

VIRL – Virtual Internet Routing Lab

Personal Edition

Beau Williamson
CCIE R&S 1346 Emeritus

T-Mobile

Housekeeping

DFW CUG



Please turn off all Cell Phones and (and for the Dinosaurs in the room) Pagers!



WARNING: This session is being recorded via the super sensitive overhead mics in the room! Please avoid side conversations. (Anything you say will be used against you on social media.)

Acknowledgements



A big thanks to Joel Obstfeld and Alejandro Gallego from the Cisco VIRL team who helped answer my many questions and assisted with putting this presentation together¹.

¹Some of the slides in this presentation are courtesy of Cisco.

Opening Statements

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- I am not an Expert on VIRL.
 - You may ask me questions at any time but . . .
 - There are no bonus points for “stumping” the presenter.
 - Other people here may have more experience with VIRL.
 - If so, please speak up.
 - We want to benefit from your knowledge.

Agenda

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- **What is VIRL?**
- **VIRL Architecture**
- **VIRL Components**
- **VIRL Installation**
- **VIRL Basics**
- **AutoNetkit**
- **Layer-2 Switching**
- **VIRL Advanced Features**

What is VIRL

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- Up to 30 Cisco virtual machines in a box
 - Runs same OS as Cisco's physical routers and switches
 - IOS, IOS-XR, IOS-XE NX-OS¹, IOS L2 Switching, ASA
- Powerful GUI for network design and simulation control
- Auto-Netkit Configuration engine
 - Can build complete Cisco configuration automatically
 - IPv4/v6 Addressing, OSPF Areas, BGP ASN, etc.
- Connectivity to outside Physical Networks
 - Requires extra physical Network ports (NICs) on VIRL server
- Portability/Repeatability

¹ Titanium Release – No VPC, etc.

Agenda

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VIRL Architecture – Virtual OS

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IOS XR



Virtualized
in
IOS XRx

NX-OS



Virtualized
in NX-OSv

IOS XE



Virtualized in
CSR1000v

IOS



Virtualized
in IOSv and
IOSvL2

Servers



Ubuntu, Cirros,
3rd party Virtual
Machines

Virtual Machines run the operating system but are NOT representations of a particular hardware platform – no fans, no switch fabric, no ASIC models

VIRL Architecture – Virtual OS

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IOS XR



Virtualized
in
IOS XRx

NX-OS



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Servers



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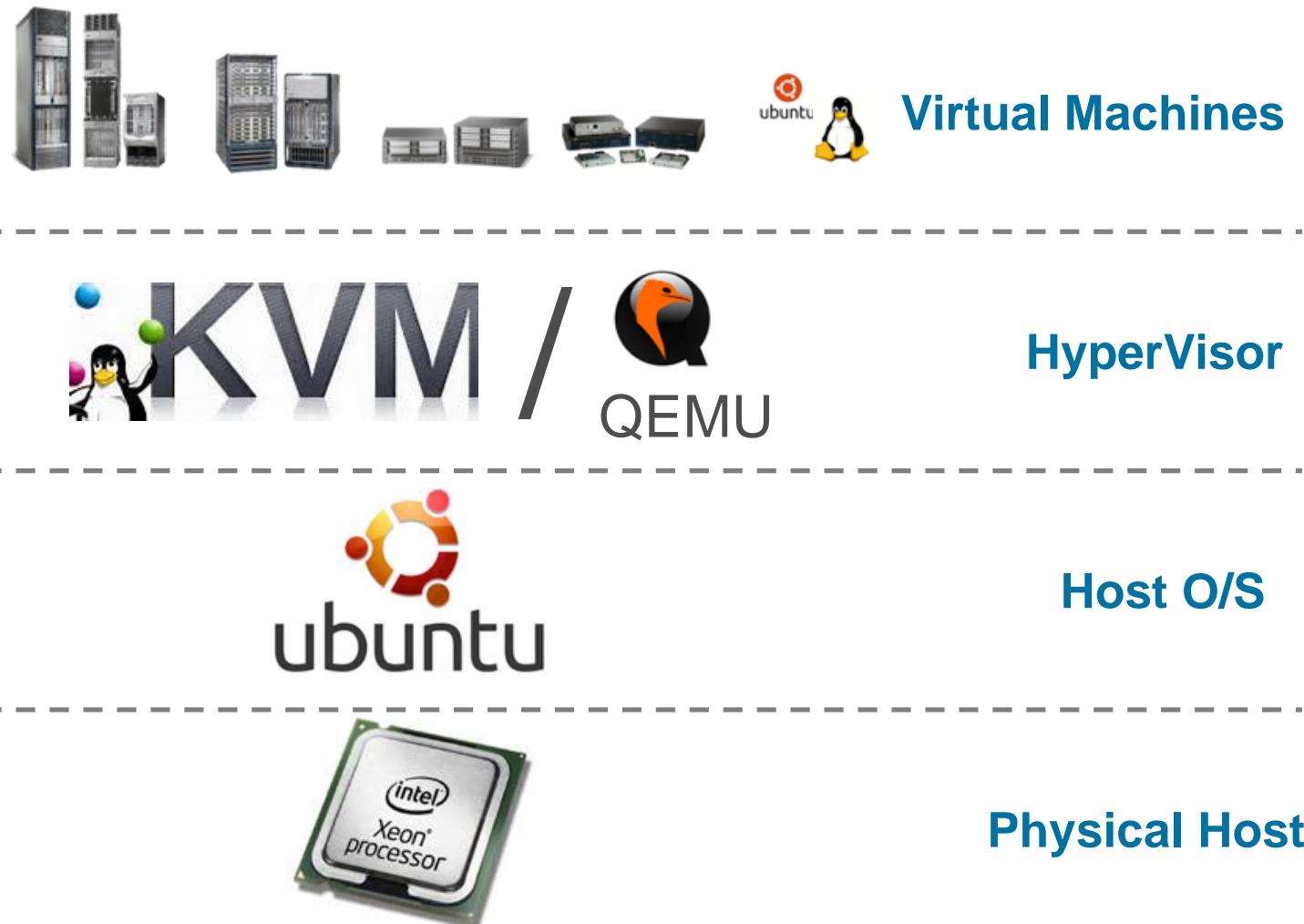
- Same Control-plane code
- Same Management plane code
- Same memory footprint

- Different CPU performance
- Different Forwarding plane code
- No ASIC emulation

Nested Virtualization

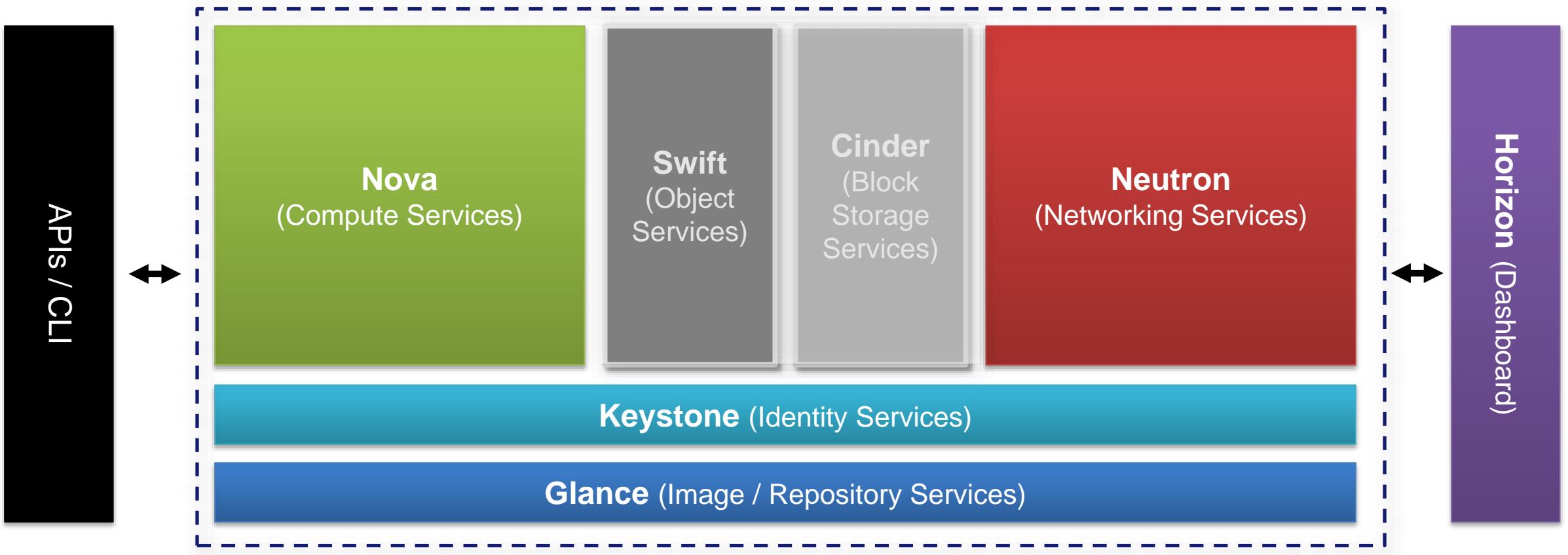
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- Virtualized devices (CPU, I/O, memory) enable a single host to support many virtual machines
- KVM / QEMU provides a kernel-based Hypervisor / host-virtualization facility
- Ubuntu provides the basic host operating system
- Intel VT-x / AMD-V capable CPUs expose hardware-virtualization functions to Ubuntu / KVM



Built on OpenStack

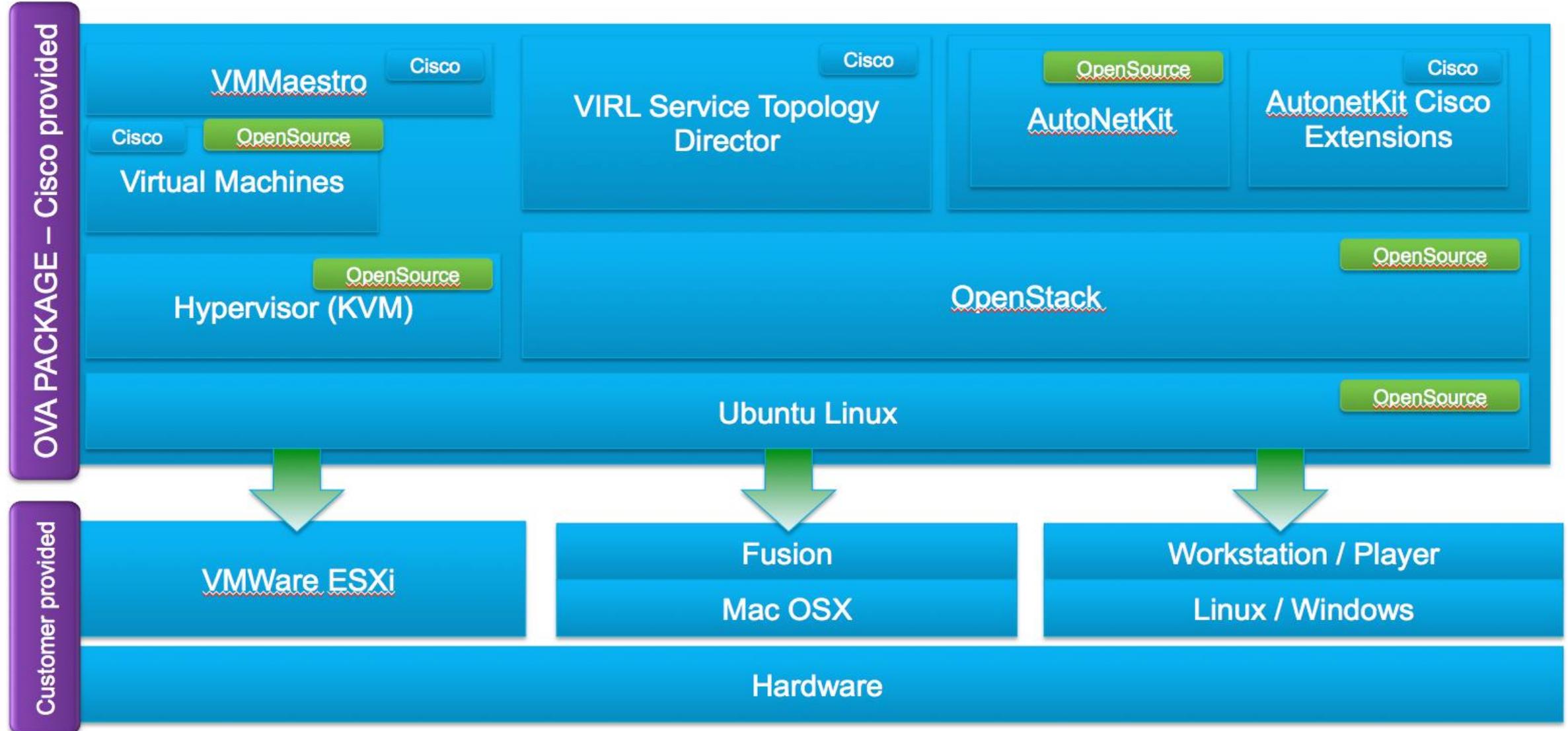
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IaaS / cloud orchestration software – creates, manages, and deletes virtual resources according to API- or CLI-based instructions

VIRL OVA Delivery

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VIRL ISO Delivery

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Cisco provided installer

VMMaestro

Cisco

Cisco IOSv VM

Cisco

Hypervisor (KVM)

OpenSource

VIRL Service Topology
Director

Cisco

OpenSource

AutoNetKit

Cisco

AutoNetKit Cisco
Extensions

OpenSource

OpenStack

Ubuntu Linux

OpenSource

Hardware

Customer
provided

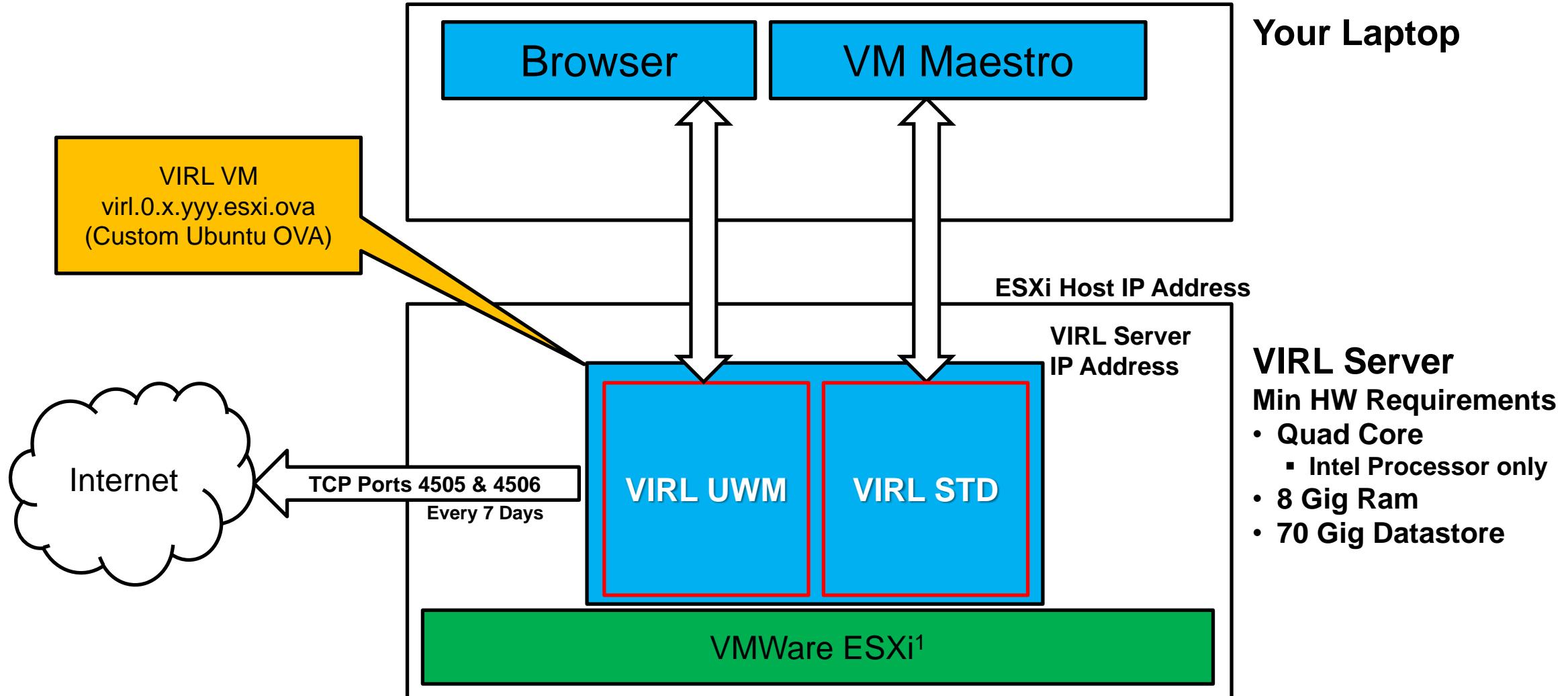
Agenda

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- **VIRL Components**
- VIRL Installation
- VIRL Basics
- AutoNetkit
- Layer-2 Switching
- VIRL Advanced Features

VIRL Components (ESXi Version)

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¹ Not supported on Oracle VirtualBox

Your Laptop

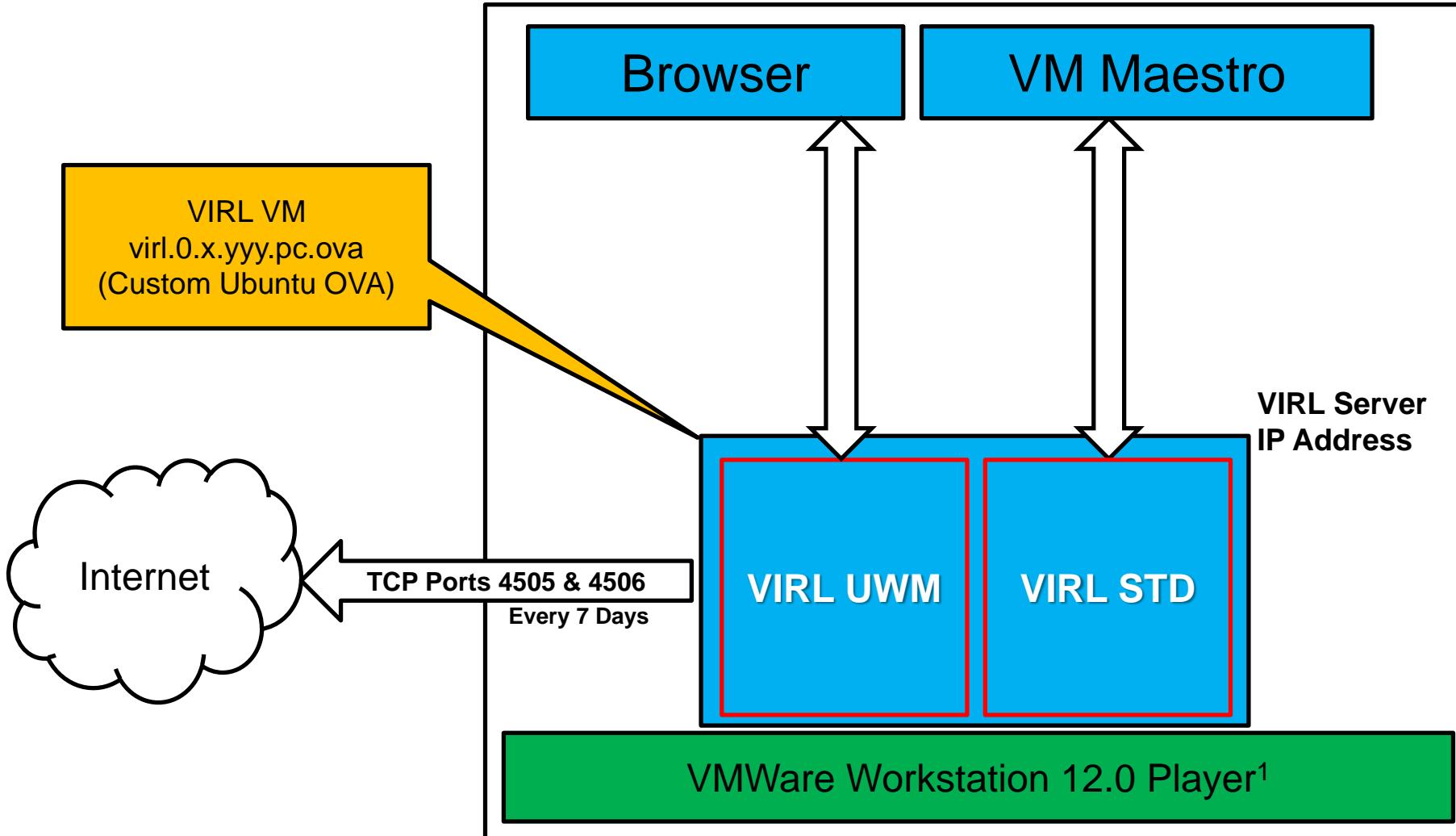
VIRL Server

Min HW Requirements

- Quad Core
 - Intel Processor only
- 8 Gig Ram
- 70 Gig Datastore

VIRL Components (Workstation 12.0 Player Version)

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¹ Not supported on Oracle VirtualBox

Your Laptop
Min HW Requirements

- Quad Core
- 8 Gig Ram
- 70 Gig Datastore

Agenda

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VIRL Installation



- 1. Purchase VIRL**
- 2. Install ESXi or VMWare Workstation Player**
- 3. Create VIRL NW Port-Groups (Optional)**
- 4. Deploy the VIRL OVA**
- 5. Adjust VIRL VM Resources (Optional)**
- 6. Configure Static IP (Optional)**
- 7. Configure Internet Proxies (Optional)**
- 8. Prepare VIRL for Activation (Optional)**
- 9. Activate VIRL**
- 10. Customize VIRL Config (Optional)**
- 11. Validate VIRL Installation (Optional)**
- 12. Install and Configure VM Maestro**

Step 1: Obtain VIRL

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- **Hardware Requirements**
 - Four CPU cores
 - Min. 8GB of DRAM that can be allocated to the VIRL VM
 - Recommendations: 12GB(for 20 nodes) or 15GB(for 30 nodes)]
 - Host system must be able to access the Internet on a regular basis
 - TCP ports 4505 & 4506 outbound enabled
 - Used for License Verification at least every 7 days
 - Virtualization Extensions present
 - Intel VT-x / EPT or
 - AMD-V / RVI (VMWare Workstation 12.0 Player only)
 - Enabled in the BIOS
 - 70GB of free disk space for installation

Step 1: Obtain VIRL

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- Visit the “GetVIRL” Web site <http://virl.cisco.com/getvirl/>
- Pricing (as of today)
 - Personal Edition 20 nodes - \$199.99/yr
 - Personal Edition 30 nodes - \$299.99/yr
 - Academic Edition 20 nodes - \$79.99/yr
 - Limited to faculty, staff and students of any public or private K-12 institution or Higher Education institution.
- Once purchased you will receive email with:
 - Download links for software (~5.4Gig), license key file & Hash
 - Links good for 3 days.
 - Verify download using MD5 Hash

Step 2: Install VMWare on target machine

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- VMWare ESXi, VM Workstation 12.0 Player
 - ESXi Versions
 - ESXi 5.1U2 (Build 1483097)
 - ESXi 5.5U1 (Build 1623387)
 - ESXi 6.0 (Build 2494585)
 - *Oracle VirtualBox not supported*
- “Some” VMWare experience is assumed.
 - If no experience, install VM Workstation 12.0 Player
 - Experiment with creating/configuring/managing Virtual Machines
 - Don’t Panic!!!
 - It’s really fairly easy and you need to learn this stuff anyway.

Step 3: Create VIRL Network Port-Groups

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localhost.localdomain VMware ESXi, 6.0.0, 2494585

Getting Started Summary Virtual Machines Resource Allocation Performance Configuration Users Events Permissions

Hardware

- Health Status
- Processors
- Memory
- Storage
- Networking
 - Storage Adapters
 - Network Adapters
 - Advanced Settings
 - Power Management

Software

- Licensed Features
- Time Configuration
- DNS and Routing
- Authentication Services
- Virtual Machine Startup/Shutdown
- Virtual Machine Swapfile Location
- Security Profile
- Host Cache Configuration
- System Resource Reservation
- Agent VM Settings
- Advanced Settings

View: vSphere Standard Switch

Networking

Standard Switch: vSwitch0

Remove... Properties...

- Virtual Machine Port Group
 - VM Network
 - Physical Adapters: vmnic0 1000 Full
- 1 virtual machine(s) | VLAN ID: 10
VIRL-Nov15-.1.0.0
- Virtual Machine Port Group
 - Flat
 - 1 virtual machine(s) | VLAN ID: 10
VIRL-Nov15-.1.0.0
- Virtual Machine Port Group
 - Flat1
 - 1 virtual machine(s) | VLAN ID: 20
VIRL-Nov15-.1.0.0
- Virtual Machine Port Group
 - SNAT
 - 1 virtual machine(s) | VLAN ID: 40
VIRL-Nov15-.1.0.0
- Virtual Machine Port Group
 - INT
 - 1 virtual machine(s) | VLAN ID: 50
VIRL-Nov15-.1.0.0
- VMkernel Port
 - Management Network
vmk0 : 192.168.205.89
fe80::6e0b:84ff:fe43:c7fa

Step 3: Create VIRL Network Port-Groups

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- See it done

<http://virl-dev-innovate.cisco.com/video.lib/vdbplayer.swf?volume=100&url=video/client.networking.mp4>

Step 4: Deploy the VIRL OVA

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192.168.205.89 - vSphere Client

File Edit View Inventory Administration Plug-ins Help

New >

Deploy OVF Template...

