Enhanced Cloud Architectures to Enable Cross-Federation

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Introduction

- Cloud federation is the process of interconnecting the cloud computing environments of two or more service providers to create a uniform environment spanning public and private clouds.

- Cloud federation enables consistency and access controls when different clouds share authentication, computing resources, command and control, or access to storage resources.
Current Scenario

- **Stage 1: Monolithic clouds**
  Eg. Amazon, Google, Microsoft

- **Stage 2: Vertical Federation**
  Cloud providers will leverage cloud services from other providers. Eg. Cloud federation using middleware such as Eucalyptus, Nimbus etc

- **Stage 3: Horizontal Federation**
  Cloud providers will federate themselves to gain economies of scale and an enlargement of their capabilities. Eg. services such as FutureGrid & EGI Federated Cloud?
Cross Cloud Federation

- Foreign Cloud A
  - Virtualization Resources
  - Virtual Resources placed in Foreign Cloud A and placed in its virtualization infrastructure
  - Virtual Resources used by Foreign Cloud A and rent to Home Cloud
  - Cross-Cloud Federation (Stage 3: Horizontal Federation)

- Home Cloud
  - Virtualization Resources
  - Virtual Resources owned by Home Cloud and placed in its virtualization infrastructure

- Foreign Cloud B
  - Virtualization Resources
  - Virtual Resources placed in Foreign Cloud B and rent to Home Cloud
  - Virtual Resources used by Foreign Cloud B and placed in its virtualization infrastructure

- Enterprice
- Government End-user
Cross Cloud Federation

- **Home cloud**
  - Already provides services to other clouds (stage 2)
  - Can’t instantiate more VMs due to lack of resources.
  - Forwards federation requests to other foreign clouds to host its VM on their infrastructure (stage 3)

- **Foreign cloud**
  - Leases part of storage and computing capabilities of its virtualization infrastructure to home clouds

- A cloud provider can be both home cloud and/or foreign cloud at the same time.
Cross-Cloud Federation Manager

- Adds an additional communication layer on the top of the existing architecture
3 phase cross-cloud federation model

• Discovery

The home cloud looks for other available clouds using p2p approach based on presence detection.

Follows publish and subscribe software pattern (using centralized repository)

Implemented using the concept of IM service using XMPP(Extensible Messaging and Presence Protocol)
3 phase cross-cloud federation model

• Match making

Home cloud selects other clouds which best meets its requirements based on CPU, RAM, QoS etc

Carries out a numerical analysis on the quantifiable parameters to select the best foreign cloud

Implemented using XACML (Extensible Access Control Markup Language)
3 phase cross-cloud federation model

- Authentication

Home cloud establishes mutual trust with selected foreign clouds.

Home cloud logs into foreign cloud using SSO login service provided by a third party ID provider (IdP).

Implemented using SAML (Security Assertion Markup Language)
Overall Architecture
Conclusion

• Can be added to existing systems with minor modifications

• Centralized repository can be a single point of failure.

• Paper could have simulated the architecture for performance evaluation.

• Overall, good solution to start cloud federation.