FutureGrid Documentation

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CONTENTS

FutureGrid Rain is a tool that will allow users to place customized environments like virtual clusters or IaaS frameworks onto resources. The process of raining goes beyond the services offered by existing scheduling tools due to its higher-level toolset targeting virtualized and non-virtualized resources. Rain will be able to move resources from one infrastructure to another and compare the execution of an experiment in the different supported infrastructures.

In order to support Rain we need a flexible image management framework. Thus, Rain includes the FutureGrid Image Management framework which defines the full life cycle of the images in FutureGrid. It involves the process of creating, customizing, storing, sharing and registering images for different FutureGrid environments.

This framework allows users to generate personalized abstract images by simply specifying a list of requirements such as OS, architecture, software, and libraries. These images are generic enough that through manipulations they can be adapted for several IaaS or HPC infrastructures with little effort by the users. It will support the management of images for Nimbus, Eucalyptus, OpenStack, OpenNebula, and bare-metal HPC infrastructures.

CHAPTER

ONE

WHAT IS FUTUREGRID RAIN?

1.1 Summary

FutureGrid *Rain* is a tool that will allow users to place customized environments like virtual clusters or IaaS frameworks onto resources. The process of raining goes beyond the services offered by existing scheduling tools due to its higher-level toolset targeting virtualized and non-virtualized resources. Rain will be able to move resources from one infrastructure to another and compare the execution of an experiment in the different supported infrastructures.

In order to support Rain we need a flexible *Image Management* framework. Thus, Rain includes the FutureGrid Image Management framework which defines the full life cycle of the images in FutureGrid. It involves the process of creating, customizing, storing, sharing, and registering images for different FG environments. To this end, we have several components to support the different tasks involved. First, we have an *Image Generation* tool that creates and customizes images according to user requirements. The second component is the *Image Repository*, which is in charge of storing, cataloging and sharing images. The last component is an *Image Registration* tool, which prepares, uploads and registers images for specific environments, like HPC or cloud frameworks. It also decides if an image is secure enough to be registered or if it needs additional security tests.

Image Management provides the low-level software needed to achieve Dynamic Provisioning and Rain. *Dynamic Provisioning* is in charge of allocating machines with the requested image. The requested image must have been previously registered in the infrastructure. On the other hand, *Rain* will be our highest level component that will use Dynamic Provisioning and Image Management to provide custom environments that may or may not exist. Therefore, a Rain request may involve the creation, registration, and provision of one or more images in a set of machines.

1.2 Rain

Due to the variety of services and limited resources provided in FG, it is necessary to enable a mechanism to provision needed services onto resources. This includes also the assignment of resources to different IaaS or PaaS frameworks.

Rain makes it possible to compare the benefits of IaaS, PaaS performance issues, as well as evaluating which applications can benefit from such environments and how they must be efficiently configured. As part of this process, we allow the generation of abstract images and universal image registration with the various infrastructures including Nimbus, Eucalyptus, OpenNebula, OpenStack, but also bare-metal via the HPC services.

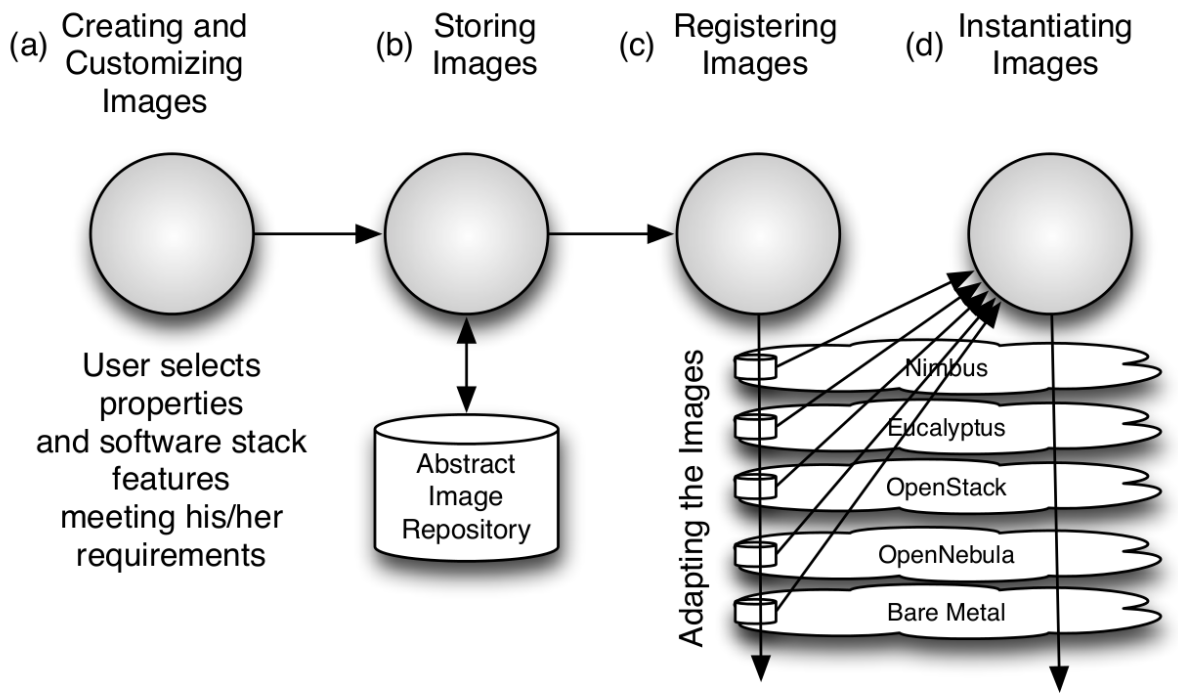
It is one of the unique features about FutureGrid to provide an essential component to make comparisons between the different infrastructures more easily possible. Rain will offers four main features:

- Create customized environments on demand.
- Compare different infrastructures.
- Move resources from one infrastructure to another by changing the image they are running plus doing needed changes in the framework.

- Ease the system administrator burden for creating deployable images.

1.3 Image Management

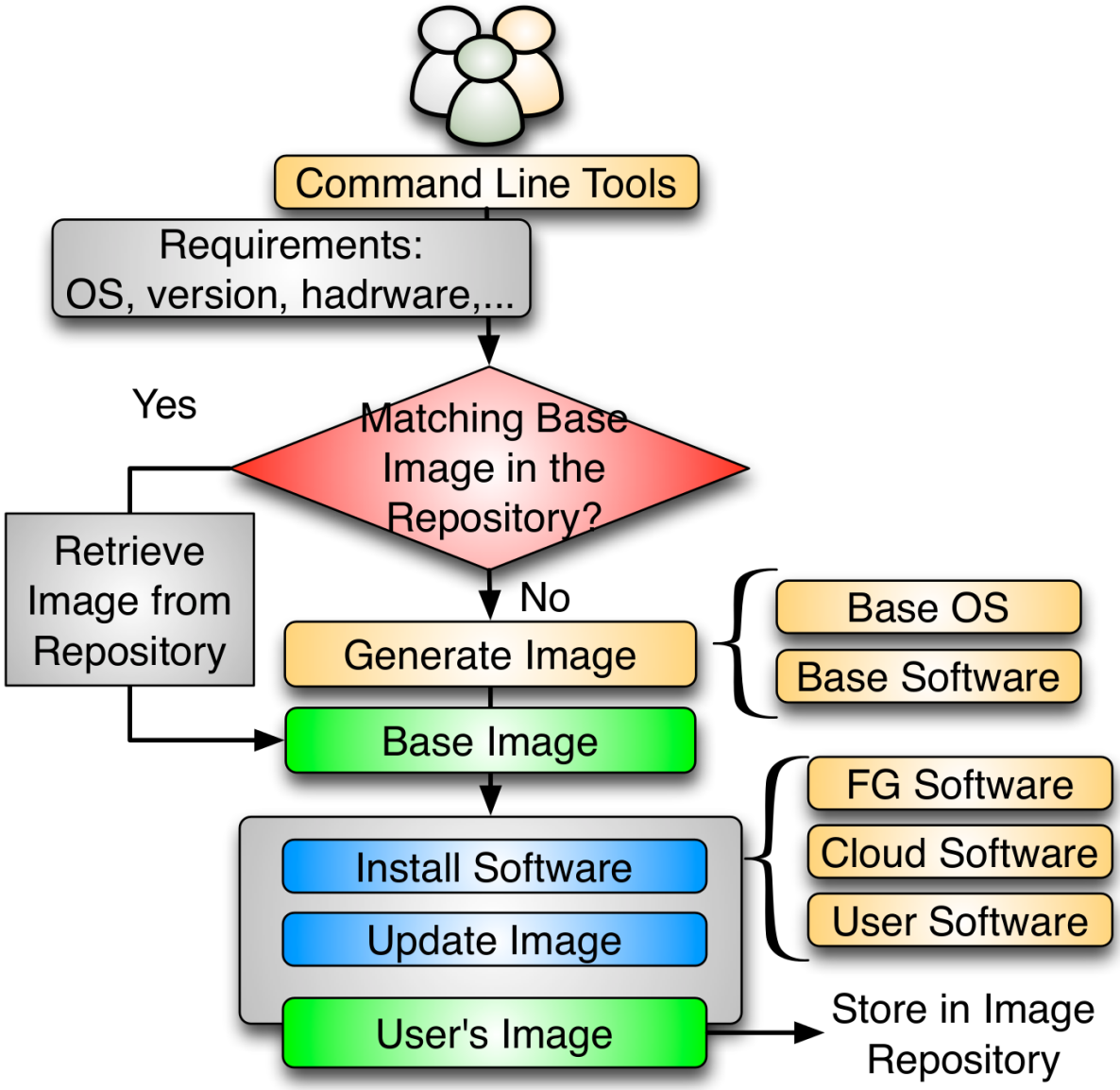
Image management is a key component in any modern compute infrastructure, regardless if used for virtualized or non-virtualized resources. We distinguish a number of important processes that are integral part of the life-cycle management of images. They include (a) image creation and customization, (b) sharing the images via a repository, (c) registering the image into the infrastructure, and (d) image instantiation. The problem of targeting not one, but multiple infrastructures amplifies the need for tools supporting these processes. Without them, only the most experienced users will be able to manage them under great investment of time.



1.4 Image Generation

The image generation provides the first step in our image management process allowing users to create images according to their specifications. Since FG is a testbed that support different type of infrastructures like HPC or IaaS, the images created by this tool are not aimed to any specific environment. Thus, it is at the registration time when the images are customized to be successfully integrated into the desired infrastructure. This clear separation between image generation and registration provides a powerful model that allow us to independently increase the OS and infrastructures supported, respectively. Moreover, it reduces the amount of images that we need to manage in the image repository and therefore the disk usage.

The flowchart depicted in the next figure shows the process followed to create an image.



Users initiate the process by specifying their requirements. These requirements can include the selection of the OS type, version, architecture, software, services, and more. First, the image generation tool searches into the image repository to identify a base image to be cloned, and if there is no good candidate, the base image is created from scratch. Once we have a base image, the image generation tool installs the software required by the user. This software must be in the official OS repositories or in the FG software repository. The later contains software developed by the FG team or other approved software. The installation procedure can be aided by Chef, a configuration management tool to ensure the software is installed and configured properly. After updating the image, it is stored in the image repository and becomes available for registration into one of the supported infrastructures. Our tool is general to deal with installation particularities of different operating systems and architectures.

1.5 Image Repository

The image repository catalogs and stores images in a unified repository. It offers a common interface for distinguishing image types for different IaaS frameworks but also bare-metal images. This allows us to include a diverse set of images contributed not only by the FG development team but also by the user community that generates such images and wishes to share them. The images are augmented with information about the software stack installed on them including versions, libraries, and available services. This information is maintained in the catalog and can be searched by users and/or other FG services. Users looking for a specific image can discover available images fitting their needs using the catalog interface.

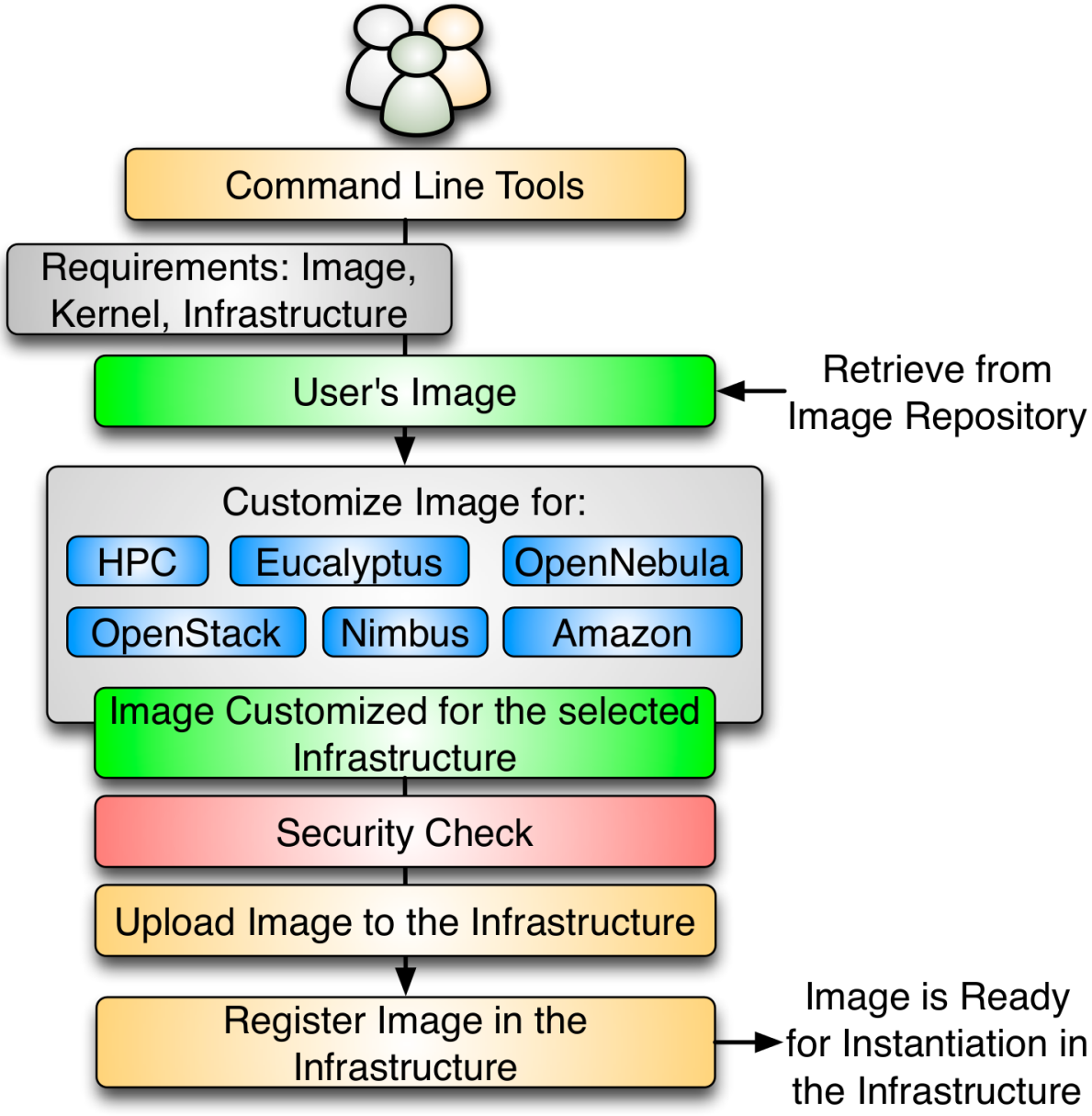
The information associated to the images is stored using the fields collected in the next table.

