CHAMELEON: A LARGE-SCALE, RECONFIGURABLE EXPERIMENTAL ENVIRONMENT FOR CLOUD RESEARCH

Principal Investigator: Kate Keahey

Presented By Joe Mambretti, Director,
International Center for Advanced Internet Research, Northwestern University
Metropolitan Research and Education Network (MREN)
Executive Committee Meeting
National Center for Supercomputing Applications (NCSA)
Urbana Illinois
August 20 2015
CHAMELEON: A POWERFUL AND FLEXIBLE EXPERIMENTAL INSTRUMENT

- Large-scale instrument
  - Targeting Big Data, Big Compute, Big Instrument research
  - ~650 nodes (~14,500 cores), 5 PB disk over two sites, 2 sites connected with 100G network

- Reconfigurable instrument
  - Bare metal reconfiguration, operated as single instrument, graduated approach for ease-of-use

- Connected instrument
  - Workload and Trace Archive
  - Partnerships with production clouds: CERN, OSDC, Rackspace, Google, and others
  - Partnerships with users

- Complementary instrument
  - Complementing GENI, Grid’5000, and other testbeds

- Sustainable instrument
  - Industry connections
CHAMELEON HARDWARE

Switch
Standard Cloud Unit
42 compute
4 storage
x2

Switch
Standard Cloud Unit
42 compute
4 storage
x10

Core Services
Front End and Data Mover Nodes

Core Services
3 PB Central File Systems, Front End and Data Movers

Chameleon Core Network
100Gbps uplink public network (each site)

To UTSA, GENI, Future Partners

504 x86 Compute Servers
48 Dist. Storage Servers
102 Heterogeneous Servers
16 Mgt and Storage Nodes

Heterogeneous Cloud Units
Alternate Processors and Networks

SCUs connect to core and fully connected to each other

Chicago
Austin
CAPABILITIES AND SUPPORTED RESEARCH

- Development of new models, algorithms, platforms, auto-scaling HA, etc., innovative application and educational uses
  - *Persistent, reliable, shared clouds*

- Repeatable experiments in new models, algorithms, platforms, auto-scaling, high-availability, cloud federation, etc.
  - *Isolated partition, pre-configured images reconfiguration*

- Virtualization technology (e.g., SR-IOV, accelerators), systems, networking, infrastructure-level resource management, etc.
  - *Isolated partition, full bare metal reconfiguration*
SOFTWARE: CORE CAPABILITIES

- **Persistent Clouds**
  - OpenStack

- **User-Deployed Clouds**

**Pre-configured Image Catalog**
- Bare metal images

**Provisioning, Network, Scheduling and Orchestration**
- Linux Operating System Framework (LosF), (TACC)
- KaDeploy, KaVLAN, OAR2, (Grid’5000)
- Ironic, Neuron, OnMetal (OpenStack, Rackspace)
- Orchestration: Nimbus, Interactive Experiment Management

www.chameleoncloud.org
EXPERIMENT WORKFLOW

- User interface: log in, manage profile
- Find Resources
  - Machine-parsable description (JSON)
  - Versioning (hardware upgrades, etc.)
  - Verification (maintenance, failures, etc.)
- Reserve Resources (browsing vs matching)
- Reconfigure testbed
- Shape experimental conditions
- Monitoring and metrics
  - Including fine-grain and energy monitoring
- Integration with workload generators, simulation, etc.
OUTREACH AND ENGAGEMENT

▶ Early User Program
  ▶ Committed users, driving and testing new capabilities, enhanced level of support

▶ Chameleon Workshop
  ▶ Annual workshop to inform, share experimental techniques solutions and platforms, discuss upcoming requirements, and showcase research

▶ Advisory Bodies
  ▶ Research Steering Committee: advise on capabilities needed to investigate upcoming research challenges
  ▶ Industry Advisory Board: provide synergy between industry and academia
PARTNERSHIP WITH GENI COMMUNITY

- Chameleon Will Enable the GENI Virtual Laboratory For Networking and Distributed Systems Research and Education To Extended Significantly With Many New Types of Resources.
- This Blending of Resources Will Enable Investigations Of New Types Of Innovative Highly Distributed Environments at Scale.
- The Architectural Options For Blending Chameleon and GENI Are Being Discussed
EXPERIMENTER RESOURCES

- Unique Deeply Programmable Blending Of Resources.
- Extremely Close Integration (Ideally, Seamless) of Programmable Networks With Programmable Clouds
- A Richly Resourced Platform For Experimentation With Exceptional Novel Architecture.
- Enables the Creation of New, Highly Innovative Distributed Environments, Including Specialized/Customized vs Generic Environments
- Highly Granulated Levels of Experimental Research Control, Measurement, Analytics, Visualization, and Reproducibility.
CURRENT PROJECT SCHEDULE

- **Now**: FutureGrid@Chameleon
- **Winter 2014**: Meetings, Workshops, Planning Discussions
- **Spring 2015**: Maintain the momentum: Initial bare metal reconfiguration available on FutureGrid UC&TACC resources for Early Users
- **Summer 2015**: New hardware: large-scale homogenous partitions available to Early Users
- **Fall 2015**: Large-scale homogenous partitions generally available
- **2015/2016**: Refinements to experiment management capabilities
- **Fall 2016**: Heterogeneous hardware available
TEAM

Kate Keahey
Chameleon PI
Science Director

Joe Mambretti
Programmable networks

DK Panda
High-performance networks

Paul Rad
Industry Liason

Dan Stanzione
Facilities Director

Warren Smith
Director of Operations

www.chameleoncloud.org
PARTING THOUGHTS

- Large-scale, responsive experimental testbed
  - Targeting critical research problems at scale
  - Evolve with the community input
- Reconfigurable environment
  - Support use cases from bare metal to production clouds
  - Support for repeatable and reproducible experiments
- One-stop shopping for experimental needs
  - Trace and Workload Archive, user contributions, requirement discussions
- Engage the community
  - Network of partnerships and connections with scientific production testbeds and industry
  - Partnerships with existing experimental testbeds
  - Outreach activities
- Come visit us at www.chameleoncloud.org!