# Introduction to GENI

ECE671

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Outline

- Testbeds – What are they?
- GENI Testbed
- What resources do I select?
- How can I reserve resources?
  - The learning switch – hands-on tutorial
- Systematic Experiment Design
- Automate Orchestration
- OVS Commands – Setup bridge and Debug commands
- Useful links – OpenFlow and GENI

Testbeds – What are they?

- Resources for developing and prototyping systems
  - E.g. Two laptops connected by a switch

http://en0.ch/2014/07/routers-vs-switches-whats-the-difference/

Commercial
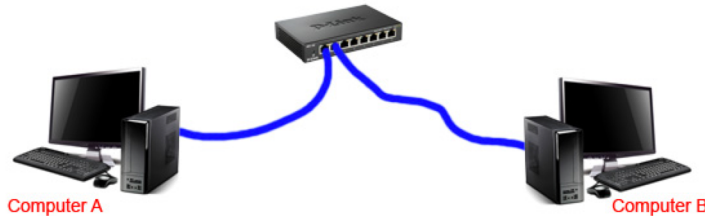
Research

- Network testbeds
  - Frμit - 10,000 Raspberry Pis!
  - GENI - Global Environment for Network Innovations
    - Geographically distributed compute and storage connected by Gigabit fiber
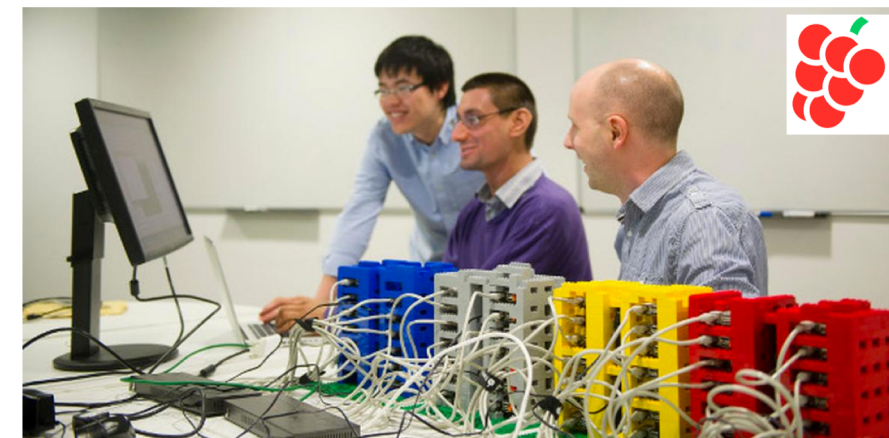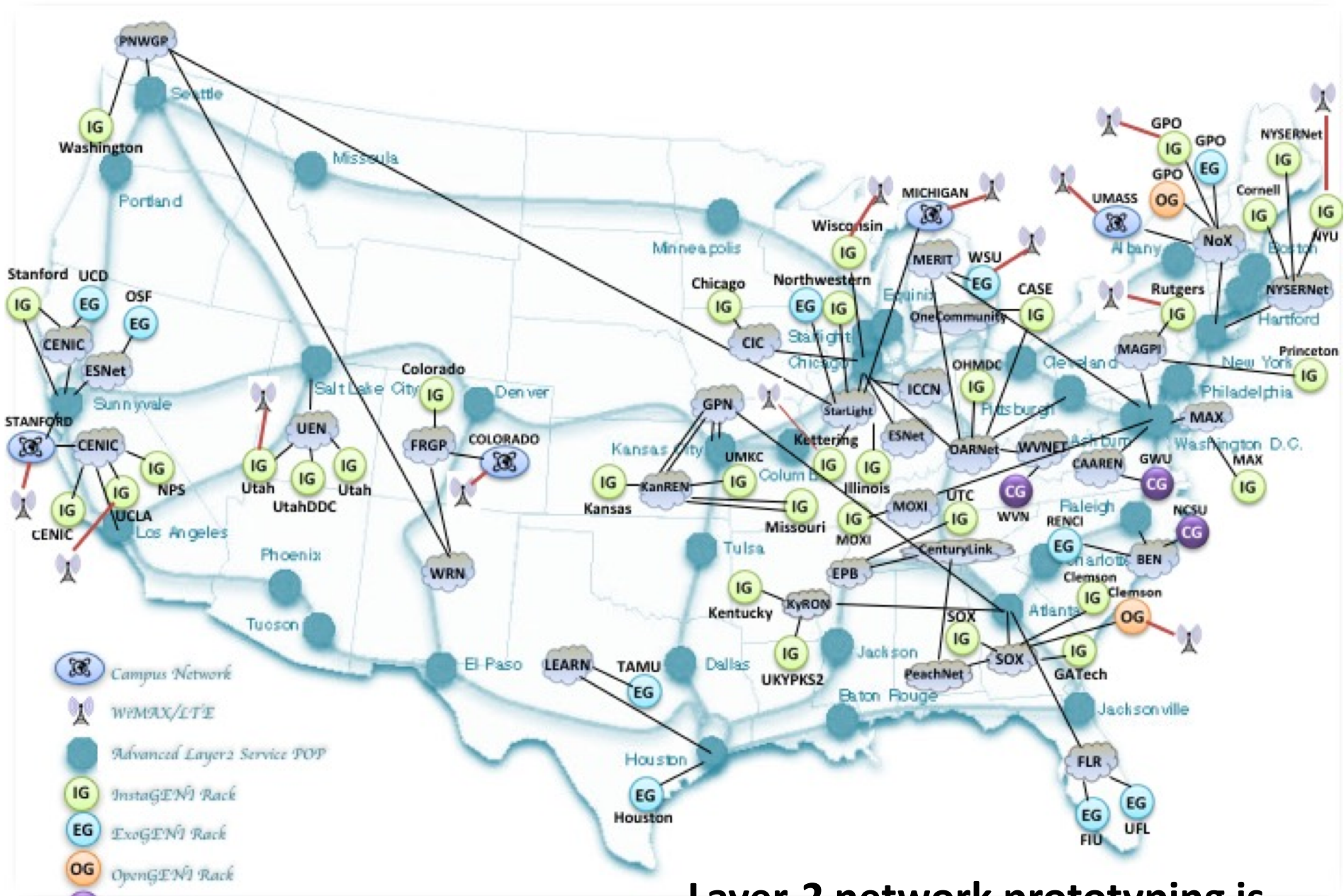   - Largest OpenFlow enabled testbed
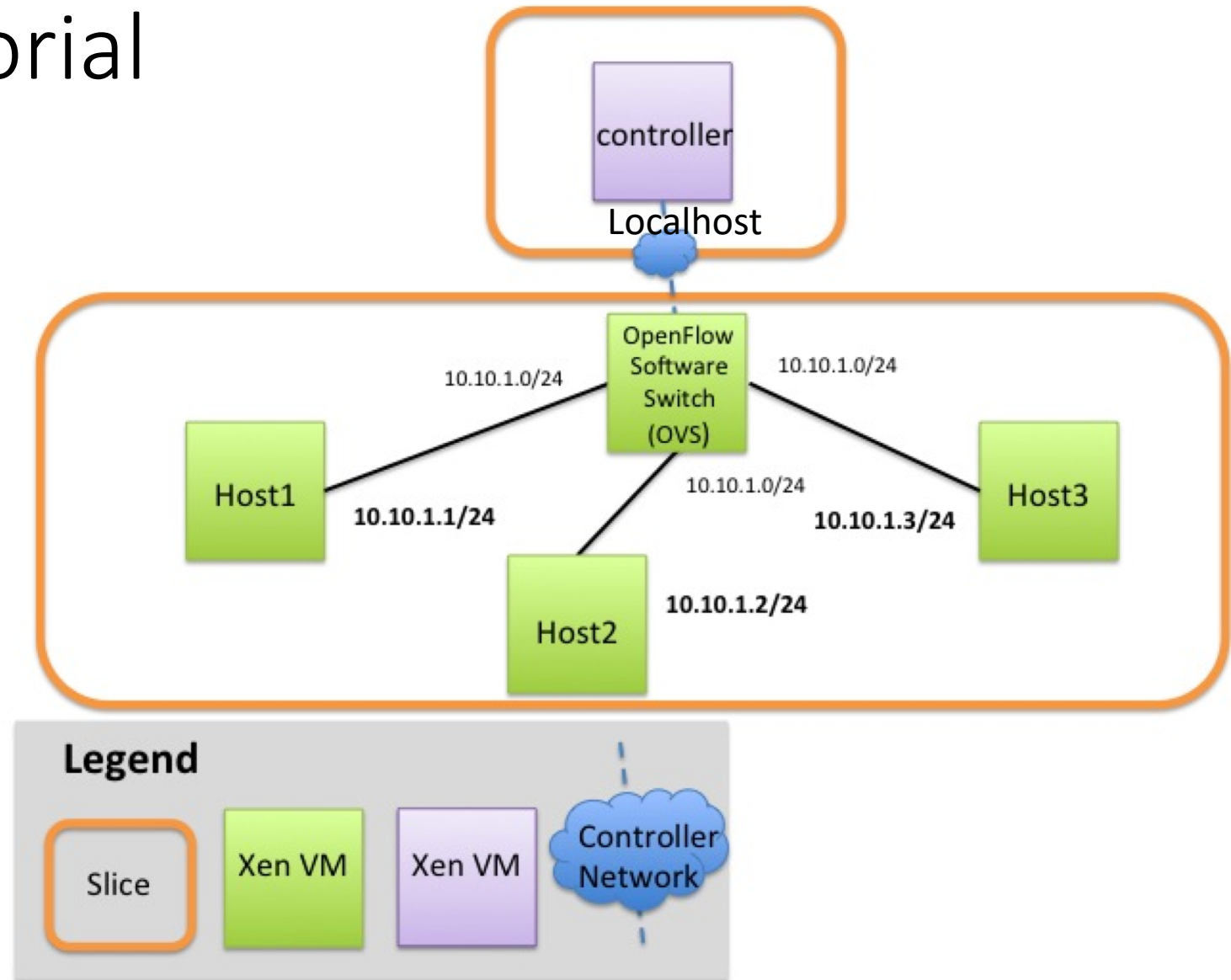
https://www.zdnet.com/pictures

