Deploy a Highly-dynamic Virtual Cluster Based on OpenNebula and Xen in Grid'5000

Rodrigue Chakode
(INRIA/Mescal - LIG Laboratory- Grenoble University)
Ph.D Student
Rodrigue.Chakode@{gmail.com,imag.fr}

Grid'5000 Challenge
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INSTITUT NATIONAL DE RECHERCHE EN INFORMATIQUE ET EN AUTOMATIQUE
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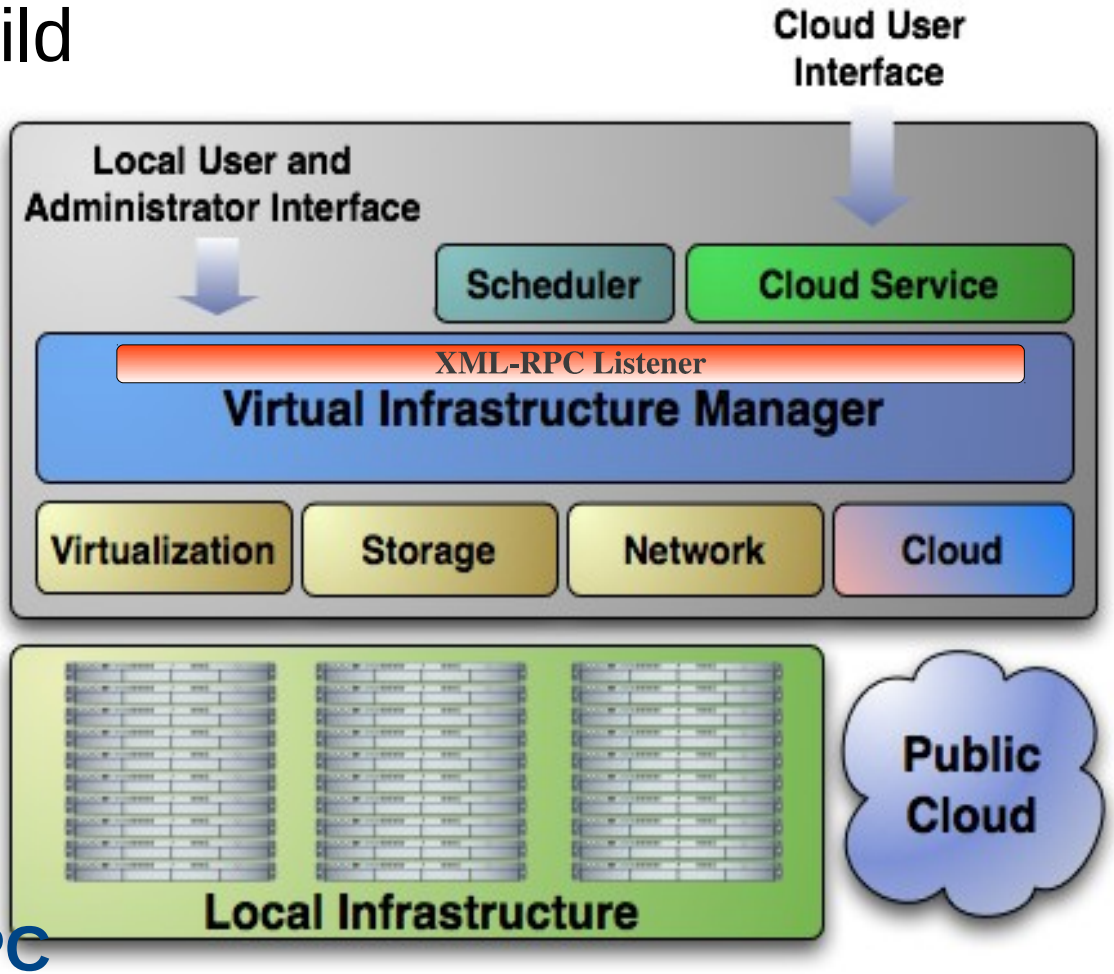
Key points

- Automatic deployment and customization of an OpenNebula cloud on Grid'5000
- Introducing SVMSched, a tool designed to enable the set-up of custom VMs on-the-fly onto such a cloud
- Easily reproducible experiment
  - Script-based deployment and configuration of the virtual cluster's nodes
  - Custom environments + Kadeploy3
  - ...

