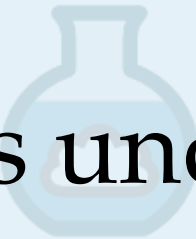# Overview

- What is CloudLab?

- What's under the hood?

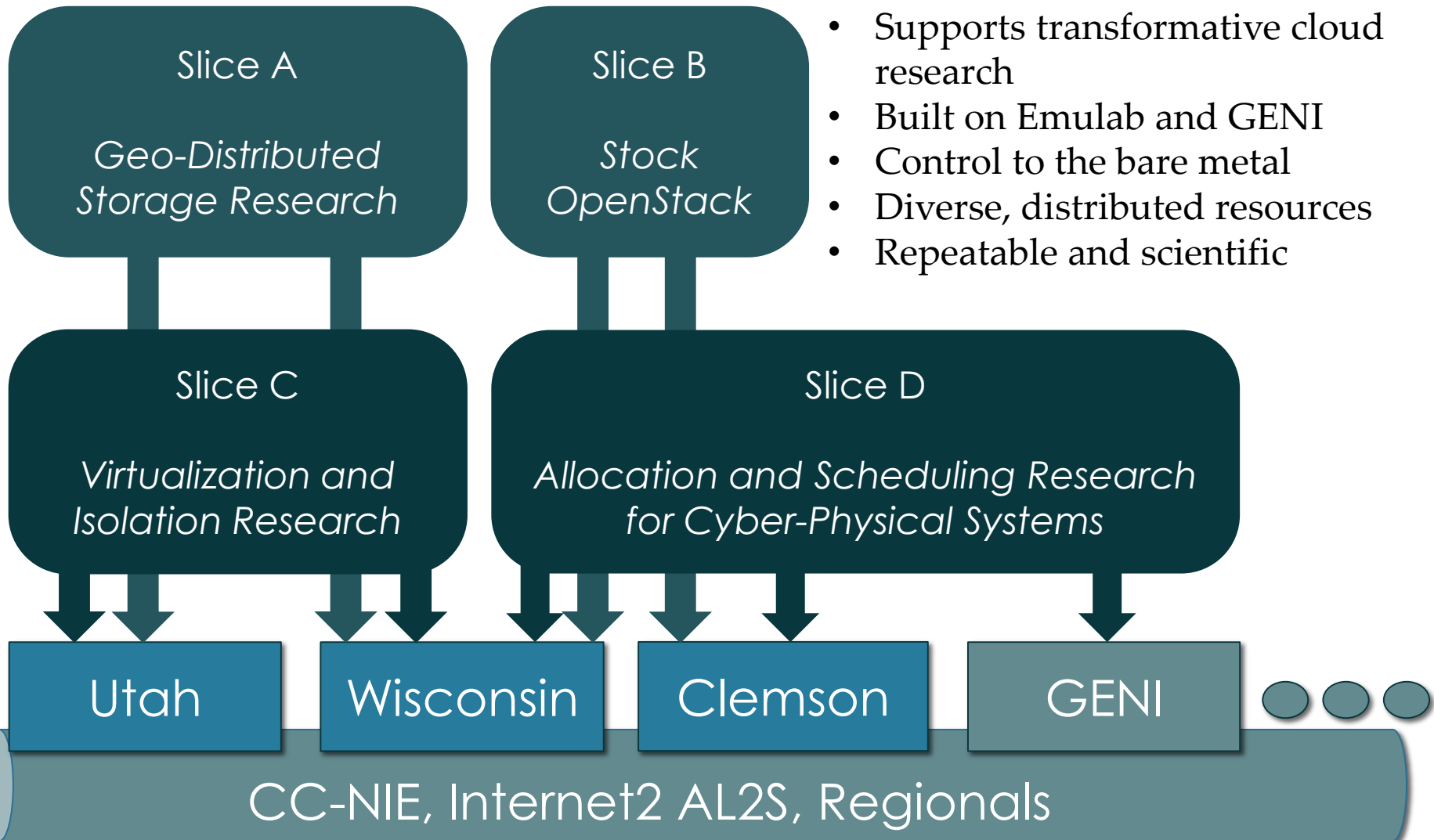- How does it relate to GENI?

The CloudLab Vision

- A "meta-cloud" for building clouds
- Build your own cloud on our hardware resources
- Agnostic to specific cloud software
  - Run existing cloud software stacks (like OpenStack, Hadoop, etc.)
  - … or new ones built from the ground up
- Control and visibility all the way to the bare metal
- "Sliceable" for multiple, isolated experiments at once

With CloudLab, it will be as easy to get a cloud tomorrow as it is to get a VM today

What Is CloudLab?

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

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

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)
- 8-28 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.**
- 8 or 10 Cores
- 128 or 160 GB RAM
- 2 x 1 TB Disk
- 480 GB SSD
- Clos topology
- *Cisco and HP*

Clemson

- **High-memory**
- 256GB
- 16 or 24 cores
- Bulk block store
- 40Gb Infiniband
- 2 x GPU nodes
- *Dell*

Utah

- **Power-efficient**
- ARM64 / x86
- Power monitors
- Flash on ARMs
- NVMe on x86
- Very dense
- *HP*