Field Name	Type	Valid Values	Description	Access
`imgId`	String		Unique identifier	Read-Only
`owner`	String		Image's owner	Read-Only
`os`	String		Operating system	Read-Write
`arch`	String		Architecture of the Image	Read-Write
`description`	String		Description of the image	Read-Write
`tag`	String list		Image's keywords	Read-Write
`vmType`	String	none, xen, kvm, virtualbox, vmware	Virtual machine type	
`imgType`	String	machine, kernel, eucalyptus, nimbus, opennebula, openstack	Aim of the image	Read-Write
`permission`	String	public, private	Access permission to the image	Read-Write
`imgStatus`	String	available, locked	Status of the image	Read-Write
`createdDate`	Date		Upload date	Read-Only
`lastAccess`	Date		Last time the image was accessed	Read-Only
`accessCount`	Long		# times the image has been accessed	Read-Only
`size`	Long		Size of the image	Read-Only

1.6 Image Registration

Once the image has been created and stored into the repository, we need to register it into the targeted infrastructure before we can instantiate it. Users requirements are simply the image, the targeted infrastructure and the kernel. The kernel is an optional requirement that allows advance users to select the most appropriate kernel for their experiments. This tool provides a list of available kernels organized by infrastructure. Nevertheless, users may request support for other kernels like one customized by them. Registering an image also includes the process of adapting it for the infrastructure. Often we find differences between them requiring us to provide further customizations, security check, the upload of the image to the infrastructure repository, and registering it. The process of adaptation and registration is depicted in Figure 4 in more detail. These customizations include the configuration of network IP, DNS, file system

table, and kernel modules. Additional configuration is performed depending on the targeted deployed infrastructure.



In the HPC infrastructure the images are converted to network bootable images to be provisioned on bare-metal machines. Here, the customization process configures the image, so it can be integrated into the pool of deployable images accessible by the scheduler. In our case this is Moab. Hence, if such an image is specified as part of the job description the scheduler will conduct the provisioning of the image for us. These images are stateless and the system is restored by reverting to a default OS once the running job requiring a customized image is completed.

Images targeted for cloud infrastructures need to be converted into VM disks. These images also need some additional configuration to enable VM's contextualization in the selected cloud. Our plan is to support the main IaaS clouds, namely Eucalyptus, Nimbus, OpenStack, OpenNebula, and Amazon Web Service (AWS). As our tool is extensible, we can also support other cloud frameworks.

CHAPTER

TWO

RAIN QUICKSTART

2.1 Requirements

At this moment, our software only provides command line interfaces. Thus, users need access to the machine where the client part of the software is installed. Currently, this is installed and configured in the India cluster (`india.futuregrid.org`). Since our software is going to interact with different cloud infrastructures, users need to have the appropriated credentials for each case.

- If users want to register and run images on Eucalyptus, they need an Eucalyptus account, download and uncompress the credentials (see FG Eucalyptus Tutorial). The important file is the `eucarc` that contains the needed information about Eucalyptus and the user.
- If users want to register and run images on OpenStack, they need an OpenStack account (see FG OpenStack Tutorial). User credentials should be in his `HOME` directory of the India cluster. After uncompressing the credentials file, user will find the `novarc` file that contains important information about Nimbus and the user.
- If users want to register and run images on Nimbus, they need a Nimbus account (FG Nimbus Tutorial). We are going to use the Nimbus infrastructure available in the Hotel cluster from India (The other Nimbus deployments should work if they have the kernels needed by the images). User credentials should be in his `HOME` directory of the Hotel cluster (`hotel.futuregrid.org`). Users have to copy and uncompress their credentials in their `HOME` directory of India. Then, users have to create a directory called `.nimbus` in their `HOME` directory of India and copy the files `usercert.pem` and `userkey.pem`. Other important file is the `hotel.conf` that contains information about Nimbus and the user user.

Once users have the appropriate accounts, they can login on India and use the module functionality to load the environment variables:

```
$ ssh <username>@india.futuregrid.org
$ module load futuregrid
```

Note: At this point, users have to explicitly request access to the Image Management and rain tools by sending a ticket to https://portal.futuregrid.org/help.

2.2 FG-Shell vs Command Line Interfaces

To ease the use of the FG tools, we have created a shell that provides a common interface for all these tools. So, users just need to remember how to execute the shell. Once users login into the shell, a number of features will be exposed to them. These features include help, command's auto-completion, and list of available commands organized by tool. Moreover, users only need to type the password when they login into the shell.

Users can log into the shell by executing:

```
$ fg-shell -u <username>
```

Note: Users need to use their FutureGrid portal password.

More information about using the shell can be found in the *FutureGrid Shell Manual*.

2.3 Using Image Repository

The Image Repository is a service to query, store, and update images through a unique and common interface. Next, we show some examples of the Image Repository usage (`fg-repo` command). More details can be found in the *Image Repository Manual*.

Additionally, the Image Repository manages the user database for all the image management components. This database is used to authorize users, to control the user's quotas and to record usage information. Therefore, this database complements the LDAP server which is mainly focused on the user authentication.

When using `fg-shell`, users need to load the Image Repository context by executing `use repo` inside the shell. The Image Repository environment is also included in the Image Management (`image`) and Rain (`rain`) contexts. Once there is an active context, the `help` command will show only the available commands for such context. Available contexts can be listed using the `contexts` command. More information about the shell can be found in the *FutureGrid Shell Manual*.

- Upload an image
  - Using the CLI

    ```
    $ fg-repo -p /home/javi/image.iso "vmtype=kvm&os=Centos5&arch=i386&description=this is a tes
    $ fg-repo -p /home/javi/image.iso "ImgType=Openstack&os=Ubuntu&arch=x86_64&description=this
    ```

  - Using the Shell

    ```
    put  /home/javi/image.iso ImgType=Openstack&os=Ubuntu&arch=x86_64&description=this is a test
    ```

Note: The & character is used to separate different metadata fields.

- Get an image
  - Using the CLI

    ```
    $ fg-repo -g 96416026327480308764011 2 -u jdiaz
    ```

  - Using the Shell

    ```
    get 964160263274803087640112
    ```

- Modify the metadata of an image
  - Using the CLI

    ```
    $ fg-repo -m 964160263274803087640112 "ImgType=Opennebula&os=Ubuntu10" -u jdiaz
    ```

  - Using the Shell

    ```
    modify 964160263274803087640112 ImgType=Opennebula&os=Ubuntu10
    ```

- Query Image Repository
  - Using the CLI

    ```
    $ fg-repo -q "* where vmType=kvm" -u jdiaz
    ```

  - Using the Shell

    ```
    list * where vmType=kvm
    ```

- Add user to the Image Repository
  - Using the CLI

    ```
    $ fg-repo --useradd juan -u jdiaz
    $ fg-repo --usersetstatus juan active
    ```

  - Using the Shell

    ```
    user -a juan
    user -m juan status active
    ```

2.4 Using Image Generation

This component creates images, according to user requirements, that can be registered in FutureGrid. Since FG is a testbed that supports different type of infrastructures like HPC or IaaS frameworks, the images created by this tool are not aimed at any specific environment. Thus, it is at registration time when the images are customized to be successfully integrated into the desired infrastructure.

Next, we provide some examples of the Image Generation usage (`fg-generate` command). More details can be found in the *Image Generation Manual*.

When using `fg-shell`, users need to load the Image Management context by executing `use image` inside the shell. The Image Management environment is also included in the Rain (`rain`) contexts. Once there is an active context, the `help` command will show only the available commands for such context. Available contexts can be listed using the `contexts` command. More information about the shell can be found in the *FutureGrid Shell Manual*.

- Generate a CentOS image
  - Using the CLI

    ```
    $ fg-generate -o centos -v 5 -a x86_64 -s wget,emacs,python26 -u jdiaz
    ```

  - Using the Shell

    ```
    generate -o centos -v 5 -a x86_64 -s wget,emacs,python26
    ```

- Generate an Ubuntu image
  - Using the CLI

    ```
    $ fg-generate -o ubuntu -v 10.10 -a x86_64 -s wget,openmpi-bin -u jdiaz
    ```

  - Using the Shell

    ```
    generate -o ubuntu -v 10.10 -a x86_64 -s wget,emacs,python26
    ```

2.5 Using Image Registration

This tool is responsible for customizing images for specific infrastructures and registering them in such infrastructures. Currently, we fully support HPC (bare-metal machines), Eucalyptus, OpenStack, and Nimbus infrastructures. OpenNebula is also implemented but we do not have this infrastructure in production yet.

Next, we provide some examples of the image registration usage (`fg-register` command). A detailed manual can be found in the *Image Registration Manual*

When using `fg-shell`, users need to load the Image Management context by executing `use image` inside the shell. The Image Management environment also loads the Image Repository context. The Image Management is also included in the Rain (`rain`) contexts. Once there is an active context, the `help` command will show only the available commands for such context. Available contexts can be listed using the `contexts` command. More information about the shell can be found in the *FutureGrid Shell Manual*.

Note:

- To register an image in the HPC infrastructure, users need to specify the name of that HPC machine that they want to use with the -x/–xcat option. The rest of the needed information will be taken from the configuration file.
- To register an image in Eucalyptus, OpenStack and Nimbus infrastructures, you need to provide a file with the environment variables using the -v/–varfile option.

- Register an image for the HPC Infrastructure India
  - Using the CLI

    ```
    $ fg-register -r 964160263274803087640112 -x india -u jdiaz
    ```

  - Using the Shell

    ```
    register -r 964160263274803087640112 -x india
    ```

- Register an image for OpenStack
  - Using the CLI

    ```
    $ fg-register -r 964160263274803087640112 -s -v ~/novarc -u jdiaz
    ```

  - Using the Shell

    ```
    register -r 964160263274803087640112 -s -v ~/novarc
    ```

- Customize an image for Ecualyptus but do not register it (here `-v ~/eucarc` is not needed because we are not going to register the image in the infrastructure)
  - Using the CLI

    ```
    $ fg-register -r 964160263274803087640112 -e -g -u jdiaz
    ```

  - Using the Shell

    ```
    register -r 964160263274803087640112 -e -g
    ```

- Register an image for Nimbus
  - Using the CLI

```
$ fg-register -r 964160263274803087640112 -n -v ~/hotel.conf -u jdiaz
```

  - Using the Shell

```
register -r 964160263274803087640112 -n -v ~/hotel.conf
```

- List available kernels for the HPC infrastructure India
  - Using the CLI

```
fg-register --listkernels -x india -u jdiaz
```

  - Using the Shell

```
hpclistkernels india
```

- List available kernels for OpenStack
  - Using the CLI

```
fg-register --listkernels -s -u jdiaz
```

  - Using the Shell

```
cloudlistkernels -s
```

2.6 Using RAIN

This component allow users to dynamically register FutureGrid software environments as requirement of a job submission. This component will make use of the previous registration tool. Currently we only support HPC job submissions.

Next, we provide some examples of the Rain usage (`fg-rain` command). A detailed manual can be found in the *Rain Manual*.

When using `fg-shell`, users need to load the Image Management context by executing `use rain` inside the shell. The Rain environment also loads the Image Repository and Image Management contexts. Once there is an active context, the `help` command will show only the available commands for such context. Available contexts can be listed using the `contexts` command. More information about the shell can be found in the *FutureGrid Shell Manual*.

Note:

- To register an image in the HPC infrastructure, users need to specify the name of that HPC machine that they want to use with the -x/–xcat option. The rest of the needed information will be taken from the configuration file.
- To register an image in Eucalyptus, OpenStack and Nimbus infrastructures, you need to provide a file with the environment variables using the -v/–varfile option.

- Run a job in 4 nodes on India using an image stored in the Image Repository (This involves the registration of the image in the HPC infrastructure)
  - Using the CLI

```
$ fg-rain -r 1231232141 -x india -m 4 -j myscript.sh -u jdiaz
```

  - Using the Shell

```
use rain    #if your prompt is different to fg-rain>
fg-rain> launch -r 1231232141 -x india -m 4 -j myscript.sh
```

- Run a job in 2 nodes on India using an image already registered in the HPC Infrastructure India
  - Using the CLI

    ```
    $ fg-rain -i centosjavi434512 -x india -m 2 -j myscript.sh -u jdiaz
    ```

  - Using the Shell

    ```
    use rain    #if your prompt is different to fg-rain>
    fg-rain> launch -i centosjavi434512 -x india -m 2 -j myscript.sh
    ```

- Interactive mode. Instantiate two VMs using an image already registered on OpenStack
  - Using the CLI

    ```
    $ fg-rain -i ami-00000126 -s -v ~/novarc -m 2 -I -u jdiaz
    ```

  - Using the Shell

    ```
    use rain    #if your prompt is different to fg-rain>
    fg-rain> launch -i ami-00000126 -s -v ~/novarc -m 2 -I
    ```

CHAPTER

THREE

RAIN DOCUMENTATION

3.1 User Documentation

In this section you will find information on how to use the command line interfaces of our tools.

Note: These tools require users to authenticate using their usernames and portal passwords.

3.1.1 Image Repository (fg-repo)

The Image Repository is a service to query, store, and update images through a unique and common interface.

fg-repo

```
usage: fg-repo [-h] -u user [-d]
               (-q [AttributeString] | -g imgId | -p imgFile [AttributeString ...] | -m imgId Attribu
                 | -r imgId [imgId ...] | -s imgId permissionString | --useradd userId | --userdel us
                 | --userlist | --setuserquota userId quotaExpresion | --setuserrole userId role | --
                 | --histimg [imgId] | --histuser [userId])
               [--nopasswd]

Options between brackets are not required. Parenthesis means that you need to specify one of the opti
```

Option	Description
-h/--help	Shows help information and exit.
-u/--user <userName>	FutureGrid HPC user name, that is, the one used to login into the FG resources.
-q/--list [queryString]	Get list of images that meet the criteria.
-g/--get <imgId>	Get an image by specifying its unique identifier.
-p/--put <imgFile> [attributeString]	Store image into the repository and its metadata defined in attributeString. Default metadata is provided if the argument is missing.
-m/--modify <imgId> <attributeString>	Modify the metadata associated with the image.
-r/--remove <imgId> [imgId ...]	Delete images from the Repository.
-s/--setpermission <imgId> <permissionString>	Change the permission of a particular image. Valid values are public, private.
--histimg [imgId]	Get usage information an image. If no argument provided, it shows the usage information of all images.
--nopasswd	If this option is used, the password is not requested. This is intended for systems daemons like Inca.

The following options are available only for users with admin role.

Option	Description
--useradd <userId>	Add a new user to the image management database.
--userdel <userId>	Delete an user from the image management database.
--userlist	List of users.
--setuserquota <userId> <quota>	Modify the quota of a user. The quota is given in bytes, but math expressions are allowed (4*1024*1024). By default each user has 4GB of disk space.
--setuserrole <userId> <role>	Modify the role of a user. Valid values: admin and user roles.
--setuserstatus <userId> <status>	Modify the status of a user. Valid values: pending, active, and inactive.
--histuser [userId]	Get usage info of an User. If no argument provided, it shows the usage information of all users. This option can be used by normal users to show their own information

Note: While using the command line interface, the attributeString, queryString and quotaExpression arguments must be enclosed by " characters.

