

CernVM Online and Cloud Gateway

a uniform interface for
CernVM contextualization and
deployment

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PH-SFT / CERN

Background

CernVM: a virtual appliance that serves as a portable environment for developing and running LHC data analysis

- easily deployed in *cloud* or *local* environment by supporting various image types and hypervisors
- see Jakob's talk about **μCernVM**, the next-generation CernVM: <http://chep2013.org/contrib/213>
- visit: <http://cernvm.cern.ch>

Background

Virtual machine contextualization: is the process of configuring a VM instance for the needs of various deployment use cases

- we apply a **context**
 - INI file - based on the AMIConfig library
 - defines settings for the various **contextualization plugins** - INI file sections
- using
 - *user-data* field in clouds that support it
 - *HEPIX* contextualization

Motivation

This work has to main goals:

1. make contextualization of local VMs easier

- no need to write contexts manually
- reduce the use of the *CernVM web appliance* to configure local virtual machines by providing easier alternatives

2. deployment of CernVM

- in local environments
- virtual clusters in the cloud

CernVM Online / Cloud Gateway: interface for contextualization and deployment

CernVM Online

contextualization made easy

cernvm-online.cern.ch

Can connect with CERN authentication or create a local account

CernVM Online

Web application: used to *define, store and share contexts*

- Contexts are immutable. They cannot change, they can only be **cloned**
- **Secure contexts** are supported by encrypting context content with user defined passphrase
 - context may contain sensitive information like passwords, keys, etc..

CernVM Online

Marketplace: share contexts for common use cases

Deployment: user can deploy VMs locally with the **CernVM WebAPI**

- browser plugin able to spawn virtual machines automatically using *VirtualBox hypervisor* (is installed by the plugin if not available)
- implemented by Ioannis Charalampidis for Theory division at CERN (<http://crowdcrafting.org/app/cernvm/>)

Pairing: contextualization of already running CernVM instances *with console access*

Dashboard

Deploy VM locally

Publish to marketplace

- Commands**
- Dashboard
 - Pair an instance
 - Create Context
 - Create Cluster
 - Marketplace

- Recent Definitions**
- T4T-AtomSmasher
 - T4T-Copilot-Server-v12
 - Condor worker
 - T4T-Client-5
 - Condor master

Dashboard

Your context definitions

Name	ID	Operations	Deployment
Condor master	2a6143b44dcb461bbc1688f385e4c61c	Clone Publish	WebAPI
Condor worker	6302bff3261c46cfbac12b282d20f071	Clone Publish	WebAPI
Local VM context	030cc9b469dd466bade2499b26c8091f	Clone Publish	WebAPI

Create new context...

Your cluster definitions

Name	ID	Operations
Condor cluster	1e9227b4d185445e9e00a31c0ae4e4d	Clone Publish

Create new cluster

Paired VMs

Your virtual machines

Machine	CernVM	Context	Operations
No instances paired yet			

Pair an instance of CernVM

Context creation

Context template

Please fill the following parameters and click create in order to create a new virtual machine context

General

Context name: Condor worker

Description: This machine

Secret key:

Protect this context

CVMFS Configuration

Users

CVMFS Configuration

Select the repositories you want your virtual machine to use.

Main group: LHCB

Additional groups:

- atlas-nightlies
- atlas
- cms
- atlas-condb
- lcd
- alice

CVMFS HTTP Proxy:

- Auto
- Do not use proxy (Direct connection)
- HTTP Proxy
- HTTPS (Secure) Proxy

Users

Services

Environment


- CernVM-FS configuration
- Adding users / groups
- Environment variables
- Startup script
- Services to start
- SSH key
- **Condor configuration**

Marketplace


CernVM Marketplace **experimental**

Pick one of the public contextualization information and pair you CernVM instance.

T4T-Client-5




T4T-AtomSmasher



This is a pilot project from Test4Theory group that allows users to play while helping CERN physicists.