Export Report Print Maps Exit

localhost.localdomain VMware ESXi, 6.0.0, 2494585

Getting Started Summary Virtual Machines Resource Allocation Performance Configuration Users Events Permissions close tab X

What is a Host?

A host is a computer that uses virtualization software, such as ESX or ESXi, to run virtual machines. Hosts provide the CPU and memory resources that virtual machines use and give virtual machines access to storage and network connectivity.

You can add a virtual machine to a host by creating a new one or by deploying a virtual appliance.

The easiest way to add a virtual machine is to deploy a virtual appliance. A virtual appliance is a pre-built virtual machine with an operating system and software already installed. A new virtual machine will need an operating system installed on it, such as Windows or Linux.

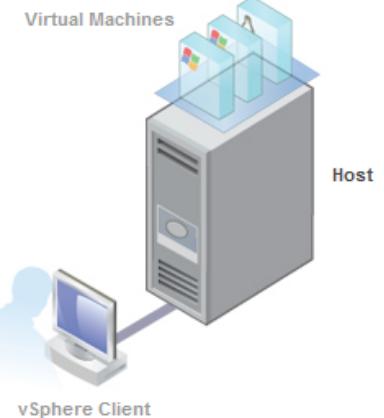
Basic Tasks

 [Create a new virtual machine](#)

Explore Further

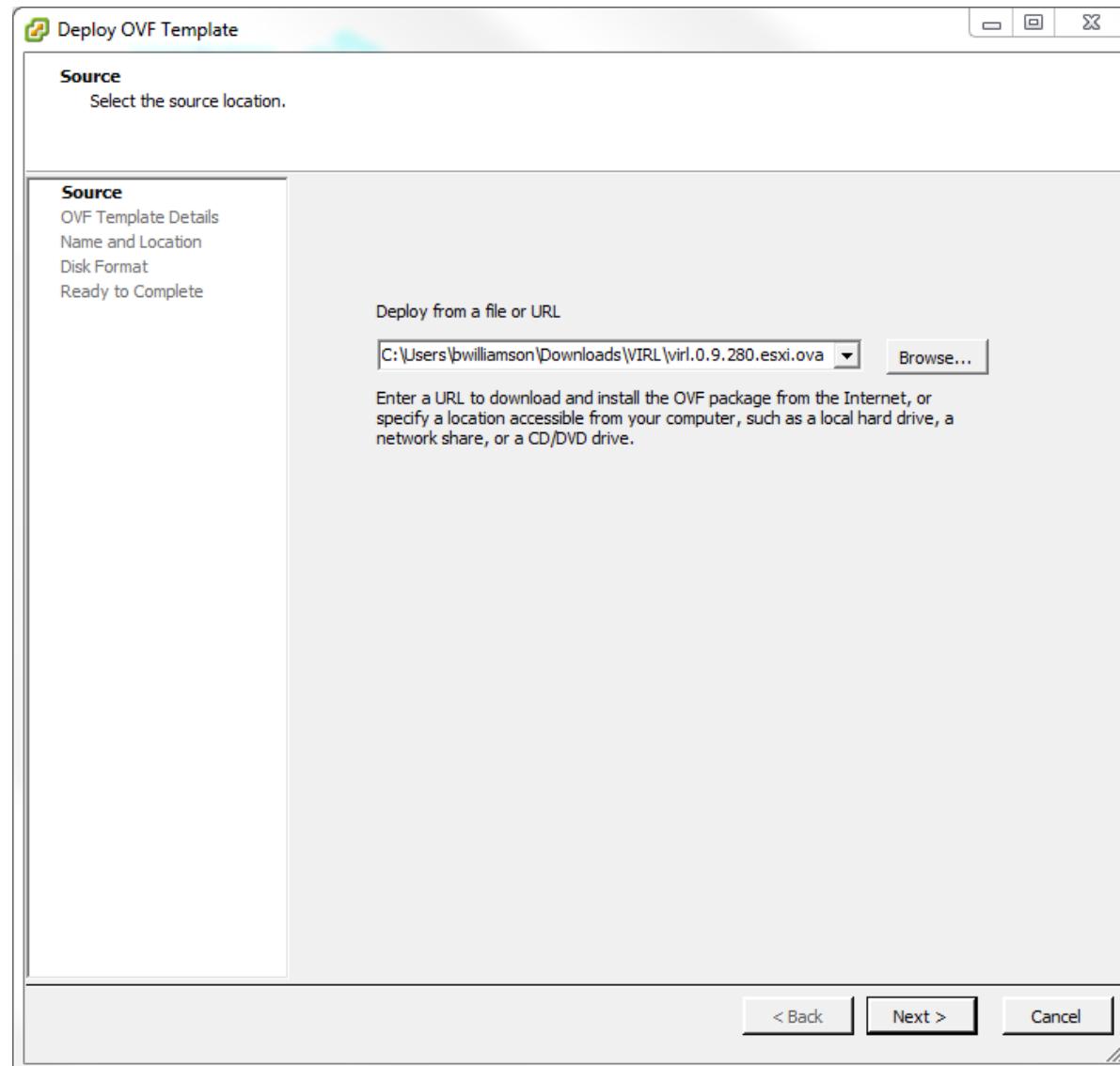
 [Learn about vSphere](#)
Manage multiple hosts, eliminate downtime, load balance your datacenter with vMotion, and more

 [Evaluate vSphere](#)



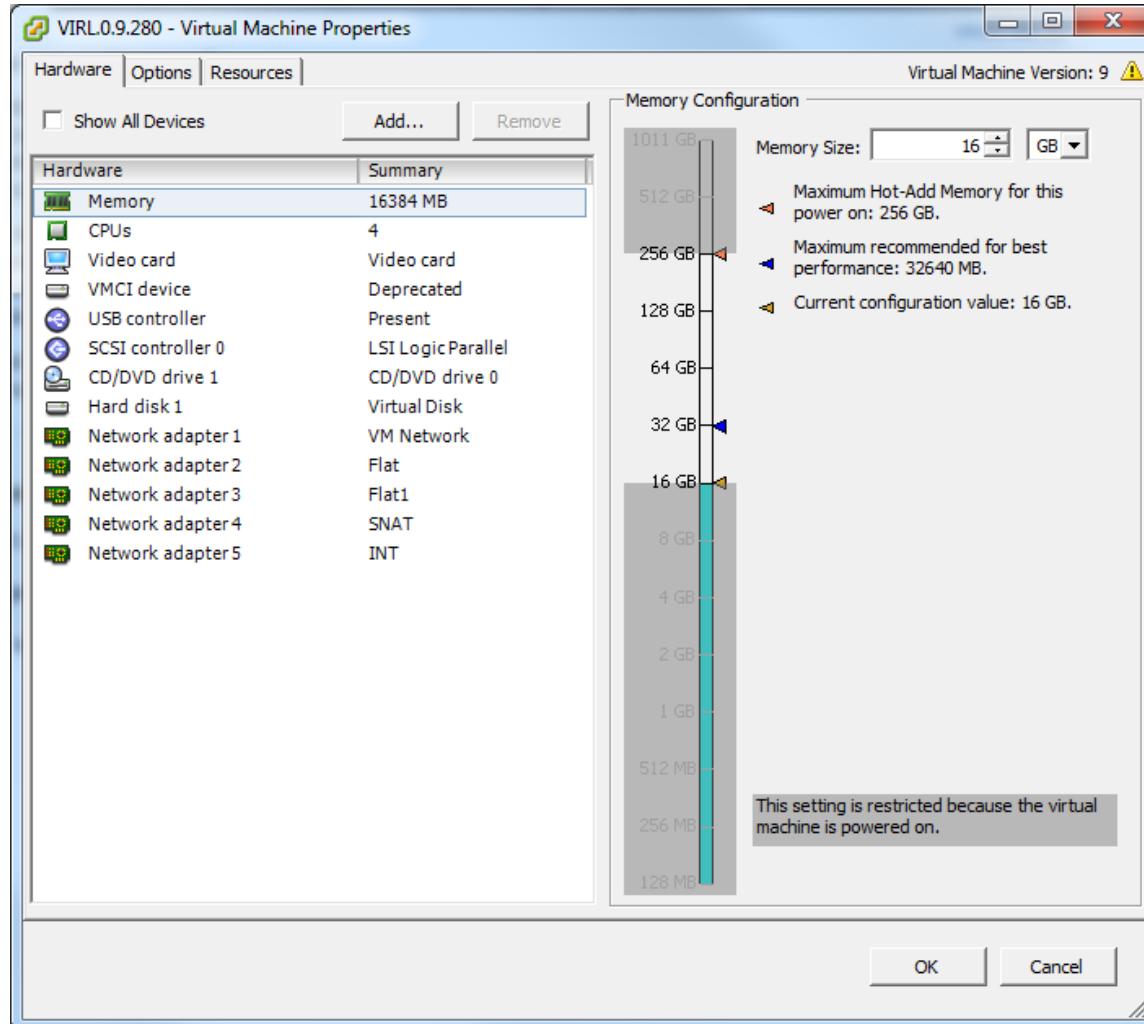
Step 4: Deploy the VIRL OVA

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Step 5: Adjust VIRL VM Resources (Optional)

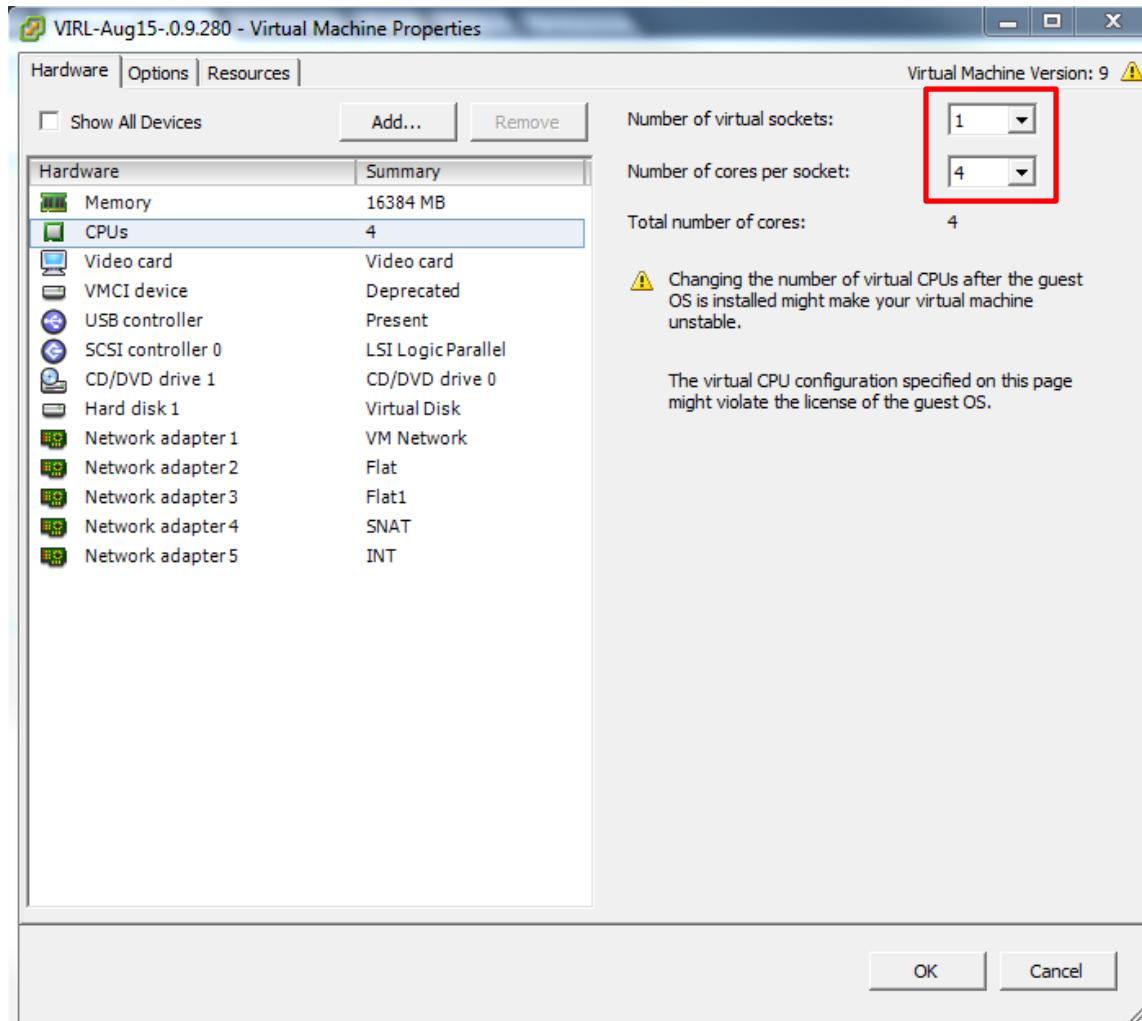
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- Navigate to VM manifest in vSphere Client.
- Right-click on the VIRL VM
- Select 'Edit Settings'.
- Adjust memory
- Adjust number of vCPUs

Step 5: Adjust VIRL VM Resources (Optional)

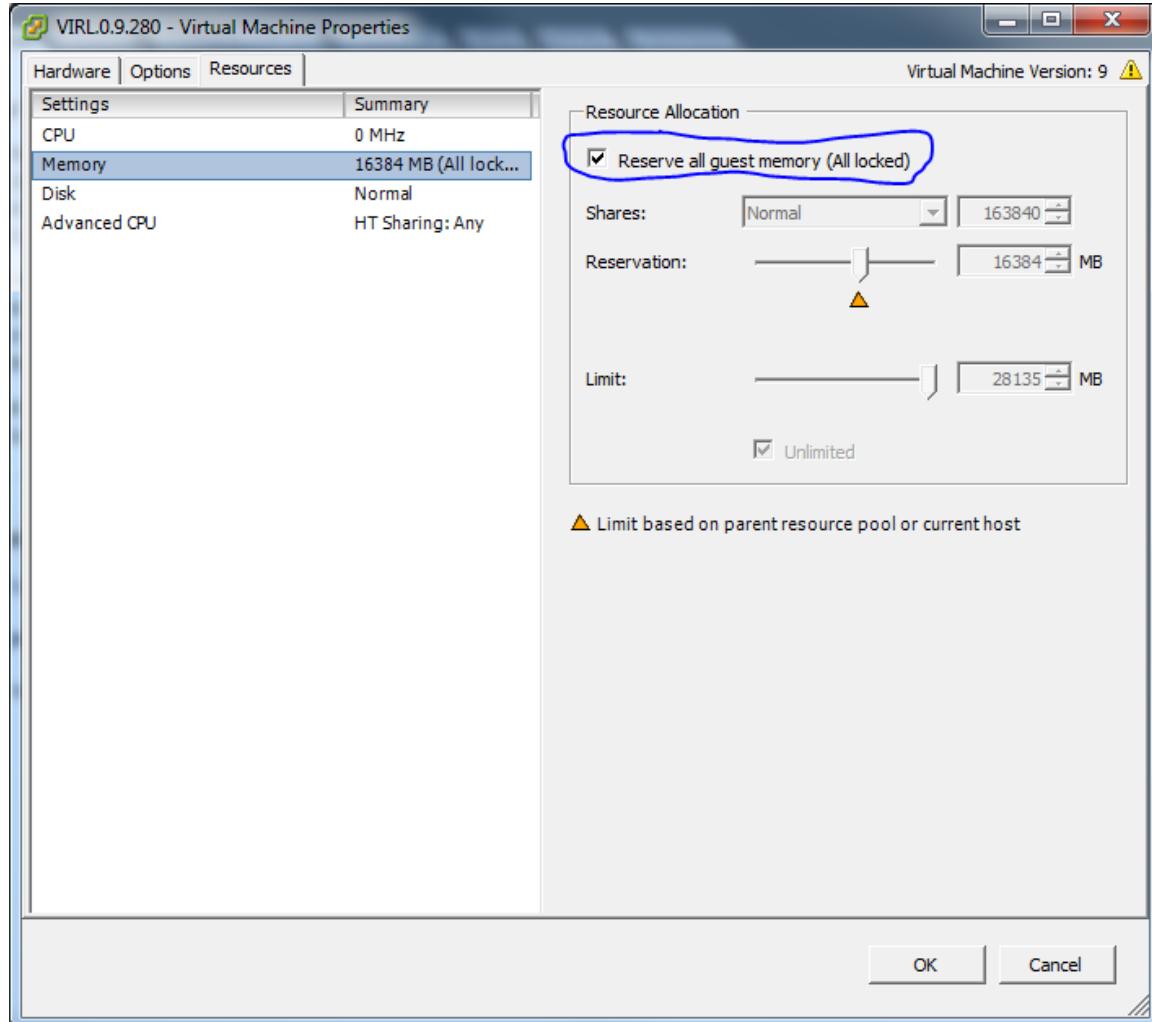
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- Adjust number of vCPUs

Step 5: Adjust VIRL VM Resources (Optional)

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- Select 'Resources' tab.
- Select 'Memory' from settings list.
- Enable 'Reserve all guest memory (All locked)'.

Step 6: Configure Static IP (Optional)

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- Connect to VM Console
- Double-click xterm
- Edit Interface

```
sudo nano /etc/network/interfaces
iface eth0 inet static
address n.n.n.n
netmask mmm.mmm.mmm.mmm
gateway g.g.g.g
dns-nameservers a.a.a.a b.b.b.b
```

- Exit xterm & reboot

Control-X, Enter 'Y' to save.

`sudo reboot now`

Step 7: Configure Internet Proxies (Optional)

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- Only if deployed where proxies are in use
 - Use xterm on VM console to edit “.bashrc” & “apt.conf”
 - Requires knowledge of your site-specific proxy parameters.
 - See Step 7 instructions on VIRL Web page for details

<http://virl-dev-innovate.cisco.com/client.php>

Example “.bashrc” changes:

```
export http_proxy=http://proxy.domain.tld:port/
export https_proxy=http://proxy.domain.tld:port/
export HTTP_PROXY=$http_proxy
export HTTPS_PROXY=$https_proxy
```

Example “.apt-conf” changes:

```
Acquire::http::proxy "proxy.domain. ld:port/"
```

Step 8: Prepare VIRL for Activation (Optional)

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- Login to VIRL VM Console via VSphere
- Launch xterm
- Perform following steps per Web page instructions:
<http://virl-dev-innovate.cisco.com/client.php>
 - Reset SSH server's RSA key
 - If not installing from OVA
 - Confirm “KVM acceleration” can be used
 - Confirm Internet connectivity
 - Confirm NTP Peering is established
 - Debug and correct if not. (Instructions are provided on Web page)

Step 8: Prepare VIRL for Activation (See it done.)



<http://virl-dev-innovate.cisco.com/video.lb/video/prepare.virl.mp4>

Step 9: Activate VIRL

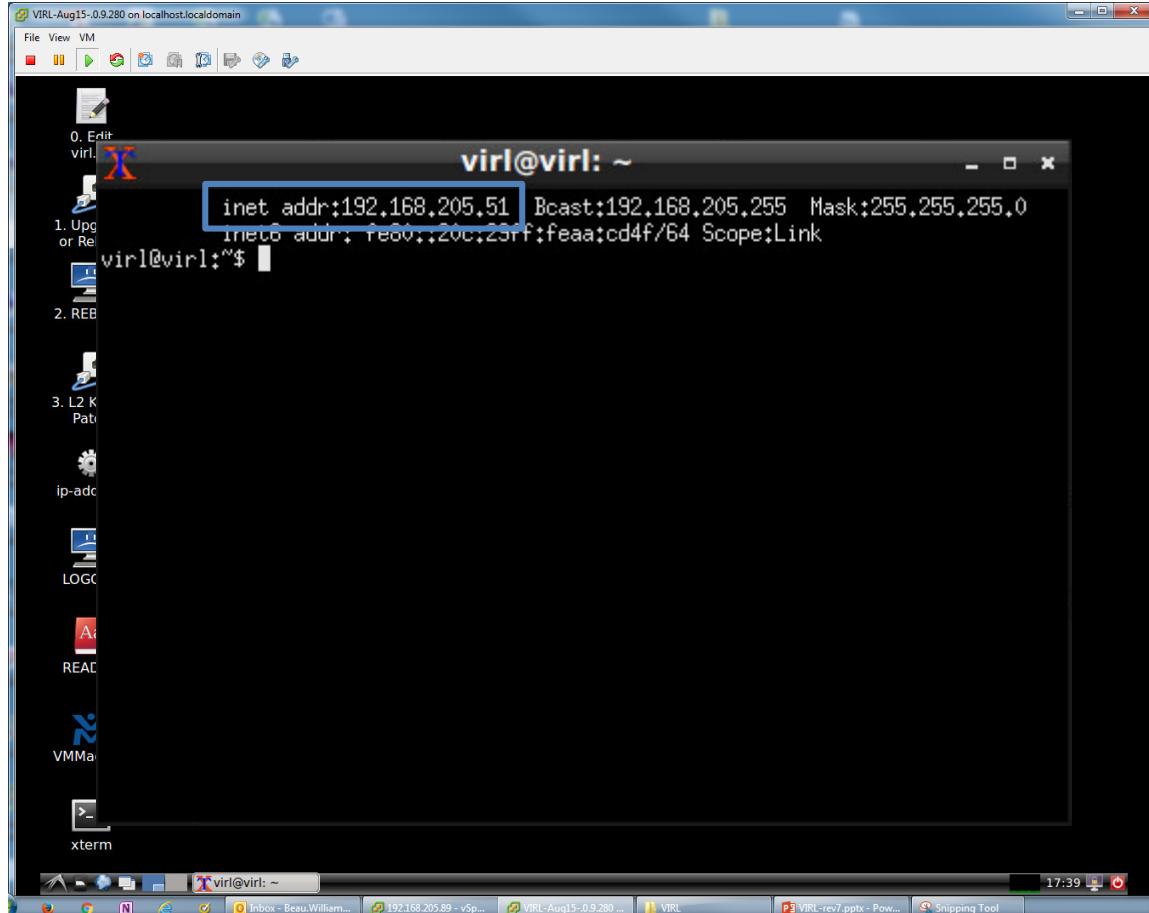
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- Obtain VIRL Server address
 - Connect to VIRL VM console via VSphere.
 - Double-click “ip-address” icon to display server address.
 - In this case 192.168.205.100

Step 9: Activate VIRL

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- Obtain VIRL Server address
 - Connect to VIRL VM console via VSphere.
 - Double-click “ip-address” icon to display server address.
 - In this case 192.168.205.51

Step 9: Activate VIRL

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- Use Browser to connect to VIRL Server IP address
- Select User Workspace Management

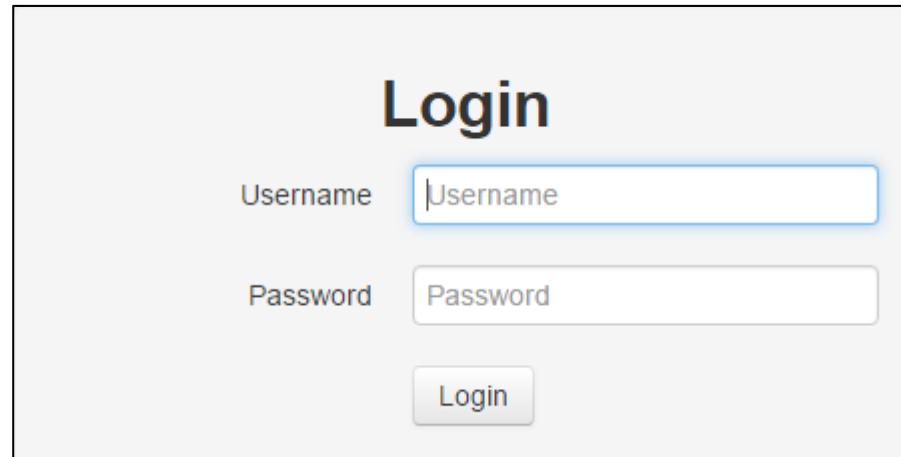


Step 9: Activate VIRL

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- Login to User Workspace Management

Userid: uwmadmin, Password: password



The image shows a login interface with a light gray background. At the top center, the word "Login" is displayed in a bold, dark font. Below it, there are two input fields: "Username" and "Password", each preceded by a label and followed by a text input box. At the bottom center is a blue "Login" button.

- Have your Salt License Key file handy

Example: AB12CD35.virl.info.pem

Step 9: Activate VIRL

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The screenshot shows the UWM (Cisco Unified Wireless Manager) interface. On the left, there's a sidebar with links: Overview, My simulations, Project simulations, Projects, Users, and VIRL Server. Under VIRL Server, the 'Salt Configuration and Status' link is highlighted with a blue box and a red arrow pointing to it, labeled '1. Select "Salt Configuration & Status"'. The main content area is titled 'Salt status'. It contains two buttons: 'Reset keys and ID' and 'Check status now'. Below the buttons, the 'Current status' section displays information: 'Last successful contact: 2015-11-27', 'Contact with Salt master required: in 7 days', and 'Allowed Cisco node count: 20'. The 'Current configuration' section contains a truncated message about configuration against Cisco nodes. A red arrow points from the 'Check status now' button to a yellow box labeled '2. Click "Reset keys & ID"'.