- A attributeString can be composed by a list of metadata fields separated by the & character. Valid metadata fields are:
  - vmtype: it can be none, xen, kvm, virtualbox, vmware.
  - imgtype: it can be machine, kernel, eucalyptus, nimbus, opennebula, openstack.
  - os: String.
  - arch: String.
  - description: String.
  - tag: List of Strings.
  - permission: it can be public, private.

  - `imgStatus`: it can be `available`, `locked`.
- Valid `queryString` are:
  - "*"
  - "* where field=XX"
  - "field1,field2 where field3=XX"
- Valid `quotaExpression` (in bytes): "4294967296", "2048 * 1024"

Examples

- Upload an image

```
$ fg-repo -p /home/javi/image.iso "vmtype=kvm&os=Centos5&arch=i386&description=this is a tes
$ fg-repo -p /home/javi/image.iso "ImgType=Openstack&os=Ubuntu&arch=x86_64&description=this
```

Note: The & character is used to separate different metadata fields.

- Get an image

```
$ fg-repo -g 964160263274803087640112 -u jdiaz
```

- Modify the metadata of an image

```
$ fg-repo -m 964160263274803087640112 "ImgType=Opennebula&os=Ubuntu10" -u jdiaz
```

- Query Image Repository

```
$ fg-repo -q "* where vmType=kvm" -u jdiaz
```

- Add user to the Image Repository

```
$ fg-repo --useradd juan -u jdiaz
$ fg-repo --usersetstatus juan active
```

3.1.2 Image Generation (fg-generate)

This service generates images with the requested OS and software stacks specification.

fg-generate

```
usage: fg-generate [-h] -u USER [-d] -o OSName [-v OSversion] [-a arch]
                   [--baseimage | -s software] [--scratch] [-n givenname]
                   [-e description] [-g] [-z SIZE] [--nopasswd]

Options between brackets are not required. Parenthesis means that you need to specify one of the opti
```

Option	Description
-h/--help	Shows help information and exit.
-u/--user <userName>	FutureGrid HPC user name, that is, the one used to login into the FG resources.
-o/--os <osName>	Specify the desired Operating System for the new image. Currently, CentOS and Ubuntu are supported
-v/--version <osVersion>	Operating System version. In the case of Centos, it can be 5 or 6. In the case of Ubuntu, it can be karmic(9.10), lucid(10.04), maverick(10.10), natty (11.04)
-a/--arch <arch>	Destination hardware architecture (x86_64 or i386)
--baseimage	Generate a Base Image that will be used to generate other images. In this way, the image generation process will be faster.
-s/--software <software>	List of software packages, separated by commas, that will be installed in the image.
--scratch	Generate the image from scratch without using any Base Image from the repository.
-n/--name <givenname>	Desired recognizable name of the image.
-e/--description <description>	Short description of the image and its purpose.
-g/--getimg	Retrieve the image instead of uploading to the image repository.
-z/--size <SIZE>	Specify the size of the Image in GigaBytes. The size must be large enough to install all the software required. The default and minimum size is 1.5GB, which is enough for most cases.
--nopasswd	If this option is used, the password is not requested. This is intended for systems daemons like Inca.

Examples

- Generate a CentOS image

```
$ fg-generate -o centos -v 5 -a x86_64 -s wget,emacs,python26 -u jdiaz
```

- Generate an Ubuntu image

```
$ fg-generate -o ubuntu -v 10.10 -a x86_64 -s wget,openmpi-bin -u jdiaz
```

3.1.3 Image Registration (fg-register)

This service registers images in the selected infrastructures. After this process, images become available for instantiation in such infrastructures.

fg-register

```
usage: fg-register [-h] -u user [-d] (-i ImgFile | -r ImgId | -l | -t)
                   [-k Kernel version] [-a ramdiskId]
                   (-x MachineName | -e [Address:port] | -o [Address] | -n [Address] | -s [Address])
                   [-v VARFILE] [-g] [-p] [-w] [--nopasswd] [-j]

Options between brackets are not required. Parenthesis means that you need to specify one of the opti
```

Option	Description
-h/--help	Shows help information and exit.
-u/--user <userName>	FutureGrid HPC user name, that is, the one used to login into the FG resources.
-i/--image <imgFile>	Select the image to register by specifying its location. The image is a tgz file that contains the manifest and image files.
-r/--imgid <imgId>	Select the image to register by specifying its Id in the repository.
-k/--kernel <version>	Specify the desired kernel. **Case a)** if the image has to be adapted (any image generated with fg-generate) this option can be used to select one of the available kernels. Both kernelId and ramdiskId will be selected according to the selected kernel. This case is for any infrastructure. **Case b)** if the image is ready to be registered, you may need to specify the id of the kernel in the infrastructure. This case is when -j/--justregister is used and only for cloud infrastructures.
-a/--ramdisk <ramdiskId>	Specify the desired ramdisk that will be associated to your image in the cloud infrastructure. This option is only needed if -j/--justregister is used.
-l/--list	List images registered in the HPC or Cloud infrastructures.
-t/--listkernels	List kernels available for HPC or Cloud infrastructures.
-x/--xcat <MachineName>	Register the image into the HPC infrastructure named MachineName (minicluster, india ...).
-e/--euca [Address:port]	Register the image into the Eucalyptus Infrastructure, which is specified in the argument. The argument should not be needed.
-s/--openstack [Address]	Register the image into the OpenStack Infrastructure, which is specified in the argument. The argument should not be needed.
-n/--nimbus [Address]	Register the image into the Nimbus Infrastructure, which is specified in the argument. The argument should not be needed.
-o/--opennebula [Address]	Register the image into the OpenStack Infrastructure, which is specified in the argument. The argument should not be needed.
-v/--varfile <VARFILE>	Path of the environment variable files. Currently this is used by Eucalyptus, OpenStack and Nimbus.
-g/--getimg	Customize the image for a particular cloud framework but does not register it. So the user gets the image file.
-p/--noldap	If this option is active, FutureGrid LDAP will not be configured in the image. This option only works for Cloud registrations. LDAP configuration is needed to run jobs using fg-rain
-w/--wait	Wait until the image is available in the targeted infrastructure. Currently this is used by Eucalyptus and OpenStack.
--nopasswd	If this option is used, the password is not requested. This is intended for systems daemons like Inca.
-j, --justregister	It assumes that the image is ready to run in the selected infrastructure. Thus, no additional configuration will be performed. Only valid for Cloud infrastructures. (This is basically a wrapper of the tools that register images into the cloud infrastructures)

Note:

- To register an image in the HPC infrastructure, users need to specify the name of that HPC machine that they want to use with the -x/–xcat option. The rest of the needed information will be taken from the configuration file.
- To register an image in Eucalyptus, OpenStack and Nimbus infrastructures, you need to provide a file with the environment variables using the -v/–varfile option.

Examples

- Register an image for the HPC Infrastructure India

```
$ fg-register -r 96416026327480308764011 2 -x india -u jdiaz
```

- Register an image for OpenStack

```
$ fg-register -r 96416026327480308764011 2 -s -v ~/novarc -u jdiaz
```

- Customize an image for Ecualyptus but do not register it (here `-v ~/eucarc` is not needed because we are not going to register the image in the infrastructure)

```
$ fg-register -r 96416026327480308764011 2 -e -g -u jdiaz
```

- Register an image for Nimbus

```
$ fg-register -r 96416026327480308764011 2 -n -v ~/hotel.conf -u jdiaz
```

- List available kernels for the HPC infrastructure India

```
fg-register --listkernels -x india -u jdiaz
```

- List available kernels for OpenStack

```
fg-register --listkernels -s -u jdiaz
```

3.1.4 Rain (fg-rain)

Rain is a service that a command to dynamically deploy a FutureGrid software environments and stacks.

fg-rain

```
usage: fg-rain [-h] -u user [-d] [-k Kernel version]
               (-i ImgId | -r ImgId) (-x MachineName | -e [Address:port] | -s [Address])
               [-v VARFILE] [-m #instances] [-w hours]
               (-j JOBSCRIPT | -I) [--nopasswd]

Options between brackets are not required. Parenthesis means that you need to specify one of the opti
```

Option	Description
-h/--help	Shows help information and exit.
-u/--user <userName>	FutureGrid HPC user name, that is, the one used to login into the FG resources.
-k/--kernel <version>	Specify the desired kernel (fg-register can list the available kernels for each infrastructure).
-i/--registeredimageid <imgId>	Select the image to use by specifying its Id in the target infrastructure. This assumes that the image is registered in the selected infrastructure.
-r/--imgid <imgId>	Select the image to use by specifying its Id in the repository. The image will be automatically registered in the infrastructure before the job is executed.
-x/--xcat <MachineName>	Use the HPC infrastructure named MachineName (minicluster, india ...).
-e/--euca [Address:port]	Use the Eucalyptus Infrastructure, which is specified in the argument. The argument should not be needed.
-s/--openstack [Address]	Use the OpenStack Infrastructure, which is specified in the argument. The argument should not be needed.
-n/--nimbus [Address]	*(NOT yet supported)* Use the Nimbus Infrastructure, which is specified in the argument. The argument should not be needed.
-o/--opennebula [Address]	*(NOT yet supported)* Use the OpenStack Infrastructure, which is specified in the argument. The argument should not be needed.
-v/--varfile <VARFILE>	Path of the environment variable files. Currently this is used by Eucalyptus, OpenStack and Nimbus.
-m/--numberofmachines <#instances>	Number of machines needed.
-w/--walltime <hours>	How long to run (in hours). You may use decimals. This is used for HPC and Nimbus.
-j/--jobscript <JOBSCRIPT>	Script to execute on the provisioned images. In the case of Cloud environments, the user home directory is mounted in /tmp/N/u/<username>. The /N/u/<username> is only used for ssh between VM and store the ips of the parallel job in a file called /N/u/<username>/machines
-I/--interactive	Interactive mode. It boots VMs or provisions bare-metal machines. Then, the user is automatically logged into one of the VMs/machines.
--nopasswd	If this option is used, the password is not requested. This is intended for systems daemons like Inca.

Examples

- Run a job in 4 nodes using an image stored in the Image Repository (This involves the registration of the image on xCAT/Moab)

```
$ fg-rain -r 1231232141 -x india -m 4 -j myscript.sh -u jdiaz
```

- Run a job in 2 nodes using an image already registered on xCAT/Moab

```
$ fg-rain -i centosjavi434512 -x india -m 2 -j myscript.sh -u jdiaz
```

- Interactive mode. Instantiate two VMs using an image already registered on OpenStack

```
$ fg-rain -i ami-00000126 -s -v ~/novarc -m 2 -I -u jdiaz
```

- Run a job in a VM using an image already registered on Eucalyptus

```
$ fg-rain -i ami-00000126 -e -v ~/eucarc -j myscript.sh -u jdiaz
```

3.1.5 FutureGrid Shell (fg-shell)

The FutureGrid shell simplifies the access to the different FutureGrid software components. This shell is a common entry point for every components that offer a customized environment where only the FutureGrid commands are available. It has features similar to the regular GNU/Linux shell like command auto-completion.

fg-shell

```
usage: fg-shell [-h] -u user [-q] [-i] [-f script_file] [--nopasswd]

Options between brackets are not required. Parenthesis means that you need to specify one of the opti
```

Option	Description
-h/--help	Shows help information and exit.
-u/--user <userName>	FutureGrid HPC user name, that is, the one used to login into the FG resources.
-q/--quiet	Prevent to load banner and welcome messages
-i/--interactive	After the commands are interpreted the shell is put into interactive mode
-f/--file <script_file>	Execute commands from a file.
--nopasswd	If this option is used, the password is not requested. This is intended for systems daemons like Inca.

Usage

- The shell is executed by typing:

  ```
  fg-shell -u <username>
  ```

  After executing the previous command and typing your password, the prompt should change to `fg>`.

Note: Using shell from outside FutureGrid: If the shell is installed outside of FutureGrid, users will not be able to enter in the shell using their passwords. The security reasons, the LDAP server cannot be contacted from outside of FutureGrid. Therefore, users will have to use the option `--nopasswd` and set their password inside the shell by executing the command `setpasswd`. In this way, users can authenticate against the different FutureGrid components without typing the password everytime.

This is useful when a user install the shell in his local machine because he will not be able to enter in the shell typing his password.

Note: Context concept: It is essential to understand how to use the shell the concept **CONTEXT**. A context is an environment specialized for a particular tool or service. This allows us to use only the components we are interested on and organize the commands by component. For example, if we want to use the image repository, we initialize its context by typing `use repo` and only the image repository commands will be available. See `contexts` and `use` commands.

- Autocompletion by pressing tab key.
- System commands can be executed directly from the shell. If the command typed does not exists inside the shell, it tries to execute it as system command. Moreover, the shell will execute as system commands any command preceded by the **!** character.

Next, we explain the available commands that you can find inside the FutureGrid Shell.

Generic Commands

Commands listed in this section are available in any context.

- Help Related Commands

Command	Description
`help [command]`	Show help message for a command or List of all available commands organized by context if we are in the generic context `fg>` (see `use` and `context` commands). However, if we are in a specific context (e.g. `fg-repo>`) it only show the generic commands and the specific commands of this particular context.
`manual`	List help message for all commands in the shell.
`shortcuts`	List all available shortcuts.

- CONTEXT Related Commands

Command	Description
`contexts`	List of available contexts.
`use [context]`	Change the Shell CONTEXT to use a specified FG component. If no argument is provided, it returns to the default context.

- History Related Commands

Command	Description
`history`, `hist` and `hi`	Show historic of executed commands.
`historysession`, `hists` and `his`	Show historic of the commands executed in the current session.
`l`, `li`	List last executed command.
`save [N]`	Save session history to a file. N => number of command (from `historysession`), or *. Most recent command if omitted.

- Execution Related Commands

Command	Description
`load <filename>` and `exec <filename>`	Load commands from an script and stay in the shell
`pause [text]`	Displays the specified text then waits for the user to press RETURN.
`py [command]`	py <command>: Executes a Python command. py: Enters interactive Python mode. End with `Ctrl-D` (Unix) / `Ctrl-Z` (Windows), `quit()`, `exit()`.
`run, r`	Re-run the last executed command
`script [filename]`	When Script is active, all commands executed are stored in a file. Activate it by executing: `script [file]`. If no argument is provided, the file will be called `script` and will be located in your current directory. To finish and store the commands execute: `script end`

- User-Settable Parameters Related Commands

Command	Description
`setpassword`	Set the password for the current session without leaving the shell. The password is stored encrypted
`set [parameter] [value]`	Sets a cmd2 parameter. Call without arguments for a list of settable parameters with their values.
`show`	List of settable parameters with their values.

Image Repository

These commands are available when Image Repository (`repo`) or Image Management (`image`) contexts are active. To activate the image repository context execute `use repo`. If we execute `help`, we will see which commands are generic and which ones are specific of this context.

- Image Related Commands

Command	Description
`list [queryString]`	Get list of images that meet the criteria.
`get <imgId>`	Get an image by specifying its unique identifier.
`put <imgFile> [attributeString]`	Store image into the repository and its metadata defined in `attributeString`. Default metadata is provided if the argument is missing.
`modify <imgId> <attributeString>`	Modify the metadata associated with the image.
`remove <imgId>`	Delete images from the Repository.
`setpermission <imgId> <permissionString>`	Change the permission of a particular image. Valid values are `public`, `private`.
`histimg [imgId]`	Get usage information an image. If no argument provided, it shows the usage information of all images.