T4T-Copilot-Server-v12



User can pair/clone contexts made by others

Search for contexts





T4T-AtomSmasher 0

The Virtual Atom Smasher is an interactive game from the Test4Theory group that allows people from outside CERN to help physicists, by playing an interactive game.

Author: icharala

Tags: t4t + - volunteer + -

Access: Open

 Pair  Clone  

ATLAS
CMS
ALICE
LHCb
NA61

Experimental

Virtual machine pairing

Pair instance - Step 2

Wait your virtual machine to boot and put the following key in your virtual machine contextualization screen. You will have the option to contextualize it right after.


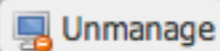
1) Obtain PIN from CernVM online


51 85 64

2) Apply PIN

```
Local VM context VM [Running]
Welcome to CERN Virtual Machine, version 3.0.0.0
based on Scientific Linux release 6.4 (Carbon)
Kernel 3.7.10-17.cernvm.x86_
IP Address of this VM: 10.0.2.
In order to apply cernvm-online context, use #<PIN> as user
localhost login: #518564_
```

Your virtual machines

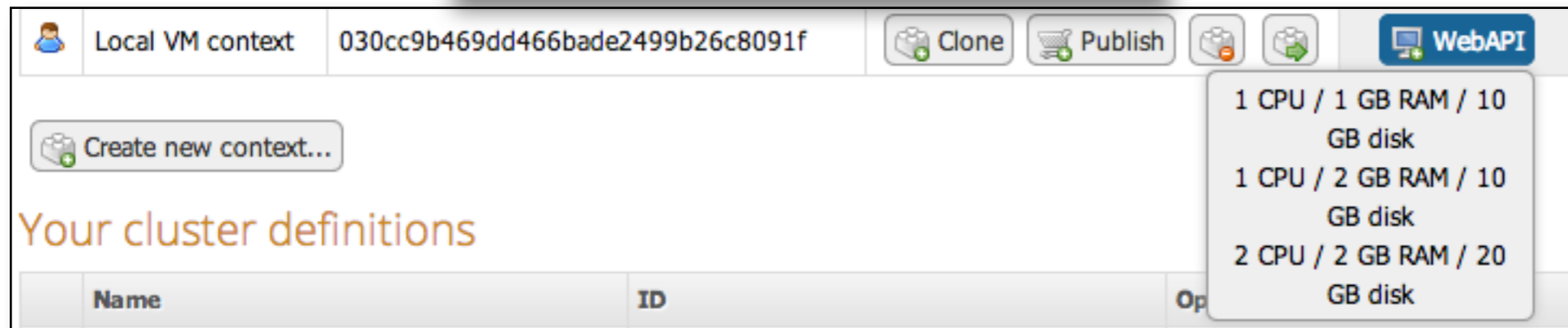
Machine	CernVM	Context	Operations
 128.141.235.236 (6c8e7a1b-a0cc-42cf-b9d2-d04423366c0f)	3.0.0.0	Local VM context	

