Open Cloud Standards
In The Real World:
Cloud Standards Testing
For Developers

A Project Of the National Science Foundation Cloud and Autonomic Computing Industry/University Cooperative Research Center At Texas Tech University

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Site Director
First, some preliminaries...

What it often looks like when developers encounter standards committees.
What it ought to look like:

(Taken from an actual Cloud Plugfest.)
A New Research Effort
A New Research Effort

Cloud and Autonomic Computing Center
NSF CAC Current Participants:

**CAC Industry Members:**

- Cognizant
- Microsoft
- ERDC
- Stack Velocity
- Happy State Bank
- AVIRTEK
- Xerox
- FIFTH:GEN
- DIANA
- NIMBOXX
- Samsung

**Technical Partnerships:**

- THE AEROSPACE CORPORATION (Existing)
- Cloud Standards Customer Council (Pending)

**Other CAC Sites:**

- Others to come!

**Other CAC University Sites:**

- UF University of Florida
- Rutgers
- University of Arizona
New NSF Award — April 2014

Texas Tech University (TTU) is proposing to be added as a site to the existing I/UCRC for Cloud and Autonomic Computing (CAC). TTU site will focus on cloud standards and standards-based software development innovation. It will extend and enhance the activities of the CAC in areas related to cloud computing best practices and standards research, including standards-based software, development and use of software stacks and reference implementations, and industry applications in real-world settings. TTU site will be working with the largest and most active of the computing-oriented Standards Development Organizations and vendors. The research effort will meet the industry need to organize, classify, develop reference implementations and contribute to the standards-based software in advanced distributed computing. Development of appropriate industry- and community-based consensus standards and application of these methods are required to exploit the capacity for transformative change provided by the new techniques for cloud and other advanced distributed computing. Without coordination on interface standards, algorithms and techniques, many potential advantages of these methods may be compromised due to a chaotic multiplicity of approaches, protocols and application programmer interfaces.

The TTU site will leverage contacts with three outreach-oriented organizations with which TTU site can impact and inform a broad spectrum of clients and stakeholders at all levels of technical skill and business need. These organizations include the Open Cloud Computing Alliance (OCA), Object Management Group (OMG), and the Cloud Standards Coalition (CSC).
Background: Large-Scale Academic Computing

TTU High Performance Computing Center:

- In Top 500
- 3rd in Texas and Big 12
- In Top 100 academic institutions in the world

Supports high-quality academic research across many fields of science, business data analysis and engineering.
Background: Big Data

2005

2014:

Phones: 100+ Gigabytes

Science and Business: 100s to 1000s of Petabytes
Experience:

Related CyberInfrastructure Projects
Experience In Global-Scale Computing

Running jobs: 268149
Transfer rate: 11.38 GiB/sec

OSCON 2014 Open Cloud Day
July 21, 2014
The Role of Standards for Risk Reduction and Inter-operation in XSEDE

XSEDE: The Next Generation of US Supercomputing Infrastructure

Cloud and grid standards now power some of the largest academic supercomputing infrastructures in the world!
Over 13 million service units/day typically delivered as of 2014 across all XSEDE supercomputing sites (about 3 million core hours/day), totaling about 1.6 billion core hours per year.
**XSEDE Services Layer: Simple services combined in useful ways**

- Resource Namespace Service 1.1
- OGSA Basic Execution Service
- OGSA WSRF BP – metadata and notification
- OGSA-ByteIO
- GridFTP
- JSDL, BES, BES HPC Profile
- WS Trust Secure Token Services
- WSI BSP for transport of credentials
- ... (more than we have room to cover here)

**Examples – (not a complete list)**

**Used between supercomputers and all the way to university campuses!**

**Bottom line:** XSEDE represents a demonstration of the effective use of standards to provide interoperability within large-scale supercomputing cyberinfrastructure.
Distributed Across 124 Sites

Open Science Grid currently consists of over 124 geographical sites, operating on a wide variety of computing systems.
Science VOs on the Open Science Grid

• Astrophysics
• Biochemistry
• Bioinformatics
• Earthquake Engineering
• Genetics
• Gravitational-wave physics
• Mathematics
• Nanotechnology
• Nuclear and particle physics

... and many others!
### EGI international presence numbers

<table>
<thead>
<tr>
<th></th>
<th>Value (yearly increase)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CPU cores</strong></td>
<td><strong>361,300 across 53 countries (1.44 M job/day)</strong></td>
</tr>
</tbody>
</table>

#### Storage Value (yearly increase)

<table>
<thead>
<tr>
<th></th>
<th>Disk (PB)</th>
<th>Tape (PB)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Value</strong> (PB)</td>
<td>235 PB (+69%)</td>
<td>176 PB (+32%)</td>
</tr>
</tbody>
</table>