Step 9: Activate VIRL

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3. Enter License Filename
(omit .pem extension)

4. Enter your email address

UWM

Overview

My simulations

Project simulations

Pro

Users

VIRL Server

Configuration and Status

System Configuration

System Status

VIRL Software

Connectivity

VM Control

Node resources

Reset salt settings

Salt / Reset

Failed to load current minion key: [Errno 2] No such file or directory: '/etc/salt/pki/minion/

A valid salt minion key and master configuration is required for continued function of this product.

This page allows updating and resetting this registration.

Salt ID and domain xxxxxxx.virl.info

Customer e-mail Address <your email address>

List of Cisco salt masters us-virl-salt.cisco.com

Master sign public key eft.pub

Minion private RSA key in PEM format

5. One of:
 - us-virl-salt.cisco.com
 - eu-virl-salt.cisco.com

6. Leave as "eft.pub"

7. Cut-&-paste contents of .pem License file & click "Reset" at bottom of form.

Step 9: Activate VIRL

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8. Return to “Salt Configuration & Status”

The screenshot shows the UWM (Cisco Unified Wireless Manager) interface. On the left, there is a sidebar with the following menu items:

- Overview
- My simulations
- Project simulations
- Projects
- Users
- VIRL Server ▼
- Salt Configuration and Status** (highlighted in blue)
- System Configuration
- System Status

The main content area is titled "Salt status". It contains two sections: "Current status" and "Current configuration".

Current status:

- Last successful contact: 2015-11-27
- Contact with Salt master required: in 7 days
- Allowed Cisco node count: 20

Current configuration:

The information below pertains to configuration of this server against Cisco VIRL. If the information is not what was supplied to you when you received this product, click the "Reset keys and ID" button above.

9. Click “Check status now”

10. You should see something like this.

Step 10: Customize VIRL Config (optional)

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- Edit **/etc/virl.ini** file to perform any customization
 - In most cases, the Default configuration is fine
 - The most common customizations are when:
 - Need to connect/integrate VIRL L2 or L3 networks to external networks.
 - VIRL host has >16GB of memory
 - And use of RAMdisk desired to decrease simulation startup times.
 - VIRL host has fewer than five network interfaces.

Step 10: Customize VIRL Config (optional)

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- Then from VM Console
- Perform Steps 1, 2 & 3

Just Double-Click Icons

1. Upgrades to latest pkgs
2. Reboots VM
3. Applies L2 Kernel patch



Step 11: Validate VIRL Installation (Optional)

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- Login to VIRL VM Console via VSphere
- Launch xterm
- Follow Step 11 Web page instructions:
<http://virl-dev-innovate.cisco.com/client.php>
 - To perform the following:
 - Verify Neutron Agents are all “Active”
 - Verify the VIRL STD service is active and 'listening'
 - Verify the VIRL UWM service is active and 'listening'
 - Use supplied debugging steps if necessary

Step 11: Validate VIRL Installation (See it done.)



<http://virl-dev-innovate.cisco.com/video.lb/video/validate.virl.mp4>

Step 12: Install and Configure VM Maestro

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- Use Browser to connect to VIRL Server
- Select VM Maestro Clients to download software

The screenshot shows the VIRL Server interface. At the top is a black header bar with the Cisco logo. Below it is a light gray header section with the text "VIRL Server". The main content area is divided into two columns: "System Operations" on the left and "Support" on the right. Under "System Operations", there are three blue buttons: "User Workspace Management", "VM Maestro Clients", and "Horizon (read-only)". The "VM Maestro Clients" button is highlighted with a red rectangular border. Under "Support", there are four blue buttons: "Support Forums", "API Documentation", "System Documentation and Training", and "Online Videos". At the bottom center is a small footer note: "Cisco | Trademark".

Step 12: Install and Configure VM Maestro

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- Download package appropriate to your laptop/PC

Index of /download

	Name	Last modified	Size	Description
	Parent Directory		-	
	VIRL_CLIENTS-0.10.21.7-py2-none-any.rev_eaa1fe7.bin.whl	2015-11-24 18:26	8.6M	
	VMMaestro-dev-1.2.4-363-linux.gtk.x86_64.zip	2015-11-24 18:19	152M	
	VMMaestro-dev-1.2.4-363-setup_32.exe	2015-11-24 18:19	143M	
	VMMaestro-dev-1.2.4-363-setup_64.exe	2015-11-24 18:19	146M	
	VMMaestro-dev-1.2.4-363.dmg	2015-11-24 18:19	263M	

- Install VM Maestro software package

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VIRL Basics

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- VIRL Learning Labs Tutorial
 - <http://virl-dev-innovate.cisco.com/tutorial.php>
- VIRL YouTube Channel
 - <https://www.youtube.com/channel/UC41WuzXIJCGY5qLsuZ8aHkQ>
 - Playlists
 - Monthly Webinars
 - https://www.youtube.com/watch?v=SEJ4ILAspTA&list=PLo_CEk6ClpZPCpdsOCdH5KhiKX9pMHCh4
 - Beginner's Tutorial
 - https://www.youtube.com/watch?v=XIIMc4OOXZk&list=PLo_CEk6ClpZOFDmZFfdgUzGNY4efuPJbJ
 - And more . . .

VIRL Learning Labs Tutorial

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- Exercise 1:** **Introduction to VM Maestro**
- Exercise 2:** **Creating a New VIRL Topology**
- Exercise 3:** **Creating a Simple Network using IOSv**
- Exercise 4:** **Building Configurations and Visualizations**
- Exercise 5:** **Working with VIRL Simulations**
- Exercise 6:** **Working with Router Configurations**
- Exercise 7:** **Configuring Routing Protocols – Part 1**
- Exercise 8:** **Configuring Routing Protocols – Part 2**
- Exercise 9:** **Configuring Management Access**
- Exercise 10:** **Configuring Layer-2 Switching**
- Exercise 11:** **Other Node Sub-Types and Servers**

Introduction to VM Maestro

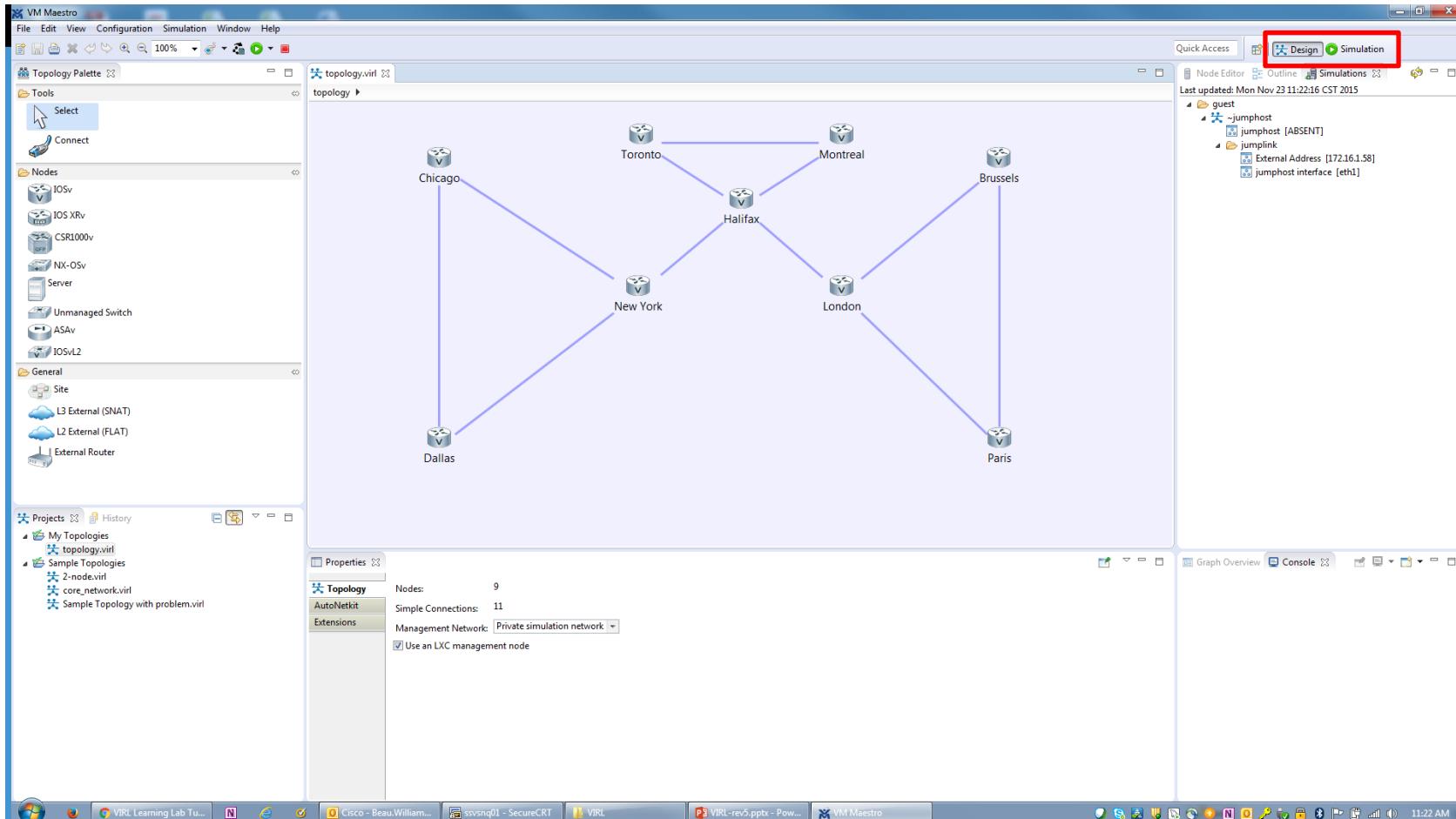
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- VM Maestro Perspectives (or Modes)
 - Design Perspective
 - Topology Editor Pane
 - Properties Pane
 - Projects Pane
 - Nodes and Tools Palette
 - Simulation Perspective
 - Topology Pane
 - Simulations Pane
 - Consoles Pane
 - Projects Pane
 - Topology and Simulation Controls

Design Perspective

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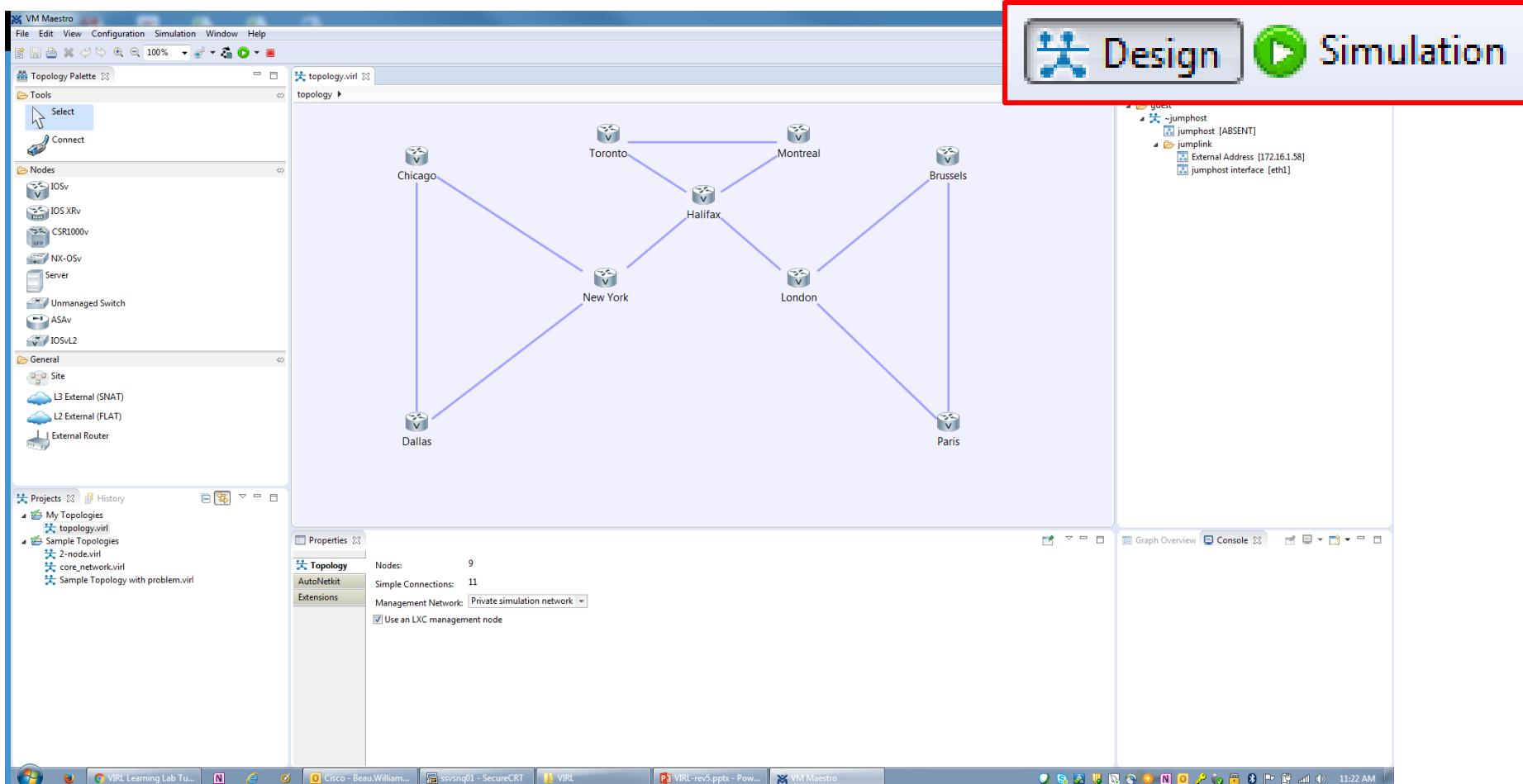
- Selecting Design Perspective



Design Perspective

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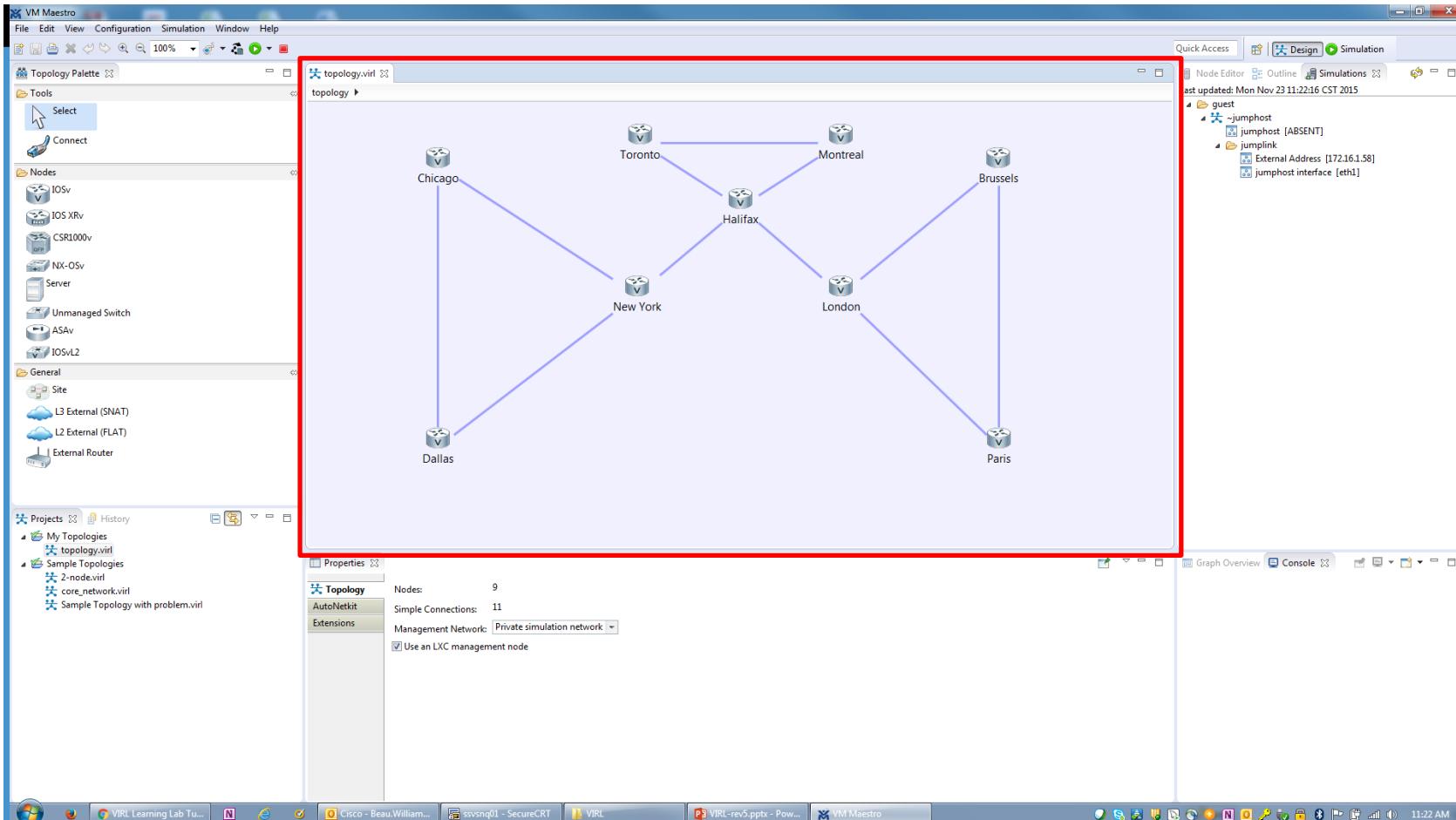
- Selecting Design Perspective



Design Perspective

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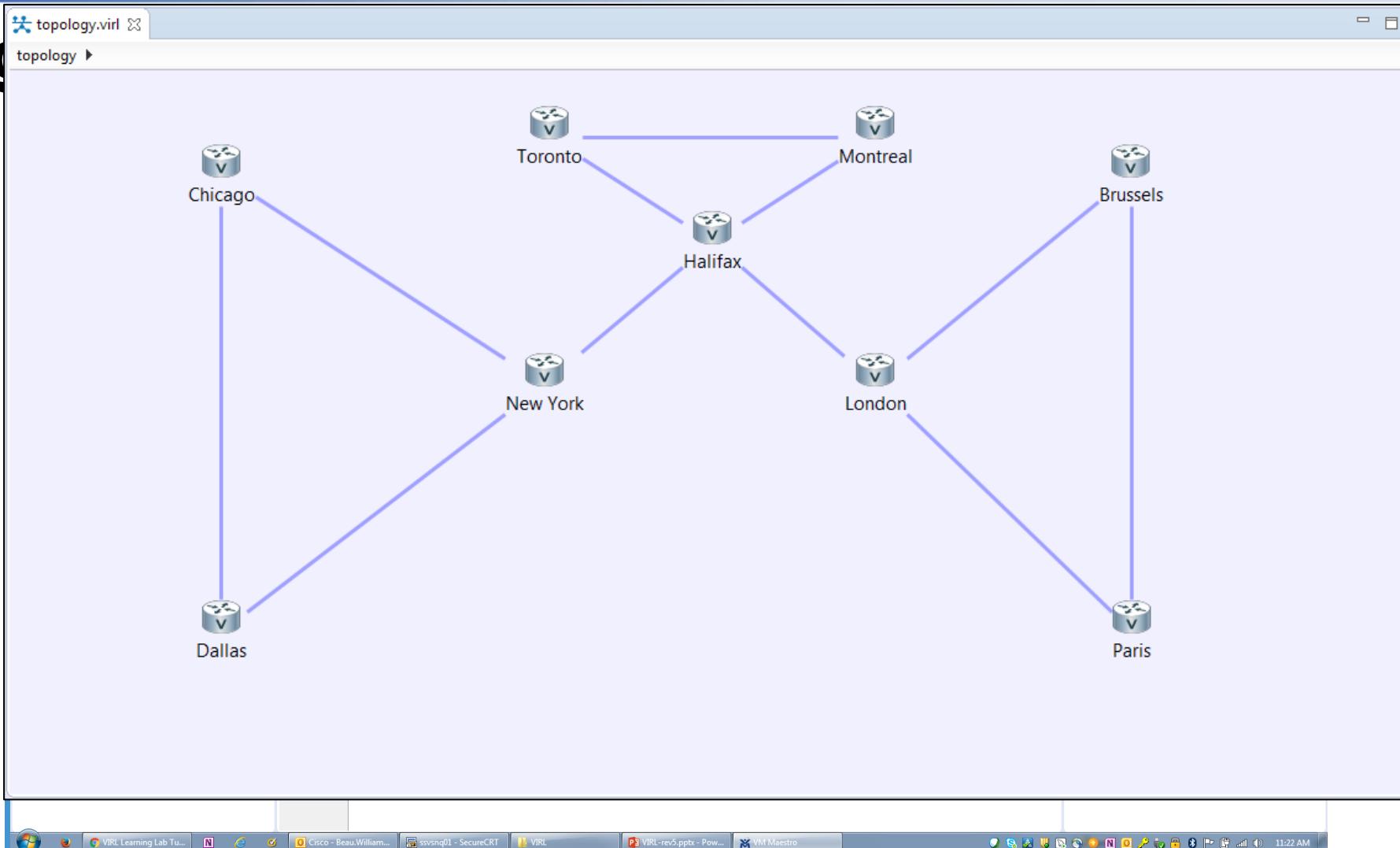
- Topology Editor Pane



Design Perspective

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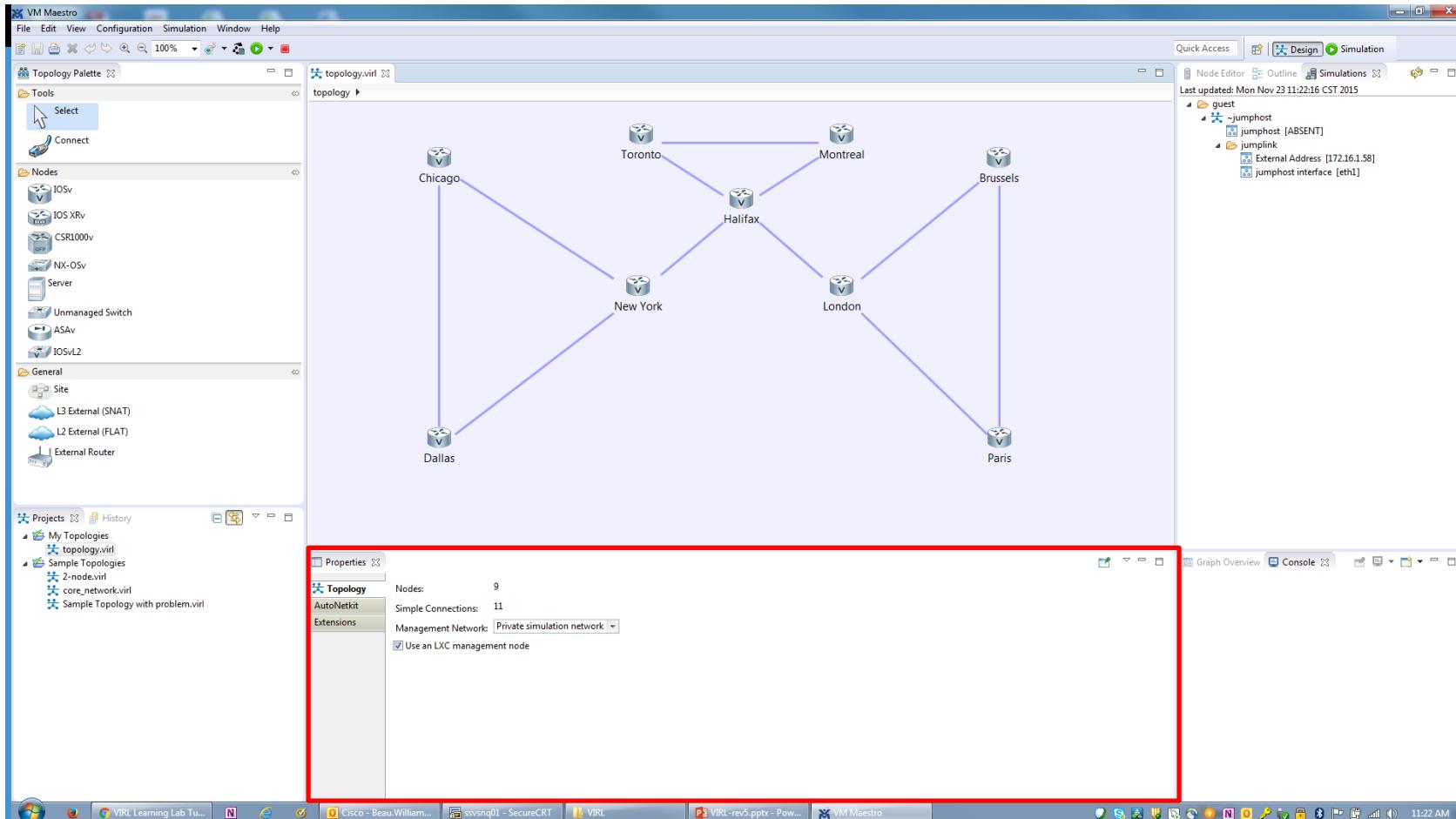
- Topology