- User Related Commands

  The following options are available only for users with `admin` role.

Command	Description
`user <options>`	Manage image management user's database. **options** `-a/--add <userId>` Add a new user to the image management database. `-d/--del <userId>` Delete an user from the image management database. `-l, --list` List of users. `-m/--modify <userId> <quota/role/status> <value>` Modify quota, role or status of an user.
`histuser [userId]`	Get usage info of an User. If no argument provided, it shows the usage information of all users. This option can be used by normal users to show their own information

Image Generation

These commands are available when the Image Management (`image`) or the Rain (`rain`) contexts are active. To activate the image management context execute `use image`. If we execute `help`, we will see which commands are generic and which ones are specific of this context.

Command	Description
`generate <options>`	Generates images with the requested OS and software stacks specification. **options** `-o/--os <osName>` Specify the desired Operating System for the new image. Currently, CentOS and Ubuntu are supported `-v/--version <osVersion>` Operating System version. In the case of Centos, it can be 5 or 6. In the case of Ubuntu, it can be karmic(9.10), lucid(10.04), maverick(10.10), natty(11.04) `-a/--arch <arch>` Destination hardware architecture (x86_64 or i386) `--baseimage` Generate a Base Image that will be used to generate other images. In this way, the image generation process will be faster. `-s/--software <software>` List of software packages, separated by commas, that will be installed in the image. `--scratch` Generate the image from scratch without using any Base Image from the repository. `-n/--name <givenname>` Desired recognizable name of the image. `-e/--description <description>` Short description of the image and its purpose. `-g/--getimg` Retrieve the image instead of uploading to the image repository. `-z/--size <SIZE>` Specify the size of the Image in GigaBytes. The size must be large enough to install all the software required. The default and minimum size is 1.5GB, which is enough for most cases.

Image Register

These commands are available when the Image Management (`image`) or the Rain (`rain`) contexts are active. To activate the image management context execute `use image`. If we execute `help`, we will see which commands are generic and which ones are specific of this context.

Command	Description
register <options>	Registers images in the selected infrastructures. After this process, images become available for instantiation in such infrastructures. **Options** -k/--kernel <version> Specify the desired kernel. -i/--image <imgFile> Select the image to register by specifying its location. The image is a tgz file that contains the manifest and image files. -r/--imgid <imgId> Select the image to register by specifying its Id in the repository. -x/--xcat <MachineName> Register the image into the HPC infrastructure named MachineName (minicluster, india ...). -e/--euca [Address:port] Register the image into the Eucalyptus Infrastructure, which is specified in the argument. The argument should not be needed. -s/--openstack [Address] Register the image into the OpenStack Infrastructure, which is specified in the argument. The argument should not be needed. -n/--nimbus [Address] Register the image into the Nimbus Infrastructure, which is specified in the argument. The argument should not be needed. -o/--opennebula [Address] Register the image into the OpenStack Infrastructure, which is specified in the argument. The argument should not be needed. -v/--varfile <VARFILE> Path of the environment variable files. Currently this is used by Eucalyptus, OpenStack and Nimbus. -g/--getimg Customize the image for a particular cloud framework but does not register it. So the user gets the image file. -p/--noldap If this option is active, FutureGrid LDAP will not be configured in the image. This option only works for Cloud registrations. LDAP configuration is needed to run jobs using fg-rain -w/--wait Wait until the image is available in the targeted infrastructure. Currently this is used by Eucalyptus and OpenStack.
cloudlist <options>	List images registered in the Cloud infrastructures. **Options** -e/--euca [Address:port] List images registered into the Eucalyptus Infrastructure, which is specified in the argument. The argument should not be needed. -n / --nimbus [Address] List images registered into the Nimbus Infrastructure, which is specified in the argument. The argument should not be needed. -o / --opennebula [Address] List images registered into the OpenNebula Infrastructure, which is specified in the argument. The argument should not be needed. -s / --openstack [Address] List images registered into the OpenStack Infrastructure, which is specified in the argument. The argument should not be needed.
cloudlistkernels <options>	List kernels available for the Cloud infrastructures. **Options** -e/--euca [Address:port] -n / --nimbus [Address] -o / --opennebula [Address] -s / --openstack [Address]
hpclist <machine>	List images registered in the HPC infrastructure named machine (minicluster, india ...).
hpclistkernels <machine>	List kernels available for HPC infrastructure named machine (minicluster, india ...).

Examples

Context Usage

- Show list of available contexts

```
$ fg-shell -u jdiaz
fg> contexts
```

  - The output shows all available contexts

```
FG Contexts:
------------
repo
image
rain
hadoop
```

- Users can select any of the previous contexts with the `use` command. Then, the environment of this particular context is initialized.

```
fg> use repo
fg-repo>
```

- Return to the normal context

```
fg-repo> use
fg>
```

Help Usage

- List available commands in the generic context

```
$ fg-shell -u jdiaz
fg> help
```

  - The output shows the list of generic commands and the list of commands that are available in each of the contexts. Note that the commands listed for each context are only available when that particular context has been loaded. Some contexts load other contexts as part of their requirements, as we explained before.

```
A complete manual can be found in https://portal.futuregrid.org/man/fg-shell

Generic Documented commands (type help <topic>):
================================================
contexts  history         load    py    save    setpasswd  use
exec      historysession  manual  quit  script  shortcuts
help      li              pause   run   set     show

Image Repository commands. Execute "use repo" to use them. (type help <topic>):
================================================================================
get  histimg  histuser  list  modify  put  remove  setpermission  user

Apache Hadoop commands. Execute "use hadoop" to use them. (type help <topic>):
==============================================================================
runjob  runscript

Image Management commands. Execute "use image" to use them. (type help <topic>):
================================================================================
cloudlist  cloudlistkernels  generate  hpclist  hpclistkernels  register

FG Dynamic Provisioning commands. Execute "use rain" to use them. (type help <topic>):
======================================================================================
launch

Please select a CONTEXT by executing use <context_name>
Execute 'contexts' command to see the available context names
```

- List available commands in the `image` context (this contexts also loads the `repo` contexts)

```
fg> use image
fg-image> help
```

  - The output is something like this.

```
A complete manual can be found in https://portal.futuregrid.org/man/fg-shell

General documented commands (type help <topic>):
================================================
contexts  history         load    py    save    setpasswd  use
exec      historysession  manual  quit  script  shortcuts
help      li              pause   run   set     show

Specific documented commands in the repo context (type help <topic>):
======================================================================
get  histimg  histuser  list  modify  put  remove  setpermission  user

Specific documented commands in the image context (type help <topic>):
======================================================================
cloudlist  cloudlistkernels  generate  hpclist  hpclistkernels  register
```

General Shell Usage

- Session example where we get an image, list all the images which `os` is centos, add an user and activate it.

```
$ fg-shell

fg> use repo
fg-repo> get image123123123
fg-repo> list * where os=centos
fg-repo> user -a javi
fg-repo> user -m javi status active
```

- Record the executed commands in an script.

```
$fg-shell
fg> script myscript.txt
fg> use repo
fg-repo> put /tmp/image.img vmtype=xen & imgtype=opennebula & os=linux & arch=x86_64
fg-repo> list
fg-repo> script end
```

  - This will create a file called myscript.txt with this content:

```
use repo
put /tmp/image.img vmtype=xen & imgtype=opennebula & os=linux & arch=x86_64
list
```

- Execute shell commands stored in a file. Then exits from the shell

```
$ cat myscript.txt| fg-shell
```

- Execute shell commands stored in a file from the shell. This stay in the shell.

```
$ fg-shell -u jdiaz
fg> load myscript.txt
```

3.2 Administrator Documentation

In this section you will find information on software deployment details.

3.2.1 Installing FutureGrid Rain

You can install the FutureGrid Rain using one of the following procedures.

- *Using the "easy_install" tool*. This is the simplest option, as `easy_install` will take care of downloading and installing not just FutureGrid Rain but also its dependencies. You must already have Python (version 2.6 or higher) and Python Distribute (version 0.6.15 or higher) installed on your machine (or you must be able to install them). To check if both are installed, try running `easy_install --version` from the command line. If the command is available, and it prints out a version number equal or higher than 0.6.15, you will be able to install FutureGrid Rain using `easy_install`.
- *Using a source tarball*. If you are unable to install FutureGrid Rain using `easy_install`, you can download a tarball with the FutureGrid Rain source code. Your machine must have Python installed on it, but not the Python Distribute package (the tarball includes a setup script that will automatically download and install Python Distribute for you).
- *Downloading the latest code from GitHub*. Choose this option if you want to track the latest code in our GitHub repository,

Using `easy_install`

This option has the following prerequisites:

- Python 2.6 or higher. If Python is not available on your machine, you can find installation instructions here: http://www.python.org/getit/. Take into account that, if you are using a Linux distribution, you should be able to install it using your distribution's package manager (e.g., `apt-get install python` on Debian and Ubuntu). If you are using a Mac, Python is included by default; however, if your version is too old, take a look at the following instructions: http://www.python.org/getit/mac/
- Python Distribute 0.6.15 or higher. As noted above, you can verify if this package is installed by running `easy_install --version`. If it is not available, you can find installation instructions here: http://pypi.python.org/pypi/distribute#installation-instructions. Take into account that, although Python Distribute is included as an optional package in most Linux distributions, it is sometimes available under the name "Setuptools" (e.g., `python-setuptools` in Debian and Ubuntu systems), since Python Distribute is a fork of the Setuptools project.

If you meet these prerequisites, you should be able to install FutureGrid Rain simply by running this as `root`:

```
easy_install -U futuregrid
```

If you are using Ubuntu or Mac OS X, you will likely just need to run this:

```
sudo easy_install -U futuregrid
```

If you do not have administrative privileges on your machine, you will have to install FutureGrid Rain under your regular user account:

```
easy_install -U futuregrid --user
```

Note: Installing FutureGrid Rain in your home directory will install the FutureGrid Rain commands in `~/.local/bin`, which may not be in your PATH environment variable. If not, make sure to update the definition of your PATH environment variable (e.g., in the `~/.profile` file if you are using a BASH shell).

Alternatively, you can also request that the commands be installed in a directory that is already in your $PATH. You may want to use `~/bin/`, as most Linux distributions will automatically include that directory in your PATH.

```
easy_install -U futuregrid  --user -s ~/bin/
```

Using a source tarball

If you do not have Python Distribute, or are unable to install it, you can still install FutureGrid Rain by downloading a source tarball yourself. This tarball contains an installation script that will install and setup Python Distribute, and then proceed to install FutureGrid Rain.

You will first have to download the latest source tarball from the Python Package Index: http://pypi.python.org/pypi/futuregrid

Next, untar the tarball and run the installation script as `root`:

```
tar xvzf futuregrid-1.0.tar.gz
cd futuregrid-1.0
python setup.py install
```

Note: If you are using Ubuntu or Mac OS X, you will likely just need to run this:

```
sudo python setup.py install
```

If you do not have administrative privileges on your machine, you can choose to install everything inside your home directory:

```
python setup.py install --user
```

Tracking latest code from GitHub

If you want to use the latest version of our code from our GitHub repository, the steps are similar to installing a source tarball. However, instead of downloading a tarball, you will use git to clone our repository on your machine. Simply run the following:

```
git clone git@github.com:futuregrid/rain.git
```

This will create a directory called `rain`. In it, you will find the same `setup.py` script described in the previous section. If you want to install FutureGrid Rain, and not make any modifications to the code, you should run `python setup.py install` as described in the previous section.

If you intend to modify the code, and want the FutureGrid Rain commands to use the code in the git repository you've created on your machine, you can instead install FutureGrid Rain in "developer" mode:

```
python setup.py develop
```

This will install FutureGrid Rain but, instead of copying the Python source code to a system directory, it will create a pointer to the source directory you checked out. That way, any changes you make to the source code will take effect immediately (without having to reinstall FutureGrid Rain).

Take into account that there are, at least, two branches in our GitHub repository: `master` and `dev`. The former always contains the latest stable release, including bug fixes, and the former contains the very latest version of our code (which may not work as reliably as the code in the `master` branch). By default, your repository will track the `master` branch. To switch to the `dev` branch, run the following:

```
git checkout dev
```

To pull the latest changes from our GitHub repository, run the following:

```
git pull origin
```

3.2.2 Setting up the FutureGrid Software

Configuration Files

There are two places where we can locate the configuration files. Our software will look into these places in the following order:

1. In the directory `~/.fg/`
2. In the directory `/etc/futuregrid/`

If you have installed FutureGrid Rain using the tarball file (*Using a source tarball*) you will find the configuration sample files in /etc/futuregrid/. Otherwise, you can download them as a tarball or a ZIP file.

Server Side: The configuration file has to be renamed as `fg-server.conf`.

Client Side: The configuration file has to be renamed as `fg-client.conf`.

Note: If you configure several clients or servers in the same machine, the `fg-client.conf` or `fg-server.conf` must be the same file.

Note: In the **Client Side**, the path of the log files must be relative to each users. Using the `$HOME` directory is a good idea.

Setting up LDAP

The authentication of our software is based on LDAP. So, we need to configure some options in the configuration files to make it possible.

Server Side

We need to configure the `[LDAP]` section. This is going to be use by all servers. More information about this section of the server configuration file can be found in *LDAP section*.

```
[LDAP]
LDAPHOST= ldap.futuregrid.org
LDAPUSER= uid=rainadmin,ou=People,dc=futuregrid,dc=org
LDAPPASS= passwordrainadmin
log= ~/fg-auth.log
```

Client Side

We need to configure the `[LDAP]` section. This is going to be use by the FutureGrid Shell. This allows the shell to store your encrypted password once it has been validated. In this way, you won't have to type to password again during that session. More information about this section of the client configuration file can be found in *LDAP section*.

```
[LDAP]
LDAPHOST=ldap.futuregrid.org
log=~/fg-auth.log
```

Setting up an http Server

This server will contain configuration files and kernel files that are needed by the different components of the FutureGrid software.

1. Setting up an Apache server.

   ```
   sudo yum install httpd

   or

   sudo apt-get install apache2

   sudo /etc/init.d/httpd start
   ```

2. Copy all configuration files into `/var/www/html/` or the directory specified in `httpd.conf` if you are not using the default options. The configuration files are in the FutureGrid private svn.

Setting up the Image Repository

In this section we explain how to configure the Image Repository.

Server Side

In the Server side we need to configure several sections. The main one is the `[RepoServer]` and we have to create another section with the of the backend system that we want to use (see *RepoServer section*). Our image repository support different backends that are described in the next table:

Backend option	Storage for Image Files	Storage for Metadata
mysql	Posix Filesystem	MySQL
mongodb	MongoDB	MongoDB
swiftmysql	Swift	MySQL
swiftmmongo	Swift	MongoDB
cumulusmysql	Cumulus	MySQL
cumulusmmongo	Cumulus	MongoDB

Note: Installation instructions for the software to be used as storage backend can be found in *Installing Image Repository Backends*

Our predefined option is `cumulusmongo`. Thus, the `[RepoServer]` section looks like:

```
[RepoServer]
port = 56792
proc_max = 10
refresh = 20
nopasswdusers = testuser:127.0.0.1,127.0.0.2; testuser2:127.0.0.1
backend = cumulusmongo
log = ~/reposerver.log
log_level = debug
ca_cert= /etc/futuregrid/certs/imdserver/cacert.pem
```

```
certfile= /etc/futuregrid/certs/imdserver/imdscert.pem
keyfile= /etc/futuregrid/certs/imdserver/privkey.pem
restConfFile = /etc/futuregrid/fg-restrepo.conf
```

Note: You may need to configure the iptables to open the port specified in the `port` option to allow the communication with the client.

