Chameleon

www. chameleoncloud.org

NEXT GENERATION CLOUDS, THE CHAMELEON CLOUD TESTBED, AND SOFTWARE DEFINED NETWORKING (SDN)

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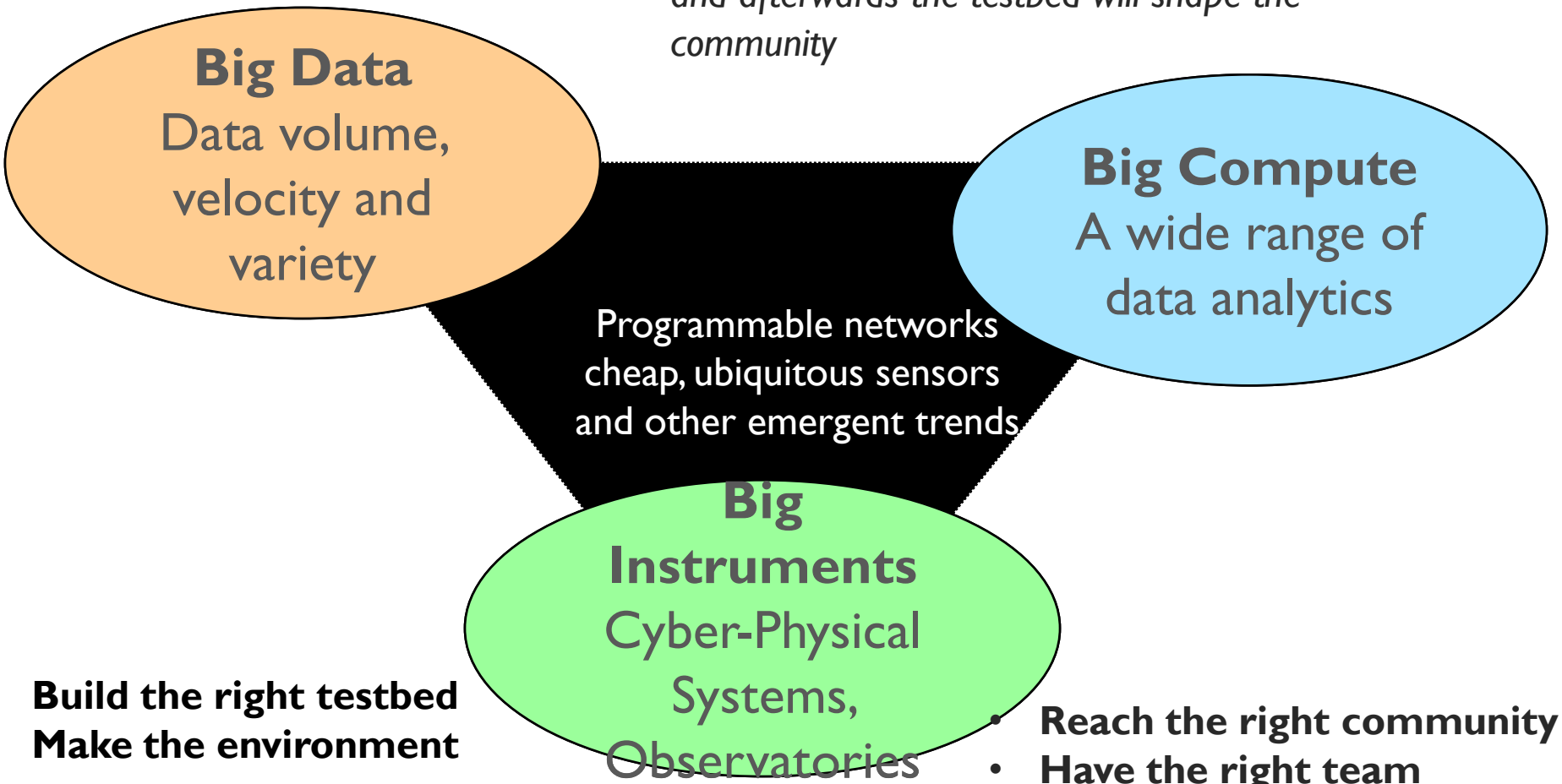
GENI-Network Innovators Community Event

San Francisco, California

November 10, 2015

TESTBED TO SUPPORT THE COMMUNITY'S RESEARCH CHALLENGES

The community builds the testbed, and afterwards the testbed will shape the community



- **Build the right testbed**
- **Make the environment**

- **Reach the right community**
- **Have the right team**

CHAMELEON: A POWERFUL AND FLEXIBLE EXPERIMENTAL INSTRUMENT

- Large-scale
  - Targeting Big Data, Big Compute, Big Instrument research
  - Over 650 nodes, 5 PB disk, 100G network
- Reconfigurable
  - Bare metal reconfiguration, single instrument, graduated approach for ease-of-use
- Connected
  - Workload and Trace Archive, partners with production clouds
- Complementary
  - Complementing GENI, Comet, Wrangler, XSEDE
  - Partnering with GENI, Grid'5000, OCC, OSDC et al (FIRE?)
- Sustainable
  - Strong industry connections
- ***Currently - Number of users is 481 Number of projects is 135.***