 Pair an instance of CernVM

list of paired instances

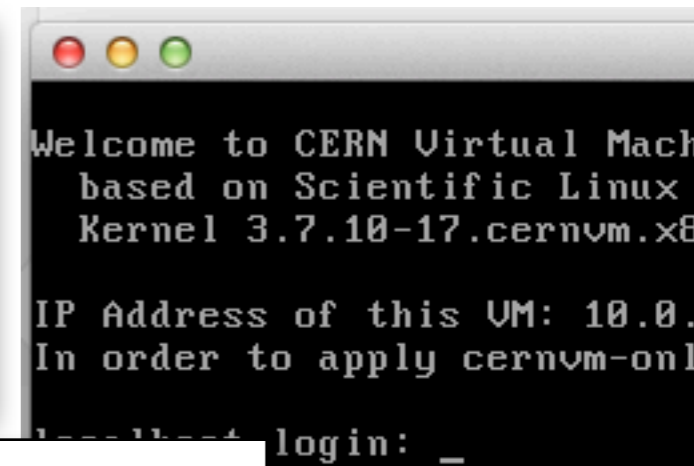
Deployment with WebAPI beta

1) Select configuration



The screenshot shows the CernVM Online interface. At the top, there is a header with a user icon, the text "Local VM context", and a long ID "030cc9b469dd466bade2499b26c8091f". To the right are buttons for "Clone", "Publish", and "WebAPI". Below the header is a "Create new context..." button. The main area is titled "Your cluster definitions" and contains a table with columns "Name", "ID", and "Op". A dropdown menu is open, showing three configuration options:

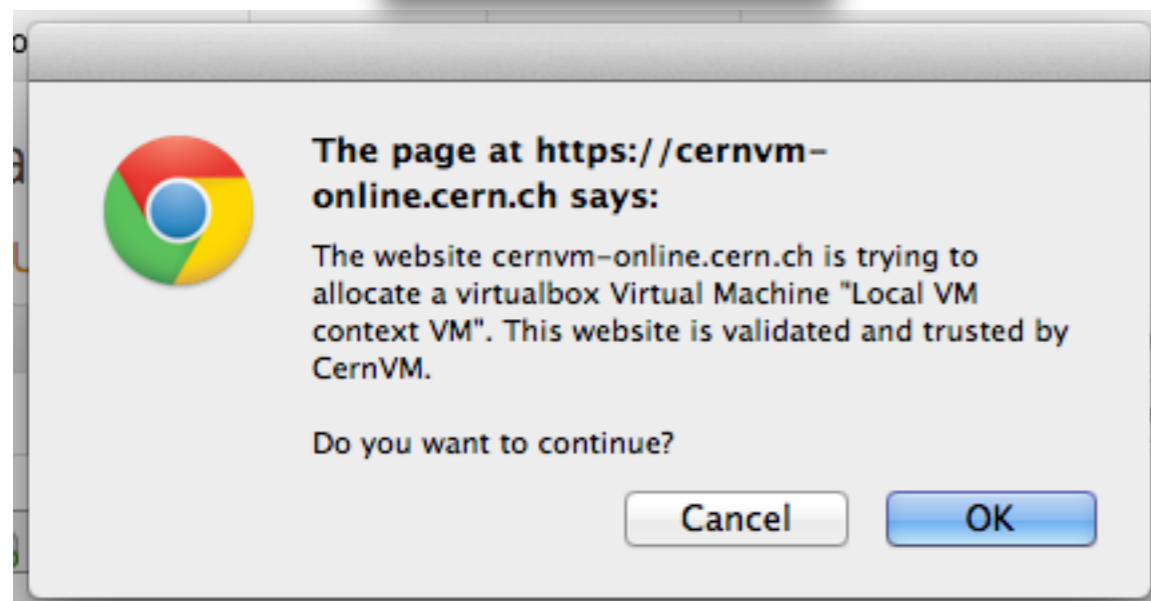
- 1 CPU / 1 GB RAM / 10 GB disk
- 1 CPU / 2 GB RAM / 10 GB disk
- 2 CPU / 2 GB RAM / 20 GB disk



```
Welcome to CERN Virtual Machine
based on Scientific Linux
Kernel 3.7.10-17.cernvm.x86_64

IP Address of this VM: 10.0.0.10
In order to apply cernvm-only
... login: _
```

2) Confirm



The screenshot shows a Chrome security warning dialog box. It features the Chrome logo on the left. The text reads: "The page at <https://cernvm-online.cern.ch> says: The website cernvm-online.cern.ch is trying to allocate a virtualbox Virtual Machine "Local VM context VM". This website is validated and trusted by CernVM. Do you want to continue?" At the bottom, there are "Cancel" and "OK" buttons.

3) Enjoy

WebAPI plugin is available for Chrome, Firefox and IE.

