CCICI Cloud
Standards and Interoperability
Dr. Dinkar Sitaram
PES University
Agenda

• Why Interoperability
  – Especially in India

• Current Interoperability efforts
  – ISO
  – IEEE P2302

• Our efforts
WHY INTEROPERABILITY
Current State of Interoperability

Fred was rapidly getting the message that his cloud solution may need more thought.
Current State of Interoperability

It had been a great party but it was really starting to catch up with Fred and his team.
Intercloud Apps: The Next Revolution
After the Internet & Internet Apps

IT Returns

IT Dept
Cloud

Overload Burst

Other Cloud

Customers: Reduce cost,
less migration resistance
- NIST: Interop key
requirement for US Govt
Cloud

Vendors: Expand market:
less migration resistance

Avoid vendor lock-in

Why Interoperability?

Interoperability Today

Customers: New Intercloud
Applications

Vendors:
- Expand market – New applications
- Reduced dev costs – Coopetetive
development

Aadhar check

Police check

AADHAAR

rackspace

Google

Microsoft Azure

Amazon Web Services

Center for Cloud Computing and Big Data, PES University
Government is fueling the adoption of CLOUD
Why India?

Our scale requires us to use cloud

An opportunity to leapfrog in technology
Joint Task Force to Develop Cloud Interoperability and Cloud Standards has been set up

- Non-profit society
- Collaborative platform
  - Academia
  - Government
  - Industry
- Mission: Foster growth of cloud computing
- Important initiatives
  - White paper
  - Advisory role to govt
  - Meity-CCICI Cloud Study
  - Interoperability task force

• Under DoT
• Developing and promoting India-specific requirements
• Standardizing solutions for meeting these requirements
• Contributing these to international standards
CURRENT INTEROPERABILITY EFFORTS: ISO AND IEEE-NIST
Highlights of ISO IEC 19941

• Goals
  – Establish common understanding
  – Establish common vocabulary

• Approach: Define facet model
  – Cloud Interoperability
  – Cloud Application portability
  – Cloud Data portability
Highlights of ISO IEC 19941

- **Cloud Interoperability facets**

<table>
<thead>
<tr>
<th>Facets</th>
<th>Aim</th>
<th>Objects</th>
<th>Requirements</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transport</td>
<td>Data transfer between systems</td>
<td>Signals</td>
<td>Protocols of data transfer</td>
<td>REST-based HTTP/S, MQTT</td>
</tr>
<tr>
<td>Syntactic</td>
<td>Receive data in an understood format</td>
<td>Data</td>
<td>Standardized data exchange formats</td>
<td>JSON, XML, ASN.1</td>
</tr>
<tr>
<td>Semantic data</td>
<td>Receive data using an understood data model</td>
<td>Programmatic interface</td>
<td>Common interpretation of data model</td>
<td>OData, shared understanding and meaning, OWL</td>
</tr>
<tr>
<td>Behavioural</td>
<td>Obtain expected outcomes to service requests</td>
<td>Information</td>
<td>Behavioural models for the cloud service</td>
<td>UML models, pre and post conditions, constraint specifications</td>
</tr>
<tr>
<td>Policy</td>
<td>Assurance that interoperating systems follow applicable regulatory and organizational policies</td>
<td>Regulatory and organizational polices and interoperation context</td>
<td>Conditions and control for use and access</td>
<td>Customer security policies, restriction on cross-border data transfer, regulations controlling PII</td>
</tr>
</tbody>
</table>
### Highlights of ISO IEC 19941

- **Cloud Interoperability facets**

<table>
<thead>
<tr>
<th>Facets</th>
<th>Aim</th>
<th>Objects</th>
<th>Requirements</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transport</td>
<td>Data transfer between systems</td>
<td>Signals</td>
<td>Protocols of data transfer</td>
<td>REST-based HTTP/S, MQTT</td>
</tr>
<tr>
<td>Syntactic</td>
<td>Receive data in an understood format</td>
<td>Data</td>
<td>Standardized data exchange formats</td>
<td>JSON, XML, ASN.1</td>
</tr>
<tr>
<td>Semantic data</td>
<td>Receive data using an understood data model</td>
<td>Programmatic interface</td>
<td>Common interpretation of data model</td>
<td>OData, shared understanding and meaning, OWL</td>
</tr>
<tr>
<td>Behavioural</td>
<td>Obtain expected outcomes to service requests</td>
<td>Information</td>
<td>Behavioural models for the cloud service</td>
<td>UML models, pre and post conditions, constraint specifications</td>
</tr>
<tr>
<td>Policy</td>
<td>Assurance that interoperating systems follow applicable regulatory and organizational policies</td>
<td>Regulatory and organizational policies and interoperation context</td>
<td>Conditions and control for use and access</td>
<td>Customer security policies, restriction on cross-border data transfer, regulations controlling PII</td>
</tr>
</tbody>
</table>
## Highlights of ISO IEC 19941