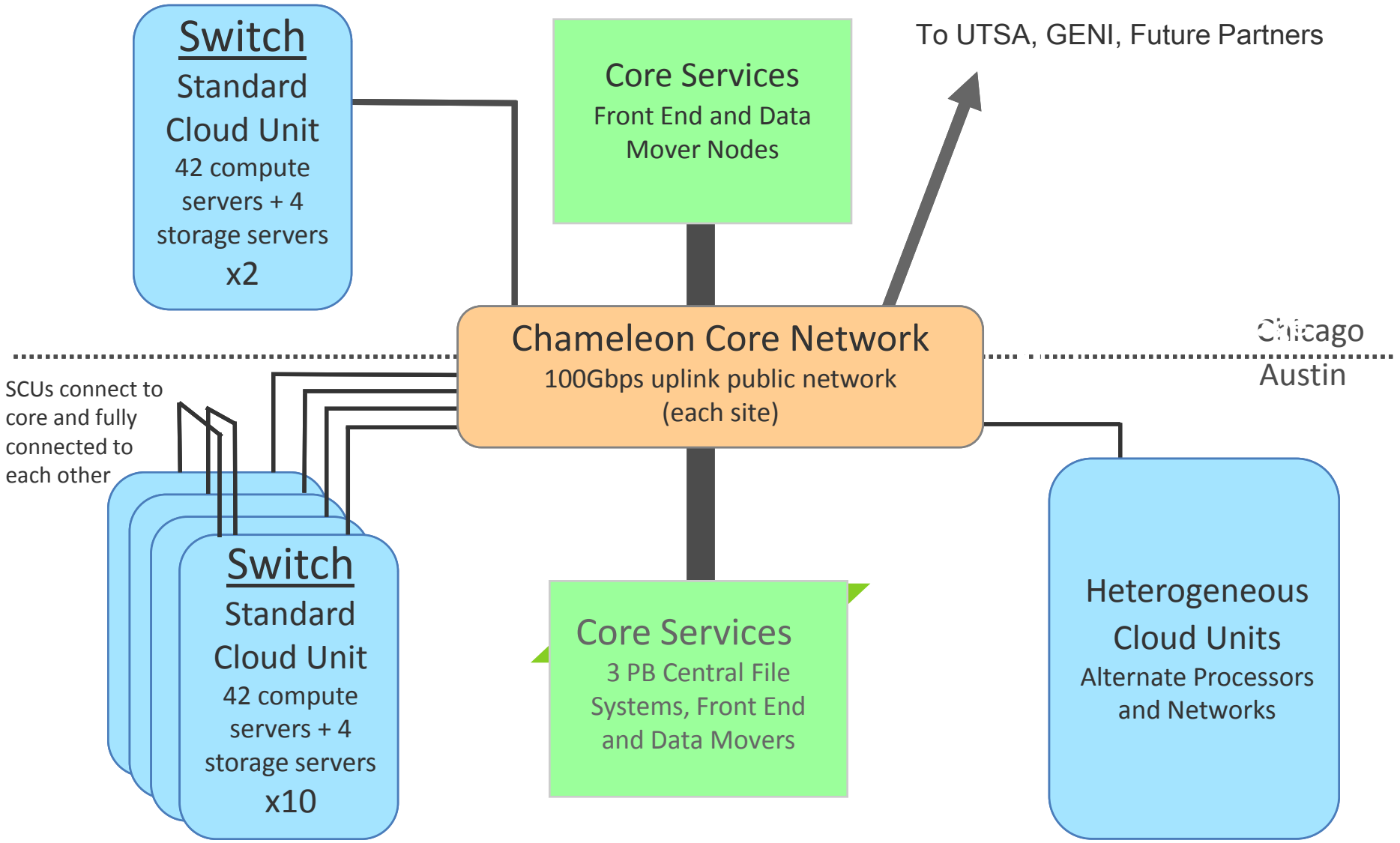
RESEARCH COMMUNITIES AND CAPABILITIES

Users	New models, algorithms, platforms, auto-scaling HA, etc., Application and educational uses	*Persistent, reliable, shared cloud*
Core Researchers and Users	Repeatable experiments in new models, algorithms, platforms, auto-scaling, HA, etc.	*Isolated partition, pre-configured images reconfiguration*
Core Researchers	Virtualization technology (SR-IOV, accelerators, etc.) Infrastructure-level resource management	*Isolated partition, full bare metal reconfiguration*

