ConPaaS: a Platform as a Service for Multi-clouds

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Lucas Cranach the Elder, 1530.
The Cloud of Eden

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Don't touch this proprietary API!

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Lucas Cranach the Elder, 1530.
Proprietary Cloud APIs

ConPaaS: a Platform as a Service for Multi-clouds
Some cloud services are (becoming) well-standardized
  - VM instance creation/management/destruction
  - Data storage

But all the high-level services are cloud-specific
  - Amazon: RDS, DynamoDB, AutoScaling, CloudWatch, ...
  - Google: APIs to access lots of Google services
  - Etc.

Why is this so?
  - It is impossible to innovate while respective standard APIs
  - Commercial lock-in strategy
Wanted: cloud provider independence

- Example: if you want DynamoDB you must use the Amazon cloud
  - Just because it was invented by Amazon

- The choice of a set of high-level services should not lock users with a single provider
  - Think of mobile phone operator, electricity providers, etc.

- How can we offer the same high-level services in multiple clouds?
  - Option 1: standardize APIs (mostly impossible for the moment)
  - Option 2: let third-parties develop cloud-independent services
  - You also want seamless application migration from one cloud to another
VM migration is not a solution

- VM migration sounds like an appealing solution
  - VMs currently run in Cloud X
  - Live-migrate them to cloud Y and the problem is solved!
  - Unfortunately things are not so simple...

- Business considerations:
  - No cloud provider wants to offer support to users who want to leave their system

- Technical considerations:
  - Different clouds often use different, incompatible hypervisors
  - VMs make use of local services offered by the cloud
  - VMs cannot maintain the same IP address after migration (we would need Mobile IP)
Platform-as-a-Service systems are usually elastic
- They can dynamically change the set of resources they are using

We can exploit these elasticity properties to implement application migration
1. The application runs in cloud X
2. Give new resources from cloud Y to the application
3. Replicate data to the new resources
4. Update the application’s access point (e.g., using DNS)
5. Shift workload to the new resources
6. Retract old resources from cloud X
Shopping list

- Platform-as-a-Service
- Cloud provider independent
- Elastic
- Easily extensible with new services
- Open-source
Hosting a simple application in a multi-cloud environment

ConPaaS: a Platform as a Service for Multi-clouds
Hosting a simple application in a multi-cloud environment
ConPaaS takes care of your applications
Web hosting services

- Code upload (PHP, Java)
  - ZIP file upload, git push
  - Choose the version you want to run

- Seamless capacity control
  - Add/remove processing power in one click

- Coordinated reconfigurations
  - No service interruption even during reconfigurations
Database services

- **Relational** (MySQL) and **NoSQL** (Scalarix)

- **Data upload**
  - Choose your administrator password
  - Upload a database dump

- **Automatic replication**
  - Add/remove replicas in one click
File system service

- Mount the file system
  - From your client machine
  - From other ConPaaS services

- Read-write data as in a local file system
  - Full POSIX support

- Automatic capacity scaling
  - Add/remove storage nodes in one click
High-performance computing services

- **TaskFarming** for scientific workflows and massive batch executions
  - Control the tradeoff between cost and execution time

- **MapReduce** for BigData processing
  - Based on Hadoop
Automated application deployment

ConPaaS can deploy entire applications in one click

A manifest file specifies all relevant information about the application
  - List of services, code/data to upload, configuration

Users can use ready-made manifests or upload their own
Release Timeline

Oct 2010: Beginning of the project

Apr 2012: ConPaaS-0.9.0
- Five services: PHP, Java, MySQL, Scalarix, MapReduce
- Support of Amazon EC2 and OpenNebula clouds

Oct 2012: ConPaaS-1.0.0
- TaskFarming and Selenium services
- Secure control communications
- GIT-based code uploads

Feb 2013: ConPaaS-1.1.0
- XtreemFS service
- Full control via command-line tools

Jun 2013: ConPaaS-1.2.0
- Multi-cloud support
- IPOP support for internal application communications
- Automated deployment of entire applications
- Performance monitoring
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ConPaaS: teams

vrije Universiteit amsterdam

UNIVERSITÉ DE RENNES

ZIB

XLAB NOT IDE

Imperial College London

SWEDISH ICT SICS
ConPaaS: industrial partners

[Logos of Vodafone and SAP]
ConPaaS: funding

**contrail**

open computing infrastructures for elastic services

**HARNESS**

**COMMIT**

EIT ICT Labs
1 Introduction
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3 Architecture
4 Multi-cloud ConPaaS
5 Conclusion
A ConPaaS service is composed of 1 Manager and $n$ Agents
- One Python class running in the Manager VM
- One Python class running in the Agent VM
All ConPaaS manager expose the same set of **standard methods**... 
- startup
- get_logs
- add_nodes
- remove_nodes
- list_nodes
- get_node_info
- shutdown

