The EGI Federated Cloud e-Infrastructure

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EGI (European Grid Infrastructure)

• EGI Council
  – 26 participants: 24 NGIs and 2 EIROs (CERN, EBI)
  – Opening membership to research communities
  – Affiliation programme for countries

• Shared interest in
  – Developing and providing e-infrastructure services that enable open science

• Sustainability
  – Sustainable core services (HW, SW, human!)
  – Project-driven innovation
    • H2020: EGI-Engage, AARC, INDIGO, ELI-Trans, etc.
    • FP7: BioVeL, FitSM, SCI-BUS, Cloud-SME, …

Membership under discussion
Armenia, Austria, Belarus, Denmark, Moldova, Norway, Russia, Ukraine
Enabling Global Infrastructures

- Distributed, federated storage and compute facilities
- Compute platforms (Grid, Cloud)
- Virtual Research Environments
- > 200 user research projects

Total capacity (grid + cloud):
- 340 resource centres in 54 countries
- 550,000 logical CPU cores
- 290 PB disk, 180 PB tape

Community SLAs
Provider OLAs
EGI Federated Cloud

- EGI Federated Cloud is a collaboration of communities developing, innovating, operating and using cloud federations for research and education.

  - Design (2011-2014)
    - Establishment of the FedCloud Task Force
    - Collect requirements, architecture design, deploy testbed services to expand EGI compute capabilities

  - Production (Since May 2014)
    - Start of production activity of the Federated Cloud as a standards-based, open cloud IaaS system

  - New federation model (2015)
    - Expansion of the federation to become a collaboration to enable cloud federations
EGI Federated Cloud Architecture

- **IaaS Capabilities**
  - **VM images**
  - **Uniform interfaces and behaviour**
  - **Cloud Management Framework**
  - **EGI Cloud Service Providers**
  - **Federation Integration**
  - **Operation-Level Federator Services**
  - **EGI Core Platform**

- **Share & endorse VM images**
- **Replicate VM images**
Federation Principles

• The EGI Cloud is a open hybrid cloud federation
  – Different levels of federation are possible offering various degrees of interoperability
  – All cloud providers pooling resources and data in a multi tenant model
    • Need to adhere to a set of common policies, procedures and processes for federated service management
    • Can join in by adopting the federation model that provides the interoperability needs of the target groups
    • Can choose among federated services offered by EGI in a modular way, while still relying on local tools and exposing own service interfaces to the federation, as applicable
  – Low barriers to join the federation
EGI Cloud Federations

**Public Cloud (1)**
- Open to any research community, maintained by EGI FC Task Force
- **Open Standards**: use of open standards to implement federation: OCCI, OVF, GLUE2, APEL, (CDMI), … Standards required.
- **Stronger integration profile**: Cloud Computing integrated into the existing production infrastructure.

**Community Clouds (n)**
- Available for specific communities, maintained by them
- **Community choices**: Services and APIs to implement federation is community choice. Standards encouraged.
- **Looser Federation profile**: Based on a subset of EGI components (accounting, monitoring, …)
IaaS Capabilities

VMs & Block Storage

- On demand compute to run any kind of workloads on virtual machines
- Persistent Block Level Storage to attach to VMs
- User control of the computing infrastructure
- OGF OCCI API

Object Storage

- Data storage infrastructure for storing and retrieving data from anywhere at any time
- Sharing and serving of data in a scalable infrastructure
- SNIA CDMI API as
VM Image Catalogue and Management

**VM Image Catalogue**

- Open Library of Virtual Appliances
- Use on clouds or for personal download
- Re-use, share, associate contextualization
- EGI endorsed set of VM images prepared to run in a cloud in a secure manner

**VM Image Management**

- Community curated sets of images
- Automatic and secure distribution of sets to cloud providers
- HEPiX lists format for distribution
AAI
- IGTF Federation with X509 certificates + VOMS extensions
- Credential translation for other IdP federations

Accounting
- Collect, aggregate and display usage information across the whole federation.
- OGF Usage Record extended for Cloud

Service Registry & Information Discovery
- Central service catalogue with static information
- Real-time view of the actual capabilities of the federation
- OGF GlueSchema 2

Availability Monitoring
- Health monitoring of services
- A/R metrics for SLA/OLAs
- EGI ARGO
Public Cloud Architecture