Design Perspective

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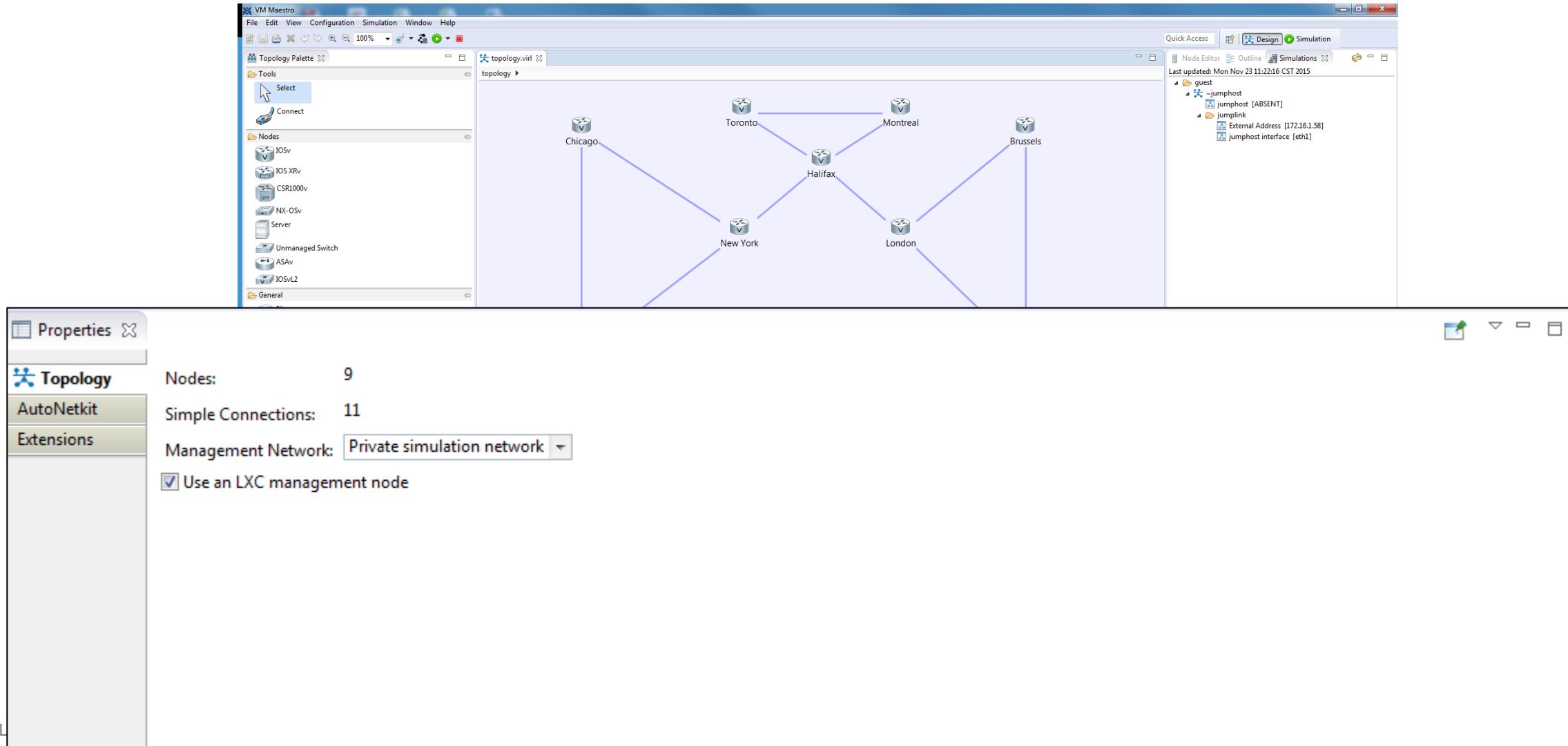
- Properties Pane



Design Perspective

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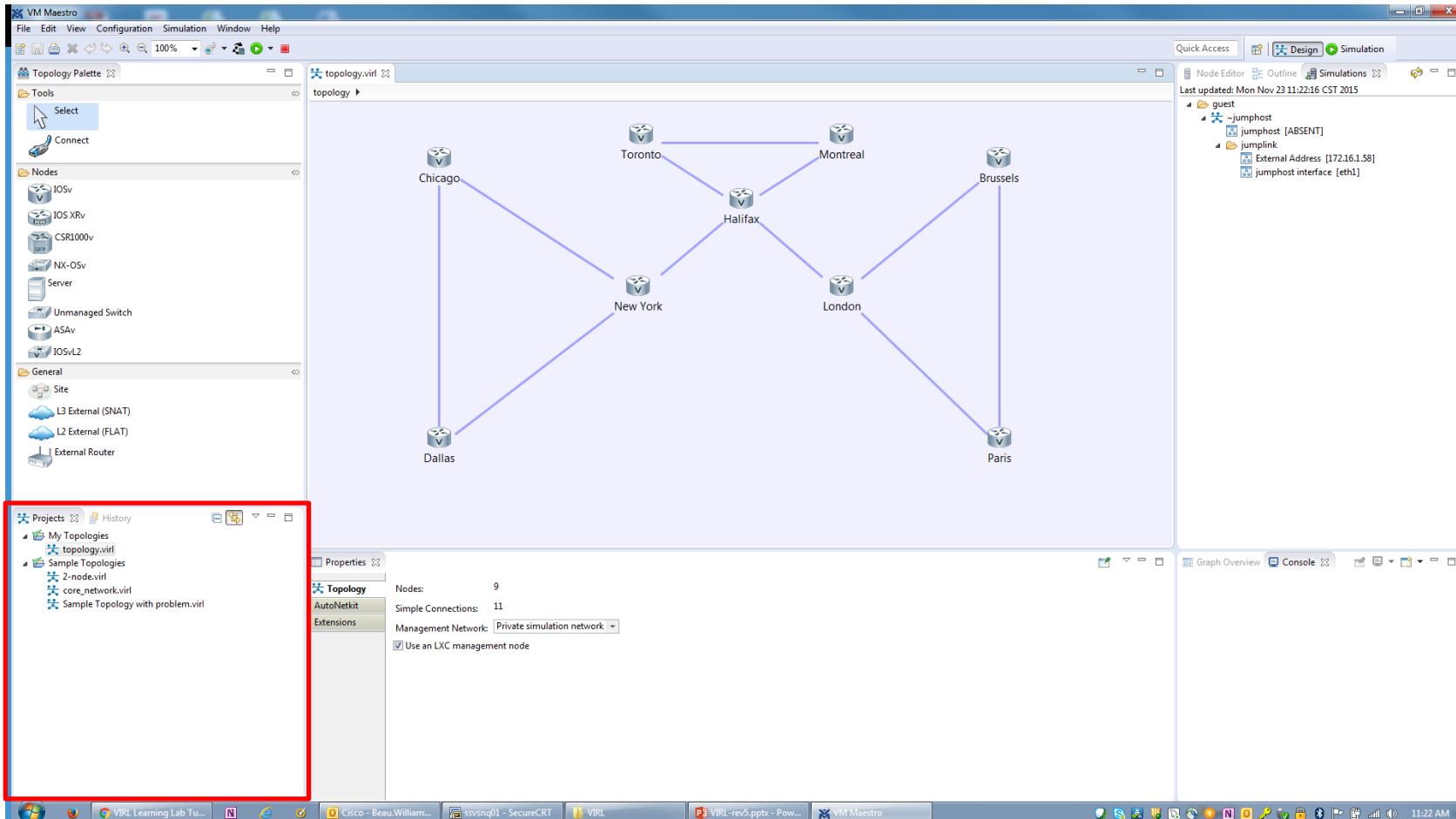
- Properties Pane



Design Perspective

DFW CUG

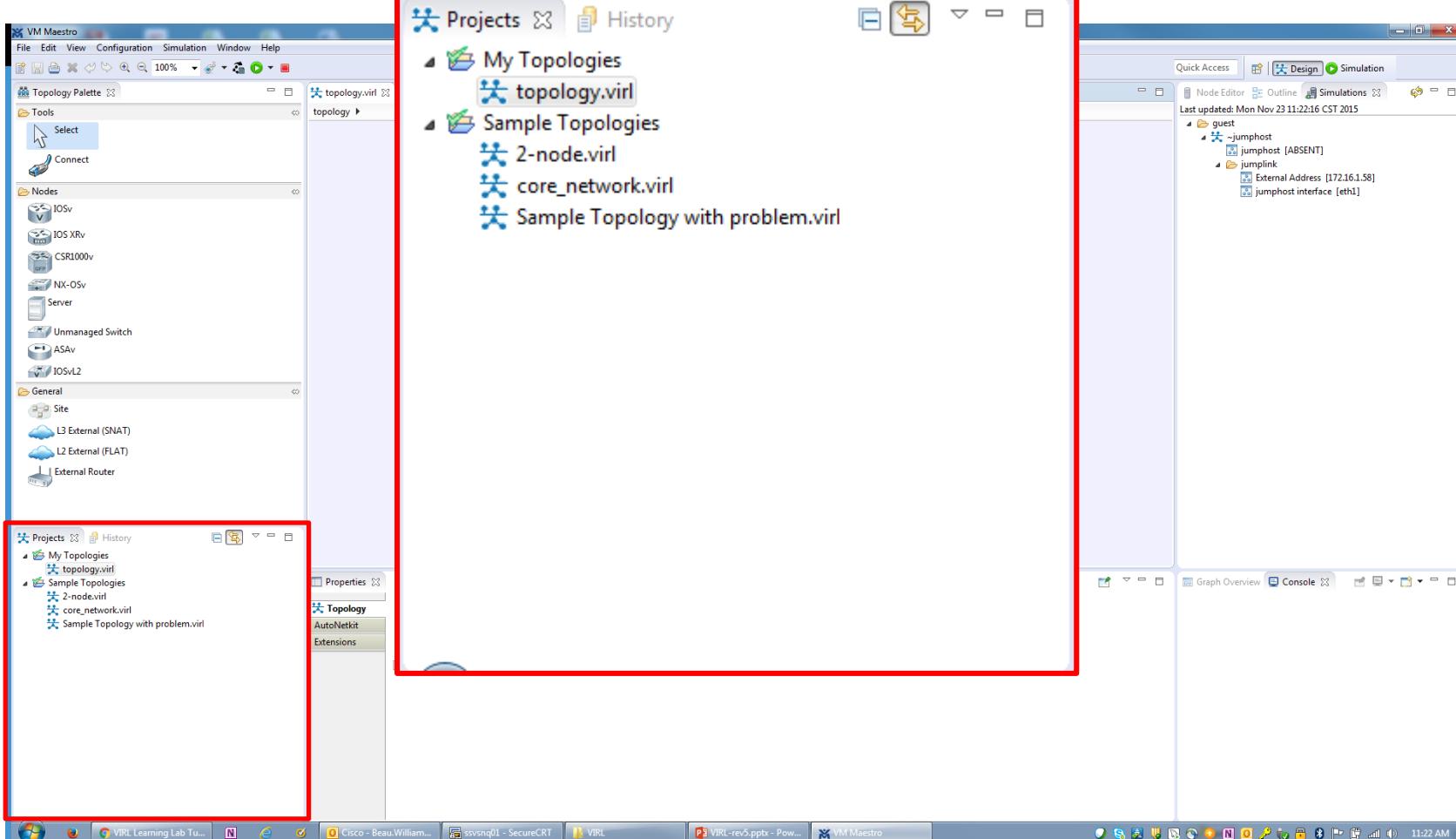
- Projects Pane



Design Perspective

DFW CUG

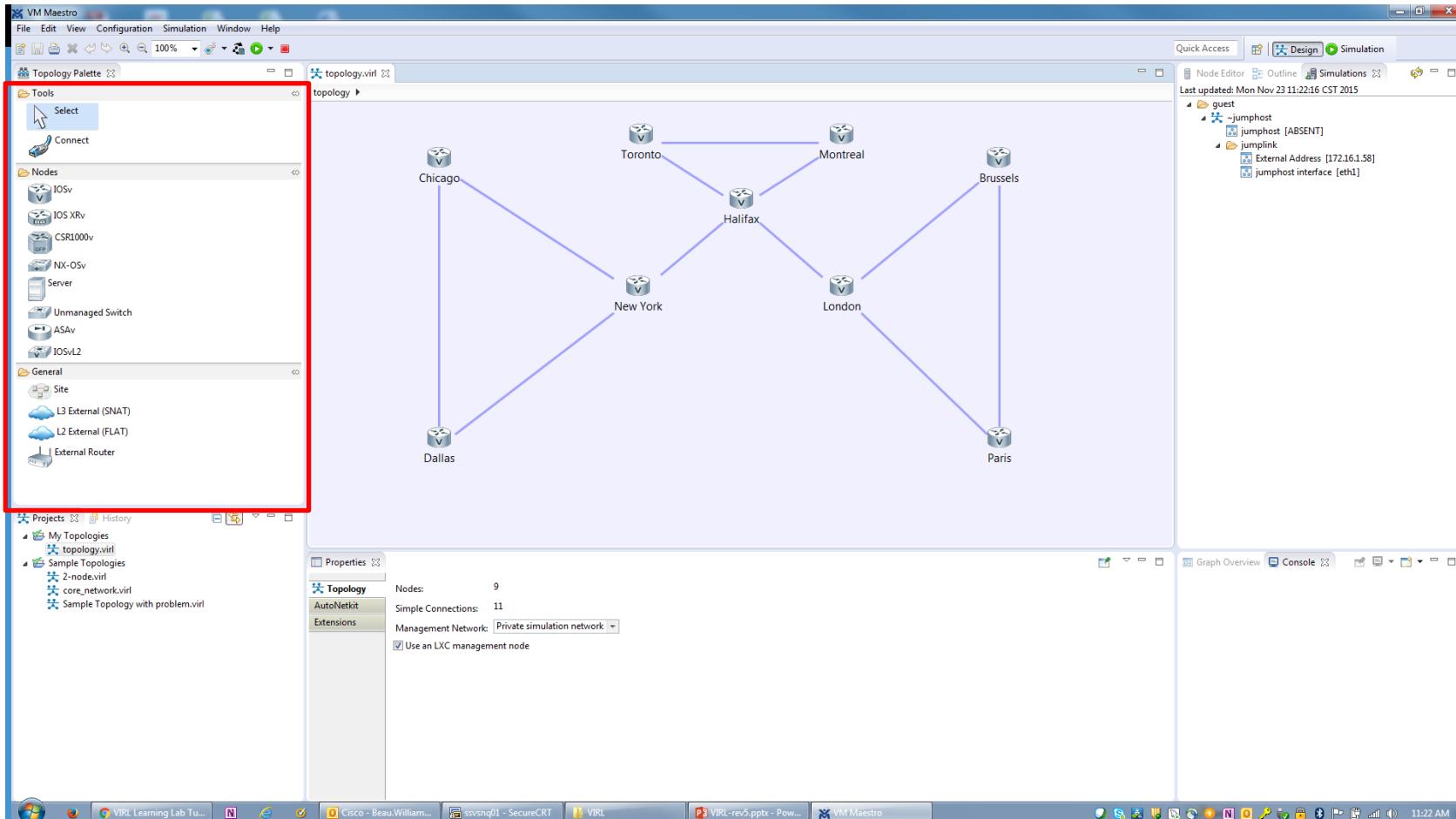
- Projects Pane



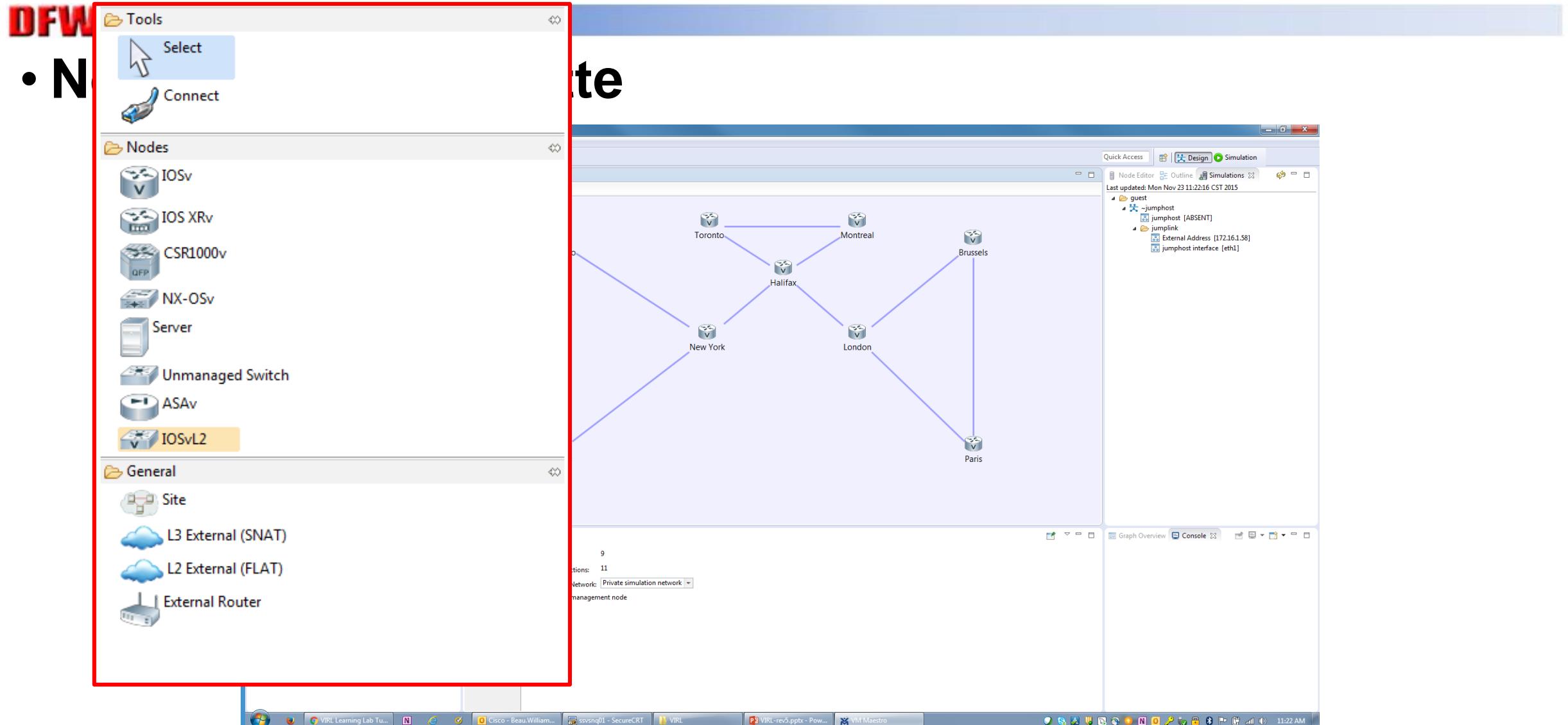
Design Perspective

DFW CUG

• Nodes & Tools Palette

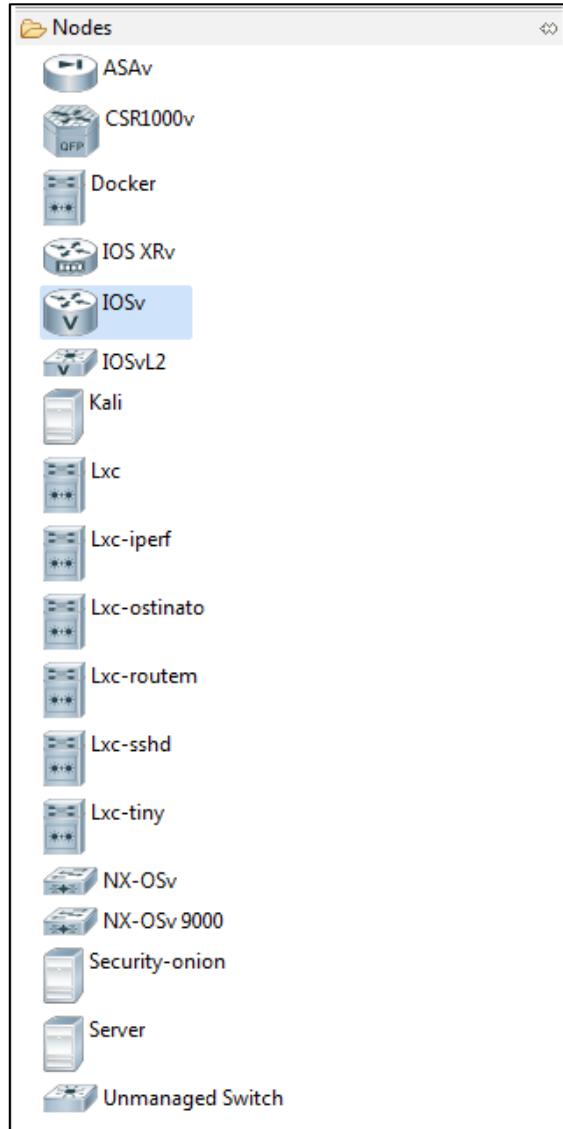


Design Perspective



Available Nodes

DFWcUG

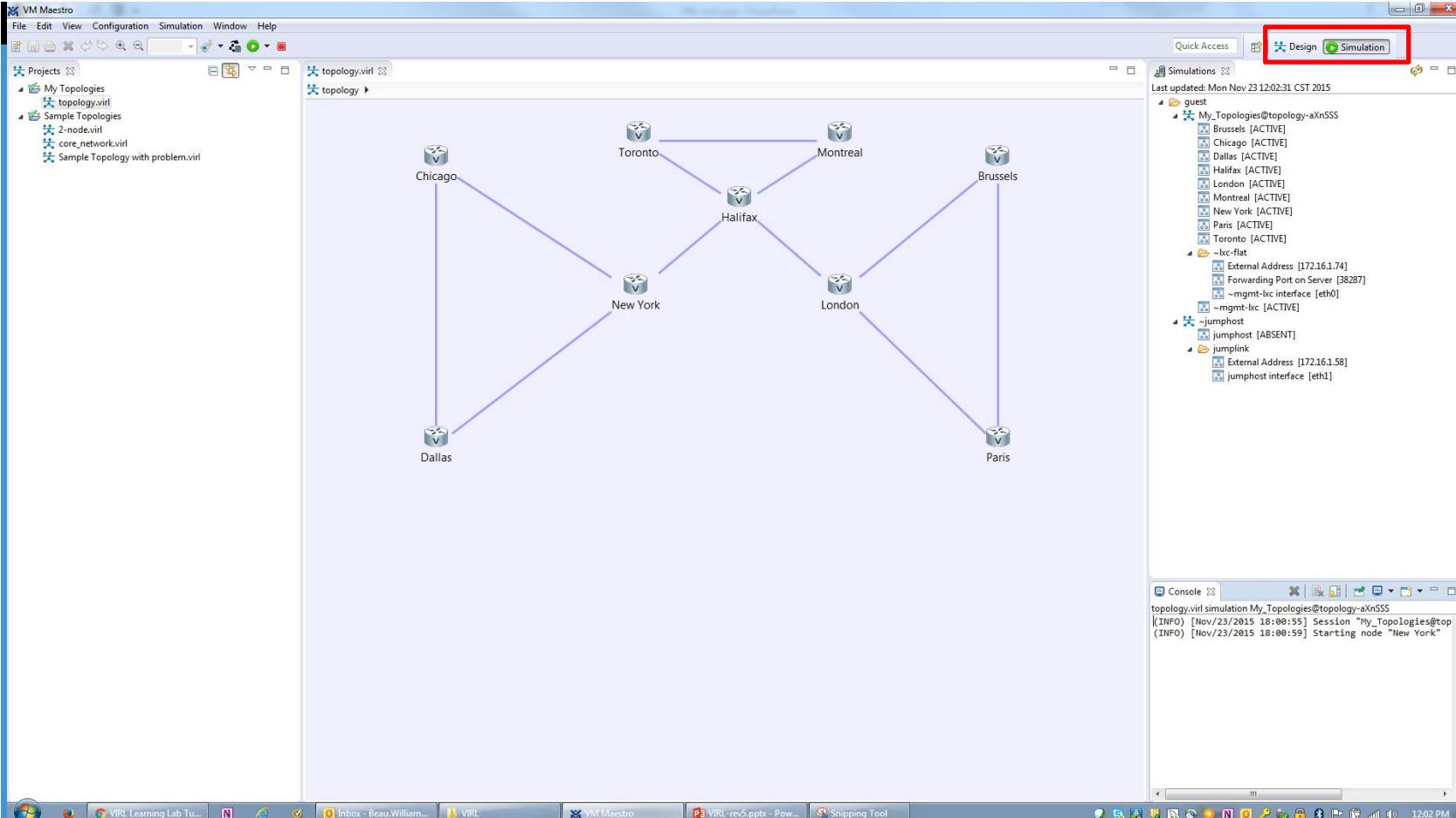


- Still want more node options?
 - Other Virtual Devices can be added
 - A10 (vthunder)
 - ALU 7750's (vSRX)
 - F5 BIG IP
 - Extreme Networks
 - Fortinet FortiGate FW
 - HP VSR1k
 - Juniper
 - vMX
 - vSRX
 - Palo Alto Networks
 - Windows
 - Others . . .