Pairing vs WebAPI

WebAPI **spawns** a VM using user's local PC resources

Pairing is **contextualizing** an existing VM

- requires *console access*
- VM can be local, or remote

Both can be used to avoid having to contextualize manually user's VM with the web appliance.

CernVM Online / Cloud Gateway: interface for contextualization and deployment

CernVM Cloud **beta**

deploy CernVM virtual clusters

cern.ch/cernvm-cloud

Contact us for a
beta tester account

CernVM Cloud Gateway

a distributed system that provides a single interface to use **multiple** and **different** clouds:

- **by cloud type:** OpenStack, CloudStack, OpenNebula, ...
- **private or public:** CERN OpenStack, AWS, ...
- **geographically distributed**

CernVM Virtual clusters

Uses cloud available cloud resources to deploy virtual clusters.

Virtual cluster is a set of VMs able to communicate with each other:

- consists of services
- each service should be deployed in the cloud
- ▶ a service defines:
 1. the *context* of the VMs that will implement it,
 2. the VM configuration (*flavor, CernVM version*)
- **fixed services** are deployed once and before any other service
- **scalable services** rely on the fixed services and they can be *scaled up and down*

Virtual cluster example

Master will start first

Condor
master

fixed service

Workers will start after
master and their context
will contain master's IP
address

