QoS Resource Management for Cloud Federations

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QoS and Resource Management for Cloud Federations

• Stems from previous research in parallel and Grid computing

• Targets QoS as a broad definition
  • Performance
  • Security (also resource location)
  • Efficient resource usage (green computing)

• Targets open and multi-tenant platforms
XtreemOS in a Nutshell

- An open source Linux-based Grid Operating System with native VO support

- Grid Operating System
  A comprehensive set of cooperating system services providing a stable interface for a large-scale wide-area dynamic distributed infrastructure

- Novel features
  - Scalability and dependability
  - Dynamic and flexible Virtual Organisation management
  - No global scheduler
  - Resource discovery on P2P overlay
  - POSIX/UNIX interfaces for developers and users
  - Support Grid standards (e.g. SAGA)
XtreemOS Software Architecture
Contrail: open computing infrastructure for elastic services

- FP7 collaborative project
  - ICT-2009.1.2: Internet of Services, Software and Virtualisation
  - 11.4 M€ costs (8.3 M€ funding)

- Academia and Industry
  - Led by INRIA

- Strong EU and Italian presence
  - CNR, HP Italy, Tiscali
  - CNR led the Federation WP
  - Joint team from ISTI and IIT
Why Clouds? Why Federations?

Clouds allow CAPEX reduction, increased flexibility and scalability in managing IT infrastructures and in provisioning services.

- Clouds are not automatically trusted platforms
  - Tendency to platform lock-in of users
  - Management of data subject to privacy constraints
  - (US based) Multinational companies
    - unclear legal framework in case of issues

- Federations as a viable solution for EU
  - Join forces among “small” service providers
  - Increase options over data, service placement
    - location and configuration
Contrail Objectives

• Cross the chasm for cloud adoption, tackling issues related to
  • Complexity of use
  • Vendor lock-in
  • Dependability
  • Unpredictability of costs & performance

Bring trust in Clouds
Contrail Federation and Resource Management in the IaaS level

Develop dependable **interoperable** and **dependable** cloud services that customers can trust and easily use in an **open cloud market**

- Services to federate IaaS Clouds
- Manage elastic applications in a scalable way
- SLA management in federated clouds
  - distribution, coordination, enforcement
Tech. viewpoint on **Interoperability**

- Simplify the whole process (selection, deployment, monitoring...)
  - Access to a variety of heterogeneous Cloud providers
  - Automatically manage accounts over cloud providers
  - Seamless adapt to heterogeneous providers = translate
    - Translate app/data API, protocols, representation
      - Emulate features
    - Automatic provider selection integrated with SLA
    - Negotiate with multiple providers
  - Application deployment and porting in the Cloud
    - Adapt to protocols for resource monitoring / management

Defragment the Cloud market:
- Horizontal and Vertical integration
- Open Standards and Open Source implementation
- Reduce vendor lock-in

Adapt to protocols for resource monitoring / management
Tech. viewpoint on **Interoperability**

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   (selection, deployment, monitoring…)

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- **Application deployment and porting in the Cloud**
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Dependability in Cloud Federations

Overcome the Cloud “black box” vision, providing customers with meaningful SLA guarantees

- Offer meaningful SLA terms: QoS and QoP
- Negotiate security and protection for data/application
- Automate the negotiation of SLA terms
- Ease price and offer comparison
- Select best fitting Cloud provider/s and simplify negotiation
- Guarantee reliable execution of applications
- React to alerts from monitoring subsystems
- Offer replicated and distributed storage
- Isolate inter-networked applications

Cloud service selection

SLA negotiation & enforcement
Resource Reservation
Elasticity
Monitoring, Auditing, Billing

contrail-project.eu
Dependability in Cloud Federations

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• **Automate** the negotiation of SLA terms
  • Ease price and **offer comparison**
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High level view on Contrail