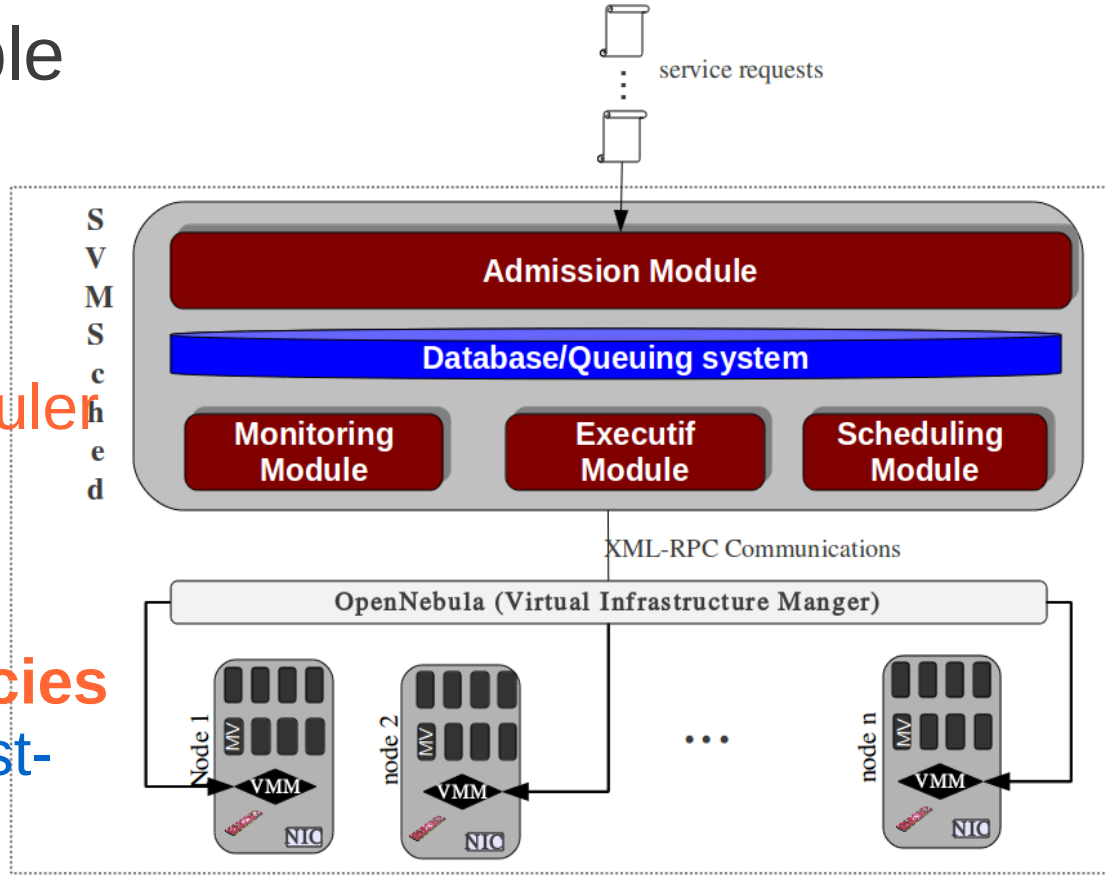
OpenNebula

- Open-source toolkit to build private, public and hybrid clouds
  - Orchestrates storage, network, virtualization, monitoring, and security technologies
  - Unix-like command line interfaces and cloud interfaces (REST, OCCI, Amazon EC2, etc.)
  - **Modular with an XML-RPC API to access its core functionality**