SUPPORTED APPLICATIONS

- CPS
  - Offloading, muti-criteria trade-off analysis (response time vs cost), auto-scaling, high availability, etc.
- Machine learning, data mining
  - Mix of Big Compute and Big Data simulations and models, design of novel data processing frameworks
- System Software/Virtualization
  - Hypervisors optimizing a range of qualities, SR-IOV, virtualizing accelerators, etc.
- Networking
  - Programmable networks & QoS, refinement and effects of SR-IOV, large dataflows, end-to-end QoS

ARCHITECTURE



SYSTEM SOFTWARE: CORE CAPABILITIES

Users

Persistent clouds
OpenStack

Pre-configured Image Catalog
VM images

Core Researchers and Users

Pre-configured Image Catalog
Bare metal images

Core Researchers

Provisioning
LosF (TACC)
OpenFlow (GENI)

Scheduling
OAR2 (Grid'5000)

Orchestration
Cloudinit.d

CHAMELEON SERVICES AND FEATURES

- User Services
  - Allocation management through reservations, automatic image deployment
  - Dedicated Web portal for reservations, docs, stats, etc.
- Experiment Support
  - Trace and Workload Archive
  - Experiment enhancement (e.g., load generators)
- Additional Features
  - Reconfigurable, connected instrument
  - Development-focused approach
  - Ease-of- use: one stop shopping for experimental needs
  - Distinct from off-the-shelf cloud services
  - Code ownership and collaboration

NETWORKING CAPABILITIES

- Expose SDN, OpenFlow, etc. to users
  - Isolation
  - Hybrid Network Capabilities
  - Programmable Topologies
  - Integration With Other Resources Within and External to the Testbed
- Pushing 100G Networks To Their Limit
  - Using 100G + SDN Optimally
  - Chameleon appliances and services allow experimenters a highly granulated view into -- and control -- over traffic flows
- Integration/Federation with GENI (Et Al…*N Testbeds)
- Within Common Policy Context

PARTNERSHIP WITH GENI COMMUNITY

- Chameleon Enables 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.

GENI-CHAMELEON FEDERATION

- Federation: ~ Identity Federation (Authentication/Authorization)
- Goal: Experiments Should Be Able To Log Into Either The GENI or Chameleon Environments Through a Federated Identity Mechanism.
- After An Experimenter Logs In, Portals Should Be Able To Identify the Groups And Or Projects In Which That Experimenter is a Member To Verify Access To Resources That Belong To Specific Projects.

GENI AND OPENID: PHASE 1

- GENI Currently Supports an OpenID Provider (OP) Through Which Identity Can Be Federated to Services.
- The Phase 1 Implementation is Thanks to *Matthew Hanlon* of TACC
- Phase 1: GENI⇔ Chameleon Federation.
  - Chameleon Has Implemented an OpenID RP To Receive Identity Information From GENI.
  - However, A Project Association Is Required
  - Currently, GENI Experimenters Who Would Like To Use Chameleon Need To Be Added As Members Of the "GENI/Chameleon Federation" Project In The GENI Environment.

GENI AND OPENID: PHASE 1 (CONT.A)

- Afterward, When They Are Project Members, Chameleon Resources Are Shown As Available.
- They Can See And Select A “Use-Chameleon” Button That Brings Them To the Chameleon/OpenID Page Where They Will Be Authenticated And Then Automatically Added To The “GENI/Chameleon Federation” Project In the Chameleon Environment.
- Subsequently, They Have Log-In Access to Chameleon OpenStack interface(s) And Can Log Into Chameleon Using Their GENI OpenID directly from the Chameleon Portal.

GENI AND OPENID: PHASE 1 (CONT.B)

- This Project Association Provides A Means To Allow Initial Exploration and Evaluation of the Chameleon Environment By Experimenters
- If The Environment Proves To Be Useful, The Experimenters Can Establish Their Own Chameleon Projects To Enable Larger Scaling of Resources
- Refernce: Subsequent Slides Depicting This Proces, Provided By Matthew Hanlon

PHASE 2

- **Phase 2: Chameleon⇔ GENI Federation**
  - **The GENI Portal Cannot Receive OpenID Federated Identity Information From Another Source (Relaying Party or RP, i.e., Chameleon)**
  - **This Issue Is Being Addressed Through the G⇔ C Federation Project.**
  - **Chameleon Will Soon Implement a Process to Transmit Identity Information to GENI Enable Federation from Chameleon -> GENI**
    - **1. Creating OpenID RP in GENI Portal**
    - **2. Creating OpenID OP in Chameleon Portal**
    - **3. Investigating Potential For Chameleon Shibboleth IdP to log In To GENI (Technique Used By SAVI, Which Uses OpenStack & ShibIdP To Send Project Data From Keystone To LDAP)**

PHASE 3

- Project Federation Between GENI and Chameleon
- A Mechanism Is Required To Enable An Experimenter To Bring a GENI Project to Chameleon
- GENI Designates A “Project Lead” Who Is Manually Approved (e.g., FT Faculty at Accredited Research Institution)