- A set of Industrial Use Cases to benchmark the platform
- PaaS system exploiting federated Cloud providers (ConPaaS)
- Federation infrastructure
  - Acting as a mediator
  - Decentralized
  - Hiding complexity and managing distributed interactions
  - Friendly to provider business
- Pervasive, horizontal features
  - Security
  - SLA capabilities
  - Monitoring and accounting
- A set of federated IaaS resources
  - Execution – Virtual Execution Platform
  - Storage - Global Autonomous File Systems
  - Networking – Virtual Networking per application
Contrail PaaS/IaaS Software Stack

Federation layer

- User registration and management
- Usage Control System
- Federation Portal & Federation API
  - Authentication

Provider layer

- User registration and management
- Usage Control System
- Provider Manager
- Application lifecycle manager
- SLA management
- EP
- Accounting
- Monitoring agent

Resource layer

- Application deployment
- Resource reservation
- GAFS
- VIN
- Appliance monitoring
- Appliance
- Appliance hosting
Federation = distribution

- Multiple access points
- Mechanism coordination and integration

Beyond Brokering: Federations in Contrail - IOS 2012, Bruxelles
SLAs in Cloud Federations

- Federation as abstraction of providers
- SLA+OVF is a unified way for expressing user requirements
- Federation as broker of providers
  - Provider selection is based on SLAs
- Federation: small providers can join forces
- SLA is a way for small providers to showcase their capabilities
The Legacy of Contrail

- Huge amount of open source software
  - OW2 public repository
  - Structured in components
  - Modules with clear functionalities
  - Daily compiled and built into packages
- Overall interest in trusted multiple Clouds is growing
- Ideal situation for commercial exploitation and technological transfer
- Either as a whole platform or separately by component
Tech. transfer : Contrail Federation

• Federation of IaaS multiple providers
  • Integration of federated authentication, submission mechanisms, monitoring, management
  • Dynamic choice among providers
  • **SLA support** on top of the platform for QoS and QoP
  • SLA for QoS includes QoP: location, security features …
• Provider **reputation** w.r.t. SLA fulfillment
• Integrate UCON continuous Authorization

• **Implementation is a moving target,**
  • as the open source Cloud landscape evolves e.g. OpenStack vs OpenNebula
  • as public Cloud giants evolve their offer
Contrail Follow-ups

• EIT-ICT
  • Contrail Federation and security
  • Joliet PaaS and adaptation framework
  • Big Data frameworks
    • Fraunhofer FOKUS, Stratosphere
  • Ease development of multi-cloud applications enjoying big data tools and obeying sharp QoS and privacy constraints

• H2020 proposal
  • Contrail federation as integrator of multiple OpenStack platforms from different providers
  • Large EU consortium led by HP EMEA
SOME TECH STUFF COMING UP NEXT!
Beware!

• Backup slides behind.
Contrail demonstrator: Multimedia Marketplace

- Lead by HP Italy
- Deployed on top of Contrail, publicly available
  - Users: media streams, search, recommendation
  - Generators: upstream of media
  - Tech. service providers: adaptation/augmentation of raw content
- Contrail meets the needs of actors
  - Security and privacy
  - Data protection, service location
  - Elasticity, scalability, reliability
Media Marketplace deployment in Contrail

ConPaaS web application hosting service

+ AC File Payments

Joomla!

Presentation layer (V)

Business layer (C)

DAO layer (M)

Media digital processing broker

Content recomm.:

ConPaaS SQL service

SQL server manager

contrail DaaS

MySQL

SQL DB

Contrail Fed. / conPaaS

Technology Provider

Contrail VEP

Autonomy

Advanced content search

GAFS

Contrail distributed storage

Contrail Fed. / conPaaS

Content Provider

Data mining system

Mahout

ConPaaS map-reduce service
Contrail Industrial use case - Distributed provision of Geo-referenced Data Virtual 3D tourist guide

- Led by Tiscali
- A distributed Geo-referenced Data rendering engine
- Implementation of a Virtual 3D Tourist Guide
  - Maps and points of interest
  - Navigation via Web browser, selectable layers
  - Multiple sources of information, user content
  - Geo-spatial data coming from different SDIs (Spatial Data Infrastructures)
- Contrail bonuses for content providers
  - Providers federate
  - Decentralized data update
  - Keep control of data services
  - Service location (legal requirements)