VM Image Catalogue

EGI AppDB

Share & endorse VM images

Replicate VM images

IaaS Capabilities

OCCI

CDMI

OpenStack

OpenNebula

Synnefo

EGI Cloud Service Providers

Federation Integration

AAI

Information discovery

Monitoring

Accounting

Service Registry

EGI Core Platform
| Capability                              | OpenStack | OpenNebula | Synnefo  |
|----------------------------------------|-----------|------------|----------|
| OCCI VM Management                     | Yes       | Yes        | Yes      |
| Integration with VM image management   | Yes       | Yes        | Yes      |
| Contextualization                      | Yes       | Yes        | Yes      |
| OCCI Block Storage                     | Yes       | Yes        | In Progress |
| CDMI Object Storage                    | In Progress | N/A      | Yes      |
| EGI AAI Integration                    | Yes       | Yes        | Yes      |
| Monitoring*                            | Yes       | Yes        | Yes      |
| Accounting records                     | Yes       | Yes        | Yes      |
| Information System                     | Yes       | Yes        | Yes      |
Example: OpenStack Integration

- **Keystone**
  - VOMS x509 proxy
  - Apache+SSL +mod_wsgi

- **Keystone-VOMS**

- **ceilometer**
  - Extract usage information

- **nova-api**
  - Extract site information

- **OCCI-OS**
  - wsgi server

- **glance**
  - Register/update images

- **vmcatcher + hooks**
  - Subscribe to image lists

- **cASO**
  - Publish accounting records

- **cloud-bdii-provider**
  - Publish endpoint information

- **OpenStack resource provider**

- **Site BDII**
  - EGI accounting repository

- **AppDB (vmcaster)**
  - EGI federator services
  - OpenStack components
  - WSGI add-ons
  - EGI integration tools

- **EGI monitoring**
  - Monitor site

- **OCCI client**

- **VOMS x509 proxy**

- **Manage VM/block storage**

- **Get access token**

- **Extract usage information**

- **Extract site information**

- **Register/update images**

- **Subscribe to image lists**

- **Example: OpenStack Integration**
Beyond IaaS

- EGI FedCloud capabilities focus on IaaS
- But open to external developments to provide PaaS/SaaS
  - Hide IaaS complexity, provide higher level programming models
  - FedCloud task force evaluates tools and offers them to support new use cases when they fit

| Tool                        | Functionality                                      |
|-----------------------------|---------------------------------------------------|
| Catania Science Gateway     | • SaaS                                            |
|                             | • Identity Federation                             |
| Slipstream                  | • PaaS for automating deployments                 |
|                             | • Used in Helix Nebula                            |
| COMPSs                      | • Framework for auto-parallelisation              |
| VMDIRAC                     | • Abstraction on top of various HPC/HTC/cloud     |
| WS-PGRADE                   | • Workflow development and enactment              |
| Vcycle                      | • VM lifecycle manager                            |
FedCloud: the infrastructure

Production operations since May 2014
Currently:
• 21 providers from 14 NGIs
• 6,000 cores in total
• 700k VMs, 9M CPUh in last 12 months
Support for the Federated Cloud

Dedicated technical consultancy for each community (Request at support@egi.eu)

- **F2F/Web Meetings**
  - Identify suitable setup
  - Allocate technical experts
  - Define milestones

- **Continuous tracking and support**
  - Technical integration
  - Periodic meetings

- **fedcloud VO**
  - Resources for prototyping
  - Enabled on all sites
  - Usable for 2x6 months

- **Docs**
  - Step by step guides
  - Tutorials
  - Examples

- **EGI VM Images**
  - Main OS versions
  - Secure, up-to-date
  - Contextualisation

- **Migration into production**
  - Identifying committed resource providers
  - Support for VO setup

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FedCloud Evolution

• In the IaaS layer:
  – Docker support (2015 Q4)
  – New abstractions in the rOCCI client (2016 Q1)
  – VA instantiation interface in AppDB (2016-17)
  – Create VM snapshots, resize VMs on sites (2016 Q1)

• In the PaaS layer:
  – Tutorials and SLAs for high-level services
  – Complete the integration and guides of emerging tools, e.g. OCCO

• In the SaaS layer
  – Community specific service developments:
    • BBMRI, ELIXIR, DARIAH, MoBrain, EISCAT_3D, LifeWatch, EPOS, Disaster Mitigation
    • HumanBrainProject, Marine and Fisheries, etc.
  – Operation of community SaaS based on SLAs

• Collaborations with cloud federations
  – Canfar, FogBow, HARNESS, Nectar, CERN, etc.
  – Technology exchange; Interoperability; User support and training
  – Consolidation of new federation model
References

- FedCloud entry point: [http://go.egi.eu/fedcloud](http://go.egi.eu/fedcloud)
- User support: [https://wiki.egi.eu/wiki/Federated_Cloud_user_support](https://wiki.egi.eu/wiki/Federated_Cloud_user_support)
- Federated Cloud Communities: [https://wiki.egi.eu/wiki/Federated_Cloud_Communities](https://wiki.egi.eu/wiki/Federated_Cloud_Communities)
- User support e-mail: support@egi.eu
Thank you for your attention.

Questions?