#### Installed compute capacity (HEP-SPEC 06) Yearly increase

<table>
<thead>
<tr>
<th></th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PY1</td>
<td>47.70</td>
</tr>
<tr>
<td>PY2</td>
<td>49.50</td>
</tr>
<tr>
<td>PY3</td>
<td>44.70</td>
</tr>
</tbody>
</table>

### Standards-based international collaboration
EGI Federated Cloud: a successful standards-based international federated infrastructure

Members
- 70 individuals
- 40 institutions
- 13 countries

Stakeholders
- 23 Resource Providers
- 10 Technology Providers
- 7 User Communities
- 4 Liaisons

Technologies
- OpenStack
- OpenNebula
- StratusLab
- CloudStack (in evaluation)
- Synnefo
- WNoDeS

Standards
- OCCI (control)
- OVF (images)
- X.509 (authN)
- CDMI (storage - under development)

An international standards-based federated cloud infrastructure:
In production, in use and growing!

Credit: David Wallom
Chair EGI Federated Cloud Task Force

(Updated July 2014)
Federated Cloud architecture

Open to new members: Join as user, or as an IaaS/PaaS/SaaS service provider: [http://go.egi.eu/cloud](http://go.egi.eu/cloud)
Examples of CAC@TTU Involvement In Cloud Standards Testing
SAJACC Phase II
Use Case Definition and Testing Project for
Cloud Standards, APIs and Cloud Software
Product Implementations

US NIST SAJACC Working Group
Alan Sill, TTU and Eugene Luster, R2AD, co-chairs

NIST Cloud Computing and Mobility
Forum and Workshop

March 25, 2014
NIST SAJACC Public Process

Standards Acceleration to Jumpstart the Adoption of Cloud Computing

Description

The goal of the SAJACC initiative is to drive the formation of high-quality cloud computing standards by providing worked examples showing how key use cases can be supported on cloud systems that implement a set of documented and public cloud system specifications. The SAJACC initiative will develop and maintain a set of cloud system use cases through an open and ongoing process engaging industry, other Government agencies, and academia. Simultaneously, the SAJACC initiative will collect and generate cloud system specifications through a similarly open and ongoing process.

The SAJACC initiative will develop tests that show the extent to which specific use cases can be supported by cloud systems that implement documented and public cloud system specifications, and will publish test results on the SAJACC web portal (this web site). The SAJACC web portal will provide pointers to known cloud system implementations, use case documents, upcoming events, and will also provide a convenient means to provide feedback to the SAJACC team. These resources will serve to both accelerate the development of high-quality cloud computing standards and reduce technical uncertainty during the interim adoption period before many cloud computing standards are formalized.

Objectives

Mailing List and Meeting Information

Weekly SAJACC working group meetings will be held as teleconferences. Meeting discussion materials and meeting minutes are posted to this site as they become available.

The dial-in information for the bi-weekly meeting series is as follows:

- Phone: (Toll Free) +1 (855) 834-4868
- Conference ID: 7398039

The URL for the web conference tool for the meeting is: http://webconf.soaphub.org/confroom/sajacc

Coordinators and contacts:

SIENA (2010-2012) was a Support Action funded by the European Commission under FP7 (2007-13) Capacities programme. This project created the ongoing “CloudScape” conference series and led to other related projects, such as CloudWatchHub and the CloudScout effort aimed at enhancing the adoption of cloud methods by SMEs.

A coordinated effort...

...towards the delivery of a future e-Infrastructures Roadmap....

...aligned with the needs of European and national initiatives and the evolving world.
Cloud Interoperability Testbed

Abstract

The Cloud Interoperability Testbed will serve as a mechanism to host interoperability tests for different machine control, data transfer, resource reporting and usage agreement standards and implementations of other new standards efforts. The primary purpose will be to give developers an opportunity to try out implementations of code that implements either server or client functionality for the use of multiple standards from different standards development organizations. The initial effort for this project will be focused on implementations of the Open Cloud Computing Interface (OCCI) from the Open Grid Forum (OGF), Cloud Data Management Interface (CDMI) from the Storage Network Industry Association (SNIA), the Cloud Infrastructure Management Interface (CIMI) and the Open Virtualization Format (OVF) from the Distributed Management Task Force (DMTF). Other standards will be added as the project proceeds.