PHASE 4

- Plans Are To Enable GENI Experiments To Reserve And Use Chameleon Resources Without Using The CC User Interface
- This Requires Some Development Activities By The Chameleon Systems Team Addressing Issues At:
  - API Layer
  - Control Plane Layer
  - Orchestration Layer
  - Data Plane Layer
  - SDI Infrastructure Federation
  - Etc

PHASE 5: FEDERATION-AS-A-SERVICE

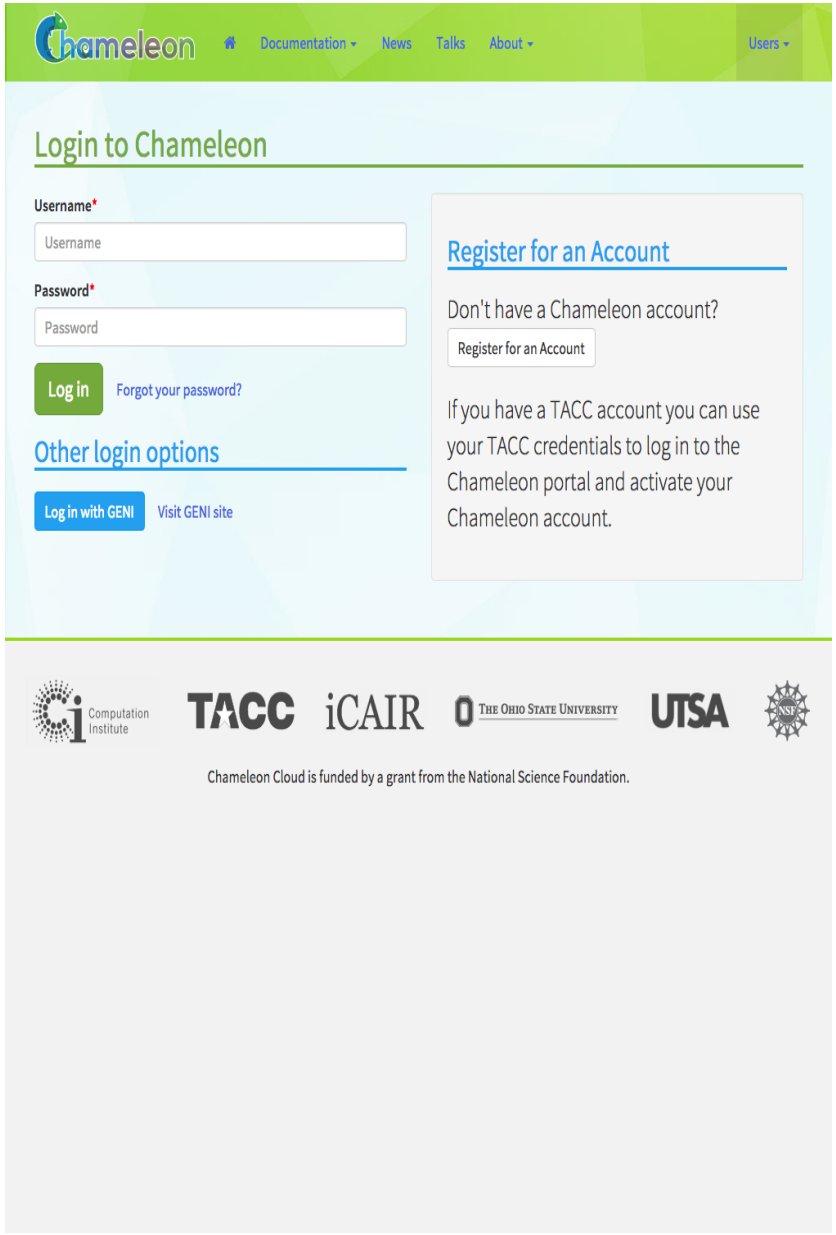
- Federation-as-a-Service
- Generalized Architectural Model For Federation With N Testbeds (GENI, FIRE, Chameleon, CloudLab, OSDC, CERN CT, SAVI, OCX, JGN-X, IOFT, NGN, GTS, and Many Others)
- SDX Implementations (e.g., StarLight SDX) Will Be Key Resources
- An Open Architecture API Would Be Useful
- Also, Mechanisms For Policy Implementation
- Architecture Should Incorporate Options For Policy Based Access to Other SDN Resources
- Policy Architecture For SDN Is Progressing Through Standardization Processes

CHAMELEON-GENI FEDERATION

The initial phase of the Chameleon-GENI Federation supports Identity and Project federation between Chameleon and GENI.