... and any number of **service-specific methods** (here: MySQL)
- load_dump
- set_password
All ConPaaS agents expose the same set of standard methods...
  ▶ check_agent_process

... and any number of service-specific methods (here: MySQL)
  ▶ setup_master
  ▶ setup_slave
  ▶ load_dump
  ▶ set_password
Writing a new service means writing two Python classes:
- A manager class
- An agent class

These class inherit from the ConPaaS core
- IaaS
- HTTPS (certificate management etc.)
- IPOP (networking)
- Ganglia (monitoring)
- ...
An application is defined as a set of ConPaaS services
  - For example: PHP + MySQL + XtreemFS
An application can be specified using a manifest:

```json
{
  "Description" : "Sudoku example",

  "Services" : [
    {
      "ServiceName" : "PHP sudoku backend",
      "Type" : "php",
      "Start" : 0,
      "Archive" : "http://www.example.org/sudoku.tar.gz"
    }
  ]
}
```
The ConPaaS Director

- The single entry point to the system
- Keeps tracks of users, credentials, services
- Handles the life-cycle of ConPaaS applications
Clients make it easy to send commands to the Director
  ▶ Command-line interface
  ▶ Web-based GUI
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5. Conclusion
Multi-cloud increases flexibility

- Points-of-presence closer to the user
- Lower latency, higher bandwidth
Multi-cloud applications are more reliable

Amazon cloud outage impacts Reddit, Airbnb, Flipboard

Amazon Web Services is experiencing problems in the East Coast region, which in turn is hurting many Web sites. A spokesperson refutes claims that Anonymous caused the outage, saying no attack took place on Amazon's cloud.

by Shara Tibken | October 22, 2012 12:30 PM PDT

An unexpected error has occurred.

We’re on the case and things should be up and running shortly!

If you need immediate customer service, please reach out to us at +1-415-800-5959. Otherwise sit tight, and the site should be back up momentarily.

- Replicate data across multiple data centers
- In case of failure: handover to other locations
Multi-cloud applications are (potentially) more secure

- Keep sensitive data in your private cloud
- Distribute data across clouds such that no cloud has all the information
ConPaaS can use **multiple underlying clouds simultaneously**

- For example: OpenNebula in my private cluster, EC2 in Virginia, and EC2 in Oregon
- We can easily add support for other clouds

Each virtual machine can be started in any cloud
Network issues in multi-cloud

- **Network issues:**
  - Disjoint IP address space
  - Firewalls, private addresses, NATs
  - Confidentiality, security

- **Solution:** IPOP, a multi-point VPN
  - IP-over-P2P (http://www.ipop-project.org)
  - Single address space between VMs
  - Elastic and easily reconfigurable

- Each application creates and manages its own VPN
IPOP multi-point VPN

ConPaaS Director

Enable IPOP Config. address space

Cloud1

Cloud2

IPOPns1

IPOPns2

IPOPnsN

Application

Mgr1 172.16.0.2

Agent1 172.16.0.3

Mgr1 172.18.0.2

Agent1 172.18.0.3

Mgr2 172.18.0.2

Agent2 172.18.0.3
Data placement issues

- Where should data be located?
  - For good throughput: in a single location
  - For good access latency: as close as possible to the users
  - For good fault-tolerance: in as many data centers as possible
  - For good security: in my private cloud

- ConPaaS will enable users to define their placement policies
  - XtreemFS distributed file system
  - Scalaris distributed key-value store
Application migration issues

- We must keep the application in working order **during the migration**
  - Add new resources in the destination cloud
  - Migrate data/workload
  - Remove old resources in the origin cloud
HARNESS E.U. project: heterogeneous cloud platforms
- GPUs, FPGAs, OpenFlow routers...
- An application may have multiple implementations
- The platform will build performance models automatically...
- ... and choose the right implementation/scale automatically

SEEP: real-time event processing service
- Scalable
- Elastic
- Dynamically reconfigurable

Considering a mobile phone network as a multi-cloud
- Data centers ⇒ mobile base stations
- Run smartphone apps backends close to the users
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Conclusion

- An integrated runtime environment for elastic cloud applications
  - Standard services can be composed to build cloud applications
  - Extending ConPaaS with new services is quite easy
  - Extending ConPaaS with new types of clouds is quite easy

- Multi-cloud support
  - On a permanent basis for performance, reliability and security
  - On a temporary basis for cloud provider independence and application migration

- Mature

- Open-source (BSD licence)

http://www.conpaas.eu/
People behind ConPaaS

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People behind ConPaaS

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Applications, Manifest
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Multi-cloud support