View Project Details

Intellectual Merit

A large amount of effort is being expended by multiple organizations to develop standards in the area of distributed computing, spanning many specific topics ranging from advanced networking control to infrastructure management to data transfer and packaging protocols. In the absence of a common framework in which these can be tested, development activities for implementations of such standards are necessarily fragmented and limited to those chosen by a particular development team. The use of a virtualized space made available through FutureGrid provides a range of opportunities to streamline tests and coordinate activities to promote common use and interoperability of code written.
CAC@TTU
Project Areas
Target Cloud Standards-Related Organizations:

- It is often said that there are “too many standards organizations”. This is a lot like saying there is “too much software”.
- Each has its own area of specialty, its own contributor base, and its own method of funding to develop its work products.
- CAC will study products and effectiveness of each of these organizations.
Initial CAC@TTU Project Areas

1. Product and Standards Testing
   • Cloud Performance Testbed
   • Cloud Standards Testbed
   • Cloud Interoperability Testbed
   • Cloud Security Testbed <— (Future)

2. Design Labs
   • Storage Design and Testing Lab
   • Network Design and Testing Lab

3. Developer Events
   • Cloud Plugfest Series
   • Participation in technical partner events
   • Organization of and participation in conferences

CAC@TTU is new!
• More coming…
Cloud Standards Testbed
Cloud Performance Testbed
Cloud Interoperability Testbed
Cloud Tester Benchmark Suite

* (In cooperation with The Aerospace Corporation and other CAC partners)
Cloud Plugfest Developer Series:

Continuing series…

Oriented towards REAL DEVELOPMENT

Past events co-sponsored by many open source and standards-related organizations including:

OGF, DMTF, SNIA, OASIS, ETSI, OCEAN and OW2

About Cloud Plugfests

The Cloud Interoperability Plugfest project (or “Cloud Plugfests” for short) is a co-operative community series designed to promote interoperability efforts on cloud-based software, frameworks, and standards among vendors, products, projects and implementations. The series supports ongoing and continuing interoperability efforts among and between the sponsoring organizations, and with the cloud community at large. These efforts include organized software demonstrations, in-person developer gatherings, and continuous access to professional-grade cloud testing frameworks and tools.

The 10th Cloud Plugfest will take place as part of the Cloud Interoperability Week to occur September 16-20, 2013 sponsored by the Distributed Management Task Force (DMTF), European Telecommunications Standards Institute (ETSI), the Organization for the Advancement of Structured Information Standards (OASIS), the Open Cloud for Europe, Japan and beyond (OCEAN) project (OCEAN), the Open Grid Forum (OGF), the O2W global open source community and the Storage Networking Industry Association (SNIA). These standards organizations and open-source communities are joining forces to promote access to information regarding standards-compliant interoperable cloud solutions and their implementation through this developer-oriented multi-featured event.

Click here to learn more about the September 2013 Cloud Interoperability Week!

Continuing our long-standing pattern of providing multiple convenient opportunities for participation, remote participation by registrants from other organizations and locations is supported at Cloud Plugfests, subject to the conditions of the participation agreement.

Developer-oriented in-person standards and software testing series

Cloud Plugfest 11 just completed!

More events in planning pipeline.

Easy to get involved and join in events as developers or project researchers

http://cloudplugfest.org

Cloud Plugfest 11 just completed!
CAC
Cloud Standards
Testing and
Implementation Projects
Testing Cloud-Oriented Use Cases

- Builds on results of publicly accessible documents and forums for general interoperability testing, in addition to internal ones that may be set up by companies and US agencies.

- Up to now these have mostly been approached piecemeal.

- CAC is carrying out an organized project within the center to extend these techniques into tools that can be used for formal support of cloud conformance, interoperability and requirements acceptance testing on an ongoing basis.

- This project builds on previous public efforts such as SAJACC.

- Our plan is to work with and contribute to public processes in open settings while creating conditions in which our expertise and value can be applied for center members to cloud standards and product testing.
Current Standards Being Tested

- **Cloud Data Management Interface (CDMI)** from the Storage Networking Industry Association (SNIA). (Reference implementation available.)

- **Open Cloud Computing Interface (OCCI)** from the Open Grid Forum (OGF). (Many implementations available.)

- **Cloud Infrastructure Management Interface (CIMI)** and **Open Virtualization Format (OVF)** from the Distributed Management Task Force (DMTF). (CIMI implementations just becoming available; OVF implementations well established.)

- **Topology and Orchestration Specification for Cloud Applications (TOSCA)** from the Organization for the Advancement of Structured Information Standards (OASIS). (Several implementations available.)

- Others under active evaluation.
Experienced university-based researchers carrying out projects with real-world applicability that draw on decades of experience and the best, newest techniques. Publication oriented, but available for practical member-driven projects. Full university support from TTU and other participating CAC university sites.
Many University Researchers, Deep Expertise

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Links For Further Information and To Join:

- NSF Cloud and Autonomic Computing Center main site: http://nsfcac.org
- CAC@TTU information and membership materials: http://www.depts.ttu.edu/cac/
- Cloud Plugfest developer series: http://cloudplugfest.org
- Cloud standards organization compilation: http://cloud-standards.org
- NSF CAC@TTU contact email: cac.info@ttu.edu