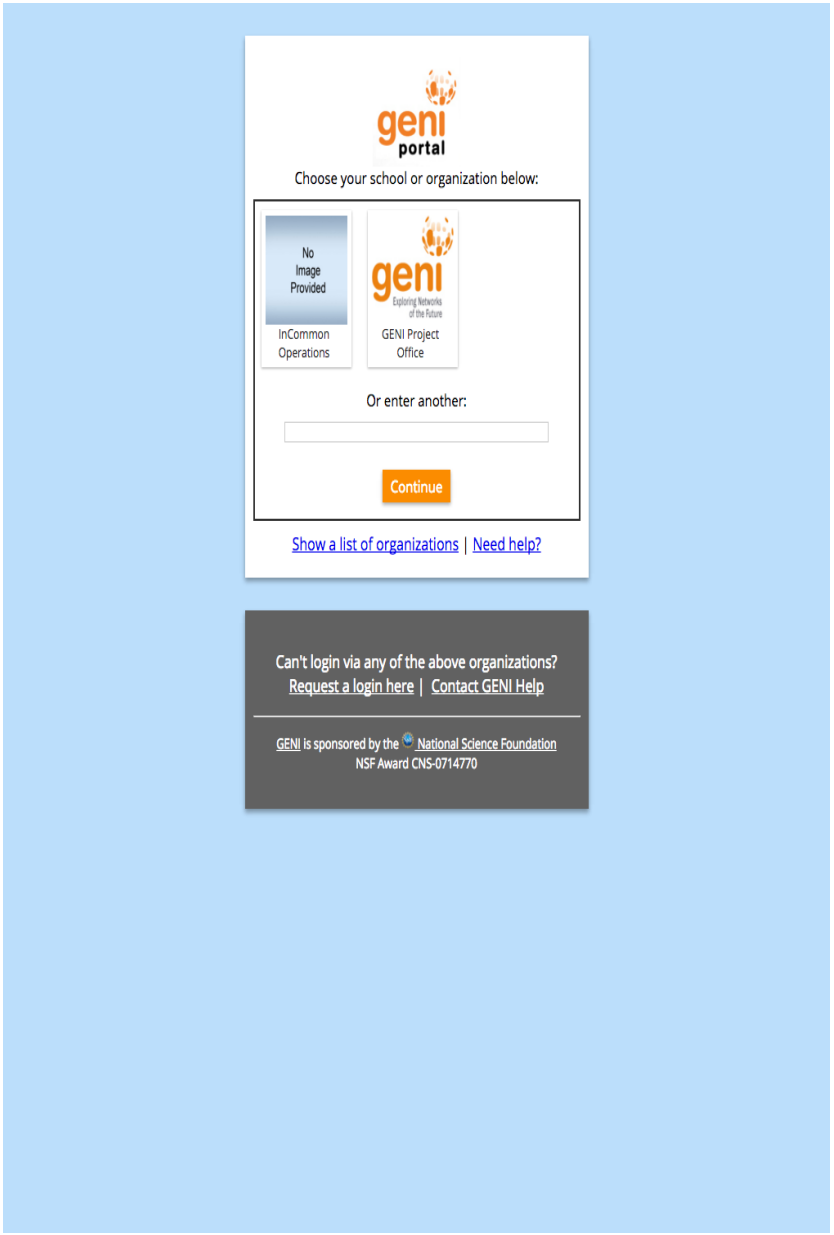
GENI users can log in to the Chameleon Portal using their GENI OpenID credentials.

From the Log In screen, select “Log in with GENI” from under “Other login options”.



CHAMELEON-GENI FEDERATION

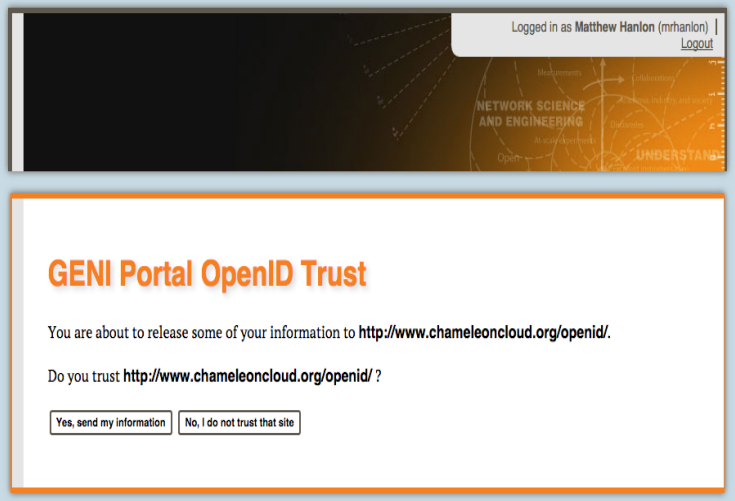
After choosing to Log in with GENI, users are directed to the GENI Portal federated login screen. Users can select their identity provider and log in to GENI as usual.