Simulation Perspective

DFW CUG

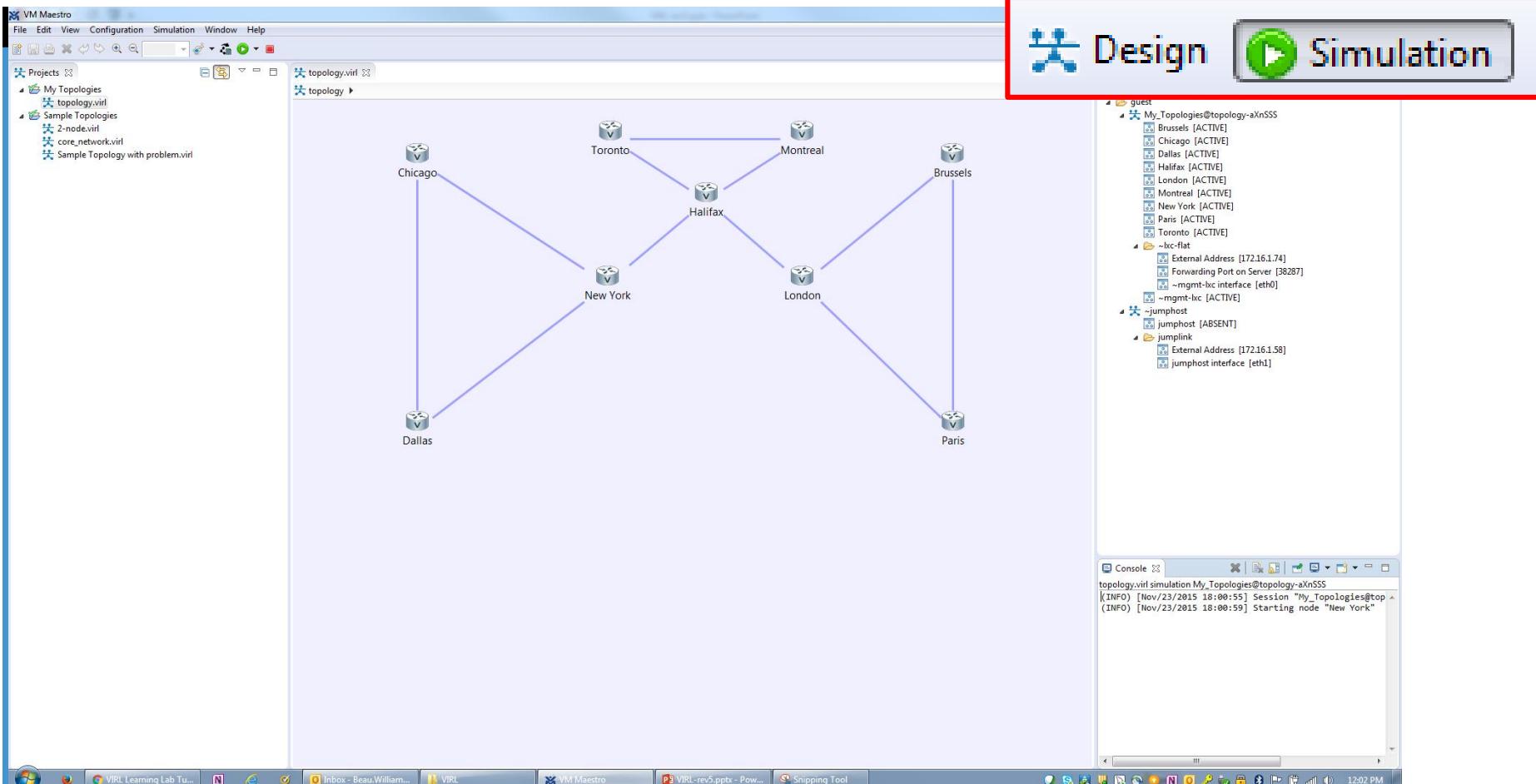
- Selecting Simulation Perspective



Simulation Perspective

DFW CUG

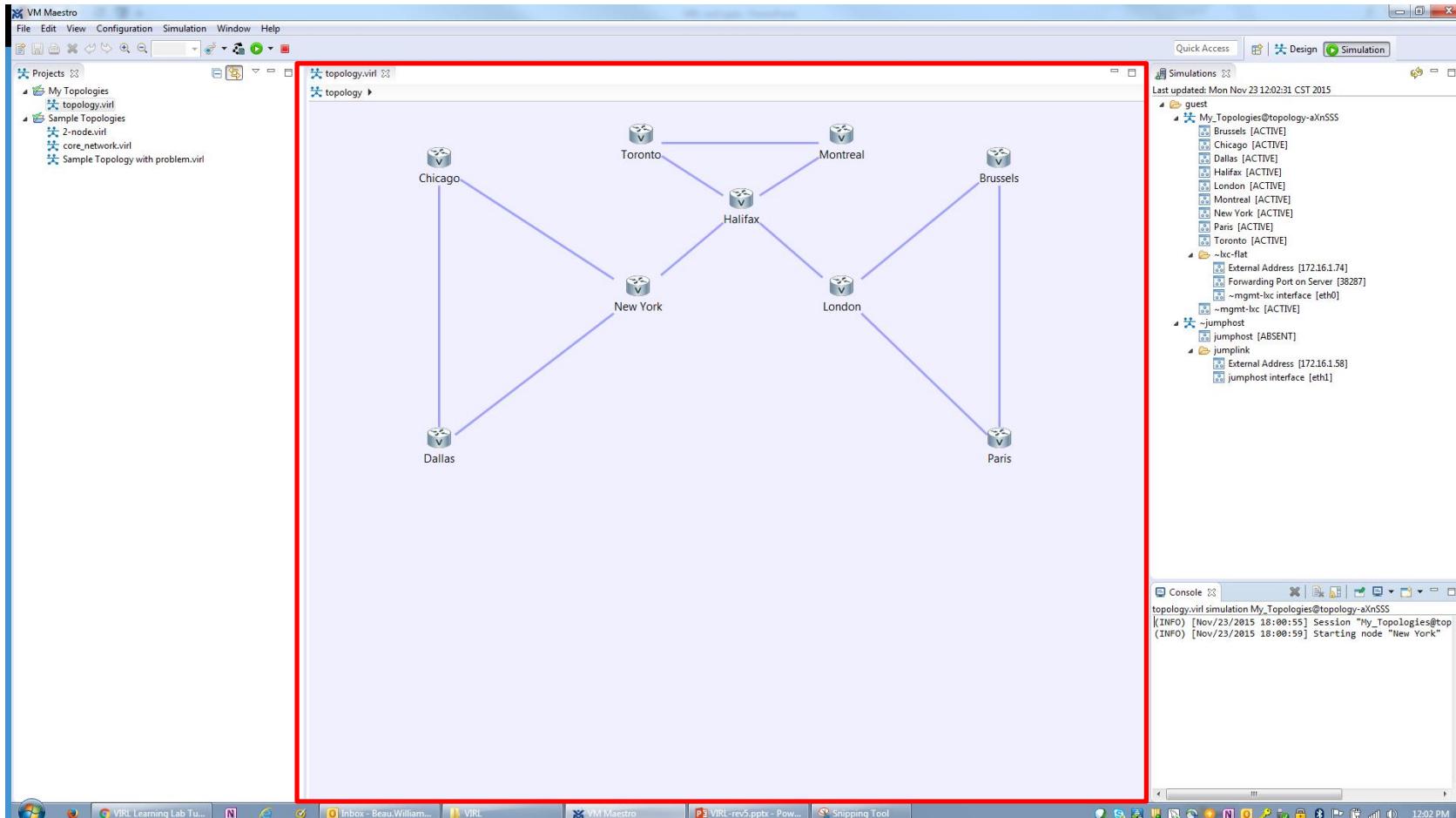
- Selecting Simulation Perspective



Simulation Perspective

DFW CUG

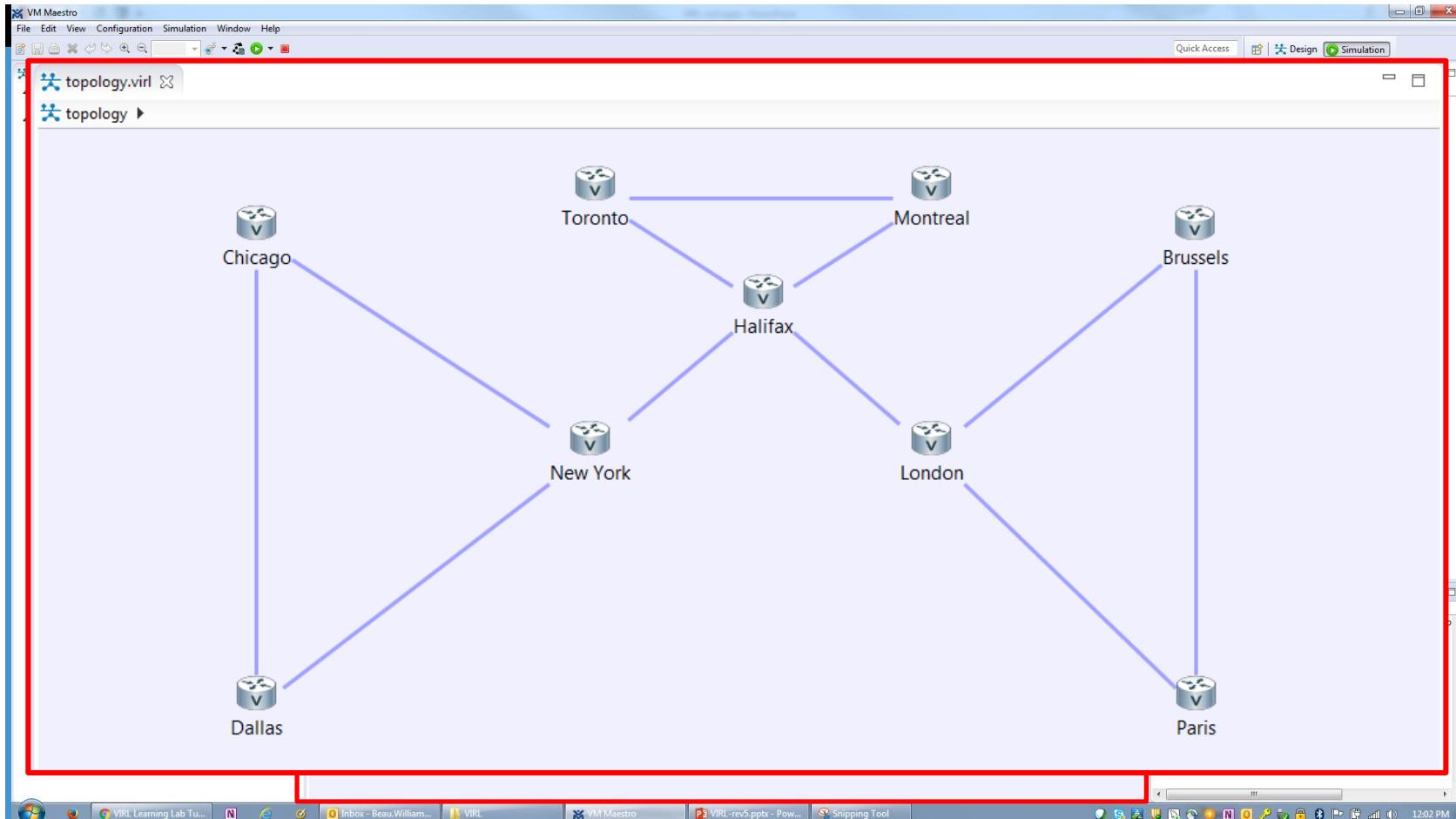
- Topology Pane



Simulation Perspective

DFW CUG

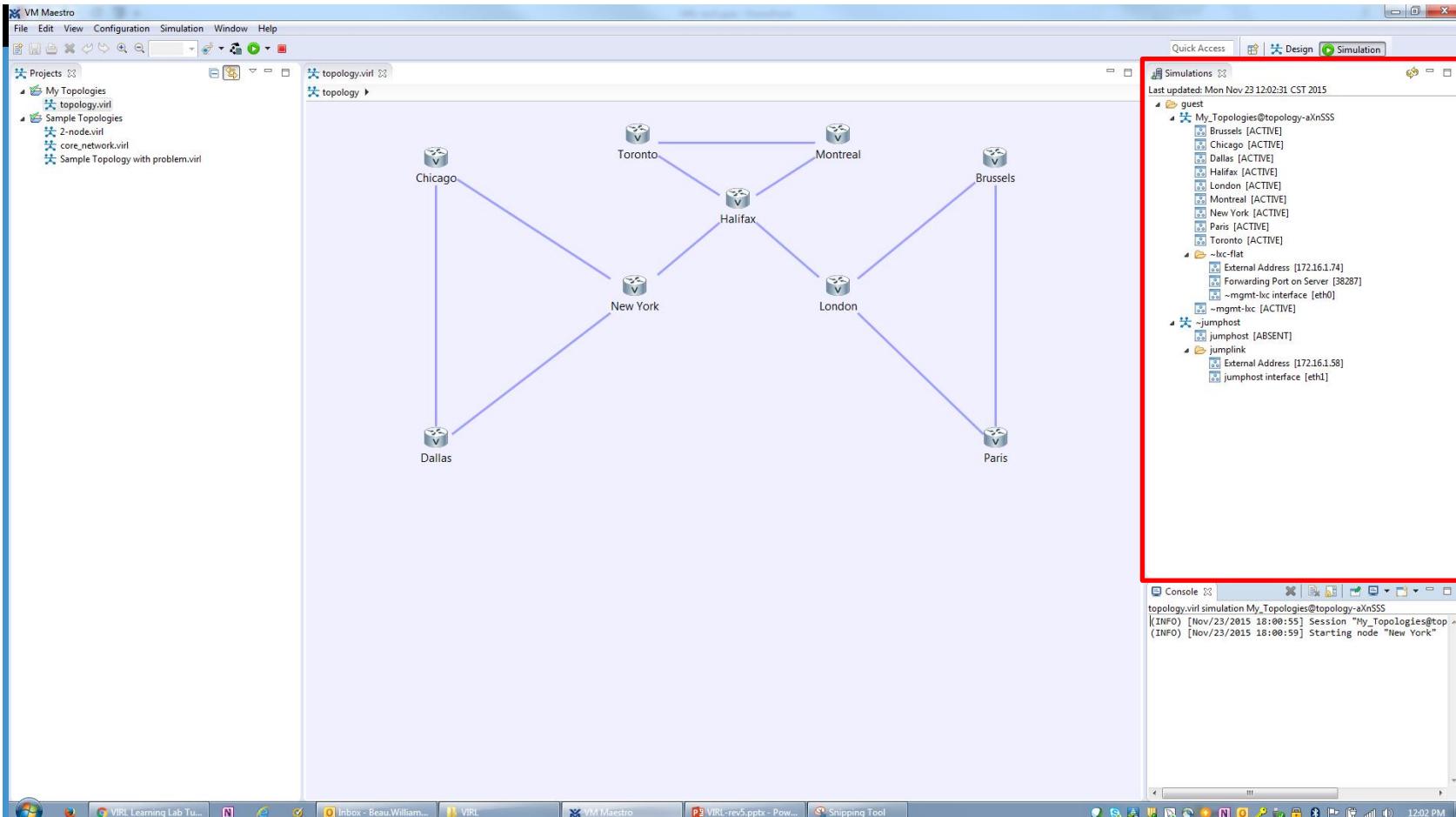
- Topology Pane



Simulation Perspective

DFWUG

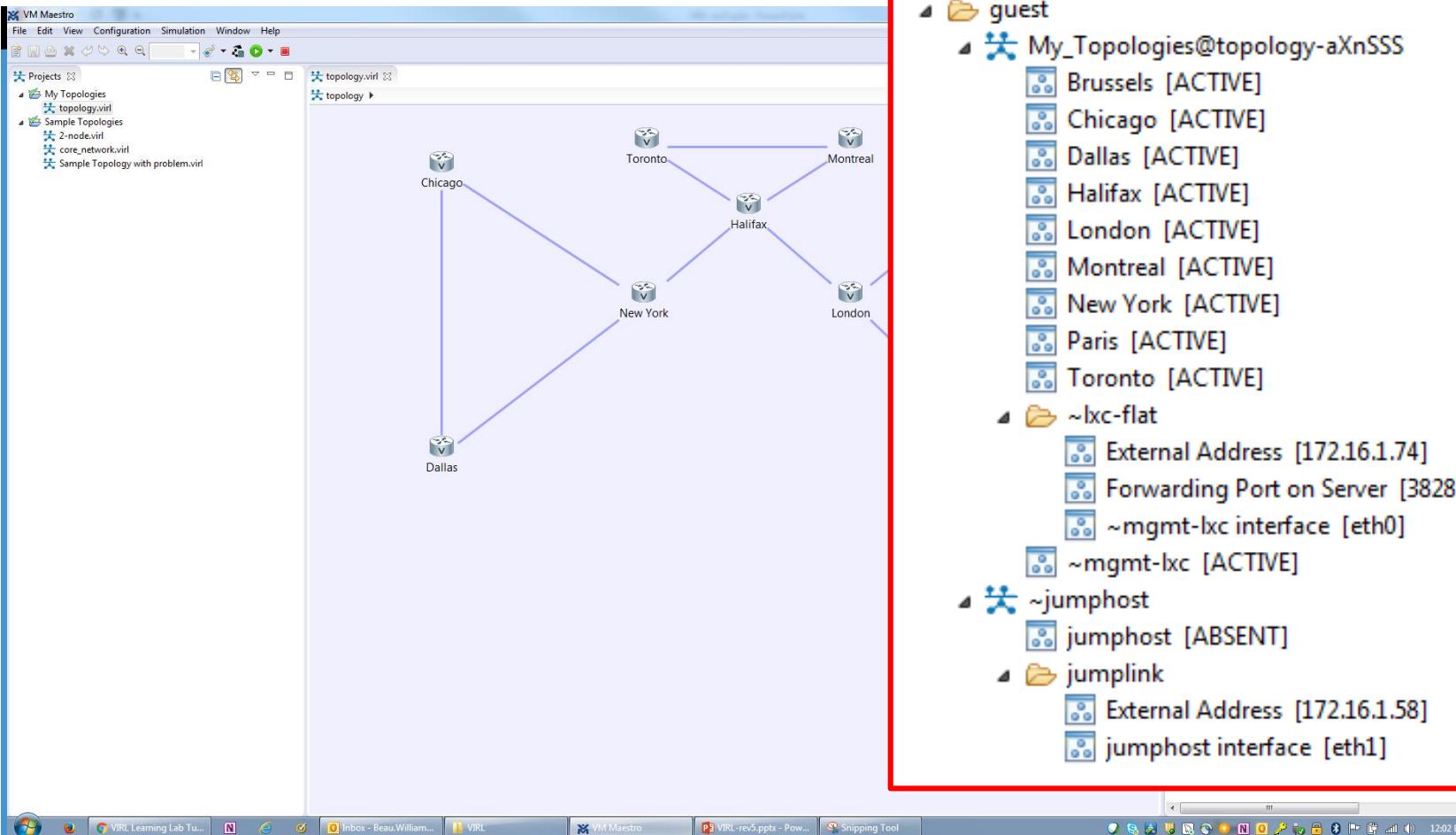
- Simulation Pane



Simulation Perspective

DFWcUG

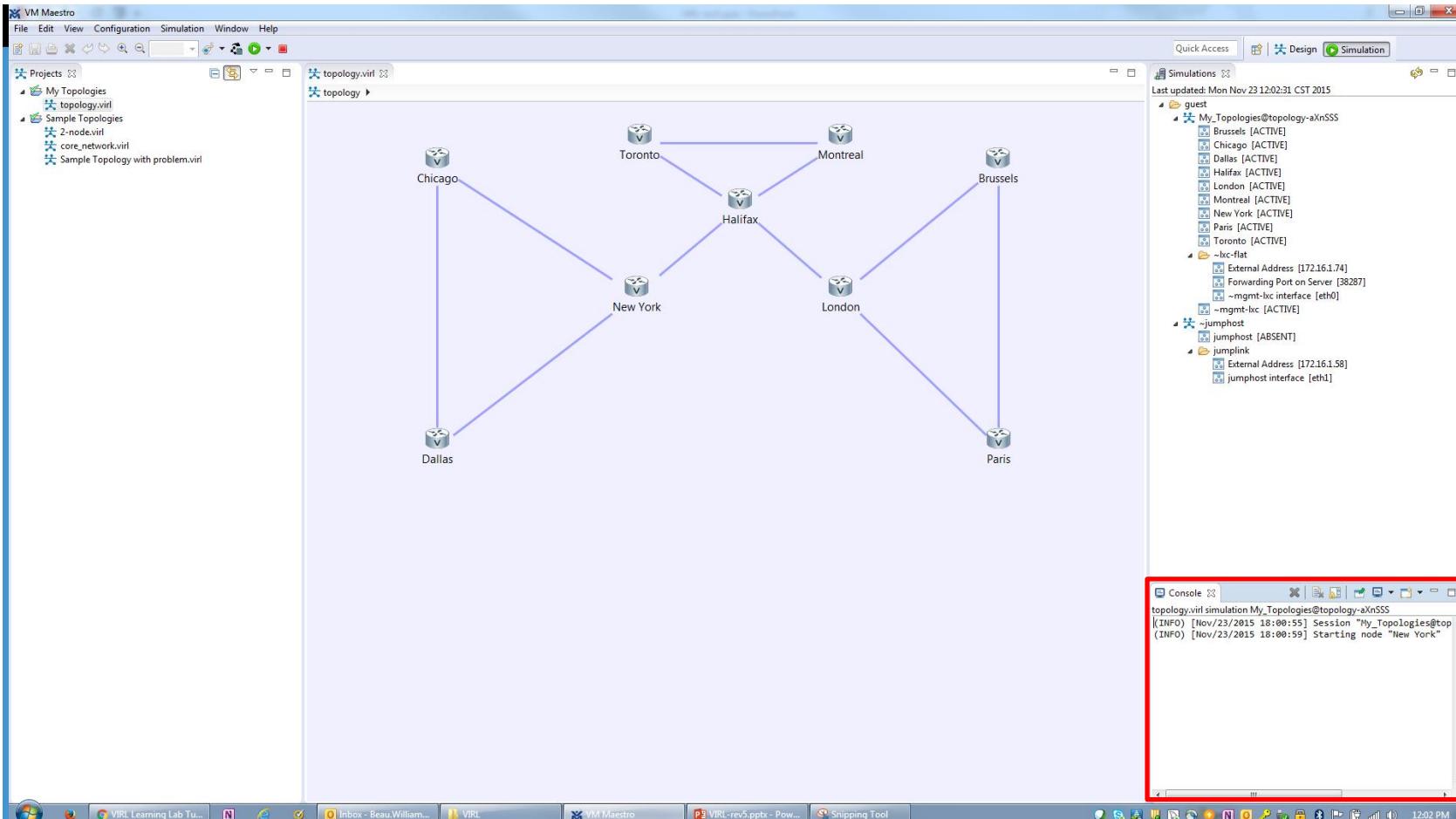
- Simulation Pane



Simulation Perspective

DFWUG

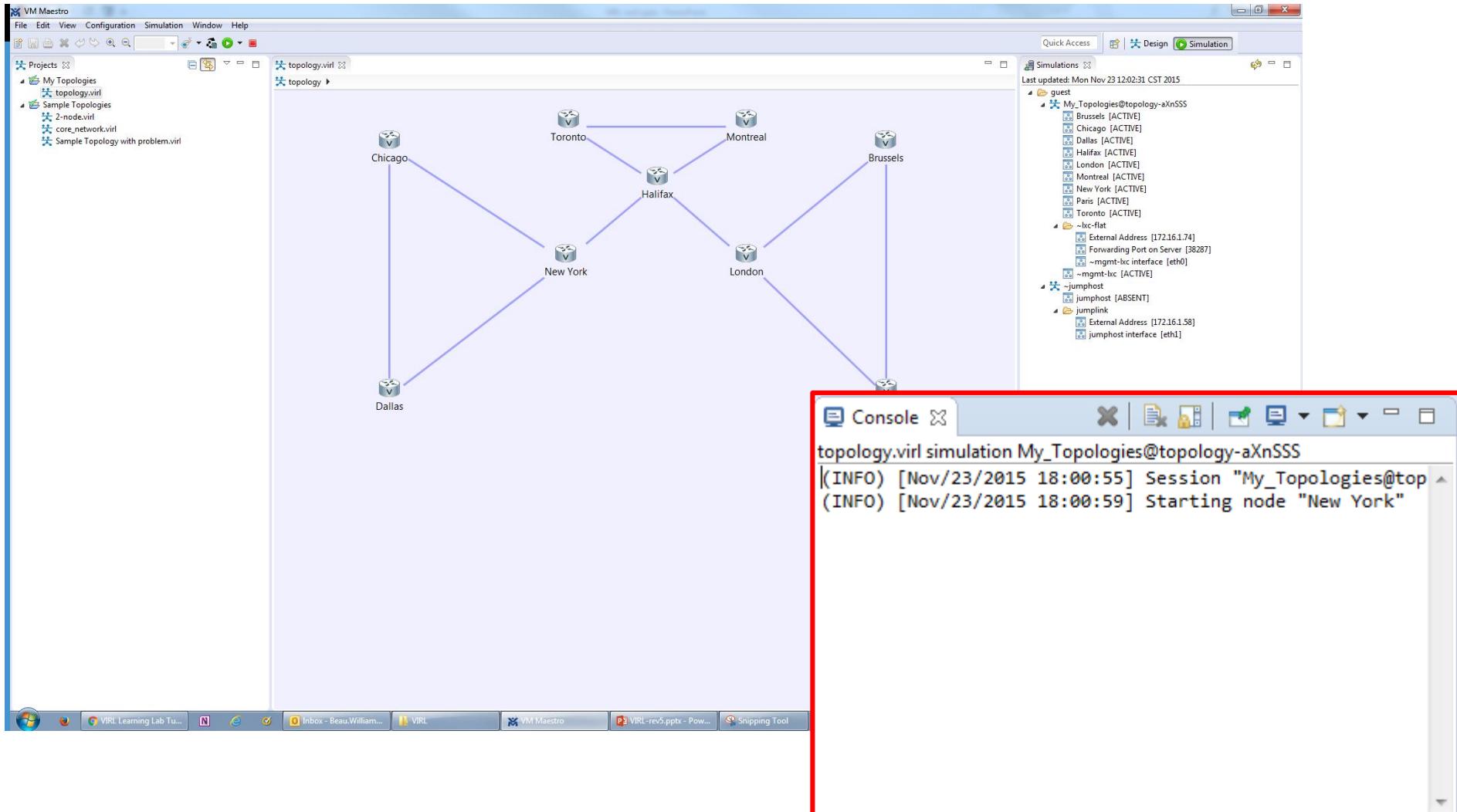
- Console Pane



Simulation Perspective

DFWCUG

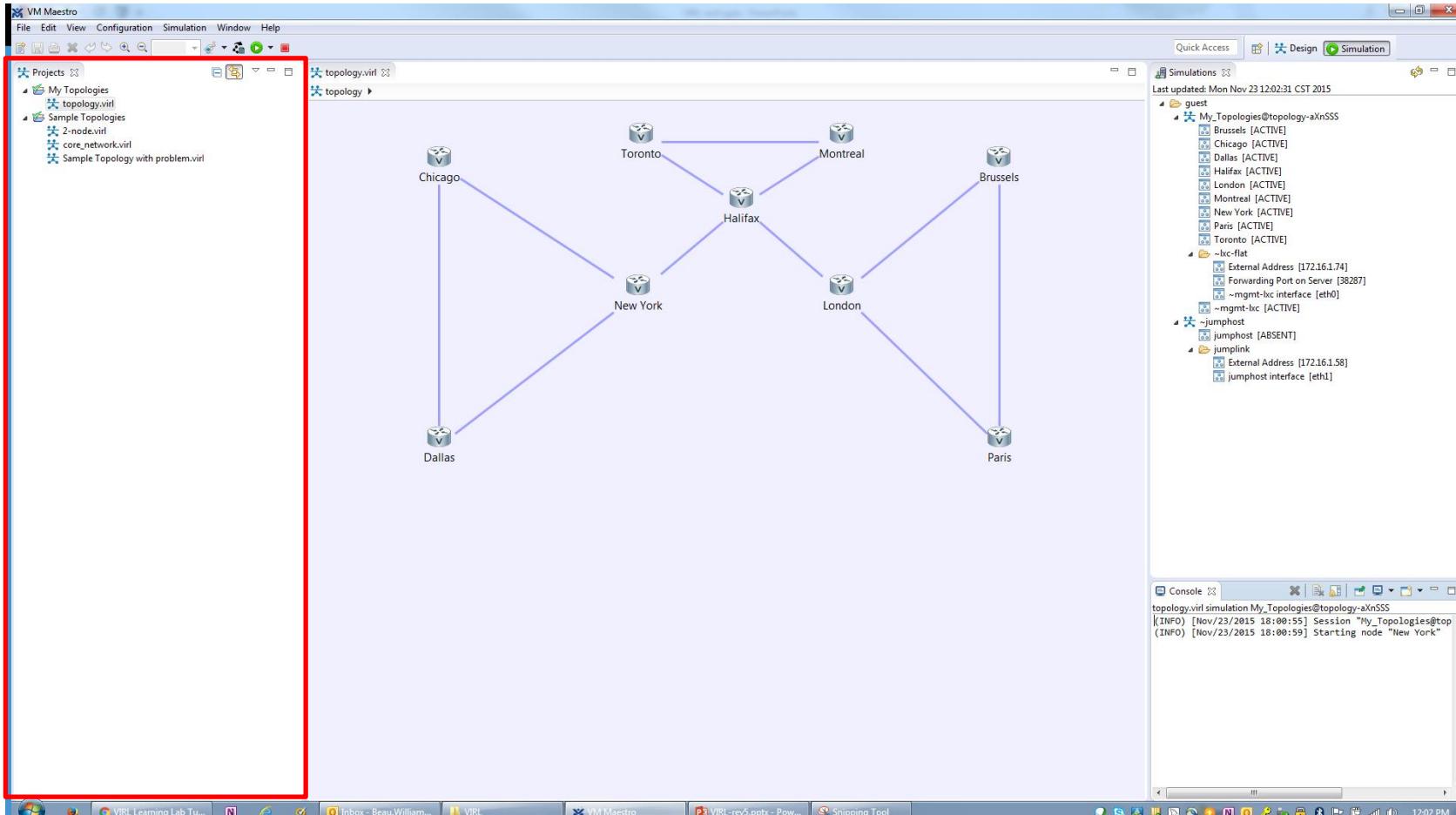
- Console Pane



Simulation Perspective

DFW CUG

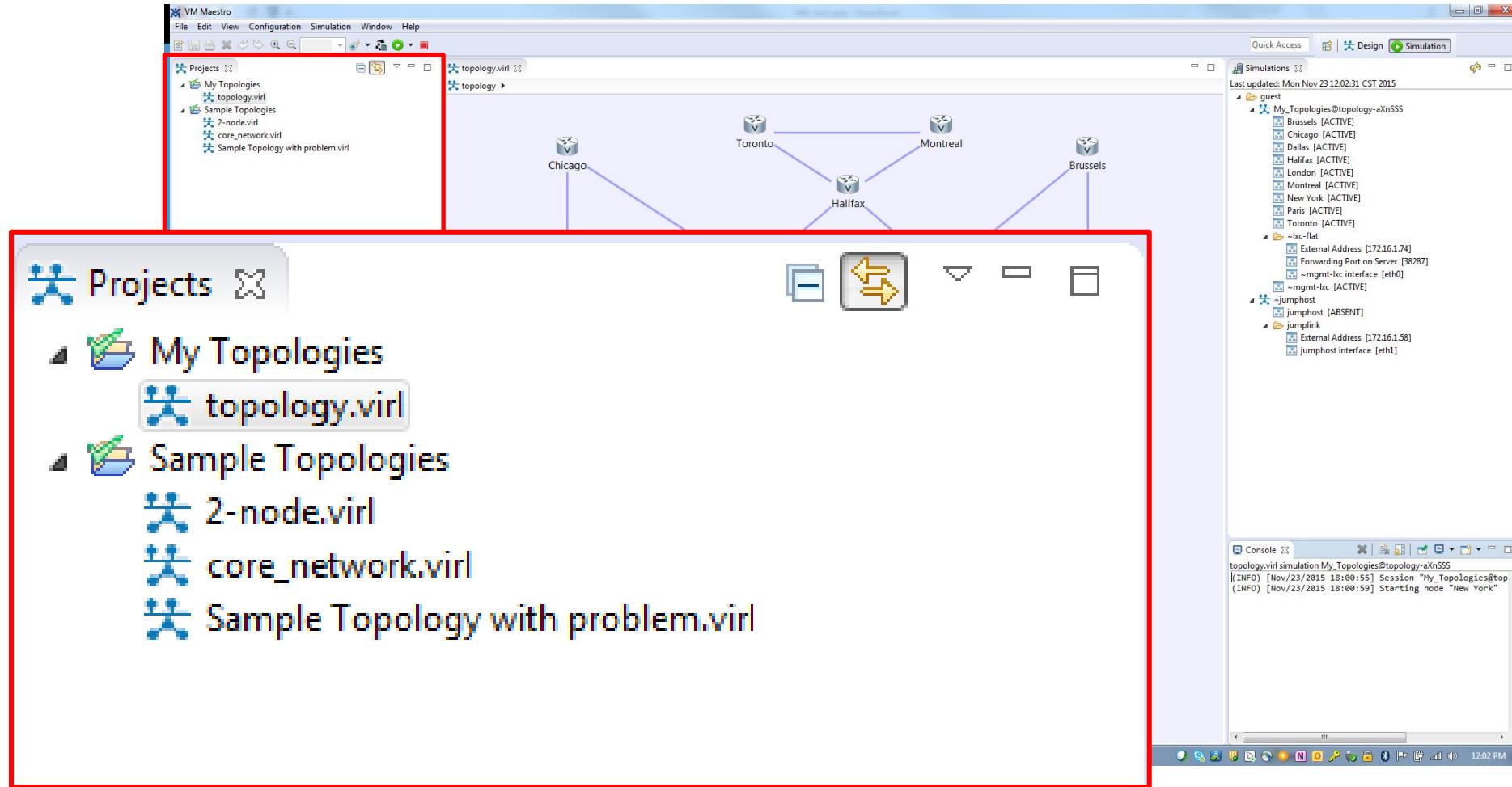
- Projects Pane



Simulation Perspective

DFWcUG

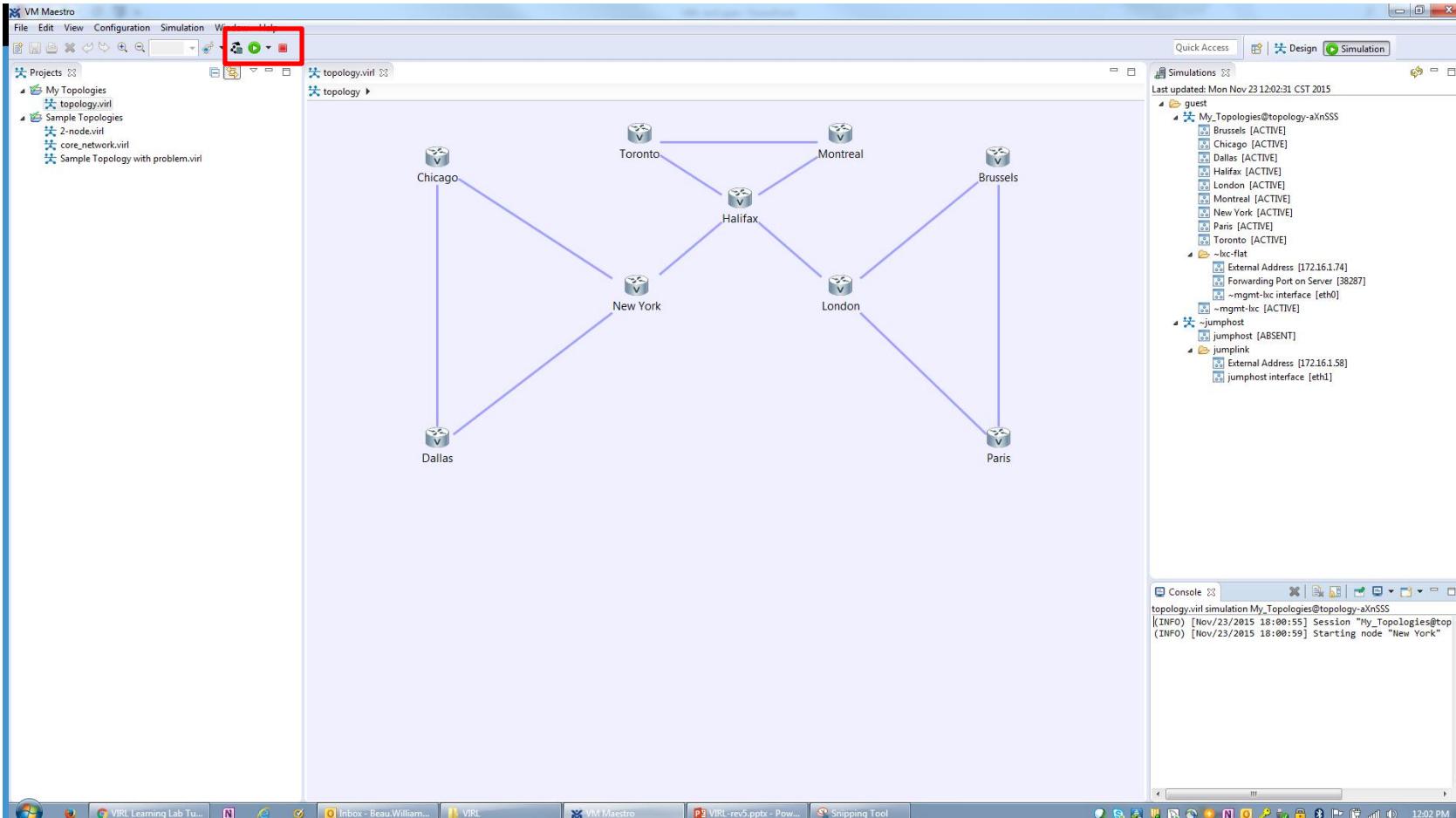
- Projects Pane



Topology & Simulation Controls

DFWCUG

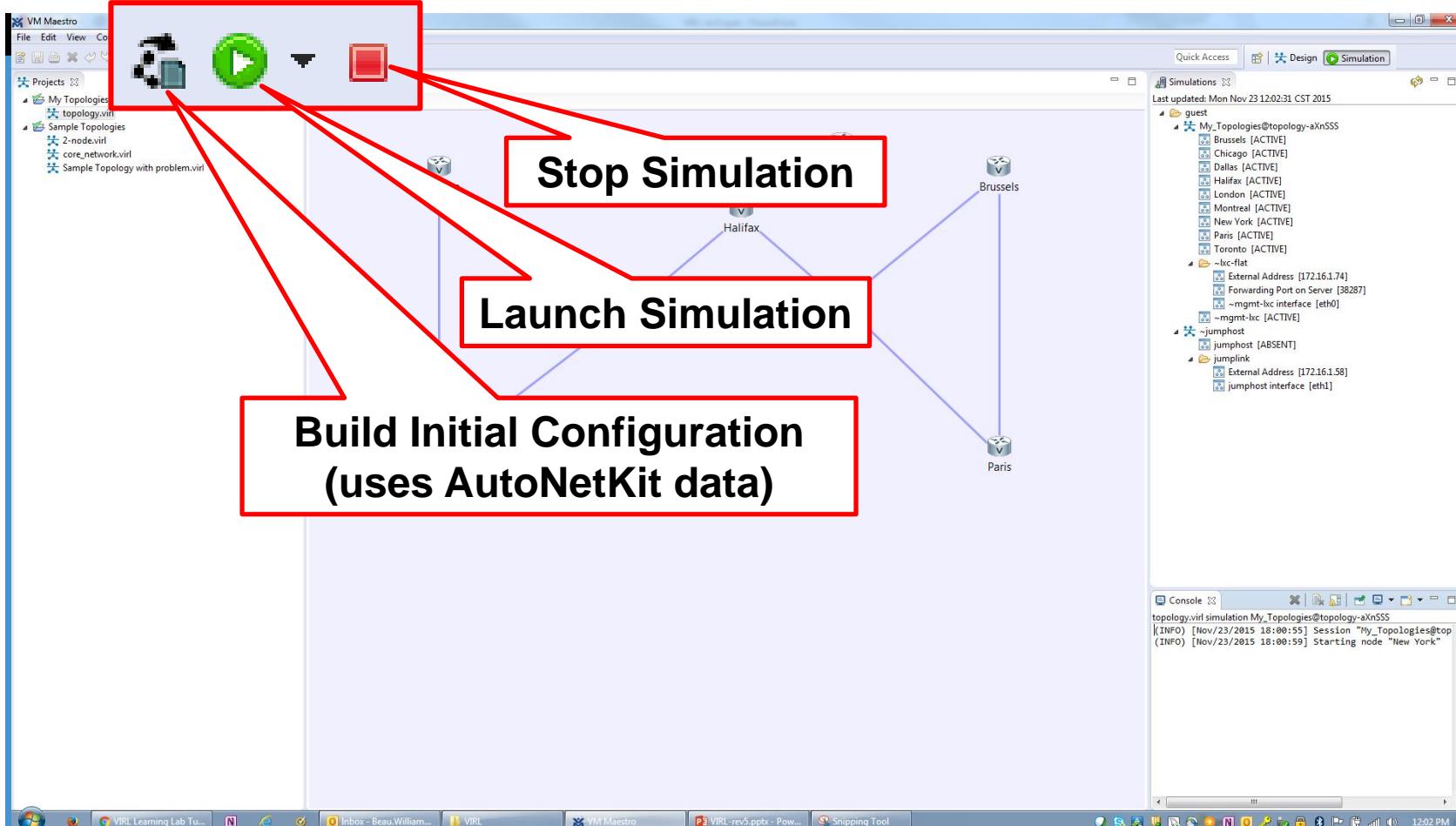
- Simulation Control Buttons