Since we have specified `backend = cumulusmongo`, we also have to add a section named `[cumulusmongo]` (see *Backend Example Section*)

```
[cumulusmongo]
address = localhost:23000
userAdmin =
configfile =
addressS = 192.168.1.2
userAdminS = PgkhmT23FUv7aRZND7BOW
configfileS = /etc/futuregrid/cumulus.conf
imgStore =/temp/
```

The `imgStore` directory is where the images are uploaded to the server via ssh. This is a temporal directory for all the different backends but the mysql one. The permission of this directory must be 777 to allow everyone to upload images. Moreover, when this is used as temporal directory, **the bit t must be disabled** because the user that executes the server (i.e. `imageman`) must be able to remove the images from the temporal directory after it has been uploaded to the final destination. By default any directory that you creates has this bit disabled. However, the /tmp directory existing in your system has this bit enabled.

The files specified in the `configfile` and `configfileS` options contain the password of the services. These files look like:

```
[client]
password=complicatedpass
```

In case we want to use a different configuration, we may need to install the python modules to support that.

- MySQL (MySQL has to be installed before you install the python module)

  ```
  sudo easy_install MySQL-python
  ```

- Swift

  ```
  sudo easy_install python-cloudfiles
  ```

Additionally, if we want to configure the Rest Interface Server, we need to specify the option `restConfFile` in `[RepoServer]` Section to identify its configuration file. In this configuration file we need to specify the information about the Rest Interface. A simple configuration file is:

```
[global]
log.error_file = 'cherrypy.error.log'
log.accessfile = 'cherrypy.access.log'
server.socket_host = "0.0.0.0"
server.socket_port = 8443
server.thread_pool = 10
server.ssl_module="builtin"
```

To enable https, we need to install `pyopenssl`,

```
sudo easy_install python-cloudfiles
```

```
or

sudo apt-get/yum install python-openssl
```

have x509 certificates and modify the configuration file:

```
[global]
log.error_file = 'cherrypy.error.log'
log.accessfile = 'cherrypy.access.log'
server.socket_host = "0.0.0.0"
server.socket_port = 8443
server.thread_pool = 10
server.ssl_module="pyopenssl"
server.ssl_certificate="server.crt"
server.ssl_private_key="server.key"
```

Once you have the configuration files ready and the backend software installed, you can start the image repository and the rest interface servers by executing `IRServer.py` and `IRRestServer.py` respectively.

Note: We recommend to have a system user that run all the servers. In this way it will be easier to manage the sudoers file when necessary.

Client Side

In the client side, we need to configure the `[Repo]` section. More information about this section of the client configuration file can be found in *Repo section*.

```
[Repo]
port = 56792
serveraddr=localhost
log=~/clientrepo.log
log_level=debug
ca_cert=/opt/futuregrid/futuregrid/etc/imdclient/cacert.pem
certfile=/opt/futuregrid/futuregrid/etc/imdclient/imdccert.pem
keyfile=/opt/futuregrid/futuregrid/etc/imdclient/privkey.pem
```

Once you have everything set up, you need to create the users in the image repository. Although users are managed in the LDAP server, the image repository also maintain a database with users to control user's access, quotas, store statistics, etc. This database is also used by the rest of the framework The first user that you create will have the `admin` role by default. In this way, you can create more users. The command to add an user is:

```
fg-repo --useradd <userid>
```

The executable file of this client is `fg-repo`. More information about how to use the image repository can be found in the *Image Repository Manual*.

Note: The userid created in the image repository must be the same that in LDAP.

Image Repository Check List

	Server Side (`fg-server.conf`)	Client Side (`fg-client.conf`)
Access to	• Storage Backend	• Users must be able to SSH the server machine to retrieve/upload images
Configure	• `[RepoServer]` section • `[LDAP]` section • Rest config file specified in `[RepoServer]` section	• `[Repo]` section
Executables	• `IRServer.py` (Server for CLI) • `IRRestServer.py` (Server for Rest Interface)	• `fg-repo`

Setting up the Image Generator

In this section we explain how to configure the Image Generator

Server Side

In the Server side we need to configure the `[GenerateServer]` Section (see *GenerateServer section*).

```
[GenerateServer]
port = 56791
proc_max = 5
refresh = 20
wait_max = 3600
nopasswdusers = testuser:127.0.0.1,127.0.0.2;testuser2:127.0.0.1
vmfile_centos = 5:/srv/cloud/one/share/examples/centos5_context.one,6:/srv/cloud/one/share/examp
vmfile_rhel =
vmfile_ubuntu = /srv/cloud/one/share/examples/ubuntu_context.one
vmfile_debian =
xmlrpcserver = http://localhost:2633/RPC2
bridge = br1
addrnfs = 192.168.1.6
tempdirserver = /srv/scratch/
tempdir = /media/
http_server = http://fg-gravel.futuregrid.edu/
oneuser = oneadmin
onepass = f8377c90fcfd699f0ddbdcb30c2c9183d2d933ea
log = ~/fg-image-generate-server.log
log_level=debug
ca_cert=/opt/futuregrid/futuregrid/etc/imdserver/cacert.pem
certfile=/opt/futuregrid/futuregrid/etc/imdserver/imdscert.pem
keyfile=/opt/futuregrid/futuregrid/etc/imdserver/privkey.pem
```

Note: You may need to configure the iptables to open the port specified in the `port` option to allow the communication with the client.

As we described in the *Image Generation Section*, the Image Generator is supported by a IaaS cloud. Currently, we use OpenNebula for this purpose. Therefore, it is a requirement to have an OpenNebula cloud installed and configured with at least one compute node. Additionally, you need to have the VMs that will be used to generate the images and the templates. The VM templates are specified in the

```
#---------------------------------------
# VM definition
#---------------------------------------
NAME = "centos5"
CPU    = 1
MEMORY = 1024
OS = [
  arch="x86_64"
  ]
DISK = [
  source   = "/srv/cloud/images/centos-5.6c1.img",
  target   = "hda",
  readonly = "no"
  ]
NIC = [ NETWORK_ID=0]
NIC = [ NETWORK_ID=1]
FEATURES=[ acpi="no" ]
CONTEXT = [
   files = "/srv/cloud/images/centos/init.sh /srv/cloud/images/imageman_key.pub",
   target = "hdc",
   root_pubkey = "imageman_key.pub"
   ]
GRAPHICS = [
  type    = "vnc",
  listen  = "127.0.0.1"
  ]
```

Configure the scratch directory specified in the `tempdirserver` option. For that, we need to export via NFS the directory to allow the VMs to mount as scratch disk. Assuming that the `tempdirserver` option is `/srv/scratch` and the subnet is `192.168.1.0/24`, the configuration steps are:

1. Install NFS support

   ```
   sudo apt-get install nfs-common

   or

   sudo yum install nfs-utils
   ```

2. Create directories

   ```
   sudo mkdir -p /srv/scratch
   sudo chmod 777 /srv/scratch
   ```

3. Export directories. Edit `/etc/exports` file to insert the following line:

   ```
   /srv/scratch 192.168.1.*(rw,async,no_subtree_check,no_root_squash) 192.168.1.*(rw,async,no_subtr
   ```

4. Refresh NFS server

   ```
   sudo exportfs -r
   ```

Configure user that is going to execute the server. Let's assume that the name of this user is `imageman`:

1. Configure ssh to don't check the host id. This is needed for login into the VMs because the same IP will be associated to different VMs over time. So, we need to edit the `$HOME/.ssh/config` file to insert the next lines. The permissons of this file is 644.

```
Host *
      StrictHostKeyChecking no
```

2. Edit `sudoers` file by executing `visudo` as `root` user and add the following lines:

```
imageman ALL=(ALL) NOPASSWD: /usr/bin/python *
imageman ALL=(ALL) NOPASSWD: /usr/sbin/chroot *
imageman ALL=(ALL) NOPASSWD: /bin/mount *
imageman ALL=(ALL) NOPASSWD: /bin/umount *
```

Configure the Image Repository client because the Image Generation must be able to retrieve and upload images to the repository. See *Setting up Image Repository Client*. The `imageman` user must be able to ssh the Image Repository Server machine without introducing password or passphrase. Therefore, we need to put the `imageman` public key in the `authorized_keys` of the machine where the Image Repository Server is running.

Once everything is set up you can start the server by execution `IMGenerateServer.py` as `imageman` user.

Client Side

In the client side, we need to configure the `[Generation]` section. More information about this section of the client configuration file can be found in *Repo section*.

```
[Generation]
serveraddr = fg-gravel.futuregrid.edu
port = 56791
log=~/clientgen.log
log_level=debug
ca_cert=/opt/futuregrid/futuregrid/etc/imdclient/cacert.pem
certfile=/opt/futuregrid/futuregrid/etc/imdclient/imdccert.pem
keyfile=/opt/futuregrid/futuregrid/etc/imdclient/privkey.pem
```

The executable file of this client is `fg-generate`. More information about how to use the image generation can be found in the *Image Generation Manual*.

Image Generation Check List

	Server Side (`fg-server.conf`)	Client Side (`fg-client.conf`)
Access to	• OpenNebula Cloud • Image Repository (ssh access with no password or passphrase to the server machine)	• Users must be able to SSH the server machine to retrieve images
Configure	• `[GenerateServer]` section • `[LDAP]` section • `/etc/sudoers` file • Export scratch directory for VMs • Image Repository client	• `[Generation]` section
Executables	• `IMGenerateServer.py` (Server for CLI)	• `fg-generate`

Setting up the Image Registrator

In this section we explain how to configure the Image Registrator for Cloud and HPC infrastructures.

Server Side for Cloud infrastructures

Here we need to configure the `[RegisterServerIaas]` Section (see *RegisterServerIaas section*).

```
[RegisterServerIaas]
port = 56793
proc_max = 5
refresh = 20
nopasswdusers = testuser:127.0.0.1,127.0.0.2;testuser2:127.0.0.1
tempdir = /temp/
http_server=http://fg-gravel.futuregrid.edu/
default_eucalyptus_kernel = 2.6.27.21-0.1-xen
eucalyptus_auth_kernels = 2.6.27.21-0.1-xen:eki-78EF12D2:eri-5BB61255; 2.6.27.21-0.1-xen-test:ek
default_nimbus_kernel = 2.6.27.21-0.1-xen
nimbus_auth_kernels = 2.6.27.21-0.1-xen:2.6.27.21-0.1-xen:2.6.27.21-0.1-xen; test1:test1:test1
default_openstack_kernel = 2.6.28-11-generic
openstack_auth_kernels = 2.6.28-11-generic:aki-00000026:ari-00000027
default_opennebula_kernel = 2.6.35-22-generic
opennebula_auth_kernels = 2.6.35-22-generic: /srv/cloud/images/vmlinuz-2.6.35-22-generic:/srv/cl
log = ~/fg-image-register-server-iaas.log
log_level = debug
ca_cert=/opt/futuregrid/futuregrid/etc/imdserver/cacert.pem
certfile=/opt/futuregrid/futuregrid/etc/imdserver/imdscert.pem
keyfile=/opt/futuregrid/futuregrid/etc/imdserver/privkey.pem
```

Configure user that is going to execute the server. Let's assume that the name of this user is `imageman` and the `tempdir` option is `/temp/`. We need to edit the `sudoers` file by executing `visudo` as `root` user and add the

following lines:

```
Defaults:imageman    !requiretty
User_Alias SOFTWAREG = imageman
Cmnd_Alias IMMANCOMND =
                     /bin/chmod * /temp/*, \
                     /bin/mkdir -p /temp/*, \
                     /bin/mount -o loop /temp/* /temp/*, \
                     /bin/rm [-]* /temp/*, \
                     /bin/sed -i s/enforcing/disabled/g /temp/*, \
                     /bin/tar xvfz /temp/* -C /temp/*, \
                     /bin/umount /temp/*, \
                     /usr/bin/tee -a /temp/*, \
                     /usr/sbin/chroot /temp/*, \
                     /usr/bin/wget * -O /temp/*, \
                     /bin/tar xfz /temp/* --directory /temp/*, \
                     /bin/mv -f /temp/* /temp/*, \
                     /bin/chown root\:root /temp/*
SOFTWAREG ALL = NOPASSWD: IMMANCOMND
```

Configure the Image Repository client because the Image Generation must be able to retrieve and upload images to the repository. See *Setting up Image Repository Client*. The `imageman` user must be able to ssh the Image Repository Server machine without introducing password or passphrase. Therefore, we need to put the `imageman` public key in the `authorized_keys` of the machine where the Image Repository Server is running.

Once everything is set up you can start the server by execution `IMRegisterServerIaas.py` as `imageman` user.

Server Side for HPC infrastructures

As we described in the *Image Registration Section*, the Image Registration for HPC is supported by a xCAT and Moab. Therefore, it is a requirement to have an such software installed in our HPC infrastructure. To interact with xCAT and Moab we have two services called `IMRegisterServerXcat.py` and `IMRegisterServerMoab.py`, respectively.

The `IMRegisterServerXcat.py` will copy the image into the xCAT directories and register the image in the xCAT tables. Our service can run in any machine that has the xCAT client configured and access to the directories `/install/netboot/`, `/tftpboot/` and `/etc/xcat`. The directories can be mounted via NFS and we only make changes in the first two directories. The last one is needed for xCAT client.