CHAMELEON-GENI FEDERATION

After successful login, users are asked to confirm that they consent to GENI releasing some information to Chameleon. This information includes:

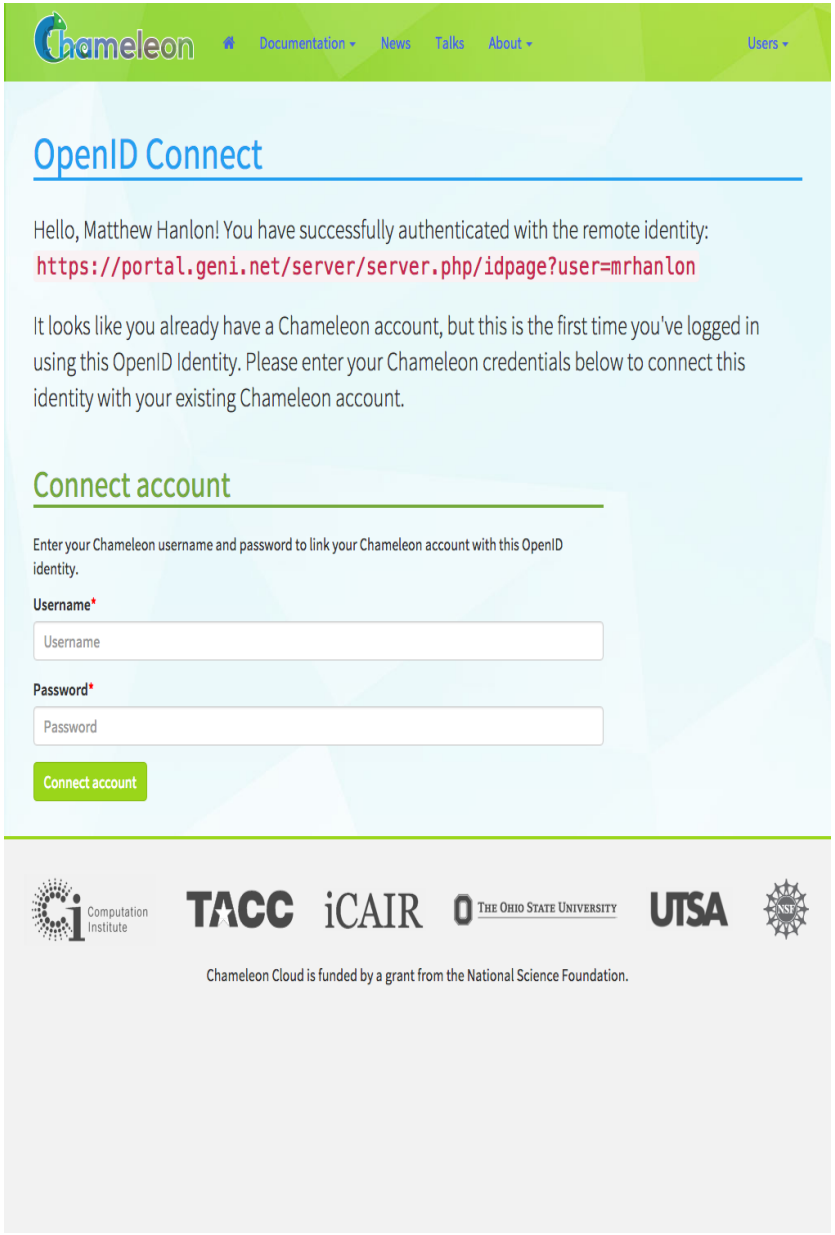
- Full name
- Email address
- GENI username
- GENI project membership



CHAMELEON-GENI FEDERATION

After consenting to information exchange between GENI and Chameleon, users are directed back to the Chameleon Portal.

If this is the first time the user has logged in to the Chameleon Portal using GENI OpenID then the user is prompted to “connect their account”. If the remote GENI user has the same email address as an existing Chameleon user, then the user is prompted to connect their account. If the email does not match then the user can either connect to an existing account to create a new account.



CHAMELEON-GENI FEDERATION

Once the identity connection between GENI and Chameleon is established, the user is logged in.

If the **Chameleon-Federation** project is not in the user's list of GENI projects they are prompted to learn more about the federation and join the **Chameleon-Federation** project on GENI.