Topology & Simulation Controls

DFWCUG

- Simulation Control Buttons



VIRL Learning Labs Tutorial

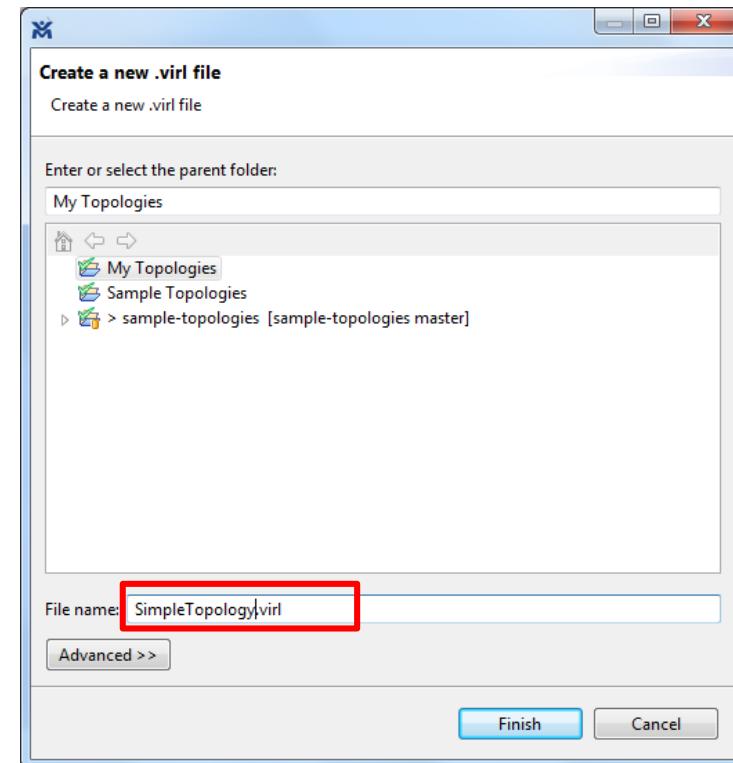
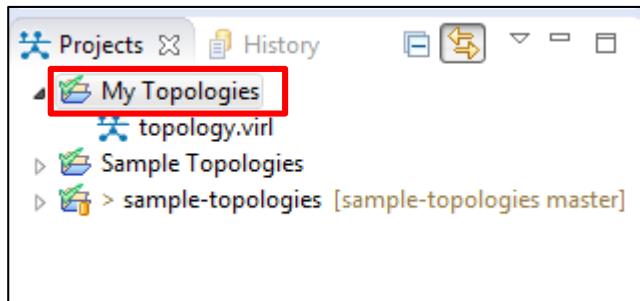
DFW CUG

- Exercise 1:** Introduction to VM Maestro
- Exercise 2:** Creating a New VIRL Topology
- Exercise 3:** Creating a Simple Network using IOSv
- Exercise 4:** Building Configurations and Visualizations
- Exercise 5:** Working with VIRL Simulations
- Exercise 6:** Working with Router Configurations
- Exercise 7:** Configuring Routing Protocols – Part 1
- Exercise 8:** Configuring Routing Protocols – Part 2
- Exercise 9:** Configuring Management Access
- Exercise 10:** Configuring Layer-2 Switching
- Exercise 11:** Other Node Sub-Types and Servers

Creating a New Topology

DFWcUG

- Right-click “My Topologies” in Projects pane
 - Select “New → Topology” and give it a name.

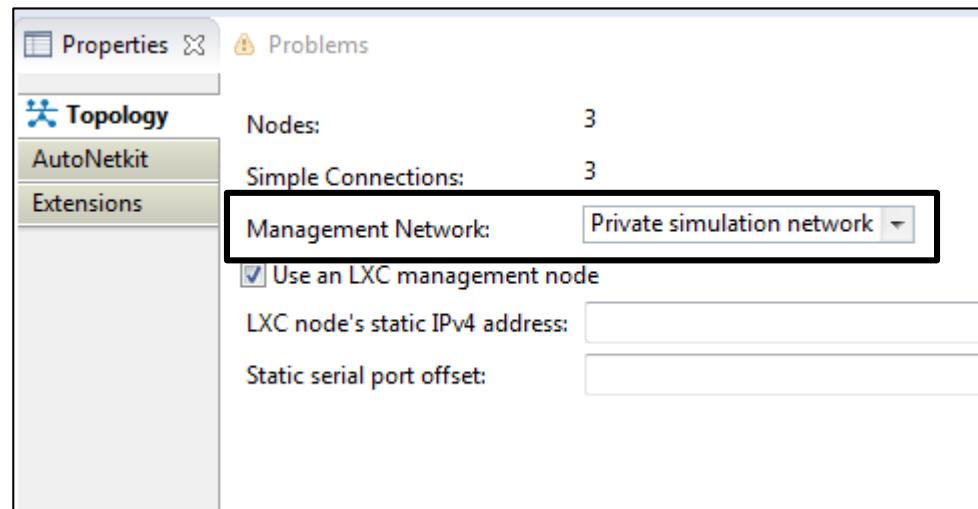


- Click “Finish”

Creating a New Topology

DFW CUG

- Set Management Network in Properties pane
 - Use “Private simulation network” for now.