Technology Foundations

- Built on Emulab and GENI ("ProtoGENI")
- In active development at Utah since 1999
- Several thousand users (incl. GENI users)
- Provisions, then gets out of the way
  - "Run-time" services are optional
- Controllable through a web interface and GENI APIs
- *Scientific instrument* for *repeatable research*
  - Physical isolation for most resources
  - *Profiles* capture everything needed for experiments
    - Software, data, and hardware details
    - Can be shared and published (eg. in papers)

protogeni

geni
Exploring Networks
of the Future

emulab
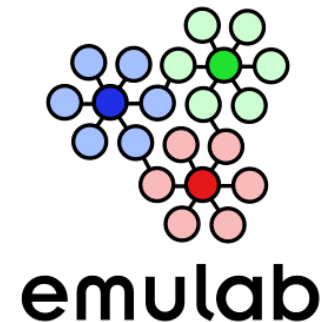
Federated with GENI

- *CloudLab can be used with a GENI account, and vice-versa*
- GENI Racks: ~ 50 small clusters around the country
- Programmable wide-area network
  - Openflow at dozens of sites
  - Connected in one layer 2 domain
- Large clusters (100s of nodes) at several sites
- Wireless and mobile
  - WiMax at 8 institutions
  - LTE / EPC testbed ("PhantomNet") at Utah
- International partners
  - Europe (FIRE), Brazil, Japan
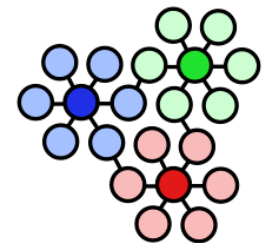
CloudLab Sites / ProtoGENI Racks

= GENI racks
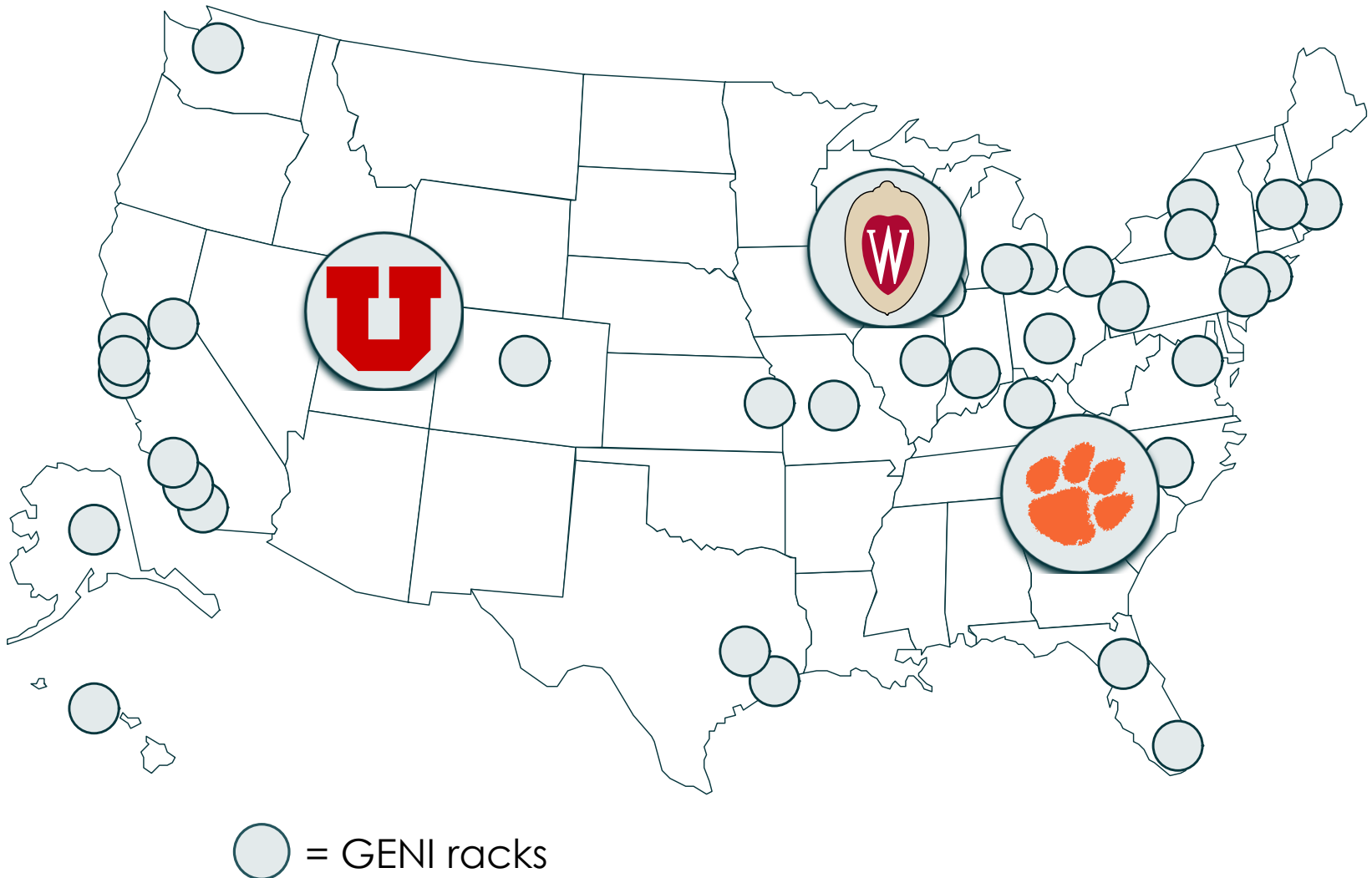
CloudLab for GENI Users

- Ways GENI users can use CloudLab
  - CloudLab web UI with GENI credentials
  - geni-lib
  - OMNI
  - GENI Desktop – kind of.
  - GENI Portal – partial support.