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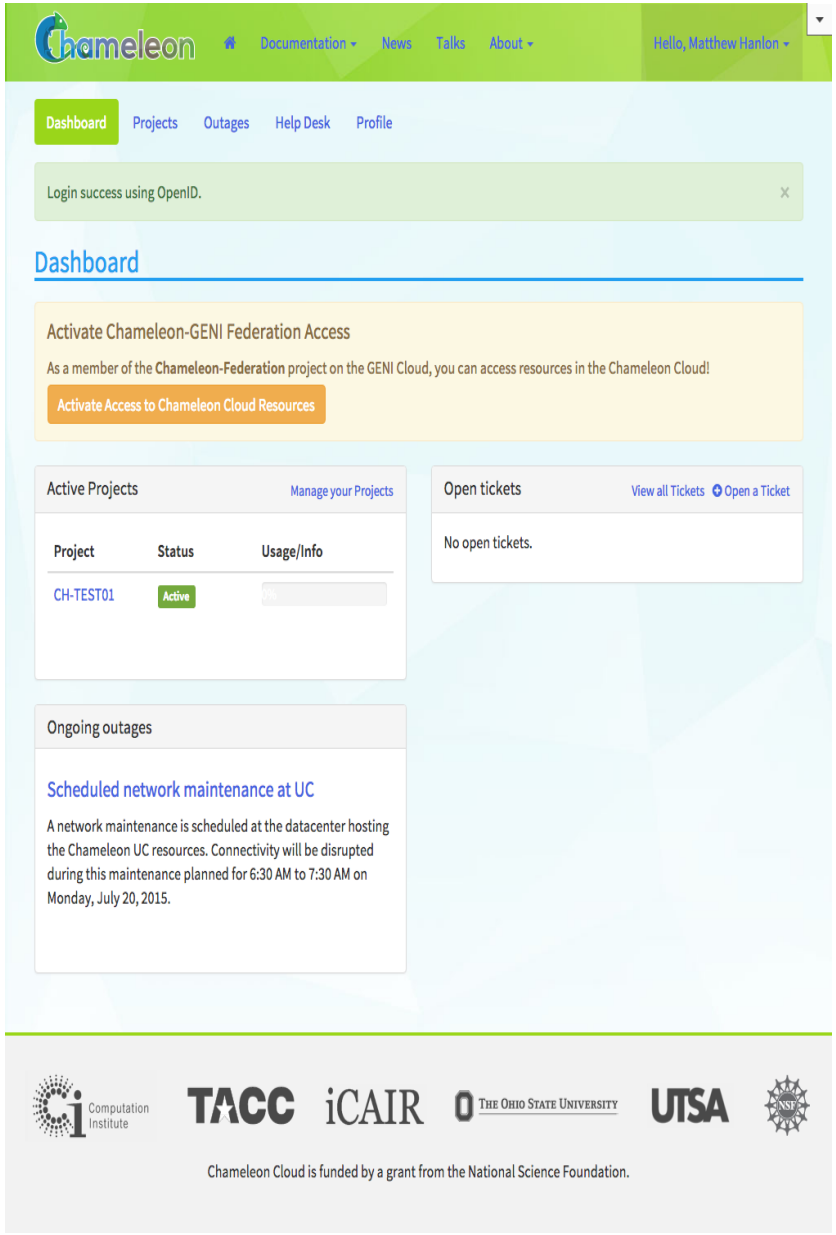
If they are on the GENI project, they can activate access to Chameleon.



