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Today's Plan

- Everyone will build their own clouds
 - Using an OpenStack profile supplied by CloudLab
 - Each is independent, with it's 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**

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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

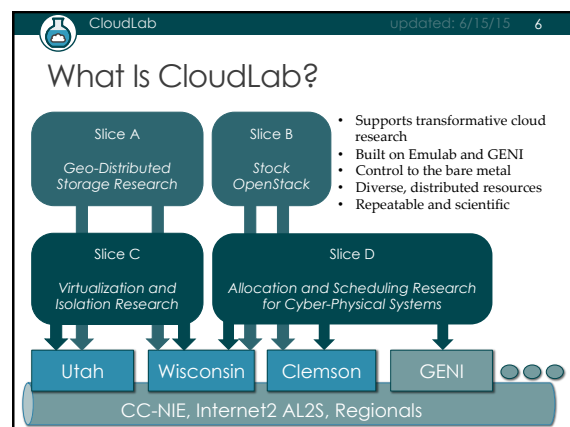


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Crash Course in CloudLab

- 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



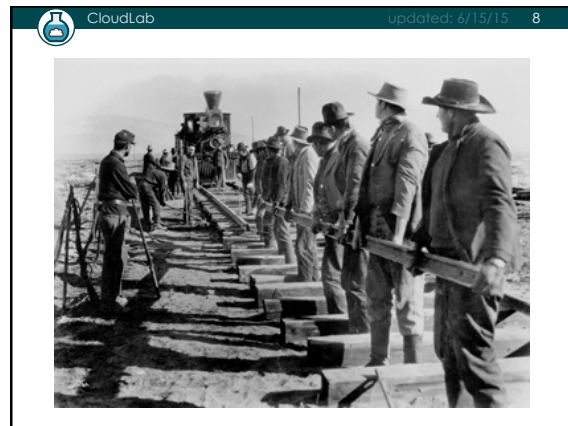
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CloudLab's Hardware

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	Clemson	Utah
<ul style="list-style-type: none"> Storage and net. Per node: <ul style="list-style-type: none"> 128 GB RAM 2x1TB Disk 400 GB SSD Clos topology Cisco 	<ul style="list-style-type: none"> High-memory 16 GB RAM / core 16 cores / node Bulk block store Net. up to 40Gb High capacity Dell 	<ul style="list-style-type: none"> Power-efficient ARM64 / x86 Power monitors Flash on ARMs Disk on x86 Very dense HP



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CloudLab Hardware

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Utah/HP: Very dense

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Utah/HP: Low-power ARM64

- 1.3
- 2 switches
- 315 nodes
- 2,520 cores
- 8.5 Tbps
- 8 cores
- 120 GB Flash
- 45 cartridges
- 64 GB RAM

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Utah/HP Network: Core switch

4x 40 Gb

320 Gb uplink

2x 10 Gb

x7

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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

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Wisconsin/Cisco

I2 Kansas City

I2 Chicago

8x10G

40G

20x12 servers

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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)

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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

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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)

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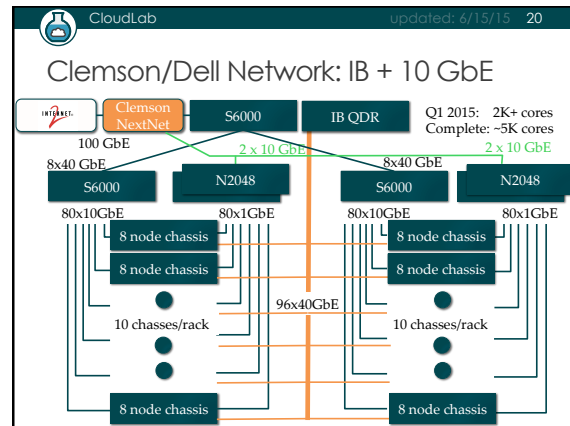
Clemson/Dell: High Memory, IB

20 cores/node	1 x 40 Gb IB/node
8 nodes/chassis	2*x 10 GbE OF/node
10 chasses/rack	2*x 1 GbE OF/node



256 GB RAM/node
2 x 1 TB drive/server

* 1 NIC in 1st build



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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

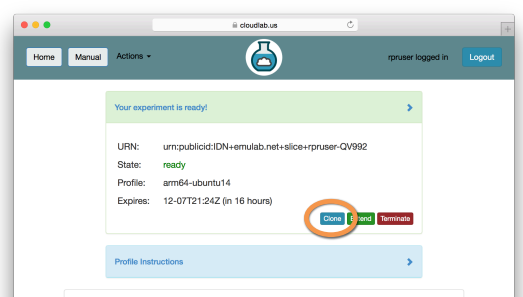
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Building Profiles



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Copy an Existing Profile



Your experiment is ready!