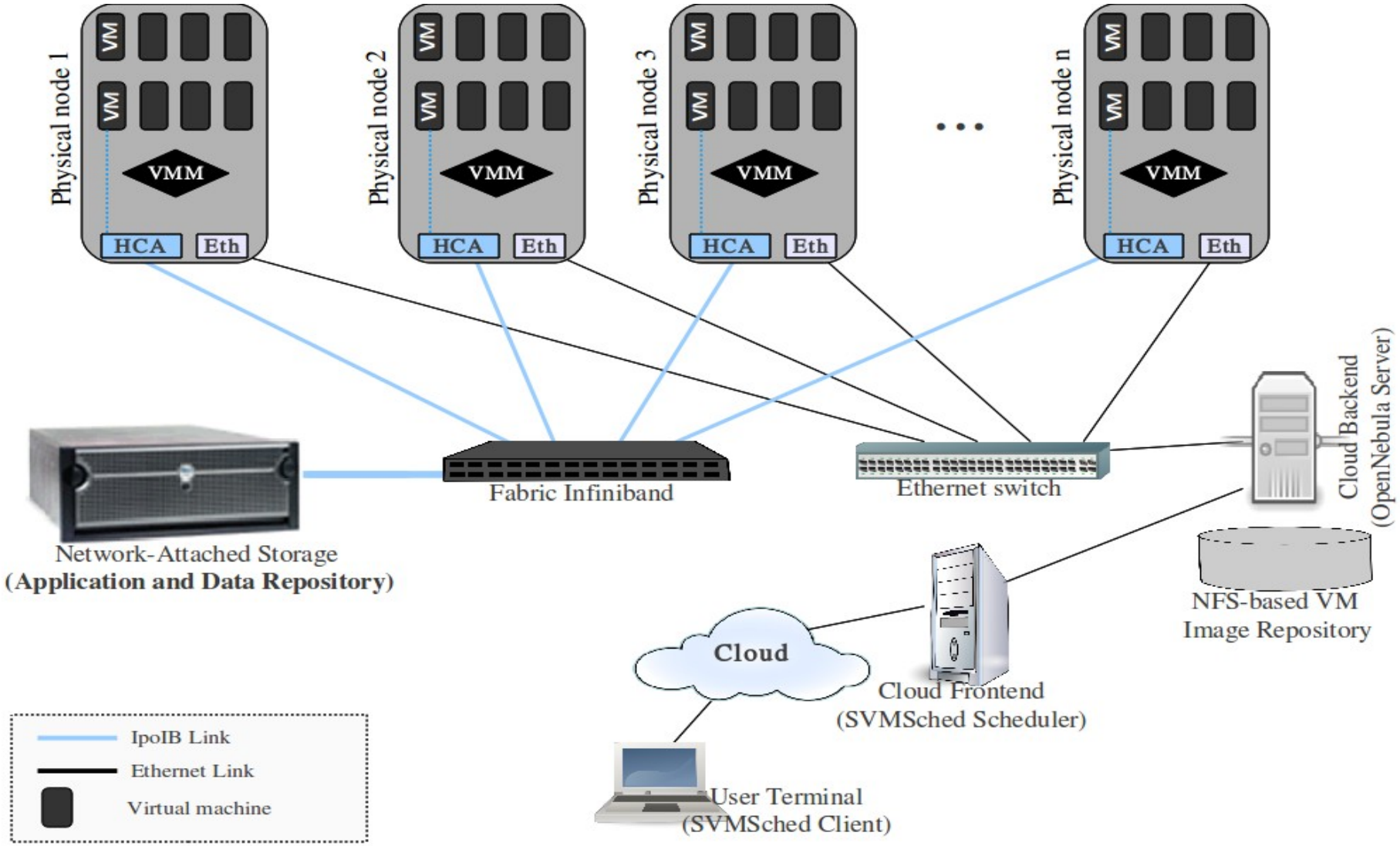


SVMSched (Smart Virtual Machine Scheduler)

