CI Facilities at the University of Utah and UEN

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Team 1 CI objectives

- Provide coordinated, high-performance information technology resources and services to CI-WATER team and other UT and WY EPSCoR researchers
- Support research data analysis, management, and curation; modeling; and simulation needs
- Tools: computing cycles, data storage, advanced networking, visualization environments, middleware, software libraries, software development, data centers
Related CI investments

- New data center in downtown SLC (2.4 MW) with dedicated research computing space – University of Utah
- New optical network in northern Utah – BONFIRE – with Utah Education Network (UEN)
  - NSF EPSCoR RII C2 award – Corbato, PI
  - UEN’s BTOP award (NTIA/Dept. of Commerce)
SLC Downtown Data Center

- 74,000+ sq ft² former industrial building south of downtown SLC (~4 miles off-campus)
- Designed for enterprise & HPC (2.4 MW)
- Co-location by research groups & partners
- Low industrial electric power rates in Utah
- High desert climate: energy efficiency
- In production early 2012; CHPC co-located
Salt Lake City metro optical network - BONFIRE
BONFIRE extended to USU & BYU
CI-WATER data repository for Big Data

- We moved away from our previous file storage system due to software reliability and performance issues – implementation delayed

- Acquired 1 Petabyte usable space (~$230/TB – Dell) and made available mid-2013
  - Includes Data Transfer Nodes (DTNs)
  - Archive tape capability added in 2014 – 690 TB

- Critical support for CI-WATER atmospheric modeling work of Court Strong

- Close coordination with another campus Big Data project
  - Partnered with Adam Bolton (Physics & Astronomy) to support Utah’s role as the U.S. data management site for Sloan Digital Sky Survey 4 (SDSS-4) – 175 TB
• Shared data repository among CI-WATER and iUTAH institutions
• Supports both fast I/O computation and long-term data archiving
• Hosted at UofU DDC
• Leverages high-speed, secure data transfer nodes (DTNs) as advocated by NERSC and ESnet
• Uses Globus toolset
Three subsequent major NSF awards

- CC-NIE Integration project: Science Slices
  - Corbato, PI, University of Utah (ACI-1341034)

- CloudLab open cloud computing platform testbed
  - Rob Ricci, PI, University of Utah (CNS-1419199)

- ACI-REF – Univ. of Utah is one six pilot participants
  - Jim Bottum, PI, Clemson (CNS-1338155)
1) Building a **dynamic Science DMZ on top of an SDN-based framework (GENI)**

2) Extending slices to key campus labs, HPC center, and the Honors residential community

3) Working closely with central IT, campus IT Governance, and Utah Education Network

**Target areas:**
- Molecular dynamics
- Astrophysics data
- Genomics
- Network/systems research
- Honors students

**Leverages new infrastructure:**
- Downtown Data Center
- Utah Optical Network (BONFIRE)
- NSF MRI for novel cluster (Apt)
- Campus Net Upgrade
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: 4GB 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 (OF 1.0)

Clemson

- High-memory
- 16 GB RAM / core
- 16 cores / node
- Bulk block store
- Net. up to 40Gb
- High capacity
- Dell (OF 1.0)

Utah

- Power-efficient
- ARM64 / x86
- Power monitors
- Flash on ARM6s
- Disk on x86
- Very dense
- HP (OF 1.3)
ACI-REF project: Condo of Condos

NSF #CNS-1338155 – PI: Jim Bottum, Clemson

ACI-REF campus research computing centers are federating to share resources – both human and computational

Also all connect to the Internet2 Layer 2/3 Network at 100G
Next steps and sustainability

- Complete final year expansion of data archive and related systems (with USU)
- Continue HPC partnership with Univ. of Wyoming
- Complete HPC consolidation with Utah State Univ.
- Work with UEN to expand BONFIRE optical network in northern Utah as needed to support demand
- Partner with Marriott Library for campus research data management program
- Leverage NSF CloudLab award for new capabilities to support combined atmospheric/hydrological research
- Leverage NSF ACI-REF approach for federating campus research computing centers for shared user services and resources and more standardized operations