Here we need to configure the `[RegisterServerXcat]` Section (see *RegisterServerXcat section*).

```
[RegisterServerXcat]
xcat_port=56789
xcatNetbootImgPath=/install/netboot/
nopasswdusers = testuser:127.0.0.1,127.0.0.0;testuser:127.0.0.1
http_server=http://fg-gravel.futuregrid.edu/
log=fg-image-register-server-xcat.log
log_level=debug
test_mode=False
default_xcat_kernel_centos = 5:2.6.18-164.el5,6:2.6.32-220.4.2.el6
default_xcat_kernel_ubuntu = karmic:2.6.35-22-generic,lucid:2.6.35-22-generic,maverick:2.6.35-22
auth_kernels_centos = 5:2.6.18-164.el5,2.6.18-164.el5-test12; 6:2.6.32-220.4.2.el6, 2.6.32-220.4
auth_kernels_ubuntu = karmic:2.6.35-22-generic,2.6.35-22-generic-test; lucid:2.6.35-22-generic;m
tempdir=/temp/
ca_cert=/opt/futuregrid/futuregrid/etc/imdserver/cacert.pem
certfile=/opt/futuregrid/futuregrid/etc/imdserver/imdscert.pem
keyfile=/opt/futuregrid/futuregrid/etc/imdserver/privkey.pem
max_diskusage=88
```

Configure user that is going to execute the server. Let's assume that the name of this user is `imageman` and the `tempdir` option is `/temp/`. We need to edit the `sudoers` file by executing `visudo` as `root` user and add the following lines:

```
Defaults:imageman    !requiretty
User_Alias SOFTWAREG = imageman
Cmnd_Alias IMMANCOMND = /bin/chmod 600 /install/netboot/*, \
                        /bin/chmod 644 /install/netboot/*, \
                        /bin/chmod 755 /install/netboot/*, \
                        /bin/chmod 777 /install/netboot/*, \
                        /bin/chmod +x /install/netboot/*, \
                        /bin/chmod * /temp/*, \
                        /bin/chown root\:root /install/netboot/*, \
                        /bin/cp /install/netboot/* *, \
                        /bin/cp [-]* /install/netboot/* , \
                        /bin/mkdir -p /install/netboot/*, \
                        /bin/mkdir -p /install/netboot/*, \
                        /bin/mkdir -p /install/netboot/* /install/netboot/*, \
                        /bin/mkdir -p /tftpboot/xcat/*, \
                        /bin/mkdir -p /temp/*, \
                        /bin/mount -o loop /install/netboot/* /install/netboot/*, \
                        /bin/mount -o loop /temp/* /temp/*, \
                        /bin/mv -f /install/netboot/* /install/netboot/*, \
                        /bin/mv -f /temp/* /install/netboot/*, \
                        /bin/mv /install/netboot/* /install/netboot/*, \
                        /bin/rm [-]* /install/netboot/*, \
                        /bin/rm [-]* /temp/*, \
                        /bin/sed -i s/enforcing/disabled/g /install/netboot/*, \
                        /bin/sed -i * /install/netboot/*, \
                        /bin/sed -i * /temp/*, \
                        /bin/tar xfz /install/netboot/* -C /install/netboot/*, \
                        /bin/tar xfz /install/netboot/* --directory /install/netboot/*, \
                        /bin/tar xvfz /temp/* -C /temp/*, \
                        /bin/umount /install/netboot/*, \
                        /bin/umount /temp/*, \
                        /usr/bin/tee -a /install/netboot/*, \
                        /usr/bin/tee -a /temp/*, \
                        /usr/bin/tee -a /opt/moab//tools/msm/images.txt, \
                        /usr/bin/wget * -O /install/netboot/*, \
                        /usr/bin/wget * -O /tftpboot/xcat/*, \
                        /usr/sbin/chroot /install/netboot/*, \
                        /usr/sbin/chroot /temp/*, \
                        /usr/bin/wget * -O /temp/*, \
                        /bin/tar xfz /temp/* --directory /temp/*, \
                        /bin/mv -f /temp/* /temp/*, \
                        /bin/chown root\:root /temp/*
SOFTWAREG ALL = NOPASSWD: IMMANCOMND
```

Configure the Image Repository client because the Image Generation must be able to retrieve and upload images to the repository. See *Setting up Image Repository Client*. The `imageman` user must be able to ssh the Image Repository Server machine without introducing password or passphrase. Therefore, we need to put the `imageman` public key in the `authorized_keys` of the machine where the Image Repository Server is running.

Once everything is set up you can start the server by execution `IMRegisterServerXcat.py` as `imageman` user.

On the other hand, we have the `IMRegisterServerMoab.py` that register the image in Moab. This server must be running in the same machine where Moab is. In our case, it is running on the Login node. This server is very light as it only modify the `/opt/moab/tools/msm/images.txt` file and recycle the Moab scheduler.

Here we need to configure the `[RegisterServerMoab]` Section (see *RegisterServerMoab section*).

```
[RegisterServerMoab]
moab_port = 56790
moabInstallPath = /opt/moab/
log = /var/log/fg/fg-image-register-server-moab.log
log_level = debug
ca_cert=/etc/futuregrid/imdserver/cacert.pem
certfile=/etc/futuregrid/imdserver/imdscert.pem
keyfile=/etc/futuregrid/imdserver/privkey.pem
```

Configure user that is going to execute the server. Let's assume that the name of this user is `imageman`. We need to edit the `sudoers` file by executing `visudo` as `root` user and add the following lines:

```
Defaults:imageman    !requiretty
User_Alias SOFTWAREG = imageman
Cmnd_Alias IMMANCMND = /usr/bin/tee -a /opt/moab/tools/msm/images.txt, \
                       /opt/moab/bin/mschedctl -R
SOFTWAREG ALL = NOPASSWD: IMMANCOMND
```

Once everything is set up you can start the server by execution `IMRegisterServerMoab.py` as `imageman` user.

Client Side

In the client side, we need to configure the `[Register]` section. More information about this section of the client configuration file can be found in *Repo section*.

```
[Register]
xcat_port = 56789
moab_port = 56790
iaas_serveraddr = localhost
iaas_port = 56793
tempdir=/tmp/
http_server = http://fg-gravel.futuregrid.edu/
log=~/clientregister.log
log_level=debug
ca_cert=/opt/futuregrid/futuregrid/etc/imdclient/cacert.pem
certfile=/opt/futuregrid/futuregrid/etc/imdclient/imdccert.pem
keyfile=/opt/futuregrid/futuregrid/etc/imdclient/privkey.pem
```

We also need to configure a section per machine supported. In our case, we support two machines `[minicluster]` and `[india]`. In this way, users can specify the machine where they want to register their images.

```
[minicluster]
loginmachine=localhost
moabmachine=localhost
xcatmachine=localhost

[india]
loginmachine=<machine_address1>
moabmachine=<machine_address1>
xcatmachine=<machine_address1>
```

We use the euca2tools to register images in the Eucalyptus and OpenStack cloud infrastructures. Thus, they are required to be available.

The executable file of this client is `fg-register`. More information about how to use the Image Registration can be found in the *Image Registration Manual*.

Image Registration Check List

	Server Side Cloud (`fg-server.conf`)	Server Side HPC (`fg-server.conf`)	Server Side Moab (`fg-server.conf`)	Client Side (`fg-client.conf`)
Access to	• Image Repository (ssh access no password/passphrase to the server machine)	• Image Repository (ssh access no password/passphrase to the server machine) • `/install/netboot/`, `/tftpboot/` and `/etc/xcat/` directories of the machine where xCAT server is installed	• Execute in the machine where Moab is running • `/etc/moab/tools/msvimagemgmt.txt` file	• Users must be able to SSH the machine where the `IMRegisterServerIa` server is running to retrieve images • Eucalyptus (Euca2ools), OpenStack (Euca2ools), Nimbus (boto) and OpenNebula
Configure	• `[RegisterServerIaaS]` section • `[LDAP]` section • `/etc/sudoers` file • Image Repository client	• `[RegisterServerIaaS]` section • `[LDAP]` section • `/etc/sudoers` file • xCAT client • Image Repository client	• `[RegisterServerMoab]` section • `/etc/sudoers` file	• `[Register]` section
Executables	• `IMRegisterServerIaaS.py` (Server for CLI)	• `IMRegisterServerXCAT.py` (Server for CLI)	• `IMRegisterServerMoab.py`	• `fg-register`

Setting up the Rain

In this section we explain how to configure the Rain.

Client Side

Rain is currently under development and therefore its functionality is limited. The current functionality allows users to place images onto resources and run their jobs. Hence, it makes use of the image management tools and the infrastructures clients. This means that we need to configure the `[Rain]` section of the `fg-client.conf` file and the rest of the image management components. More information about this section of the client configuration file can be found in *Rain section*.

```
[Rain]
moab_max_wait = 480
moab_images_file = /opt/moab/tools/msm/images.txt
refresh = 20
log=~/clientrain.log
log_level=debug
```

The executable file of this client is `fg-rain`. More information about how to use the Rain can be found in the *Rain Manual*.

Rain Check List

	Client Side (`fg-client.conf`)
Access to	• Moab/Torque client • Eucalyptus, OpenStack, Nimbus and OpenNebula • FutureGrid Image Management services
Configure	• `[Rain]` section • Client and Servers of the Image Repository, Generation and Registration componenets
Executables	• `fg-rain`

Setting up the FutureGrid Shell

In this section we explain how to configure the FutureGrid Shell.

The FutureGrid Shell is a client side interface. Therefore, we need to configure the `[fg-shell]` section of the `fg-client.conf` file. More information about this section of the client configuration file can be found in *fg-shell section*.

```
[fg-shell]
history=~/fgshellhist.txt
log=~/fg-shell.log
log_level=debug
```

Since this shell is a wrapper for our tools, we need to configure each individual tool before we can use all the advantages of the shell. Moreover, we need to configure the `[LDAP]` section in the `fg-client.conf` file.

The executable file of this client is `fg-shell`. More information about how to use the FutureGrid Shell can be found in the *FutureGrid Shell Manual*.

FutureGrid Shell Check List

	Client Side (`fg-client.conf`)
Access to	• FutureGrid Image Management services
Configure	• `[fg-shell]` section • `[LDAP]` section • Client and Servers of the Image Repository, Generation and Registration componenets
Executables	• `fg-shell`

3.2.3 Installing Image Repository Backends

Deployment of MongoDB

In this section we are going to explain how to install a single MongoDB service. More information can be found in MongoDB

Note: In MongoDB the databases and tables are created automatically

Note: MongoDB is case sensitive

Install MongoDB on RHEL

- For all 64-bit RPM-based distributions with yum, create the file `/etc/yum.repos.d/10gen.repo` and add the following lines:

```
[10gen]
name=10gen Repository
baseurl=http://downloads-distro.mongodb.org/repo/redhat/os/x86_64
gpgcheck=0
```

- Install MongoDB

```
sudo yum install mongo-*
```

- Create DB directory

```
sudo mkdir -p /data/db/
sudo chown `id -u` /data/db     #The owner must be the user that is going to execute mongodb
```

- Run MongoDB

```
mongod --port 23000 --dbpath /data/db/ --fork --logpath=/data/db/mongo.log
```

Rebuild spider monkey

This is only needed if after running MongoDB you get warning message like this:

```
warning: some regex utf8 things will not work.  pcre build doesn't have --enable-unicode-propert
```

Rebuilding spider monkey from RHEL (Building Spider Monkey).

```
sudo yum erase xulrunner
sudo yum install curl
curl -O ftp://ftp.mozilla.org/pub/mozilla.org/js/js-1.7.0.tar.gz
tar zxvf js-1.7.0.tar.gz
cd js/src
export CFLAGS="-DJS_C_STRINGS_ARE_UTF8"
make -f Makefile.ref
JS_DIST=/usr make -f Makefile.ref export
```

Install MongoDB on Ubuntu 10.10

- Add MongoDB repository to the aptitude soucers file `/etc/apt/sources.list`.

```
deb http://downloads.mongodb.org/distros/ubuntu 10.10 10gen
```

- Install MongoDB

```
sudo apt-key adv --keyserver keyserver.ubuntu.com --recv 7F0CEB10
sudo apt-get update
sudo apt-get install mongodb-stable
```

- Create DB directory

```
sudo mkdir -p /data/db/
sudo chown `id -u` /data/db
Run MongoDB
mongod --port 23000 --dbpath /data/db/ --fork --logpath=/data/db/mongo.log
```

Install MongoDB on MacOSX

Via homebrew (MongoDB OSX)

- Install homebrew if you have not yet done

```
ruby -e "$(curl -fsSLk https://gist.github.com/raw/323731/install_homebrew.rb)"
```

- Install mongodb via homebrew

```
brew update
brew install mongodb
```

- Create DB directory

```
sudo mkdir -p /data/db/
sudo chown `id -u` /data/db
```

- Run MongoDB

```
/usr/local/Cellar/mongodb/1.6.5-x86_64/bin/mongod --port 23000 --dbpath /data/db/ --fork --l
```

- Work with client by executing mongo localhost:23000 in a different terminal

```
db.foo.save ( {a:1} )
db.foo.find ()
```

- In case you use macports, replace two first steps with

```
sudo port install mongodb
```

Deployment of Cumulus

In this section we are going to explain how to install and configure Cumulus. More information can be found in Nimbus Project

- Check the dependencies from the Cumulus Requirements.
- Download and Install the software

```
wget http://www.nimbusproject.org/downloads/nimbus-iaas-2.9-src.tar.gz

tar vxfz nimbus-iaas-2.9-src.tar.gz
cd nimbus-iaas-2.9-src/cumulus
sudo mkdir /opt/cumulus
sudo chown -R user:user /opt/cumulus
./cumulus-install.sh /opt/cumulus/
mkdir ~/.nimbus
cp /opt/cumulus/etc/cumulus.ini ~/.nimbus
```

- Test the software

```
cd /opt/cumulus/tests
./run-all.sh
```

- Run service

```
/opt/cumulus/bin/cumulus &
```

- Create user

```
/opt/cumulus/bin/cumulus-add-user javi
```

  - Output:

```
ID : eqe0YoRAs2GT1sDvPZKAU
password : S9Ii7QqcCQxDecrezMn6o5frSFvXhThYWmCE4S7nAf
quota : None
canonical_id : 048db304-6b4c-11df-897b-001de0a80259
```

Note: Remember the `ID` and `password` to fill out the fg-server.conf file (the `ID` will be the `userAdminS` and the `password` will be in the file specified in `configfileS`). More details can be found in *Configure Image Repository*.

- More Information
  - Cumulus F.A.Q.
  - Cumulus Video
  - Cumulus Administrator Reference
  - Cumulus Quickstarth
  - Cumulus Readme

Deployment of MySQL

In this section we are going to explain how to install and configure MySQL.

- Installing MySQL

```
apt-get install mysql-client mysql-common mysql-server

or

yum install mysql mysql-server mysql-devel
```

- Login into Mysql

```
mysql -u root -p
```

- Create User that will manage the image repository databases

```
CREATE USER 'IRUser'@'localhost' IDENTIFIED BY 'complicatedpass';
```

- Create databases. The name of the database is different depending on the configuration selected in the Image Repository (see *Configure Image Repository*).

Backend option	Database Name	Command to create the Database
mysql	images	create database images;
swiftmysql	imagesS	create database imagesS;
cumulusmysql	imagesC	create database imagesC;

- Create the tables for the selected database. This example is with the `images` databases. You will need to do the same with the others if you plan to use these storage configurations.
  - Select the database to be used

```
use images;
```

  - Create tables

```
create table meta ( imgId varchar(100) primary key, os varchar(100), arch varchar(100),
    tag varchar(200), vmType  varchar(100), imgType varchar(100), permission varchar(100

create table data ( imgId varchar(100) primary key, imgMetaData varchar(100), imgUri var
     accessCount long, size long, extension varchar (50), FOREIGN KEY (imgMetaData) REFE

create table users (userId varchar(100) primary key, cred varchar(200), fsCap long, fsUs
     role varchar(100), ownedimgs long);
```

  - Give all permission to the user created

```
GRANT ALL PRIVILEGES ON images.* TO 'IRUser' IDENTIFIED BY 'userpassword';
```

Note: Remember the `userId` (`IRUser`) and `password` (`userpassword`) to fill out the fg-server.conf file (the `userId` will be the `userAdmin` and the `password` will be in the file specified in `configfile`). More details can be found in *Configure Image Repository*.

Deployment of Swift

OpenStack provides some manuals to explain how to deploy Swift.

- Manual to deploy a Test Infrastructure.
- Manual to deploy a Multi-Node Infrastructure. In this case, we recommend installing the proxy server in the same machine where the Image Repository is installed.