- **Cloud Data Portability Facets**

<table>
<thead>
<tr>
<th>Facets</th>
<th>Aim</th>
<th>Objects</th>
<th>Requirements</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data syntactic</td>
<td>Receiving data in a machine readable, structured and commonly used format</td>
<td>Data</td>
<td>Common machine-readable data format</td>
<td>XML, CSV, JSON</td>
</tr>
<tr>
<td>Data semantic</td>
<td>Assured meaning of data and ontologies</td>
<td>Data schemas and ontologies</td>
<td>Mutually understood ontologies and metadata</td>
<td>OWL, Dublin Core schema</td>
</tr>
<tr>
<td>Data policy</td>
<td>Adhering to all applicable regulations and organizational policies</td>
<td>Regulatory and organizational policy</td>
<td>Agreed set of applicable regulations and organizational policies</td>
<td>Confidentiality levels, privacy rights, cross border transfer</td>
</tr>
</tbody>
</table>
IEEE-NIST P2302 Objectives

- Create cloud provider ecosystem
  - Transparent to users and applications
- Dynamic infrastructure to support evolving business models
- Infrastructure for economic audit and settlement
  - In addition to the technical issues
Federation in a Nutshell

- User (Org. A) discovers and invokes services in Org. B
- Org. B Service Providers
  - Validate Org. A credentials
  - Make correct access decisions
- User in one Regulatory Environment discover federated resources from resource catalog of Federation Broker using its Identity.

- User invokes required services that belongs to other Regulatory Environment which is part of Federation.

- Other Regulatory Environment validates this user credentials and decides on grant/denial of resources based on role and access policies.

Architecture: User-to-Cloud Federation

Similar to having SIMs for different countries say India and US
- User in one Regulatory Environment requests for resources from the cloud of which he is a part of.

- CSP can serve the request from its resources or from CSP of other Regulatory Environment by connecting via Cloud Broker.

- Other Regulatory Environment validates the resource requesting CSP and decides on grant/denial of resources based on role and access policies.

Similar to calling local network operator who forwards call to other operator

Architecture: Cloud-to-Cloud Federation
Deployment Models

- Simple, Pair-wise Federation
- Centralized, Trusted Third-Party
- Hierarchical Federation (not shown)
- P2P Federation
- Gateway Federation
Our Approach

• Look at global efforts
  – ISO
  – IEEE-NIST Intercloud

• Identify value proposition of standards
  – For customers
  – For vendors
  – For Government

• Identify gaps
Our Approach

- Identify important India-specific use cases
  - IaaS, PaaS, SaaS use cases
- Current use cases
  - IaaS: eGovernance
  - SaaS: Smart Cities
- Define standards
- Setup Interoperability Test Bed
CONCLUSIONS & Next Steps

Collaborative Innovation
Leadership
OpenForum >> Outcomes


SAGE SCENARIOS, PLATFORMS & INFRASTRUCTURE, ENABLEMENT FRAMEWORK

Driven by volunteers

DOES THIS INTEREST YOU?
HERE IS HOW YOU CAN PARTICIPATE AS A COLLABORATOR
– Join a WG, Innovation Task Force

Leadership

In collaboration with industry, academia, government, professional bodies

OpenForum >> Outcomes

In Global Forums & Accelerating deployment & adoption

SMART: Measures of success, Evaluation Framework

Working Groups, Discussion Forums, Fortnightly updates

DOE PASSION FOR TECHNOLOGY, SPIRIT OF GIVE BACK

DOES THIS INTEREST YOU?
HERE IS HOW YOU CAN PARTICIPATE AS A COLLABORATOR
– Join a WG, Innovation Task Force
WE SHOULD JOIN THE INDUSTRY CONSORTIUM THAT'S PROMOTING CLOUD COMPUTING STANDARDS.

RUN THAT PAST THE CONSORTIUM APPROVAL REVIEW BOARD AND GET A SIGN-OFF FROM THE EXECUTIVE BOARD OF REVIEW BOARD REVIEWERS.

DO THOSE EXIST?

IN A PERFECT WORLD, YES.