VIRL Learning Labs Tutorial

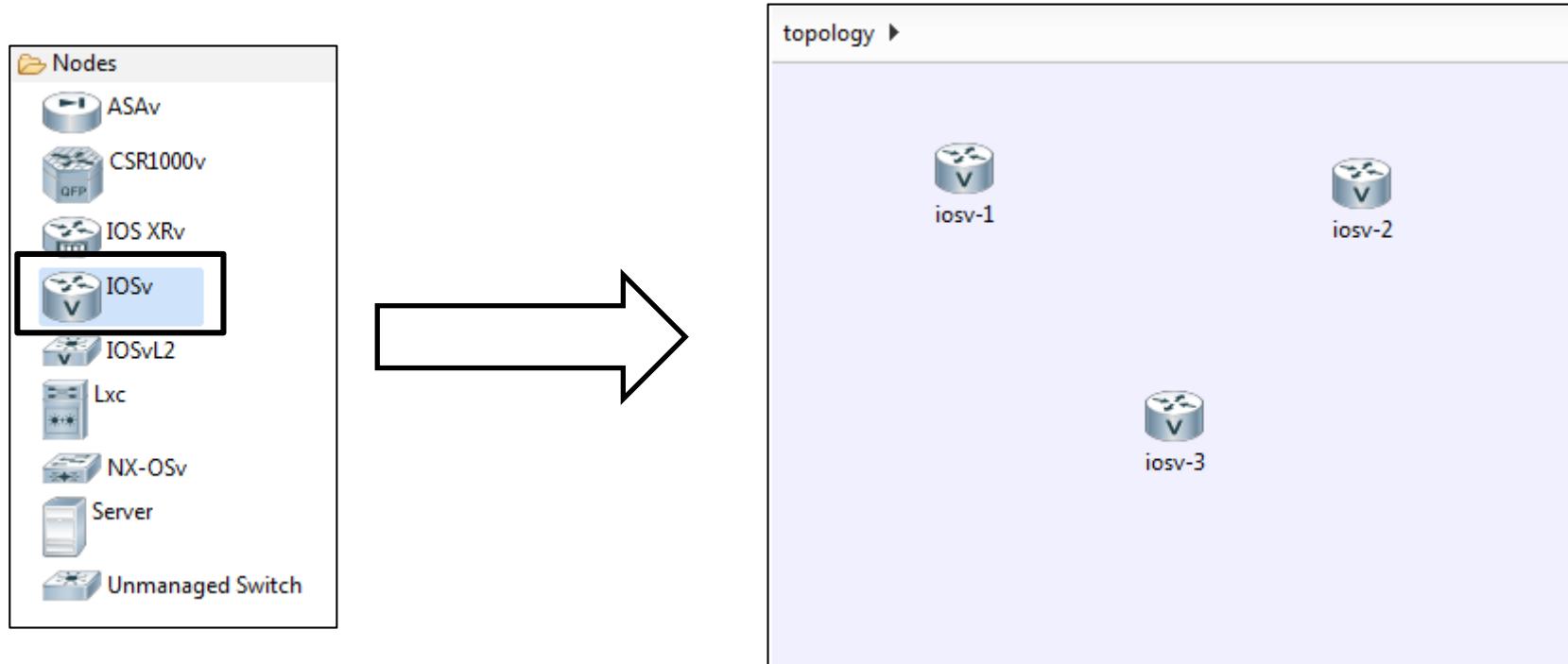
DFWCUG

- Exercise 1:** Introduction to VM Maestro
- Exercise 2:** Creating a New VIRL Topology
- Exercise 3:** **Creating a Simple Network using IOSv**
- Exercise 4:** Building Configurations and Visualizations
- Exercise 5:** Working with VIRL Simulations
- Exercise 6:** Working with Router Configurations
- Exercise 7:** Configuring Routing Protocols – Part 1
- Exercise 8:** Configuring Routing Protocols – Part 2
- Exercise 9:** Configuring Management Access
- Exercise 10:** Configuring Layer-2 Switching
- Exercise 11:** Other Node Sub-Types and Servers

Creating a Simple Network with IOSv

DFW CUG

- Select an icon from Nodes pane

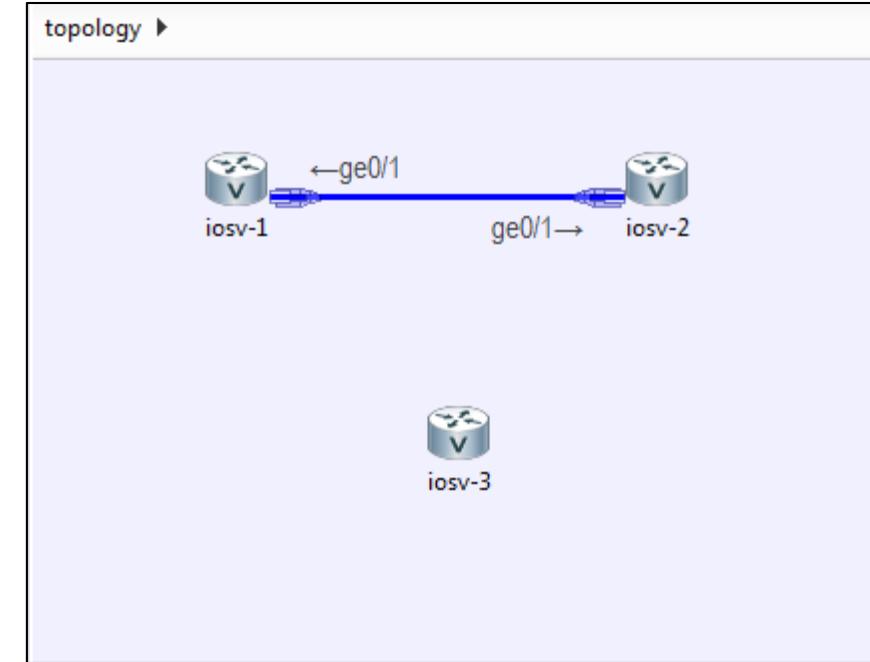


- Click on Topology pane to place

Creating a Simple Network with IOSv

DFW CUG

- Select “Connect” Tool from Tools pane



- Click on nodes to connect as desired
 - Only GigE interfaces for now

Agenda

DFW CUG

- What is VIRL?
- VIRL Architecture
- VIRL Components
- VIRL Installation
- VIRL Basics
- AutoNetkit
- Layer-2 Switching
- VIRL Advanced Features

AutoNetkit

DFW CUG

- Automatically create configurations
 - Easily prebuild networks for further experimentation
 - Assigns IP Addresses (IPv4 & IPv6)
 - Configures Interfaces
 - Configures IGP
 - Configures BGP including RR's if desired
 - Configures MPLS
 - Easily prebuild networks without configurations
 - Allows you to start configuring from scratch
 - Only contains basic config like hostname, etc.
 - May be disabled on a router by router basis

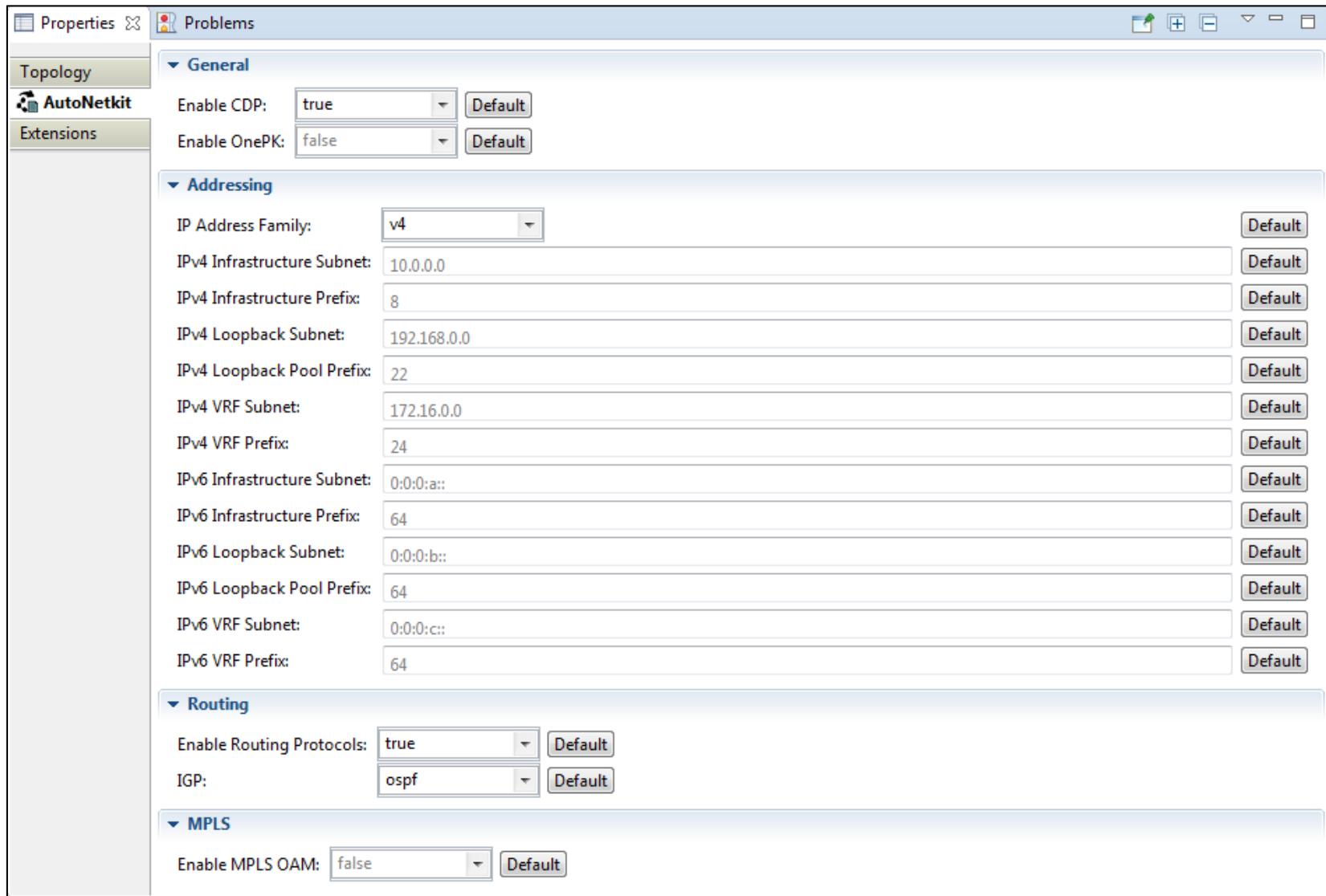
AutoNetkit

DFW CUG

- **Simulation Settings**
 - IP Families
 - CDP
 - Other Global Settings
- **Router Settings**
 - ASN
 - IGP
 - ODL Groups
 - And more

AutoNetkit – Simulation Settings

DFW CUG



AutoNetkit – Router Settings

DFW CUG

The screenshot shows the AutoNetkit configuration interface for a network topology. The topology view at the top shows two routers, 'Toronto' and 'Motreal', connected by a link. The configuration pane on the right is for the 'Node' selected in the topology. The 'Properties' tab is active.

General:

- ASN: 20

IGP:

- IGP: eigrp
- OSPF Area: 0

iBGP:

- iBGP Role: RRC
- RR Cluster: 20
- HRR Cluster: (empty)

Custom Configuration:

- Global: (empty)
- Physical Interfaces: (empty)
- Loopback Zero: (empty)
- OSPF: (empty)
- IS-IS: (empty)
- EIGRP: (empty)
- RIP-V2: (empty)
- BGP: (empty)

AutoNetkit – More Router Settings

DFW CUG

The screenshot shows a configuration interface for a router. It includes sections for MPLS, External L2TPv3, GRE Tunnel, and ODL. Each section contains various configuration parameters with dropdown menus and 'Default' buttons.

- MPLS:**
 - VRF Name:
 - LDP:
 - Enable MPLS TE:
- External L2TPv3:**
 - Remote loopback IPv4 Address:
 - Local endpoint IPv4 Address:
 - Local endpoint IPv4 Netmask:
 - PseudoWire ID:
- GRE Tunnel:**
 - IPv4 Tunnel Enabled:
 - Tunnel IPv4 Address:
 - Tunnel IPv4 Netmask:
 - IPv6 Tunnel Enabled:
 - Tunnel IPv6 Address:
 - Tunnel IPv6 Netmask:
- ODL:**
 - ODL Management Group:

Agenda

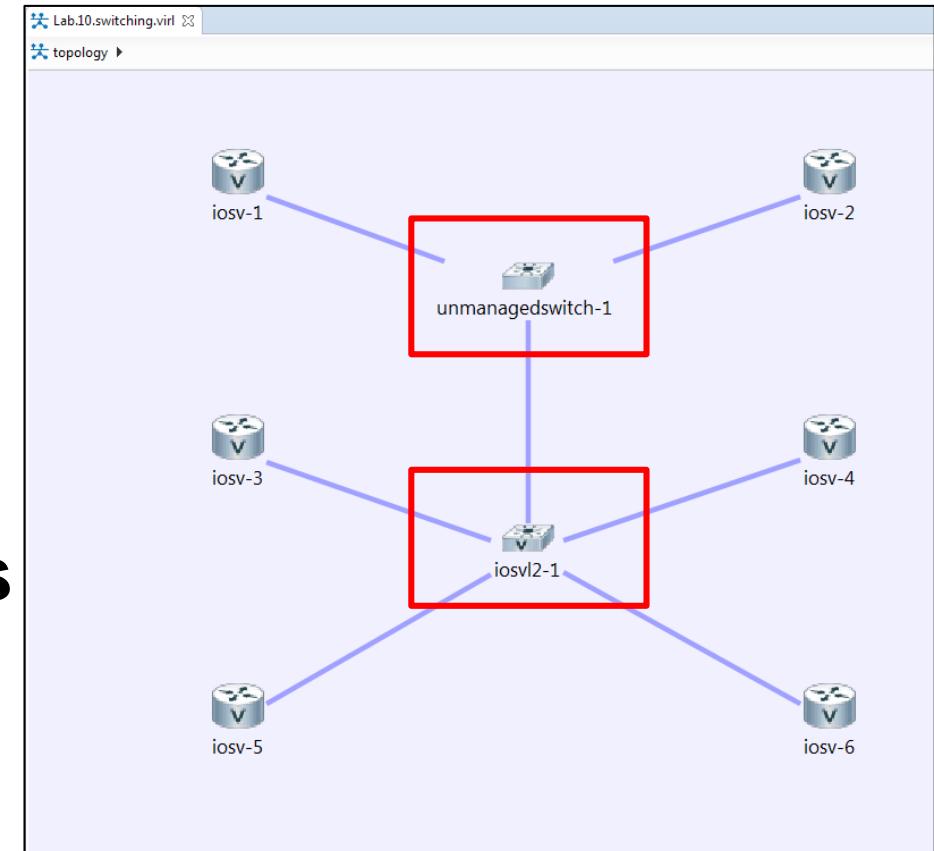
DFW CUG

- What is VIRL?
- VIRL Architecture
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- VIRL Basics
- AutoNetkit
- Layer-2 Switching
- VIRL Advanced Features

Types of L2 Switches

DFWCUG

- Unmanaged Switch
 - Simple “generic” Switch
 - Based on “Linux Bridge” vSwitch
- IOSvL2 Switch
 - Based on IOS
 - Contains most IOS L2 Switch features
 - AutoNetkit configured
 - Only key L2 functions configured
 - Others configured manually



IOSvL2 Switch Features

DFWCUG

- Layer-2 forwarding (auto-config'd)
- Switchport (auto-config'd)
- 802.1q trunk (auto-config'd)
- 802.1q vlans (auto-config'd)
- Spanning Tree (auto-config'd)
- Port-Channel (Pagp and Lacp)
- 802.1x passthrough
- Port-ACLs
- Dynamic Arp Inspection
- DHCP Snooping
- IP device tracking
- Switched Virtual Interfaces
- Layer-3 forwarding over SVIs
- Routing protocol support
 - VTP v1-3
 - PVST
 - QoS
 - Inter-vlan routing
 - Vlan Access Maps (VACLs / access control lists for vlans)
 - ACL functionality for both layer2 and layer3 protocol packets
 - Dynamic Trunking Protocol support
 - Switchport protected mode

Agenda

DFW CUG

- What is VIRL?
- VIRL Architecture
- VIRL Components
- VIRL Installation
- VIRL Basics
- AutoNetkit
- Layer-2 Switching
- **VIRL Advanced Features**

VIRL Advanced Features

DFW CUG

- **Live Visualization**
 - Visualize and Manipulate running simulations
- **Management Access**
 - Connecting to the Outside world
- **Routem**
 - Control-plane Traffic Generator
- **Ostinato**
 - Data-plane Traffic Generator

Live Visualization

DFWCUG

- Fast Experimentation Platform
- Interface to running simulation controls
- Run commands on multiple devices
- Aggregated Syslog
- Live Topology Views
 - Including Visual Traceroute

Live Visualization

DFWCUG

- Topology Plotting
 - Overlays: phy, OSPF, ISIS, EIGRP BGP(I or E)
 - Node/Interface Controls: Shutdown, Trace From/To, etc.
 - Hover-over Tool Tips: Node & Interface status info
- Actions Menu
 - Collect various running information
 - Interface, Routing, ARP or Route tables, Configs, etc.
- Logs
 - Displays collected data
- Syslog
 - Provides aggregated Syslog information

VIRL Advanced Features

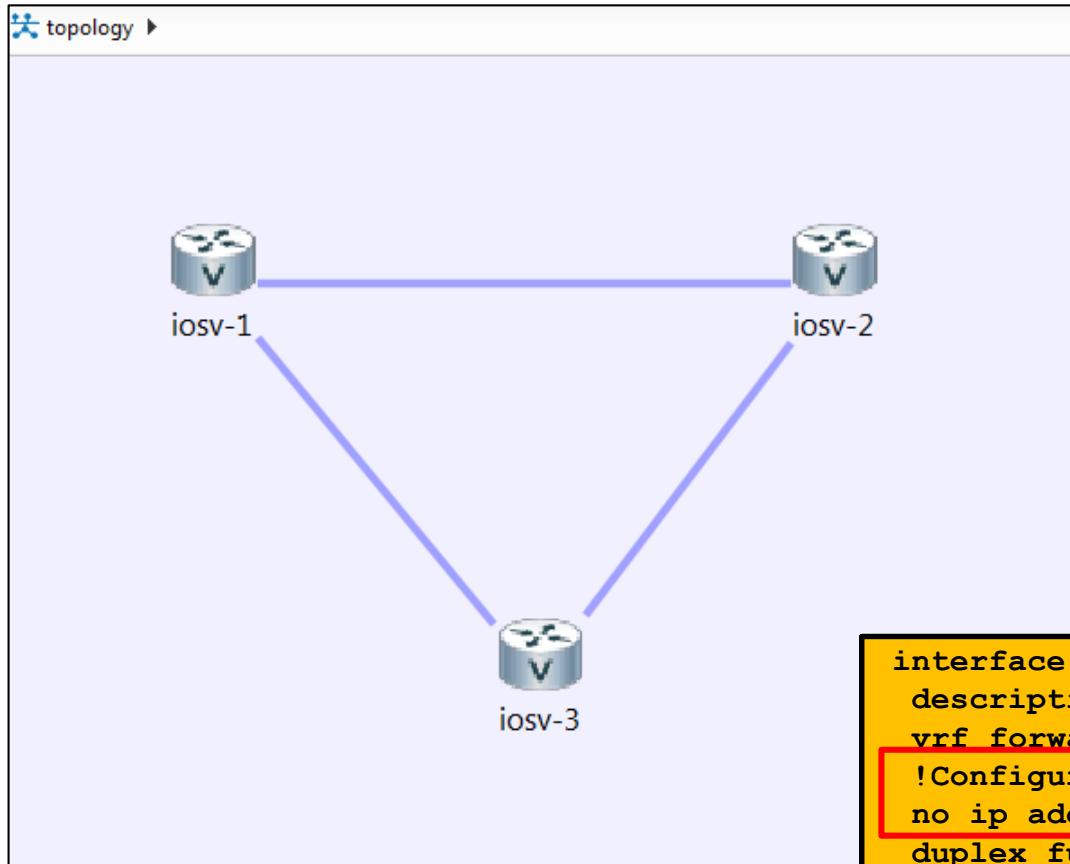
DFW CUG

- Live Visualization
 - Visualize and Manipulate running simulations
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- Ostinato
 - Data-plane Traffic Generator

VIRL Management Access

DFW CUG

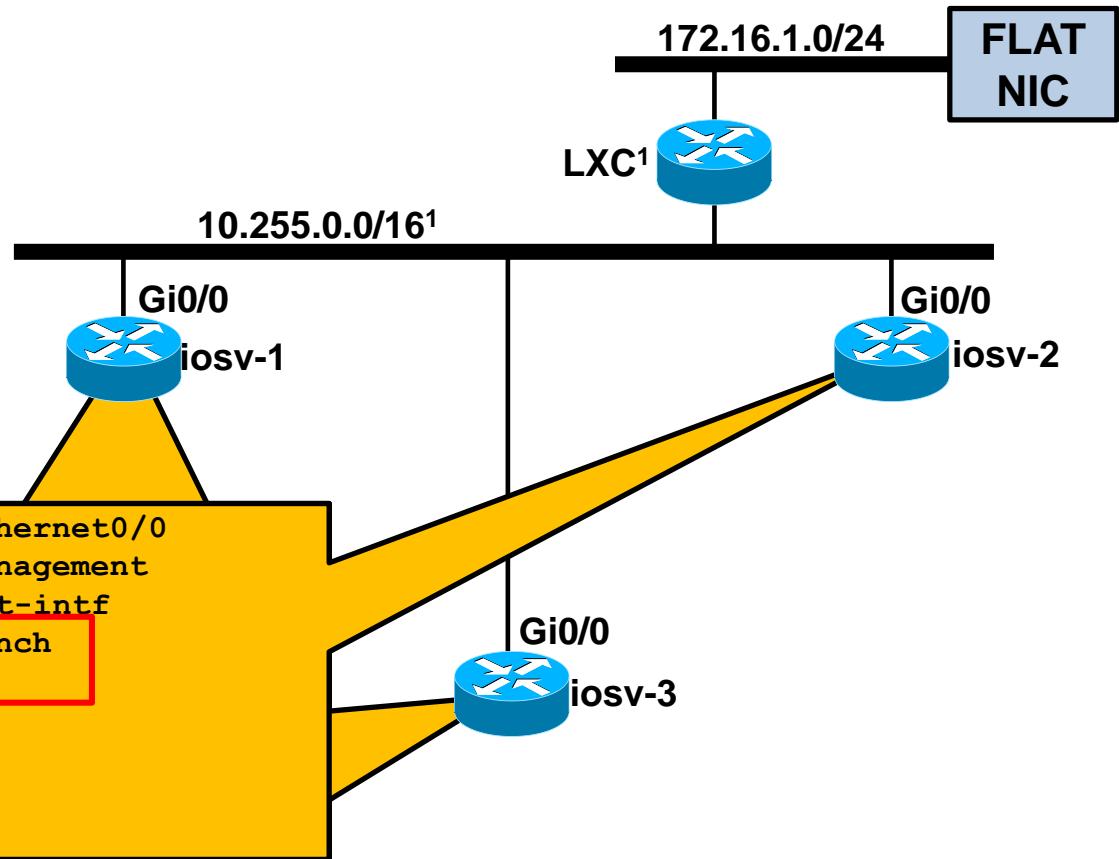
- VIRL Topology



```
interface GigabitEthernet0/0
description OOB Management
vrf forwarding Mamt-intf
!Configured on launch
no ip address
duplex full
speed auto
media-type rj45
end
```

