CloudLab

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
- Contained to the bare metal
- Diverse, distributed resources
- Repeatable and scientific
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, MN
- 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
- 36 GB RAM / core
- 36 cores / node
- Bulk block store
- Net. up to 40Gb
- High capacity
- Dell

Utah

- Power-efficient
- ARM64 / x86
- Power monitors
- Flash on ARM6s
- Disk on x86
- Very dense
- HP

cloudlab.us/tutorial

Utah/HP: Very dense

Utah/HP: Low-power ARM64
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

- 2X10G Nexus 3132Q
- 8X10G Nexus 3172PQ
- 20X12 servers

Compute and storage

- 90X Cisco 220 M4
- 10X Cisco 240 M4

- 2X 8 cores @ 2.4GHz
- 128GB RAM
- 1X 480GB SSD
- 2X 1.2 TB HDD
- 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
- 256 GB RAM/node
- 2 x 1 TB drive/server
- 2 x 40 Gb IB/node
- 2 x 1 GbE OF/node
- 2 x 10 GbE OF/node

*1 NIC in 1st build

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

CloudLab

Building Profiles

Copy an Existing Profile

Use a GUI (Jacks)
Write Python Code (geni-lib)

```python
import geni.v3.rspec as pg

nc = pg.NC(nc)

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

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

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

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

# Add both node interfaces to the link.
link.addInterface(if1)
link.addInterface(if2)
```

GENI-LIB

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

or


Build From Scratch

Sign Up At CloudLab.us

Sign Up