Condor
worker

Condor
worker

Condor
worker

Condor
worker

scalable service

There are cases with more than one fixed services:
proxy server, VO box, etc

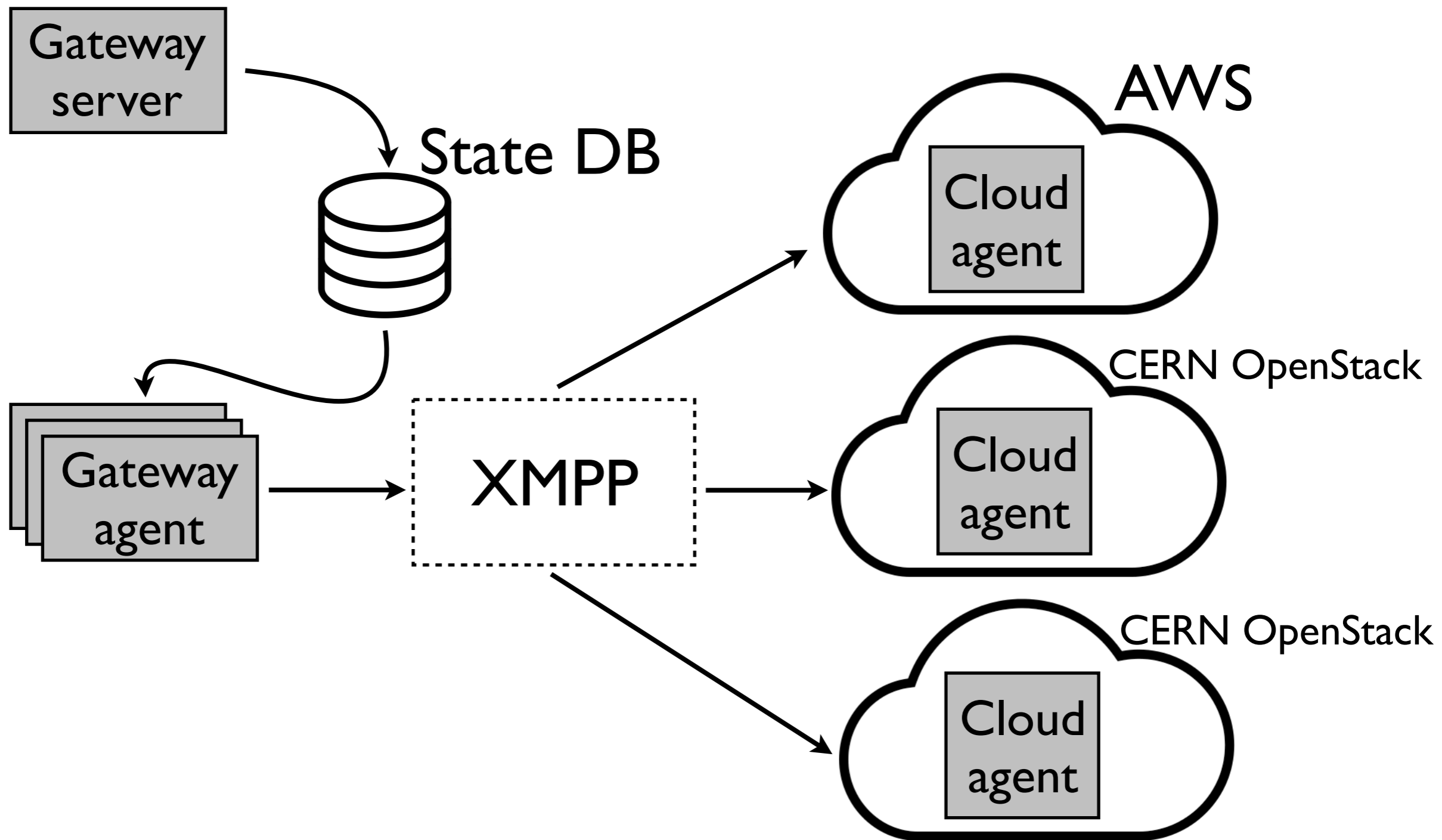
Implementation tools

iAgent Framework: implemented in Perl, it provides ways to develop agents that can expose their functionality through XMPP.

XMPP: communication protocol. Has useful features as:

- **Presence:** to know which agents are online
- **Queuing:** messages will be delivered once agent is up
- **PubSub channels:** many cloud agents listen for messages from the gateway agents

Architecture



Gateway server / agent

Gateway server: API endpoint and web interface

- Handles client authentication
 - users and groups
- Feeds the system with *user requests*
- **Web interface** works with mobile devices (*responsive*)
- **REST API** provides complete functionality for deploying clusters (<http://cern.ch/cernvm-cloud/Wiki/Documentation.html>)

Gateway agent: processes the user requests and forwards them to *cloud agents* though XMPP.

Cloud Agent

Associated with a single cloud access credentials

- **Listens** to XMPP PubSub channel for user requests
 - **simple ACL:** administrator can define which users/groups for cloud gateway can use his cloud instance
 - **soft quota** for managed cloud resources
 - **mapping** of general flavors / templates to cloud specific
- Communicates with *respective cloud* via a **cloud driver** that “speaks” its API

Cloud credentials storage

Current model: cloud credentials are stored in the cloud agents

- ✓ cloud agent can run in a machine managed by the owner of the credentials
- ✓ sensitive credentials are not communicated to the central server
- a cloud agent has to be deployed for each cloud key-pair

CernVM Online / Cloud Gateway: interface for contextualization and deployment

CernVM Cloud in action

Defining a cluster

Service definition

Secret key: worker

Context: Condor worker

Template: uCernVM 1.11

Min. instances: 5

Service offering: Single Unit - Small

Disk offering: No disk

Network offering: No preference

Create Cluster

General

Cluster name: Condor cluster

Description:

Create Cluster

General

Context selection

Context: Condor

- Condor master
- Condor worker

Author: George Lestaris

Description:

Cluster services

Secret key:

Services

Create cluster

	Key	#	Context	Template	Network	Disk	CPU	Operations
☰	master	1	Condor master	uCernVM 1.11			Single Unit - Medium	Del Edit
▲ Fixed services (Infrastructure)				Scalable services (Workers) ▼				
☰	worker	5	Condor worker	uCernVM 1.11			Single Unit - Small	Del Edit