Layer-2 network prototyping is possible!

http://www.geni.net/

What resources do I select?

- Type of resources
  - Raw PC
  - Virtual Machine
    - Containers
    - Xen and KVM
  - Link Type
    - Local
    - Stitched

- Type of Aggregate Managers
  - InstaGENI
    - Smaller resources (compute and storage), many in number
    - Xen virtualization
    - Limited public IPs
  - ExoGENI
    - Larger resources (compute and storage), fewer in number
    - KVM Virtualization
    - Default Public IPs

Hands-On tutorial
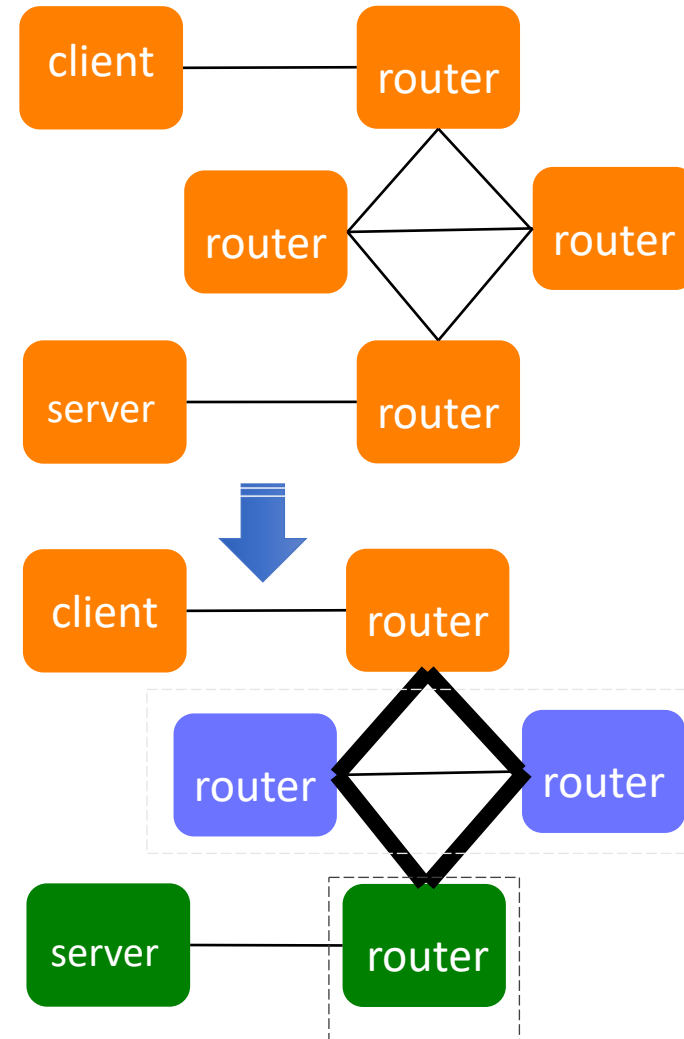
- Learning Switch – E.g. InstaGENI