- Originally designed to enable and ease the set-up of on-demand SaaS clouds
  - Drop-in replacement for the OpenNebula's default scheduler
  - **Dynamic VM provisioning** → according to requests
  - **Advanced scheduling policies** → e.g. resource sharing, best-effort + preemption, etc.
  - **Proper interfaces** to deal with requests



Deployment Architecture



Grid'5000 Deployment

- Deployment data

  nancy@g5k:/home/rchakode/g5kss11challenge/

- Single site deployment
  - Edit **oar.conf** to reserve X nodes for Y hours for example
  - Edit **nets.conf** to be compliant with the use of network addressing in Grid'5000
- Custom kadeploy3 environments

  # kaenv3 -l

```
lenny-x64-svmsched-backend 1
lenny-x64-svmsched-frontend 1
lenny-x64-svmsched-node 1
```

- Running the deployment

  # cd /tmp

  # $SVMSCHED_DIR/g5kss11challenge.sh 2> /tmp/svmsched_debug.msg

- Get debugging details about the deployment processing

  # tail -f /tmp/svmsched_debug.msg

Cloud Configuration

svmsched.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE Config SYSTEM "svmsched.dtd" >
<Config>
<!-- CLOUD CONFIGURATION SECTION -->
        <Cloud>
                <RpcUrl>http://opennebula@server:2633/RPC2</RpcUrl>    <!-- Url to bind to the OpenNebula's XML-RPC listener -->
                <OneAuth>oneadmin:7bc8559a8fe509e680562b85c337f170956fcb06</OneAuth>
                <RootDir>/opt/cloud</RootDir>    <!-- Default data-repository to mount automatically to each VM -->
                <AppPrefix>/opt/cloud/install</AppPrefix>
                <TempDir>/tmp</TempDir>
        </Cloud>
<!-- VM CONFIGURATION SECTION -->
        <SvmDescription>
                <ServerAddress>svmsched@server</ServerAddress>
                <DefaultXenVmTemplate> /opt/cloud/svmsched/etc/xenvm.tpl </DefaultXenVmTemplate>
                <ContextFiles>                  <!-- Generic data use to customize each VM machine -->
                        <ContextFile> /opt/cloud/svmsched/etc/init.sh </ContextFile> <!-- Script to initialize VM at startup -->
                        <ContextFile> /opt/cloud/svmsched/etc/svmschedclient </ContextFile> <!-- Generic data use to customize each VM machine -->
                </ContextFiles>
        </SvmDescription>
 <!-- SERVICE CONFIGURATION SECTION -->
        <AppServices>
                <AppService id="defaultapp">
                        <Software executable="/opt/cloud/install/jivarod" userid="jivarod" type="sequential"> JivaroD </Software>
                        <DataServer>opennebula@server</DataServer>    <!-- Required a NFS-based OpenNebula deployment -->
                        <DataRepository>/opt/cloud</DataRepository>   <!-- If the service requires a specific data-repository -->
                        <Description>The default App is Jivarod</Description>
                        <ResourceAllocation weight="1">               <!-- Set the level of accessing ressources by a service-->
                                <DefaultVmMemory>256</DefaultVmMemory>
                                <DefaultVmMemoryCpu>1</DefaultVmMemoryCpu>
                                <ParallelismLevel>1</ParallelismLevel>
                        </ResourceAllocation>
                </AppService>
        </AppServices>
</Config>
```

SVMSched's Client Interfaces

- Unix-like command line client
- System Workload Format-compatible load injector

```
rchakode@fnancy.nancy.grid5000.fr: ~/g5kss11challenge/load-injector 158x34
rchakode@fnancy:~/g5kss11challenge/load-injector$ ./bin/svmschedclient -h
NAME
       svmschedclient is the client module of svmsched

SYNOPSIS
       svmschedclient [-h]
       svmschedclient [-H server_addr] [OPTIONS] -r <service> -a <data>