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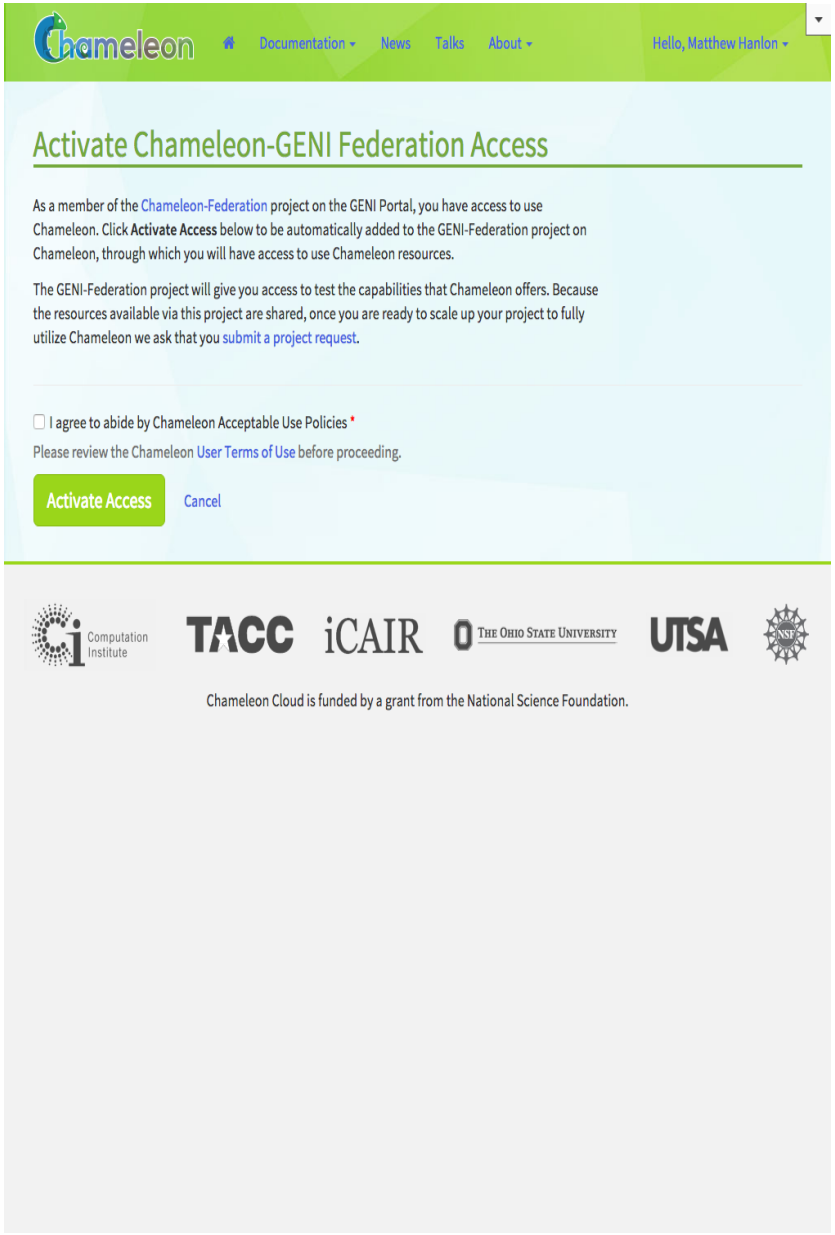
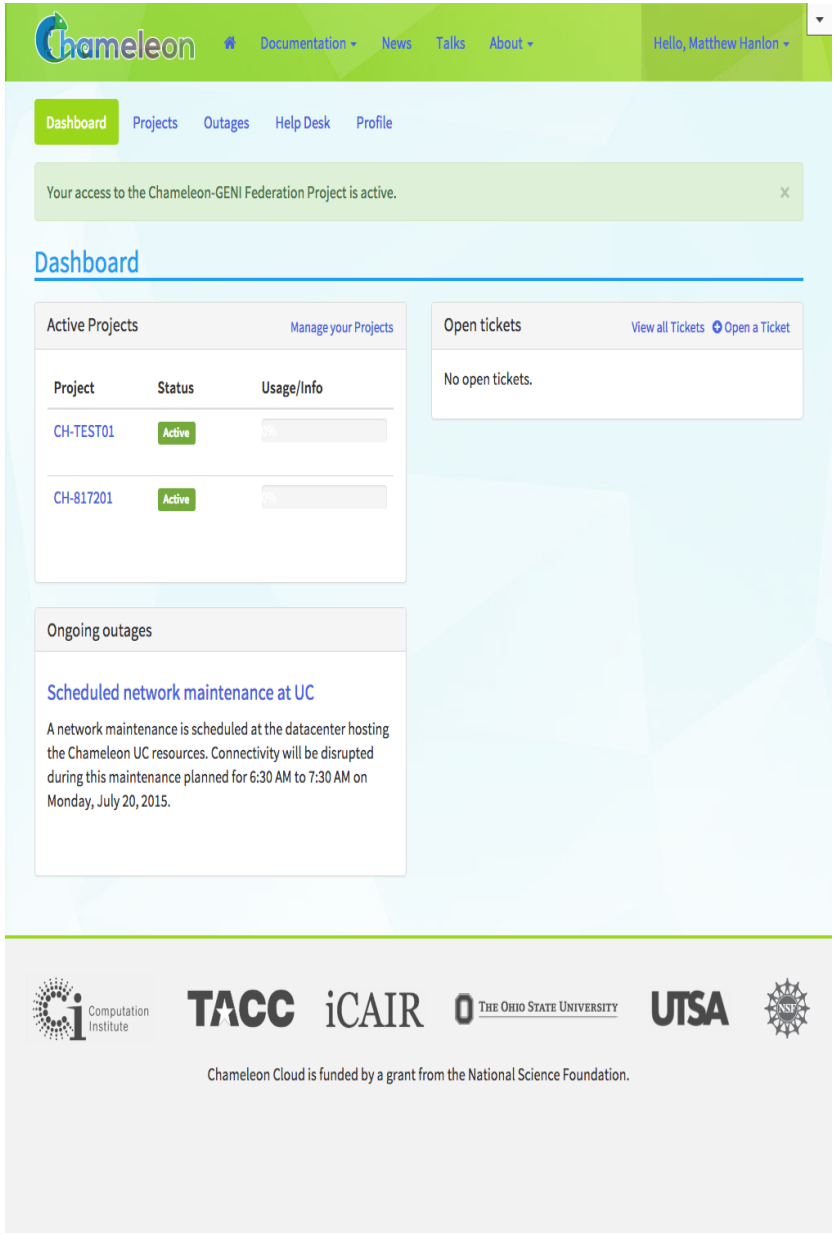


CHAMELEON-GENI FEDERATION

Once active, the project will appear in the users list of Active Projects, and access to launch instances under that project will be available in the OpenStack Dashboard.

After testing out Chameleon using the shared GENI-Federation Project, users who wish to scale up their research experiments on Chameleon should submit a project request in order to acquire more time on the system.



THANKS!