Systematic Experimentation

router → router (diamond of 4 routers) → client/server topology with routers
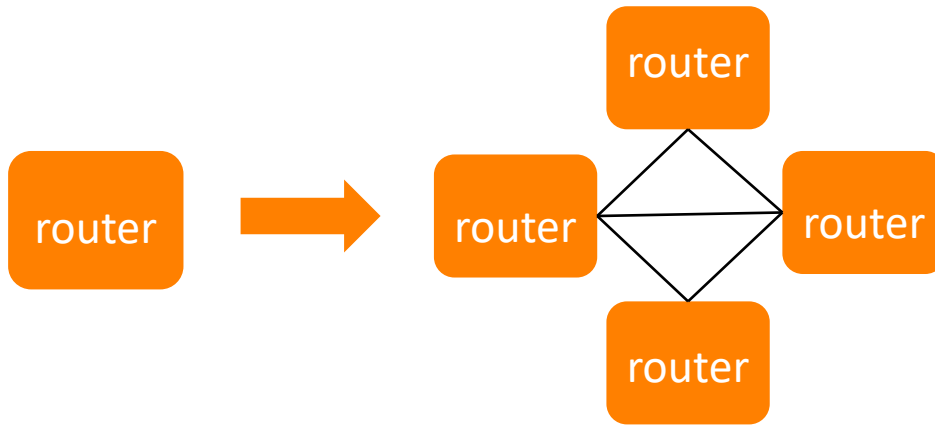
Start small
- Create Image

Add similar nodes and local links
- Test connectivity and bandwidth
- Test image
- Automate

Add other nodes
- Test application
- Automate

Create a stitched topology
- Test connectivity and bandwidth
- Test application
- Automate

Adapted from Slides by Xuan Liu:
https://groups.geni.net/geni/wiki/GENIExperimenter/Tutorials/
SystematicExprCaseStudy#ATutorialonSystematicExperimentalDesign

Automate Orchestration

- Login to resources
  - SSH key pair - Public-private key authentication
  - Private key stored in secure location on your system (e.g. ~/.ssh)
  - Public key uploaded on resource
  - System can be sure you are the one logging in since you need to use your private key
- Images and PostBoot Scripts
  - Custom Images
  - Install and execute
- Ansible
  - YAML-like syntax
  - Remotely run commands on machine (ping, iperf etc.)
- Paramiko
  - Python library – login and remotely run commands on machine
- Jupyter
  - Web-based interface – login and run commands, plot results using matplotlib

OVS – Bridge setup and debug commands

- Name of bridge can be anything but name of the port should be the same as what you see when you run "ifconfig" for the interfaces that you wish to add to the bridge
  - sudo ovs-vsctl add-br <name_of_bridge>
  - sudo ovs-vsctl add-port <name_of_bridge> <name_of_port>
- Set controller for bridge – In this example, IP=127.0.0.1
  - sudo ovs-vsctl set-controller <name_of_bridge> tcp:<ip_of_controller>:6653
- Set secure mode – This is used so that traffic is NOT routed by the OVS until the rule is explicitly specified by the controller
  - sudo ovs-vsctl set-fail-mode <name_of_bridge> secure
- Check flow table to see what flow rules have been installed
  - sudo ovs-ofctl dump-flows <name_of_bridge>

Useful Links – OpenFlow and GENI

- http://docs.openvswitch.org/en/latest/

- https://openflow.stanford.edu/display/ONL/POX+Wiki

- http://groups.geni.net/geni/wiki/GENIExperimenter/Tutorials
  - Not all of these are being actively maintained but it should give an idea of what you can do with GENI
  - https://www.youtube.com/watch?v=s-2mWDJLiRo – Lab Zero (A simple experiment using GENI)

 - Jupyter Tutorial: https://docs.google.com/document/d/ 1ThSGBSFCgSSptoGzkyml8tzLltb1MxHYsMvEQYSbxEs
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