forwarding

- The network frames sent out by the guest operating system are received by VirtualBox's NAT engine, which extracts the TCP/IP data and resends it using the host operating system.

- To an application on the host, or to another computer on the same network as the host, it looks like the data was sent by the VirtualBox application on the host, using an IP address belonging to the host. VirtualBox listens for replies to the packages sent, and repacks and resends them to the guest machine on its private network.

NAT Mode (Cont'd)

- The virtual machine receives its network address and configuration on the private network from a DHCP server integrated into VirtualBox.
  - The IP address thus assigned to the virtual machine is usually on a completely different network than the host.
  - As more than one card of a virtual machine can be set up to use NAT, the first card is connected to the private network 10.0.2.0, the second card to the network 10.0.3.0 and so on.

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