- Management Network

- Not shown in topology pane
- IP Addresses assigned at launch

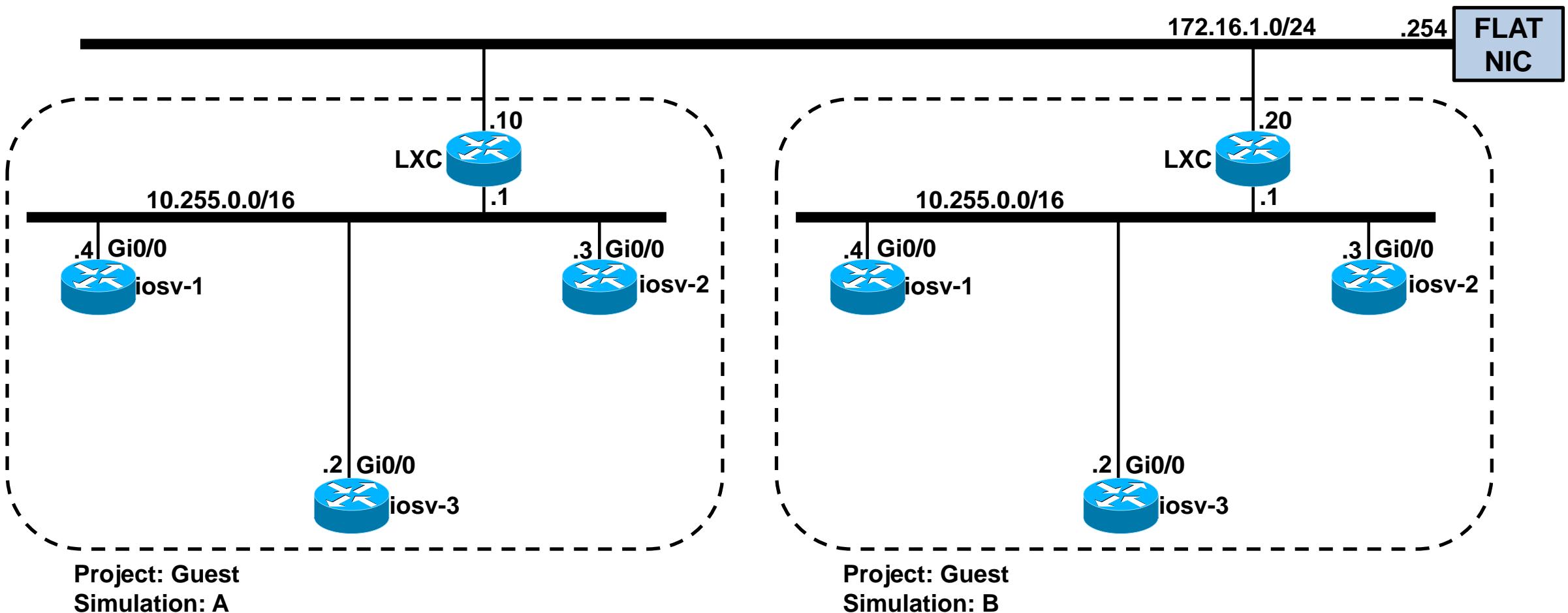


¹ Private Project/Simulation Networking Only

VIRL Management Access

DFW CUG

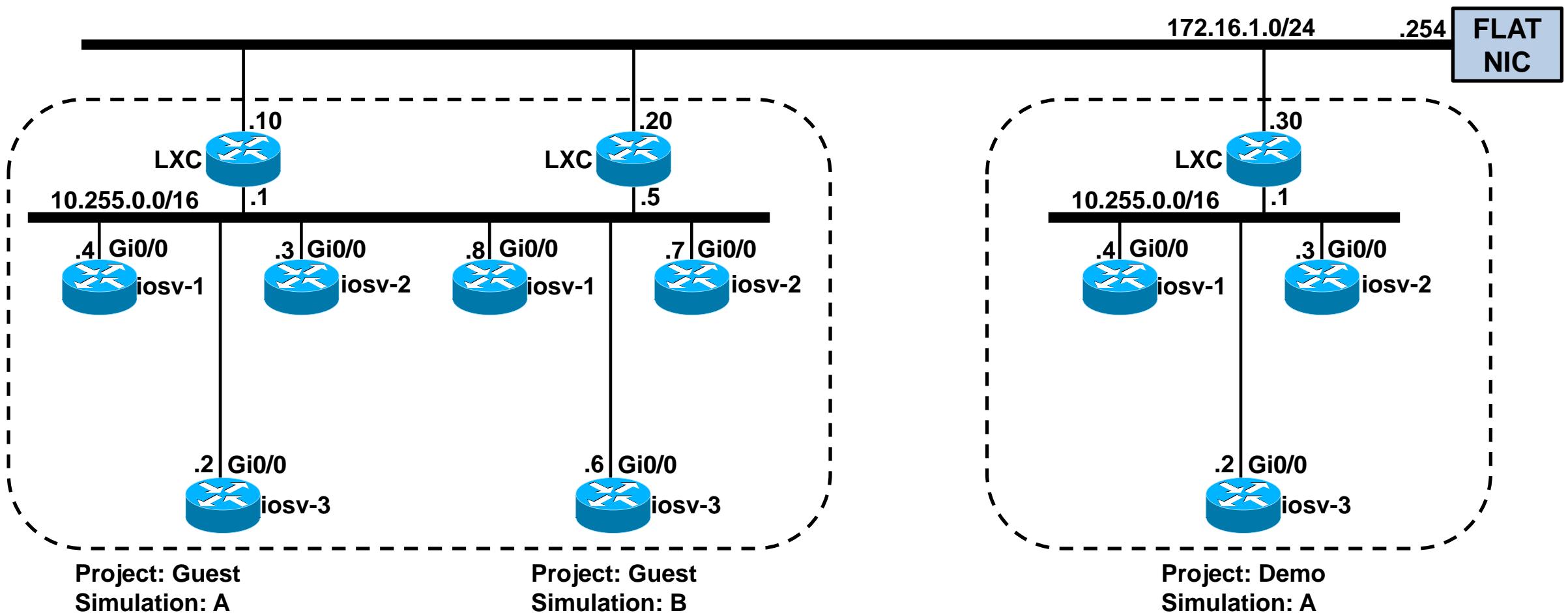
- Private Simulation Networking



VIRL Management Access

DFW CUG

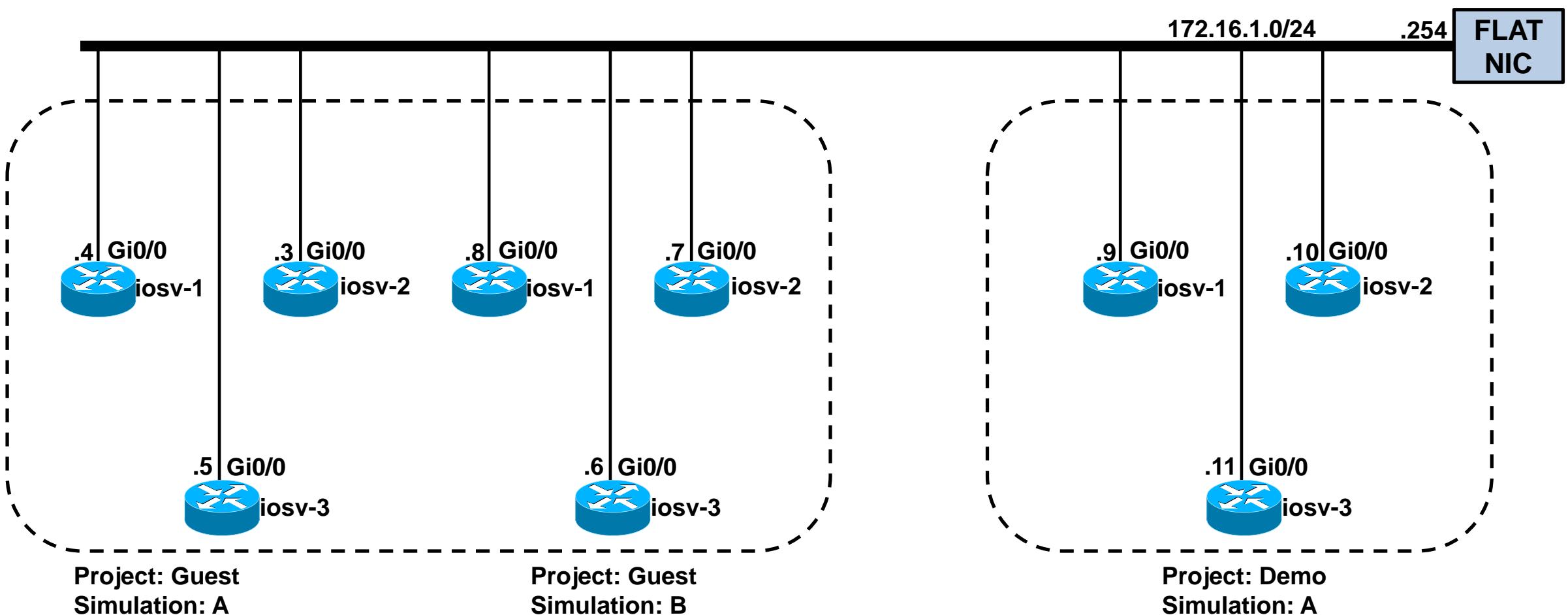
- Private Project Networking



VIRL Management Access

DFW CUG

- Shared Flat Networking



NICs on a VIRL Host

DFWCUG

localhost.localdomain VMware ESXi, 6.0.0, 2494585

Getting Started Summary Virtual Machines Resource Allocation Performance Configuration Users Events Permissions

Hardware

- Health Status
- Processors
- Memory
- Storage
- Networking
 - Storage Adapters
 - Network Adapters
 - Advanced Settings
 - Power Management

Software

- Licensed Features
- Time Configuration
- DNS and Routing
- Authentication Services
- Virtual Machine Startup/Shutdown
- Virtual Machine Swapfile Location
- Security Profile
- Host Cache Configuration
- System Resource Reservation
- Agent VM Settings
- Advanced Settings

View: vSphere Standard Switch

Networking

Standard Switch: vSwitch0

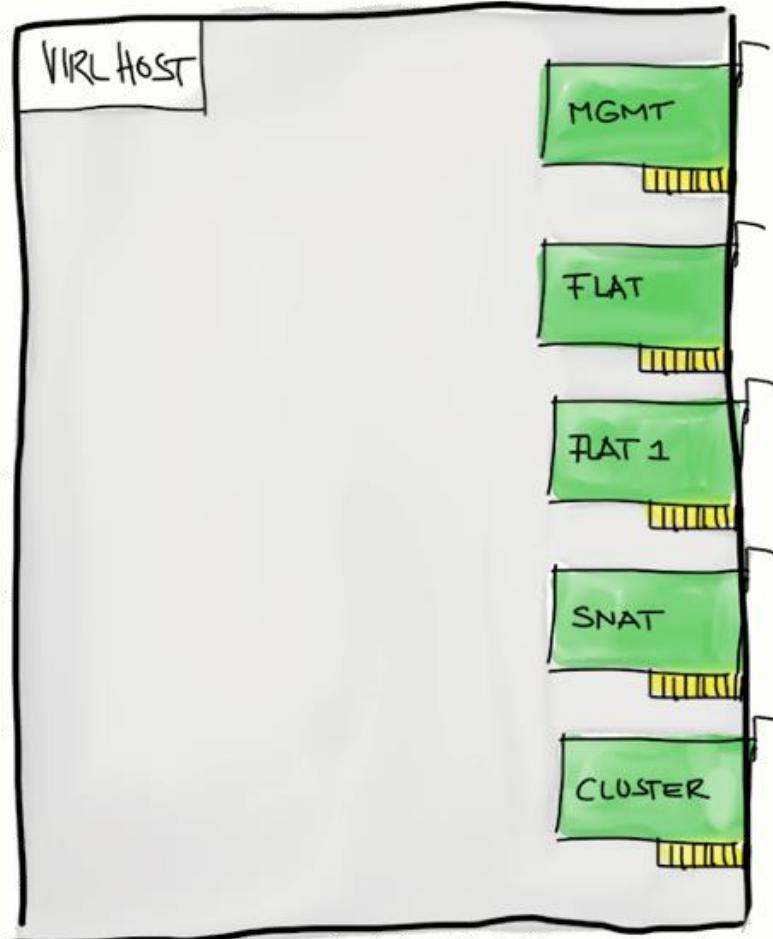
Remove... Properties...

Physical Adapters: vmnic0 1000 Full

- Virtual Machine Port Group:
 - VM Network
 - 1 virtual machine(s) | VLAN ID: 10
VIRL-Nov15-1.0.0
 - Flat
 - 1 virtual machine(s) | VLAN ID: 20
VIRL-Nov15-1.0.0
 - Virtual Machine Port Group
 - SNAT
 - 1 virtual machine(s) | VLAN ID: 40
VIRL-Nov15-1.0.0
 - Virtual Machine Port Group
 - INT
 - 1 virtual machine(s) | VLAN ID: 50
VIRL-Nov15-1.0.0
 - VMkernel Port
 - Management Network
vmk0 : 192.168.205.89
fe80::6e0b:84ff:fe43:c7fa

NICs on a VIRL Host

DFWCUG



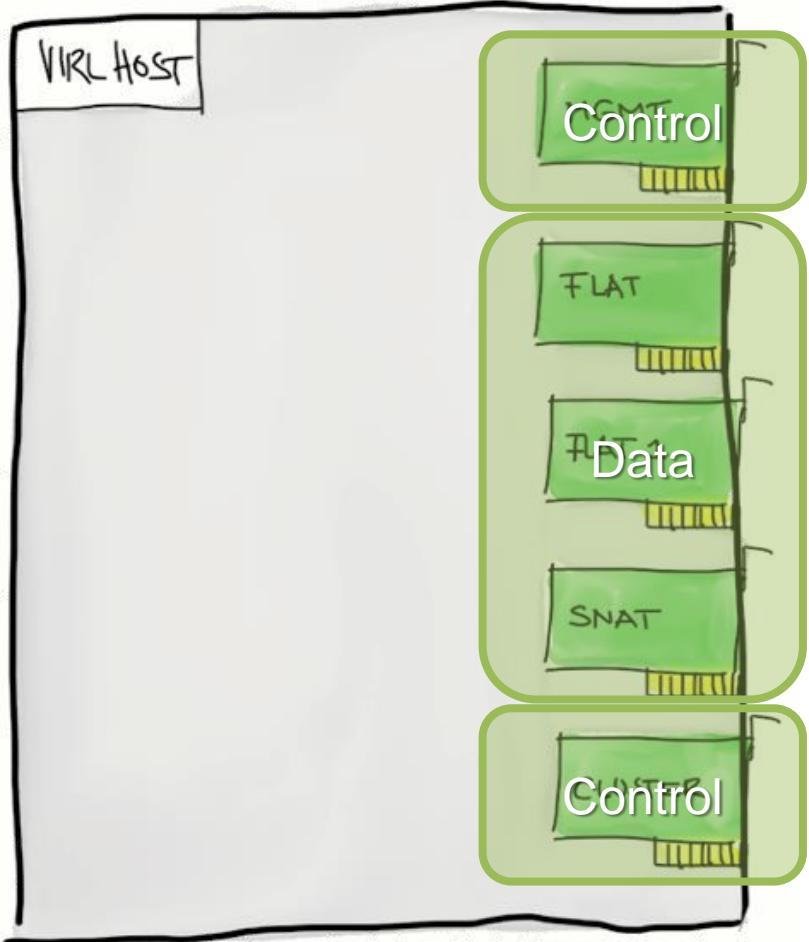
Up to five NICs on each VIRL Host

- **MGMT:** Mandatory. Management access via this interface
- **FLAT and FLAT1:** Optional. Full, Layer-2 bi-directional connectivity for all VIRL Nodes connected to the FLAT and the FLAT1 network segment
- **SNAT*:** Optional. One-way Layer-3 access to external networks. VIRL Nodes with specific SNAT connector are externally exposed
- **Cluster Control:** Optional. Needed for clustering VIRL hosts (future)

*SNAT = Static NAT

NICs on a VIRL Host

DFWCUG



- **System Control Plane Interfaces**
 - (Management of some sorts)
- **Simulation Data Plane Interfaces**
 - (Network simulation traffic)

VIRL Advanced Features

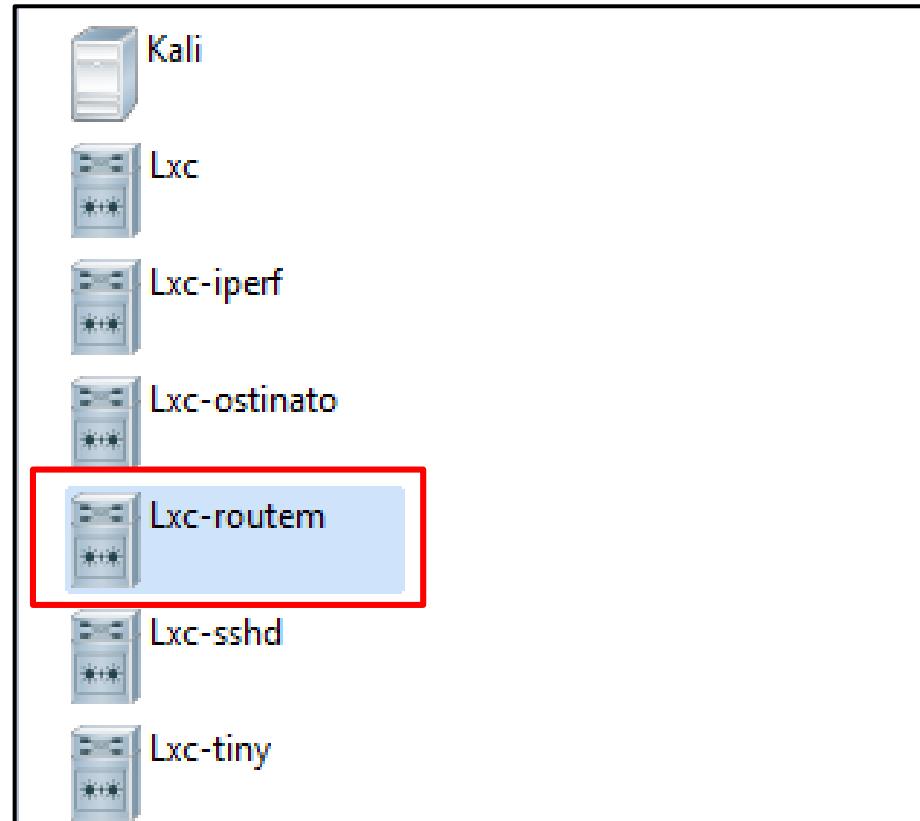
DFWCUG

- Live Visualization
 - Visualize and Manipulate running simulations
- Management Access
 - Connecting to the Outside world
- Routem
 - Control-plane Traffic Generator
- Ostinato
 - Data-plane Traffic Generator

Routem – Control-plane Traffic Generator

DFW CUG

- Routem SubType



– Routem YouTube Video on VIRL Channel

[https://www.youtube.com/watch?v= URUDAMDpSA](https://www.youtube.com/watch?v=URUDAMDpSA)

Routem – Control-plane Traffic Generator

DFWCUG

- Documentation under UWM

The screenshot shows the Cisco UWM (Unified Workforce Management) interface. On the left is a navigation sidebar with the following items:

- Overview
- My simulations
- Project simulations
- Projects
- Users
- VIRL Server
- Connectivity
- VM Control
- Node resources
- Repositories
- Documentation
 - STD API
 - UWM API
 - Routem

The main content area has a title "Routem" and a description: "Routem is a control-plane traffic generator application from Cisco. It is embedded in the 'lxc-routem' node." Below the description is a bulleted list:

- the application is supplied "as is"
- there is no commitment that any bugs identified in the application will be addressed
- there is no support for the use of this application outside of this simulation environment

On the right side of the main content area, there is a vertical list of links:

- BGP
- ISIS
- OSPF
- MSDP
- RIP
- ICMP
- TCP
- SCTP
- Traffic Generator

At the bottom of the main content area, there is a copyright notice: "© Cisco Systems, Inc."

A large red arrow points to the "Routem" link in the "Documentation" section of the sidebar.

Routem – Control-plane Traffic Generator

DFWCUG

- IOSv Router Side Config

```
int gi0/4
ip addr 10.0.0.99 255.255.0.0
no shut
!
router ospf 1
network 10.0.0.99 255.255.0.0 area 0.0.0.0
end
```

- Routem Side Config

```
ospf_default_dbd_advertise
router ospf
neighbor 10.0.0.99 update-source 10.0.101.1
networkmask 255.255.0.0
router_id 1.0.0.0
area 0.0.0.0
link 1 99.0.0.0/32 1
ext-ip 1 1.0.0.0/32 1
ext-nexthop 1 10.0.101.3
ia-ip 2 2.0.0.0/32 1
no virtual-link
#
router ospf
neighbor 10.0.0.99 update-source 10.0.101.2
networkmask 255.255.0.0
router_id 1.0.1.0
area 0.0.0.0
link 1 99.1.0.0/32 1
ext-ip 1 1.1.0.0/32 1
no virtual-link
```

VIRL Advanced Features

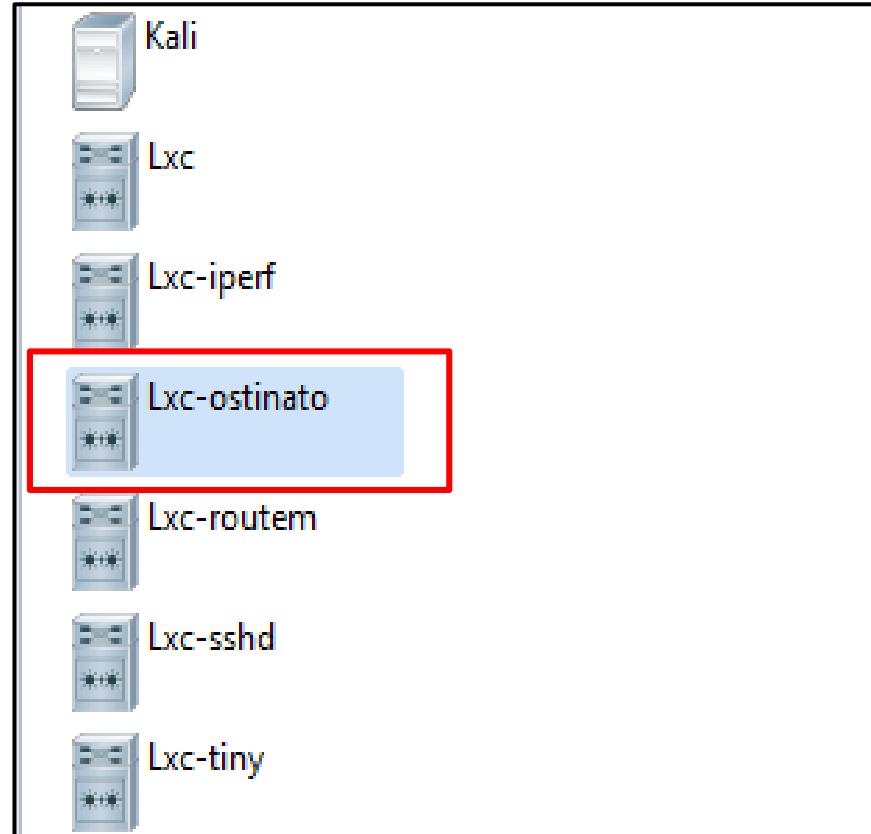
DFW CUG

- Live Visualization
 - Visualize and Manipulate running simulations
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 - Data-plane Traffic Generator

Ostinato – Data-plane Traffic Generator

DFW CUG

- Ostinato VM Maestro SubType



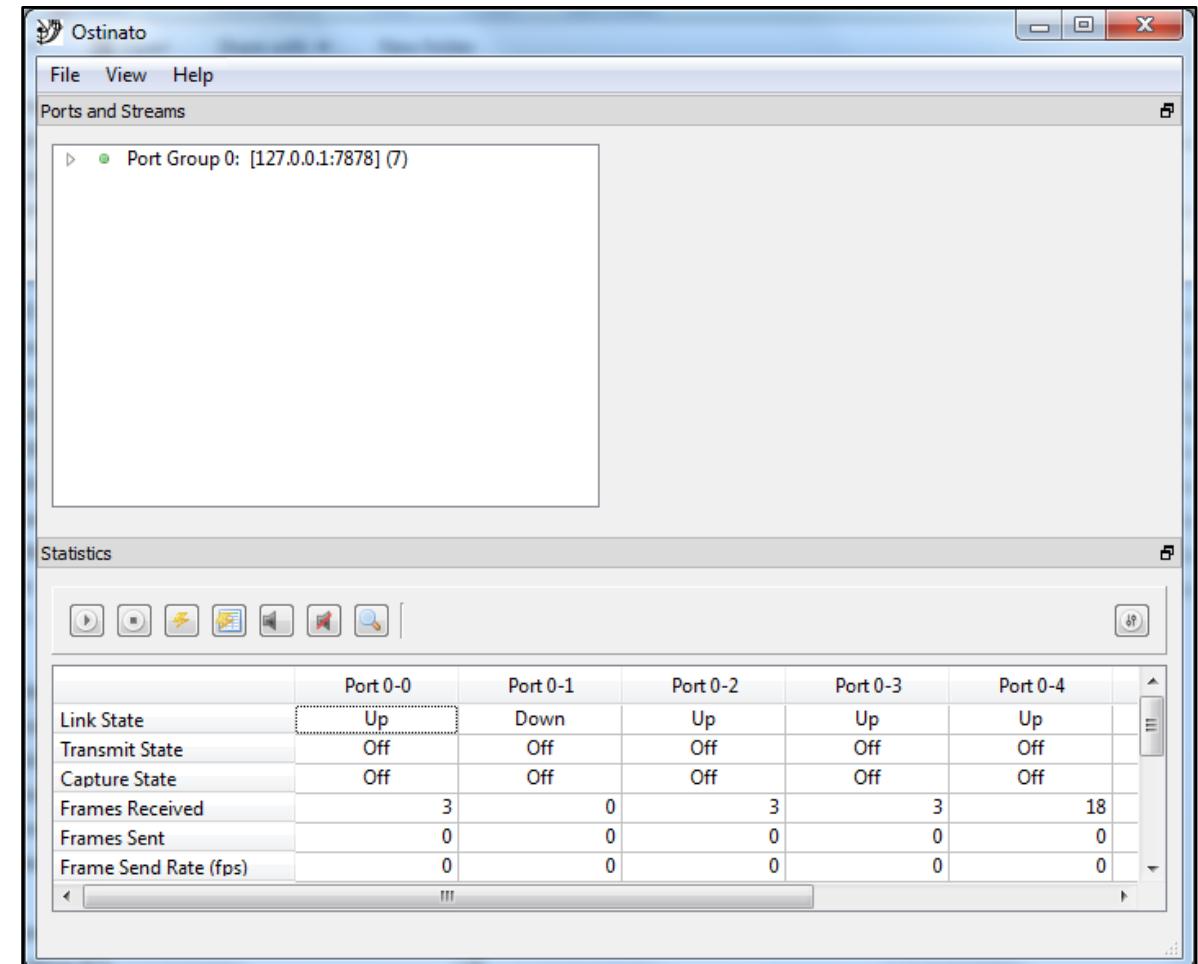
- Ostinato YouTube Video on VIRL Channel

https://www.youtube.com/watch?v=Ffk_nBlvRfU

Ostinato – Data-plane Traffic Generator

DFW CUG

- Ostinato Front End
 - Runs on your laptop
 - Configures Data Streams
 - Can replay PCAP files



Ostinato – Data-plane Traffic Generator

DFW CUG

- Features

- Runs on Windows, Linux, BSD and Mac OS X
- Use via GUI or Python API
- Open, edit, replay and save PCAP files
- Support for the most common standard protocols
- Ethernet/802.3/LLC SNAP
- VLAN (with QinQ)
- ARP, IPv4, IPv6, IP-in-IP a.k.a IP Tunnelling (6over4, 4over6, 4over4, 6over6)
- TCP, UDP, ICMPv4, ICMPv6, IGMP, MLD
- Any text based protocol (HTTP, SIP, RTSP, NNTP etc.)
- More protocols in the works ...
- Set a value for any field of any protocol
- Vary packet fields across packets at run time e.g. changing IP/MAC addresses
- User provided Hex Dump - specify some or all bytes in a packet
- User defined script to substitute for an unimplemented protocol (EXPERIMENTAL)
- Stack protocols in any arbitrary order
- Create and configure multiple streams
- Configure stream rates, bursts, no. of packets
- One agent can control and configure multiple ports on multiple computers generating traffic
- Multiple agents can share control over a single port on a single computer
- Exclusive control of a port to prevent the OS from sending stray packets provides a controlled testing environment (Windows only)
- Statistics Window shows realtime port receive/transmit statistics and rates
- Capture packets and view them (needs Wireshark to view the captured packets)
- Framework to add new protocol builders easily

DEMONSTRATION

DFWCUG

REFERENCE MATERIAL

Sample Topologies on GitHub

DFW CUG

- Includes contributions from INE and CBT Nuggets

<https://github.com/VIRL-Open/sample-topologies>

The screenshot shows the GitHub repository page for 'VIRL-Open / sample-topologies'. The page includes the repository name, a 'Watch' button with 27 subscribers, and a description: 'sample topologies that run on VIRL'. It displays statistics: 60 commits, 1 branch, 0 releases, and 5 contributors. The 'Branch: master' dropdown is set to 'sample-topologies'. A list of recent commits is shown:

Author	Commit Message	Date
CBTNuggets	Name Update	4 months ago
INE/INE_Webinar_July_2015	INE Topology	3 months ago
Layer2_switching	Layer 2 switching and trunking	6 months ago
SDN	Directory restructure	7 months ago
Test_Topologies	Directory restructure	7 months ago
Webinars	Live Visualisation demonstration topologies	27 days ago
.project	Adding a .project file so that users will be able to import the project	7 months ago
README.md	restore and update readme.md	3 months ago

CBT Installation Video

DFW CUG

- Simplified VMWare Workstation Player Installation
 - Presented by Anthony Sequeira of CBT Nuggets

<http://www.ajsnetworking.com/installing-and-using-ciscos-virl/>