OPTIONS
       -h
              print this help and exit
       -H, --server=server_addr
              allow to specify which server to contact (default=localhost)
       -r, --run=SERVICE
              (REQUIRED OPTION) allow to specify the service to execute
       -a, --args=DATA
              (REQUIRED OPTION) allow to specify the data to compute
       -n, --vcpu=CPU
              number of CPU to allocate to the virtual machine (default=1)
       -m, --memory=MEMORY
              amount of memory to allocate to the virtual machine (default=256MB)
       -p, --customer-priority=PRIORITY
              the priority to assign to the request according to customers (default=1)
       -t, --type-job=TYPE
              TYPE can be 'prod' or 'beff', resptectively for production and besteffort job (default=prod)
       -T, --lease-term=DURATION
              Integer that giving an estimate of the job duration
       -s, --short-term-job
              without argument, means that job will require a short execution time
       -c, --config=CONFIG_FILE
              allow to specify an alternative configuration file instead of the default (${SVMSCHED_LOCATION}/etc/default/svmsched.xml)
       rchakode@fnancy:~/g5kss11challenge/load-injector$
```

After the deployment

- Log files generated from kadeploy are located in ./tmp
- From a new terminal, log on to the svmschedand check the core log file

```
# ssh svmsched@cloud.frontend 'tail -f var/svmsched-core.log'
```

- From a new terminal, log on to the OpenNebula node and check the pool of physical nodes and the virtual network

```
# ssh oneadmin@cloud.backend 'onehost list ; onevnet list ; onevnet show 0'
```

- From a new terminal, log on to the svmsched node and check the monitor log file

```
# ssh svmsched@cloud.frontend 'tail -f var/svmsched-monitor.log'
```

After the deployment... Goto Test

- From the Grid'5000 site frontend create a VM that will run during 10 seconds

```
# ./bin/svmschedclient -H svmsched@server -r defaultapp – a 10
```

- Create a campaign of jobs from a SWF file

```
# ./bin/svmsched-swf-injector -H <swf file> \
        [svmsched_server=localhost] [max_job_duration=600]
```

Appendix

- Service configuration
  - **Simple program enforcing a sleep according to the parameter**

#/bin/bash

sleep $1

```
<AppService id="defaultapp">
        <Software executable="/opt/cloud/install/jivarod" userid="jivarod" type="sequential"> JivaroD </Software>
        <DataServer>opennebula@server</DataServer>    <!-- Required a NFS-based OpenNebula deployment -->
        <DataRepository>/opt/cloud</DataRepository>   <!-- If the service requires a specific data-repository -->
        <Description>The default App is Jivarod</Description>
        <ResourceAllocation weight="1">               <!-- Set the level of accessing ressources by a service-->
                <DefaultVmMemory>256</DefaultVmMemory>
                <DefaultVmMemoryCpu>1</DefaultVmMemoryCpu>
                <ParallelismLevel>1</ParallelismLevel>
        </ResourceAllocation>
</AppService>
```

- Materials and scripts
  - http://mescal.imag.fr/membres/rodrigue.chakode/paper/rcg5kss11demo.pdf
  - nancy@g5k:/home/rchakode/g5kss11challenge/
- Papers about SVMSched
  - http://mescal.imag.fr/membres/rodrigue.chakode/pubs.html
- SVMSched is open source and available for downloading
  - https://gforge.inria.fr/projects/svmsched/

Conclusion

- Automatic deployment and customization of an OpenNebula cloud
- Dynamic/On-demand provisioning of custom Vms through SVMSched
  - Cloud service-oriented approach
  - High-level abstraction of VMs
  - Transparent customization of VMs
  - Efficient way to set up SaaS (PaaS?) clouds
- Documented and easily reproducible experiment

Thanks for your attention

Design to enable enable custom integrations

- XML-RPC API to access the core functionality
- Template-based VMs
- Support for automatic configuration of VMs
- Support for contextualizing VMs