Notes for RHEL 5

- Install Python 2.6

```
sudo rpm -Uvh http://yum.chrislea.com/centos/5/i386/chl-release-5-3.noarch.rpm
sudo rpm --import /etc/pki/rpm-gpg/RPM-GPG-KEY-CHL
sudo yum install python26
sudo yum install python26-devel

or

sudo wget ftp://ftp.univie.ac.at/systems/linux/fedora/epel/5/i386/epel-release-5-4.noarch.rp
sudo rpm -Uvh epel-release-5-4.noarch.rpm
sudo yum install python26
sudo yum install python26-devel
```

- Setuptools

```
yum install python26-distribute
```

- Install python modules

```
easy_install-2.6 netifaces eventlet setuptools virtualenv paste PasteDeploy webob pysqlite u
netifaces nose paramiko paste pastedeploy pastescript scgi
```

- Install sqlite3

```
wget http://dl.atrpms.net/el5-x86_64/atrpms/testing/sqlite-3.6.20-1.el5.x86_64.rpm
wget http://dl.atrpms.net/el5-x86_64/atrpms/testing/sqlite-devel-3.6.20-1.el5.x86_64.rpm
rpm -Uvh sqlite-3.6.20-1.el5.x86_64.rpm sqlite-devel-3.6.20-1.el5.x86_64.rpm
```

- Differences with the Swift manuals for the "Storage nodes"
  - Step 4. /etc/xinetd.d/rsync to enable it
  - Step 5. service xinetd restart
  - Iptable config (/etc/sysconfig/iptalbes). Add this:

```
-A RH-Firewall-1-INPUT -p udp -m udp --dport 6000 -j ACCEPT
-A RH-Firewall-1-INPUT -p tcp -m tcp --dport 6000 -j ACCEPT
-A RH-Firewall-1-INPUT -p udp -m udp --dport 6001 -j ACCEPT
-A RH-Firewall-1-INPUT -p tcp -m tcp --dport 6001 -j ACCEPT
-A RH-Firewall-1-INPUT -p udp -m udp --dport 6002 -j ACCEPT
-A RH-Firewall-1-INPUT -p tcp -m tcp --dport 6002 -j ACCEPT
```

  - If you don't have another partition, you can create a file. In this case we don't have xfs support, so we use ext3

```
dd if=/dev/zero of=/srv/swift-disk bs=1024 count=0 seek=20000000
mkfs.ext3 /srv/swift-disk
```

  - Edit /etc/fstab and add

```
/srv/swift-disk /srv/node/sdb1 ext3  loop,noatime,user_xattr 0 0
```

– Mount it

```
mount /srv/swift-disk
```

Note: Remember the `userId:usergroup` and `password` to fill out the fg-server.conf file (the `userId:usergroup` will be the `userAdminS` and the `password` will be in the file specified in `configfileS`). More details can be found in *Configure Image Repository*. Swift users are defined in the file `/etc/swift/proxy-server.conf`.

3.2.4 Configuration file reference

`fg-server.conf` configuration file

Section `[LDAP]`

This section is used to configure the access to LDAP to verify the user passwords.

This section is required by all services

Option `LDAPHOST` **Type:** String

Required: Yes

Hostname or IP address of the LDAP server that manages the user's authentication.

Option `LDAPUSER` **Type:** user-dn

Required: Yes

This is the DN of an user that have read access to the encrypted passwords of every user. This looks like `uid=USER,ou=People,dc=futuregrid,dc=org`

Option `LDAPPASS` **Type:** String

Required: Yes

Password of the user specified in the previous section.

Option `log` **Type:** log-file

Required: Yes

Location of the file where the logs will be stored.

Option `test` **Valid values:** `True`, `False`

Required: No

This option is for development purposes. For security reasons, the LDAP server cannot be contacted from outside of FutureGrid network. Therefore, we need this option to go test our services before we deploy them on production.

Section `[RepoServer]`

This section is used to configure the Image Repository Server. To complete the configuration of this service we need to configure also a :ref:`Repository Backend <repo_backend_example>` section.

Option `port` **Type:** Integer

Required: Yes

Port where the Image Repository server will be listening.

Option `proc_max` **Type:** Integer

Required: Yes

Maximum number of request that can be processed at the same time.

Option `refresh` **Type:** Integer

Required: Yes

Interval to check the status of the running requests when `proc_max` is reached and determine if new request can be processed.

Option `authorizedusers` **Type:** String-list (comma separated)

Required: No

List of users (separated by commas) that can use the Image Repository in behalf of other users. This could be useful for other FutureGrid services that need to call the repository in behalf of an user. This also prevents that other users can hack the client to use the repository as if they were other users.

Option `nopasswdusers` **Type:** Dictionary-list (semicolon separated)

Required: No

Users listed here does need to introduce their password when using the Image Repository. Each user will be associated to one or several IP address. The format is `userid:ip,ip1; userid1:ip2,ip3`.

Option `backend` **Valid values:** `mongodb`, `mysql`, `swiftmysql`, `swiftmongo`, `cumulusmysql`, `cumulusmongo`

Required: Yes

Specify the desired storage backend (see *Image Repository Backend Table* for more details). The value specified in this option will be the name of a section that has the configuration. See *Backend example* below.

Option `log` **Type:** log-file

Required: Yes

Location of the file where the logs will be stored.

Option `log_level` **Valid values:** `debug`, `error`, `warning`, `info`

Required: No

Desired log level. The default option is `debug`.

Option `ca_cert` **Type:** ca-cert

Required: Yes

Location of CA certificate (PEM-encoded) used to generate user and service certificates.

Option `certfile` **Type:** service-cert

Required: Yes

Location of the certificate (PEM-encoded) used by the Image Repository.

Option `keyfile` **Type:** key-cert

Required: Yes

Location of the private key (PEM-encoded) of the certificate specified in `certfile`.

Option `restConfFile` **Type:** file-path

Required: No

Location of the configuration file for the Image Repository Rest Interface.

Section `[cumulusmongo]`

This sections is an example of a backend configurations.

Option `address` **Type:** String

Required: Yes

Address of the server where MongoDB or MySQL are listening. In the case of MongoDB we can use a list of `address:ports` separated by commas. In MySQL we only specify the `address` of the server.

Option `userAdmin` **Type:** String

Required: Yes

User that is going to access MongoDB or MySQL to store/retrieve the data. Although the option is required, it can be with no value.

Option `configFile` **Type:** file-path

Required: Yes

Location of the file that contains the password of the user specified in `userAdmin`. Although the option is required, it can be with no value.

Option `addressS` **Type:** String

Required: Yes

Address of the server where the complementary service is listening. Currently, this complementary service can be Cumulus or Swift. In both cases we only specify the `address` of the server.

Option `userAdminS` **Type:** String

Required: Yes

User that is going to access the complementary service (Cumulus or Swift) to store/retrieve the data. In the case of Swift, the user is typically `<user-name>:<group-name>`.

Option `configFileS` **Type:** file-path

Required: Yes

Location of the file that contains the password of the user specified in `userAdminS`.

Option `imgStore` **Type:** directory-path

Required: Yes

Location of the directory where images are uploaded to the server. This is a temporal directory in all cases but MySQL. When this is a temporal directory the permission must be `777` without the **t bit**, because the user that is running the server must be able to remove the images once they are stored in the final destination. This bit is disable by default when you create a directory. However the `/tmp/` directory has this bit enabled.

Section `[GenerateServer]`

This section is used to configure the Image Generation Server.

Option `port` **Type:** Integer

Required: Yes

Port where the Image Generation server will be listening.

Option `proc_max` **Type:** Integer

Required: Yes

Maximum number of request that can be processed at the same time.

Option `refresh` **Type:** Integer

Required: Yes

Interval to check the status of the running requests when `proc_max` is reached and determine if new request can be processed.

Option `wait_max` **Type:** Integer

Required: Yes

Maximum time that the service will wait for an image to boot, that is, the time from `penn` status to the `runn` one. If the time is exceeded, the VM is killed and the Image Generation request fails.

Option `nopasswdusers` **Type:** Dictionary-list (semicolon separated)

Required: No

Users listed here does need to introduce their password when using the Image Generation. Each user will be associated to one or several IP address. The format is `userid:ip,ip1; userid1:ip2,ip3`.

Option `vmfile_<os-name>` **Type:** String

Required: Yes

Location of the OpenNebula VM templates that boots the VMs where the image requested by the user will be generated. Currently, four OSes are considered: `centos`, `rhel`, `ubuntu` and `debian`. Therefore, we will have four options named `vmfile_centos`, `vmfile_rhel`, `vmfile_ubuntu`, `vmfile_debian`. However, only `centos` and `ubuntu` are implemented. The other options have to be there but we do not need to specify any value until they are implemented. In the case of CentOS, the value is a list of `<version>:<template-file-location>` separated by commas because CentOS 5 is not compatible with CentOS 6.

Option `xmlrpcserver` **Type:** URL

Required: Yes

Address of the OpenNebula service. It should be something like `http://localhost:2633/RPC2`

Option `bridge` **Type:** String

Required: Yes

Bridge where the VM network interface will be attached. This is used to identify the IP that OpenNebula has assigned to the VM.

Option `addrnfs` **Type:** String

Required: Yes

Address of the machine that shares the directory `tempdirserver`. This address must be in the same network that the VM address.

Option `tempdirserver` **Type:** String

Required: Yes

Location of the directory shared with the VMs. This directory will be used as scratch partition for the Vms. In this way, the VM disks can be small and we don't need to transfer the image back to the server. Users must be able to read the files in this directory to retrieve their images when needed.

Option `tempdir` **Type:** String

Required: Yes

Location of the `tempdirserver` directory inside the VM when it is mounted via NFS.

Option `http_server` **Type:** URL

Required: Yes

Address of the http server that keeps configuration files needed to generate the images. Thus, the VMs has to have access to this http server.

Option `oneuser` **Type:** URL

Required: Yes

User that will manage the VMs for the Image Generation server. It could be `oneadmin` directly or a user created for this purpose.

Option `onepass` **Type:** URL

Required: Yes

Password of the user specified in `oneuser`. You get that password by executing `oneuser list` as `oneadmin` user.

Option `log` **Type:** log-file

Required: Yes

Location of the file where the logs will be stored.

Option `log_level` **Valid values:** `debug`, `error`, `warning`, `info`

Required: No

Desired log level. The default option is `debug`.

Option `ca_cert` **Type:** ca-cert

Required: Yes

Location of CA certificate (PEM-encoded) used to generate user and service certificates.

Option `certfile` **Type:** service-cert

Required: Yes

Location of the certificate (PEM-encoded) used by the Image Generation server.

Option `keyfile` **Type:** key-cert

Required: Yes

Location of the private key (PEM-encoded) of the certificate specified in `certfile`.

Section `[RegisterServerXcat]`

This section is used to configure the Image Registration xCAT Server for HPC infrastructures.

Option `xcat_port` **Type:** Integer

Required: Yes

Port where the Image Registration xCAT server will be listening.

Option `xcatNetbootImgPath` **Type:** String

Required: Yes

Location of the directory used by xCAT to store the netboot images. Typically, this is `/install/netboot`

Option `nopasswdusers` **Type:** Dictionary-list (semicolon separated)

Required: No

Users listed here does need to introduce their password when using the Image Registration xCAT. Each user will be associated to one or several IP address. The format is `userid:ip,ip1; userid1:ip2,ip3`.

Option `http_server` **Type:** URL

Required: Yes

Address of the http server that keeps configuration files needed to adapt the images and get the kernel files.

Option `log` **Type:** log-file

Required: Yes

Location of the file where the logs will be stored.

Option `log_level` **Valid values:** `debug`, `error`, `warning`, `info`

Required: No

Desired log level. The default option is `debug`.

Option `test_mode` **Valid values:** `True`,‘‘False‘‘

Required: No

This option is for testing the service in a machine without xCAT. The default value is False.

Option `default_xcat_kernel_<os-name>` **Type:** Dictionary-List (comma separated)

Required: Yes

Default kernel name for each supported OS. The syntax is a list of `<os_version>:<kernel_version>` separated by commas. Currently, two OSes are considered: `centos` and `ubuntu`. Therefore, we will have two options named `default_xcat_kernel_centos` and `default_xcat_kernel_ubuntu`

Option `auth_kernels_<os-name>` **Type:** Dictionary-list (semicolon separated)

Required: Yes

Authorized kernels for each supported OS. The syntax is `<os_version>:<kernel1>,<kernel2>; <os_version2>:<kernel3>,<kernel4>`. Currently, two OSes are considered: `centos` and `ubuntu`. Therefore, we will have two options named `auth_kernels_centos` and `auth_kernels_ubuntu`.

Option `tempdir` **Type:** String

Required: Yes

Location of the scratch directory used to extract the image and read the manifest. Then, the image is moved to the real directory using the manifest information.

Option `ca_cert` **Type:** ca-cert

Required: Yes

Location of CA certificate (PEM-encoded) used to generate user and service certificates.

Option `certfile` **Type:** service-cert

Required: Yes

Location of the certificate (PEM-encoded) used by the Image Registration server.

Option `keyfile` **Type:** key-cert

Required: Yes

Location of the private key (PEM-encoded) of the certificate specified in `certfile`.

Option `max_diskusage` **Type:** Integer (percentage)

Required: Yes

Maximum usage of the partition where the `xcatNetbootImgPath` is located. This is specified in percentage. If the usage is higher than this value, we do not allow to register more images.

Section `[RegisterServerMoab]`

This section is used to configure the Image Registration Moab Server for HPC infrastructures.

Option `moab_port` **Type:** Integer

Required: Yes

Port where the Image Registration Moab server will be listening.

Option `moabInstallPath` **Type:** String

Required: Yes

Location where Moab is installed. For example `/opt/moab/`

Option `log` **Type:** log-file

Required: Yes

Location of the file where the logs will be stored.

Option `log_level` **Valid values:** `debug`, `error`, `warning`, `info`

Required: No

Desired log level. The default option is `debug`.

Option `ca_cert` **Type:** ca-cert

Required: Yes

Location of CA certificate (PEM-encoded) used to generate user and service certificates.

Option `certfile` **Type:** service-cert

Required: Yes

Location of the certificate (PEM-encoded) used by the Image Registration server.

Option `keyfile` **Type:** key-cert

Required: Yes

Location of the private key (PEM-encoded) of the certificate specified in `certfile`.

Section `[RegisterServerIaas]`

This section is used to configure the Image Registration Server for Cloud infrastructures.

Option `port` **Type:** Integer

Required: Yes

Port where the Image Registration IaaS server will be listening.

Option `proc_max` **Type:** Integer

Required: Yes

Maximum number of request that can be processed at the same time.

Option `refresh` **Type:** Integer

Required: Yes

Interval to check the status of the running requests when `proc_max` is reached and determine if new request can be processed.

Option `nopasswdusers` **Type:** Dictionary-list (semicolon separated)

Required: No

Users listed here does need to introduce their password when using the Image Registration IaaS. Each user will be associated to one or several IP address. The format is `userid:ip,ip1; userid1:ip2,ip3`.

Option `tempdir` **Type:** String

Required: Yes

Location of the scratch directory where images are copied and modified. The permisson has to be `777` with the **t bit** disabled to allow the user that executes the server remove the original image. This bit is disable by default when you create a directory. However the `/tmp/` directory has this bit enabled.

Option `default_<infrastructure-name>_kernel` **Type:** String

Required: Yes

Default kernel that will be used when registering an image in such infrastructure. `<infrastructure-name>` can be `eucalyptus`, `openstack`, `nimbus` and `opennebula`. Therefore, we will have two options named `default_eucalyptus_kernel`, `default_openstack_kernel`, `default_nimbus_kernel` and `default_opennebula_kernel`.