+ Add Service

Create cluster

Cluster deployment



The screenshot displays the CernVM Gateway interface. At the top, there is a navigation bar with the CernVM Gateway logo and menu items: Dashboard, CernVM Online, Infrastructure, User, Admin, and Help. The main content area is titled "Cluster instances" and features a search bar with the letter 'c' and a "Start cluster" button. A dropdown menu is open, showing a "Condor cluster" with UID: 74212a6b52264f9ab68ec0e0f501d66d. Below this, there is a "Cluster UID" input field and another "Start cluster" button. A red arrow points from the dropdown menu to the "Start cluster" button. The interface also includes sections for "Amount of service instances" and "Amount of clouds", both showing "There are currently no deployed clusters...". At the bottom, there is a "Failed jobs" section with a table header: "started on", "Operations", "Id", "Type", "Error code", "Operations". The footer contains the text: "© CERN 2012 - 2013" and "PH Department - SFT group / CernVM Software appliance".

Select cluster to deploy from the stored cluster definitions in CernVM Online


Deployment management

Service instances

Global UID	Service name	Status	
cgc-6BCC5A7E	Batch service	STARTED	Actions ▾
cgc-6BCE964A	Batch service	STARTED	Actions ▾
int-MHDAAAGXX	Head service	STARTED	Actions ▾
int-QHUIAKUBI	Vobox service	STARTED	Actions ▾

