Today’s Plan

• Everyone will build their own clouds
  • Using an OpenStack profile supplied by CloudLab
  • Each is independent, with its own compute and storage resources

• Log in using GENI accounts
• Create a cloud
• Explore the CloudLab interface
• Use your cloud
• Administer your cloud

• CloudLab is about more than OpenStack
Prerequisites

- Account on the GENI portal (sent to you as “pre work”)
- Optional, but will make your experience better:
  - SSH keypair associated with your GENI portal account
  - Knowledge of how to use the private SSH key from your laptop

- Known to work best in Chrome and Firefox browsers
- Tablets might work, but not well tested
Crash Course in CloudLab

• Underneath, it’s GENI
  • Same APIs, same account system
  • Even many of the same tools
  • Federated (accept each other’s accounts, hardware)

• Physical isolation for compute, storage (shared net.*)

• Profiles are one of the key abstractions
  • Defines an environment – hardware (RSpec) / software (images)
  • Each “instance” of a profile is a separate
  • Provide standard environments, and a way of sharing
  • Explicit role for domain experts

• “Instantiate” a profile to make an “Experiment”
  • Lives in a GENI slice

* Can be dedicated in some cases
What Is CloudLab?

- Supports transformative cloud research
- Built on Emulab and GENI
- Control to the bare metal
- Diverse, distributed resources
- Repeatable and scientific

Slice A
Geo-Distributed Storage Research

Slice B
Stock OpenStack

Slice C
Virtualization and Isolation Research

Slice D
Allocation and Scheduling Research for Cyber-Physical Systems

Utah
Wisconsin
Clemson
GENI

CC-NIE, Internet2 AL2S, Regionals
CloudLab’s Hardware

One facility, one account, three locations

- About 5,000 cores each (15,000 total)
- 8-16 cores per node
- Baseline: 8GB RAM / core
- Latest virtualization hardware
- TOR / Core switching design
- 10 Gb to nodes, SDN
- 100 Gb to Internet2 AL2S
- Partnerships with multiple vendors

Wisconsin
- Storage and net.
- Per node:
  - 128 GB RAM
  - 2x1TB Disk
  - 400 GB SSD
- Clos topology
- Cisco

Clemson
- High-memory
- 16 GB RAM / core
- 16 cores / node
- Bulk block store
- Net. up to 40Gb
- High capacity
- Dell

Utah
- Power-efficient
- ARM64 / x86
- Power monitors
- Flash on ARMs
- Disk on x86
- Very dense
- HP
cloudlab.us/tutorial
CloudLab Hardware
Utah/HP: Very dense
Utah/HP: Low-power ARM64

- 315 nodes
- 2,520 cores
- 8.5 Tbps
- 8 cores
- 120 GB Flash
- 64 GB RAM
- 45 cartridges
- 2 switches
Utah/HP Network: Core switch

- 4x 40 Gb
- 2x 10 Gb
- 320 Gb uplink
- x7
Utah - Suitable for experiments that:

- ... explore power/performance tradeoffs
- ... want instrumentation of power and temperature
- ... want large numbers of nodes and cores
- ... want to experiment with RDMA via RoCE
- ... need bare-metal control over switches
- ... need OpenFlow 1.3
- ... want tight ARM64 platform integration
Wisconsin/Cisco

I2 Kansas City

I2 Chicago

Nexus 3172PQ

8X10G

Nexus 3132Q

40G Bi-Di Optics
10G LR Optics

Existing
Campus
Network

Nexus 3172PQ

40G

20X12
servers
Compute and storage

90X Cisco 220 M4

- 2X 8 cores @ 2.4GHz
- 128GB RAM
- 1X 480GB SSD
- 2X 1.2 TB HDD

10X Cisco 240 M4

- 1X 1TB HDD
- 12X 3TB HDD
  (donated by Seagate)

Over the next year: ≥ 140 additional servers;
Limited number of accelerators, e.g., FPGAs, GPUs (planned)
Networking

Nexus 3132q  Nexus 3172pq

- OF 1.0 (working with Cisco on OF 1.3 support)
- Monitoring of instantaneous queue lengths
- Fine-grained tracing of control plane actions
- Support for multiple virtual router instances per router
- Support for many routing protocols
Experiments supported

Large number of nodes/cores, and bare-metal control over nodes/switches, for sophisticated network/memory/storage research

- ... Network I/O performance, intra-cloud routing (e.g., Conga) and transport (e.g., DCTCP)
- ... Network virtualization (e.g., CloudNaaS)
- ... In-memory big data frameworks (e.g., Spark/Shark)
- ... Cloud-scale resource management and scheduling (e.g., Mesos; Tetris)
- ... New models for Cloud storage (e.g., tiered; flat storage; IOFlow)
- ... New architectures (e.g., RAM Cloud for storage)
Clemson/Dell: High Memory, IB

- 20 cores/node
- 8 nodes/chassis
- 10 chasses/rack

- 1 x 40 Gb IB/node
- 2x 10 GbE OF/node
- 2x 1 GbE OF/node
- 256 GB RAM/node
- 2 x 1 TB drive/server

* 1 NIC in 1\textsuperscript{st} build
Clemson/Dell Network: IB + 10 GbE

Q1 2015: 2K+ cores
Complete: ~5K cores

8x40 GbE

100 GbE

8 node chassis

8 node chassis

8 node chassis

8 node chassis

10 chasses/rack

8 node chassis

8 node chassis

10 chasses/rack

8 node chassis

8 node chassis

96x40GbE
Clemson - Suitable for experiments that:

- ... need large per-core memory
  - e.g., High-res media processing
  - e.g. Hadoop
  - e.g., Network Function Virtualization
- ... want to experiment with IB and/or GbE networks
  - e.g., hybrid HPC with MPI and TCP/IP
  - e.g., cyber physical system
- ... need bare-metal control over switches
- ... need OpenFlow 1.3
Building Profiles
Copy an Existing Profile

Your experiment is ready!

URN: urn:publicid:IDN+emulab.net+slice+rpruser-QV992
State: ready
Profile: arm64-ubuntu14
Expires: 12-07T21:24Z (in 16 hours)

Profile Instructions

Topology View List View Manifest node X
Use a GUI (Jacks)
import geni.rspec.pg as pg

rspec = pg.Request()

# Create XenVM nodes
node1 = pg.XenVM("node1")
node2 = pg.XenVM("node2")

# Create interfaces for each node.
iface1 = node1.addInterface("if1")
iface2 = node2.addInterface("if2")

rspec.addResource(node1)
rspec.addResource(node2)

# Create a link with the type of LAN.
link = pg.LAN("lan")

# Add both node interfaces to the link.
link.addInterface(iface1)
link.addInterface(iface2)
GENI-LIB

http://geni-lib.readthedocs.org/

or

Build From Scratch

Create Profile

- Name
- Project: flux
- Your rspec
  - Choose file
  - Topology
  - Source
- Description
- Instructions

Who can instantiate your profile?
- Anyone on the internet (guest users)
- Only registered users of the website
Sign Up
Sign Up At CloudLab.us

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<tr>
<th>Personal Information</th>
<th>Project Information</th>
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