Option `<infrastructure-name>_auth_kernels` **Type:** List (semicolon separated)

Required: Yes

Authorized kernels for registering an image in such infrastructure. `<infrastructure-name>` can be `eucalyptus`, `openstack`, `nimbus` and `opennebula`. Therefore, we will have two options named `eucalyptus_auth_kernels`, `openstack_auth_kernels`, `nimbus_auth_kernels` and `opennebula_auth_kernels`. The syntax is `eucalyptus_auth_kernels = <kernel1>:eki:eri;<kernel2>:eki:eri`. Nimbus uses the name to identify the kernel, but we keep the syntax just in case they change in the future. OpenNebula does not have ids for now and we have to use the location of the files.

Option `log` **Type:** log-file

Required: Yes

Location of the file where the logs will be stored.

Option `log_level` **Valid values:** `debug`, `error`, `warning`, `info`

Required: No

Desired log level. The default option is `debug`.

Option `ca_cert` **Type:** ca-cert

Required: Yes

Location of CA certificate (PEM-encoded) used to generate user and service certificates.

Option `certfile` **Type:** service-cert

Required: Yes

Location of the certificate (PEM-encoded) used by the Image Registration server.

Option `keyfile` **Type:** key-cert

Required: Yes

Location of the private key (PEM-encoded) of the certificate specified in `certfile`.

`fg-client.conf` configuration file

Section `[fg-shell]`

This section is used to configure the FutureGrid Shell.

Option `history` **Type:** history-file

Required: Yes

Location of the file where the executed commands are stored.

Option `log` **Type:** log-file

Required: Yes

Location of the file where the logs will be stored.

Option `log_level` **Valid values:** `debug`,‘‘error‘‘,‘‘warning‘‘,‘‘info‘‘

Required: No

Desired log level. The default option is `debug`.

Option `script` **Type:** file

Required: Yes

Location of the default file where the commands executed are recorded after we active the `script` command in the shell. More information about how to use the FutureGrid Shell can be found in

Warning: link to the shell user manual

Section `[LDAP]`

This section is required only by the FutureGrid Shell

Option `LDAPHOST` **Type:** String

Required: Yes

Hostname or IP address of the LDAP server that manages the user's authentication.

Option `log` **Type:** log-file

Required: Yes

Location of the file where the logs will be stored.

Option `test` **Valid values:** `True`, `False`

Required: No

This option is for development purposes. For security reasons, the LDAP server cannot be contacted from outside of FutureGrid network. Therefore, we need this option to go test our services before we deploy them on production.

Section `[Repo]`

This section is used to configure the Image Repository client.

Option `port` **Type:** Integer

Required: Yes

Port where the Image Repository server will be listening.

Option `serveraddr` **Type:** String

Required: Yes

Address of the machine where the Image Repository server is running.

Option `log` **Type:** log-file

Required: Yes

Location of the file where the logs will be stored.

Option `log_level` **Valid values:** `debug`, `error`, `warning`, `info`

Required: No

Desired log level. The default option is `debug`.

Option `ca_cert` **Type:** ca-cert

Required: Yes

Location of CA certificate (PEM-encoded) used to generate user and service certificates.

Option `certfile` **Type:** service-cert

Required: Yes

Location of the certificate (PEM-encoded) used by the Image Repository client.

Option `keyfile` **Type:** key-cert

Required: Yes

Location of the private key (PEM-encoded) of the certificate specified in `certfile`.

Section `[Generation]`

This section is used to configure the Image Generation client.

Option `port` **Type:** Integer

Required: Yes

Port where the Image Repository server will be listening.

Option `serveraddr` **Type:** String

Required: Yes

Address of the machine where the Image Generation server is running.

Option `log` **Type:** log-file

Required: Yes

Location of the file where the logs will be stored.

Option `log_level` **Valid values:** `debug`, `error`, `warning`, `info`

Required: No

Desired log level. The default option is `debug`.

Option `ca_cert` **Type:** ca-cert

Required: Yes

Location of CA certificate (PEM-encoded) used to generate user and service certificates.

Option `certfile` **Type:** service-cert

Required: Yes

Location of the certificate (PEM-encoded) used by the Image Generation client.

Option `keyfile` **Type:** key-cert

Required: Yes

Location of the private key (PEM-encoded) of the certificate specified in `certfile`.

Section `[Register]`

This section is used to configure the Image Registration client. To complete the configuration of this service we need to configure also the :ref:`Machines <fg-client_machines>` sections.

Option `xcat_port` **Type:** Integer

Required: Yes

Port where the Image Registration xCAT server will be listening.

Option `moab_port` **Type:** Integer

Required: Yes

Port where the Image Registration Moab server will be listening.

Option `iaas_serveraddr` **Type:** String

Required: Yes

Address of the machine where the Image Registration server for Cloud is running.

Option `iaas_port` **Type:** Integer

Required: Yes

Port where the Image Registration xCAT server will be listening.

Option `tempdir` **Type:** String

Required: No

Location of the scratch directory to extract images when `--justregister` option is used. If this option is not provided the current directory will be used.

Option `http_server` **Type:** URL

Required: Yes

Address of the http server that keeps configuration files.

Option `log` **Type:** log-file

Required: Yes

Location of the file where the logs will be stored.

Option `log_level` **Valid values:** `debug`, `error`, `warning`, `info`

Required: No

Desired log level. The default option is `debug`.

Option `ca_cert` **Type:** ca-cert

Required: Yes

Location of CA certificate (PEM-encoded) used to generate user and service certificates.

Option `certfile` **Type:** service-cert

Required: Yes

Location of the certificate (PEM-encoded) used by the Image Repository client.

Option `keyfile` **Type:** key-cert

Required: Yes

Location of the private key (PEM-encoded) of the certificate specified in `certfile`.

Sections `[minicluster]` and `[india]`

Option `loginmachine` **Type:** String

Required: Yes

Address of the login machine of the target cluster.

Option `moabmachine` **Type:** String

Required: Yes

Address of the machine where machine where Moab is installed and therefore the `IMRegisterServerMoab.py` is running.

Option `xcatmachine` **Type:** String

Required: Yes

Address of the machine where machine where the `IMRegisterServerXcat.py` is running.

Section `[Rain]`

Option `moab_max_wait` **Type:** Integer

Required: Yes

Maximum time that we wait for a image registered on Moab to became available.

Option `moab_images_file` **Type:** String

Required: Yes

Location of the file where Moab stores the list of images. If the image requested is not there, we do not wait.

Option `refresh` **Type:** Integer

Required: Yes

Interval to check the job status.

Option `log` **Type:** log-file

Required: Yes

Location of the file where the logs will be stored.

Option `log_level` **Valid values:** `debug`, `error`, `warning`, `info`

Required: No

Desired log level. The default option is `debug`.

Image Repository Rest Interface configuration file

Section `[Global]`

Option `log.error_file` **Type:** log-file

Required: Yes

Location of the file where the error logs will be stored.

Option `log.accessfile` **Type:** log-file

Required: Yes

Location of the file where the access logs will be stored.

Option `server.socket_host` **Type:** String

Required: Yes

Address of the Rest Interface.

Option `server.socket_port` **Type:** Integer

Required: Yes

Port where the Rest Interface is listening.

Option `server.thread_pool` **Type:** Integer

Required: Yes

Number of concurrent threads.

Option `server.ssl_module` **Valid values:** `builtin`, `pyopenssl`

Required: Yes

Determine the ssl module.

Option `server.ssl_certificate` **Type:** ssl-cert

Required: No

Location of the certificate used for https. If this option is not provided the protocol will be http.

Option `server.ssl_private_key` **Type:** log-file

Required: Yes

Location of the certificate key for the certificate specified in `server.ssl_certificate`. If this option is not provided the protocol will be http.

3.2.5 Configuring a Module for FutureGrid Software

The software packages on the FutureGrid machines is manage using the Environment Modules. The Environment Modules package provides for the dynamic modification of a user's environment via modulefiles.

In this section, we explain how to create a module for our software.

1. Create a directory to place the software `/N/soft/futuregrid-1.0/`.
2. Locate the directory where Modules is installed. In the case of India, this is installed in `/opt/Modules/`. From now on we will refer to this location as `$MODULES_PATH`.
3. Create a directory in `$MODULES_PATH/default/modulefiles/tools/futuregrid`
4. In this directory we need to create a file with the version number. In this example the file is named 1.0. The content of this file is some information about the software location and the list of modules that need to be loaded as requirements.

```
#%Module1.0#####################################################

set ver 1.0
set path /N/soft/futuregrid-$ver

proc ModulesHelp { } {
puts stderr "This module adds the FutureGrid toolkit to your environment"
}

module-whatis "Configures your environment for the FutureGrid toolkit"

prepend-path PATH $path
prepend-path PATH $path/bin/

if [ module-info mode load ] {
puts stderr "futuregrid version $ver loaded"
}

if [ module-info mode switch2 ] {
puts stderr "futuregrid version $ver loaded"
}

if [ module-info mode remove ] {
puts stderr "futuregrid version $ver unloaded"
}

module load euca2ools
module load python_w-cmd2
module load moab
module load torque
```

Note: If the python is not the one installed in the system, the binaries may be inside your python directory.

1. In case the software binaries were copied into `/usr/bin` or `/usr/local/bin`. We need to move them to the directory `/N/soft/futuregrid-1.0/bin/`

3.2.6 Building the Rain Documentation

The documentation has been created using Sphinx and therefore you have to build it before you can see the final html files. The source files of the documentation can be found under the `doc` directory of our software package. Next, we define the needed steps to build the documentation.

1. Install the documentation *Using a source tarball* or *Downloading the latest code from GitHub*.
2. Change your current directory to the `doc` one.

   ```
   cd doc
   ```

3. Build the documentation using the Makefile.

   ```
   make website
   ```

4. The documentation should be in the directory `build/web-<version>/`. This basically contains html files that can be copied to a regular http server.

3.3 Developer Documentation

In this section you will find information on lower level programming details.

3.3.1 FG-Shell Development

In this section we explain how to develop a new module for the FutureGrid Shell. More information can be found in the *FutureGrid Shell Manual*.

Requirement

- Download the FutureGrid code:

  ```
  git clone git@github.com:futuregrid/rain.git
  ```

- Create a branch

  ```
  git checkout -b <branch_name>
  ```

- Install in developer mode:

  ```
  sudo python setup.py develop
  ```

- Copy configuration files from etc directory to /etc/futuregrid or to ~/.fg/ and set them up (:ref:admin)

Add Your Component Functionality as a New Module

Next, we explain the steps needed to include a new module in the FutureGrid shell. As an example, we use the repository module, called “repo”

1. Create a file to develop your functionality. This file will be called fgShellRepo.py and will be located in src/futuregrid/shell/ (change Repo with your module name). The file includes a class with the same name that inherits from cmd2. See the fgShellRepo.py file for more details.
2. Add your methods that has to be like "do_<module><method>" i.e. do_repoget. In this way, in the shell we will have a command called repoget. You can also include a method called help_repoget that show information when execute "help repoget" in the shell.

Note: These methods will not have functionality. They only are a new command line interface for your existing methods. In the repository example, the functionality is in the class IRServiceProxy.

---

3. Go to file fgCLI.py and make the fgShell class to inherit from your class. For that you have to do three steps
   - Import your class.

     ```
     from futuregrid.shell.fgShellRepo import fgShellRepo
     ```

   - Add it to the fgShell class.

     ```
     classfgShell(Cmd,
                  fgShellUtils,
                  fgShellRepo):
     ```

   - We have the list of available commands in a set called self.env to determine the available contexts (each module will have a context, see section Contexts). Here you have to add the name of your context as a string. This variable is in the constructor of the class fgShell (__init__(...)) and looks like:

     ```
     self.env=["repo","rain",""]
     ```

   - In the constructor we also have to write some information about the module.

     ```
     self.text = {'repo': 'Image Repository,
                  'rain': 'FG Dynamic Provisioning'}
     ```

   - Next, we have to specify the modules that are required for the new. In this way, we only initialize the components that the user needs. This is done in the do_use method (see next section Contexts) of the fgCLI.py file. Thus, we need to add a condition and a list of requirements that the new module has. Note that the requirements strings MUST be as in the name of the classes that usually have the first character in uppercase.

     ```
     if (arg=="repo"):
        requirements=["Repo"]
     elif (arg == "rain"):
        requirements=["Repo","Image","Rain"]
     ```

4. Attention to the arguments of your methods. No matter how many arguments you have, all them are sent in a unique string. Then, in your method you have to get them by using the "getArgs(in: string): list" method, that is in the fgShellUtils class.
5. In your class (fgShellRepo in this example) you will have an __init__ method to initialize your module. However, it will be called only if you change to your module's context, see next Section.

Contexts

We have created contexts make easier the use of the FutureGrid commands by removing the prefix of your module. For that we have the show and use command. The show command list the available contexts and the use command change to a particular context. In this way, we can change to the repo context by executing "use repo". Note that the prompt change from "fg>" to "fg-repo>" Now, the get command point to the repoget command.

We have already done several steps focused to enable the context. Here, we explain some other optional steps, but highly recommendable. All this is done in the fgShellUtils.py file.

1. If your have a command that is already in this class, you do not need to add anything to it.
2. If your command is not in this class, you can add it by creating a method. For example, let assume that you have a hello method.

```
def do_hello(self, args):
    """
    Generic get command that changes its behavior depending on the
    context specified with use command.
    """
    if(self._use != ""):
        found = False
        for i in self._requirements:
            prefix=string.lower(i)
            command = "self.do_" + prefix + "hello(\"" + args + "\")"
            try:
                eval(command)
                found = True
                break
            except AttributeError:
                pass
        if not found:
            print "There is no hello method in any of the active contexts (" + str(self.requirem
            self._log.error(str(sys.exc_info()))
    else:
        self.generic_error()

help_hello = generic_help
```

3. This code will call a different method depending of the context. If your context is “repo”, you need to have a method called do_repohello(args) in your fgShellRepo class.

Log File

We have created a log file system to be use in the Shell. To use it, you only need to import the fgLog.py file:

from futuregrid.utils import fgLog Then you can write in the logs using any of this methods:

```
fgLog.degug(“text”)
fgLog.error(“text”)
fgLog.warning(“text”)
fgLog.info(“text”)
```

The log file will be store in log file specified in the “fg-shell” section of the fg-client.conf configuration file. This file is placed in /etc/futuregrid/ or in ~/.fg/

Commit the Changes

After you have created your new module, you need to push your branch into github and request to merge it with the official dev branch.

1. Upload new branch to github

```
git push origin <branch_name>
```

2. Send us a message via github to merge the code

CHAPTER

FOUR

DOWNLOAD

The latest version of the FutureGrid Rain is 1.0

The recommended way of installing Rain is using `easy_install`. You can find instructions on how to do this in the *Installation* chapter of the documentation.

If you do need to download Rain as an installable Python Egg or as a source tarball, both are available for download in the Python Package Index: http://pypi.python.org/pypi/futuregrid

4.1 Sample files

The sample configuration files shown in the documentation are available for download as a tarball or a ZIP file.

4.2 Development version

If you want to use the latest development version of Rain, you can track our GitHub repository.

The *Installation* chapter of the documentation provides instructions on how to check out our code from GitHub.

CHAPTER

FIVE

SUPPORT

If you run into problems when using FutureGrid Rain and Image Management, please use our help form at https://portal.futuregrid.org/help