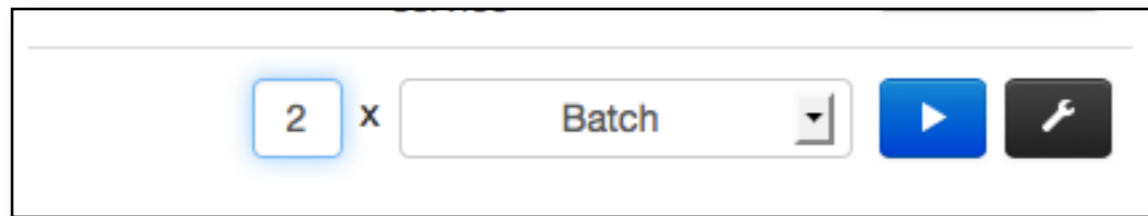
1 x -- Select a service -- ▾  

Instances map

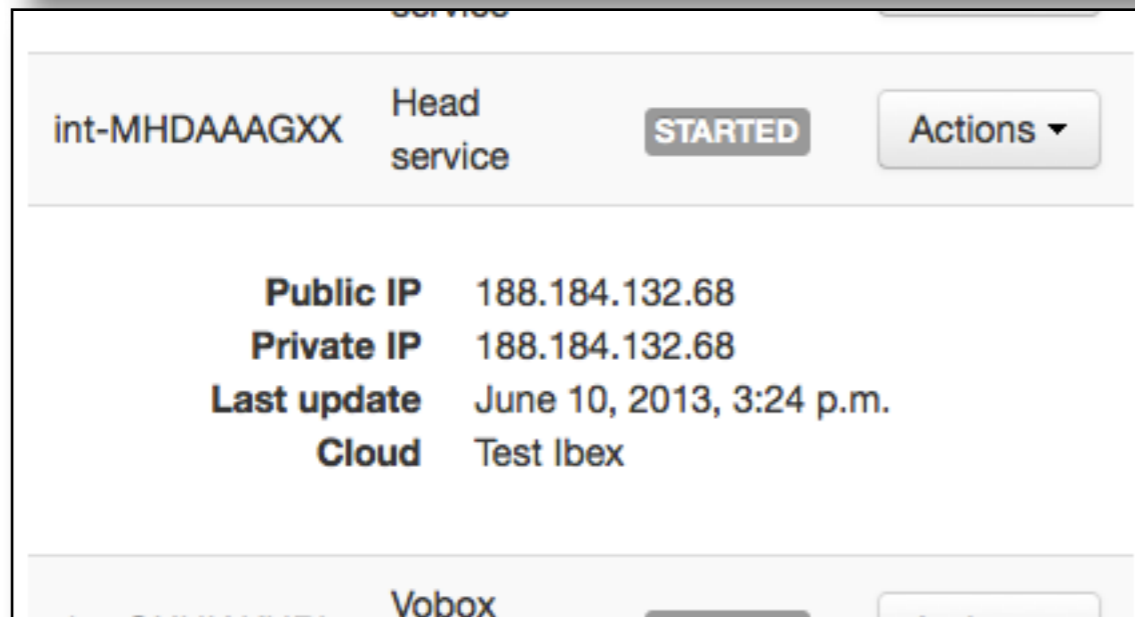


Close

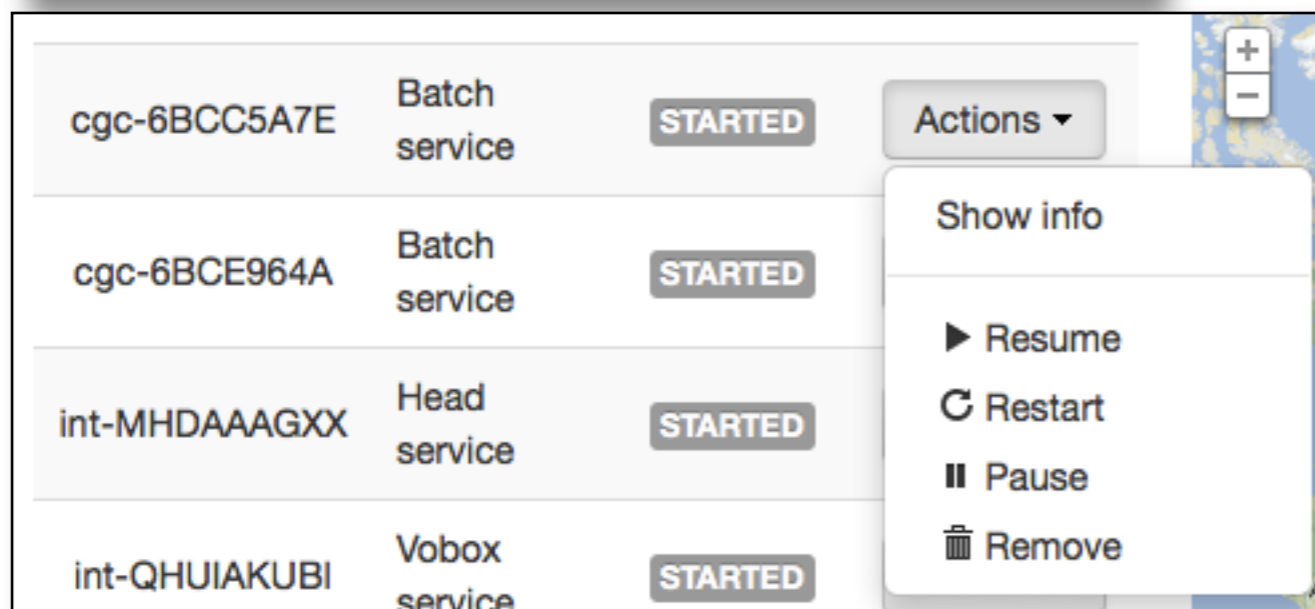
Deployment management



Scaling up services



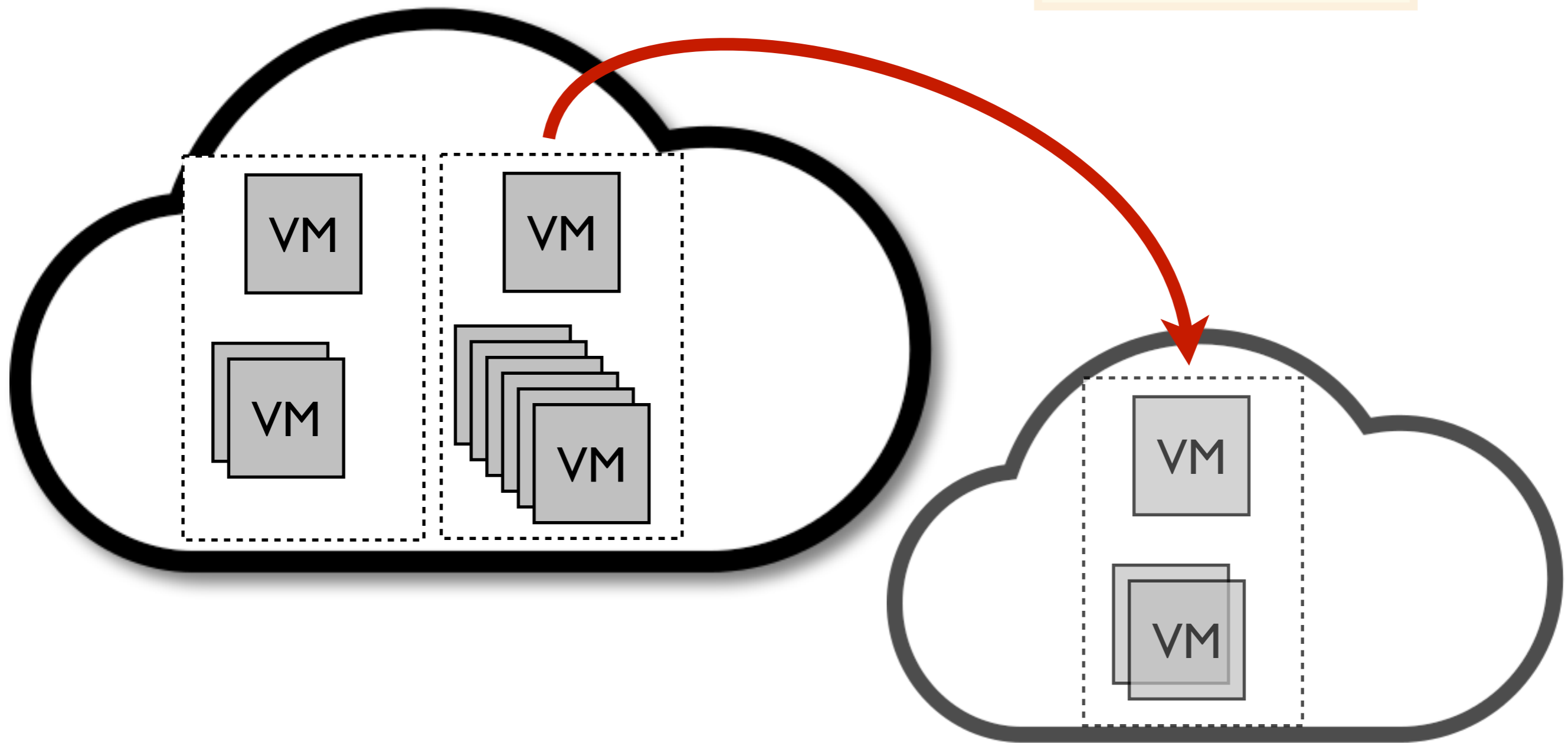
Per-instance information



VM management

Clusters overflowing clouds

Experimental



Clusters overflowing clouds

Experimental

- CernVM Cloud can support multiple clouds
- Once a cluster reaches cloud's capacity and user requests to scale it up, it **expands to another cloud**
- In this expansion the fixed services are being *replicated* to the *new* cloud
- ✓ Cluster VMs will be able to communicate with *fixed services* as they will always be in the local network of the same cloud

Conclusion

CernVM Online: production

- define, store and share *contexts* with a nice web UI
- *Pairing* and *WebAPI* to deploy single VM

CernVM Cloud: beta

- deploy *clusters* defined in CernVM online
- *multiple & different* clouds
- *overflowing clouds* and expanding clusters to different clouds
- RESTful API