URN: urn:publicid:IDN+emulab.net+slice+pruser-QV992
State: ready
Profile: amd64-ubuntu14
Expires: 12-07T21:24Z (in 16 hours)

Copy **Copy** Terminate

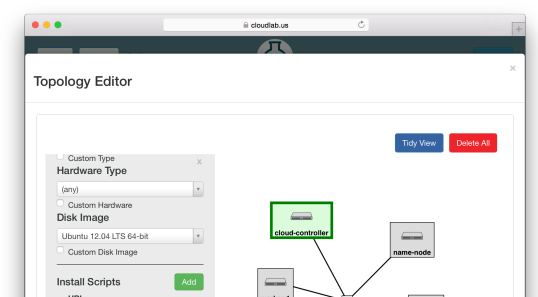
Profile Instructions

Topology View List View Manifest node

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Use a GUI (Jacks)

Topology Editor

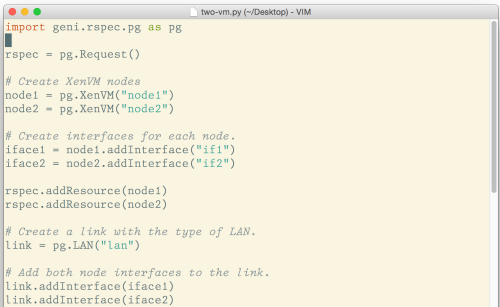


Custom Type Hardware Type (any) Custom Hardware Disk Image Ubuntu 12.04 LTS 64-bit Custom Disk Image Install Scripts Add URL: ex: http://example.com/mystuff.txt

Tidy View Delete All

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Write Python Code (geni-lib)



```

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)

```

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GENI-LIB

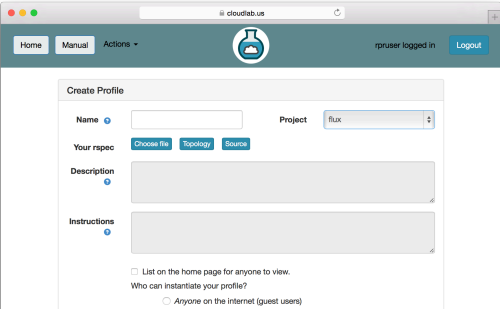
<http://geni-lib.readthedocs.org/>

or

<http://geni-lib.readthedocs.io/en/latest/>

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Build From Scratch



The screenshot shows the 'Create Profile' form on the CloudLab website. It includes fields for Name, Project (set to 'flux'), Your rspec (with tabs for Choose file, Topology, and Scripts), Description, and Instructions. There are also checkboxes for 'List on the home page for anyone to view.' and 'Who can instantiate your profile?' with radio button options for 'Anyone on the internet (guest users)'.

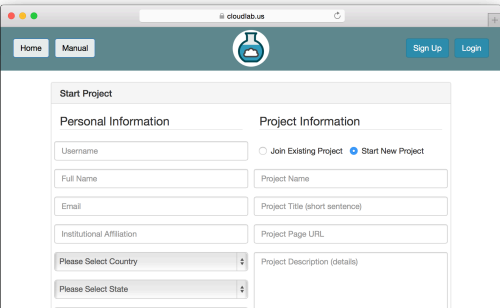
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Sign Up



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Sign Up At CloudLab.us



The screenshot shows the 'Start Project' sign-up form on the CloudLab website. It is divided into 'Personal Information' and 'Project Information' sections. The 'Personal Information' section includes fields for Username, Full Name, Email, Institutional Affiliation, Country, and State. The 'Project Information' section includes radio buttons for 'Join Existing Project' and 'Start New Project', and fields for Project Name, Project Title (short sentence), Project Page URL, and Project Description (details).