em User Manual

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# Introduction

em (Environment Manager) is a set of utilities for creating and managing environments in Amazon EC2.

# Installation

## Installation Pre-Requisites

### Java SDK

em requires access to Java SDK, version 1.7 or newer.

Download and install the latest JDK 1.7 following instructions specific to your system from Oracle web site: <http://www.oracle.com/technetwork/java/javase/downloads/index.html>

Once JDK has been installed on your system, export JAVA\_HOME in your environment and add ${JAVA\_HOME}/bin to your PATH.

### Amazon EC2 Command Line Interface Tools

em requires access to Amazon EC2 command line interface tools, version 1.7.3.0 or newer. Amazon EC2 command line interface tools can be downloaded from Amazon web site: <http://aws.amazon.com/developertools/351>.

Installation instructions are available here: <http://docs.aws.amazon.com/AWSEC2/latest/CommandLineReference/set-up-ec2-cli-linux.html>

A short version of the installation instructions, tested on Mac OS, is available here: <https://kb.novaordis.com/index.php/Amazon_EC2_CLI_Installation>

After installation, Amazon EC2 command line interface tools must be made available to em. Set the EC2\_HOME environment variable to point to the installation directory and adjust the PATH environment variable as follows:

PATH=${PATH}:${EC2\_HOME}/bin

After reloading your environment, you can check whether the installation was performed correctly by executing:

ec2-version

The command should return 1.7.3.0 or higher.

### Set the Amazon EC2 API Access Keys

Each Amazon EC2 IAM user has a set of API access keys. These keys are needed when the user attempts to make programmatic calls to AWS or EC2, using Amazon EC2 CLI tools. The user can create, modify, view and rotate these access keys.

Provision the access keys for your account. Once provisioned, set them in the environment as follows:

export AWS\_ACCESS\_KEY=your-aws-access-key-id

export AWS\_SECRET\_KEY=your-aws-secret-key

Test whether the access key installation worked by executing:

ec2-describe-regions

The command should output something similar to:

nombp1:doc ovidiu$ ec2-describe-regions

REGION eu-central-1 ec2.eu-central-1.amazonaws.com

REGION sa-east-1 ec2.sa-east-1.amazonaws.com

REGION ap-northeast-1 ec2.ap-northeast-1.amazonaws.com

REGION eu-west-1 ec2.eu-west-1.amazonaws.com

REGION us-east-1 ec2.us-east-1.amazonaws.com

REGION us-west-1 ec2.us-west-1.amazonaws.com

REGION us-west-2 ec2.us-west-2.amazonaws.com

REGION ap-southeast-2 ec2.ap-southeast-2.amazonaws.com

REGION ap-southeast-1 ec2.ap-southeast-1.amazonaws.com

### Set your Amazon EC2 Region

Pick the appropriate Amazon EC2 region from the list returned by the ec2-describe-regions command and set the following environment variable:

export EC2\_URL=https://<service\_endpoint>

where the <service\_endpoint> value should come from the third column of the ec2-describe-regions command output.

Example:

export EC2\_URL=https://ec2.us-west-2.amazonaws.com

### Instance Access Key Pairs

Amazon AWS uses public-key cryptography to secure the login to instances. The instance has no password - you use a key pair to access your instance securely. The key pairs are provisioned either via the web interface or with Amazon CLI tools. During the provisioning process, the keys pairs are named.

When the instance is created, you need to specify the name of the key pair to use to protect access to it: Amazon will install the public certificate in ~/.ssh/authorized\_keys when creating the instance, and then you need to provide the private key of the pair to your ssh client when logging into the instance.

em uses at least two key pairs: one key pair for access during instance provisioning and one or more key pairs for routine access.

#### Instance Provisioning Key Pair

You need to create and register with the Amazon EC2 management facilities a provisioning key pair.

This key pair will be used for access every time a new instance is created and configured. Once the configuration (initial overlay) phase is over, the key is removed and you are free to install as many regular access keys as you wish.

We recommend to name of the installation provisioning key pair “em-provisioning-key-pair”, but this is not required.

Details on how to create key pairs are available here: <http://docs.aws.amazon.com/AWSEC2/latest/UserGuide/ec2-key-pairs.html>

#### Instance Access Key Pairs

You must install at least one instance access key pair.

**IMPORTANT:** If you don’t register at least one instance access key pair while creating the instance with em, the instance will be inaccessible for login, because em removes temporary provisioning access credentials at the end of the instance provisioning process. Is not required to register your regular instance access keys with Amazon EC2 management facilities. em will install and manage them.

### Security Groups

General theory on security groups. Details on creating security groups needed by the environment. See “Create an NFS Server Security Group”.

### Subnets

General theory on subnets. Details on creating subnets needed by the environment. See “Building the NFS Server”.

## em Installation

### Download the Installation Archive

Download the latest release from <https://github.com/NovaOrdis/em/releases>

You will get a zip file that contains everything em needs in order to build and interact with Amazon EC2 environments.

### Extract the Installation Archive

Extract the content of the em installation zip into the directory conventionally used for external utilities. /opt or /usr/local are common choices. For the remainder of this document we will assume that the external utility directory is /opt.

The extraction process will create an “em-<version>” top-level directory.

Assuming that the top level directory is em-2.5, link to it with a generic link “em”, as follows:

cd /opt

ln –s ./em-2.5 ./em

### Setup the Environment Variables

Set the EM\_HOME environment variable to point to the generic “em” link. This way, you will be able to upgrade by simply unzipping a new version and re-linking, without any environment modification.

Also adjust the PATH environment variable as follows:

export EM\_HOME=/opt/em  
export PATH=${PATH}:${EM\_HOME}/bin:~/.em/bin

~/.em/bin is the directory where em creates “direct login” links, where executing a remote environment instance name as a command logs the user into that instance.

### Install the Instance Provisioning Private Key File

The Amazon EC2 instance provisioning key creation process generates a private key file in PEM format that is automatically downloaded by the browser when the key pair is created. For more details, see “Instance Provisioning Key Pair”.

You will need to make this key accessible to em.

Conventionally, the private key file generated by Amazon is stored under a different name (em-provisioning-private-key.pem) in the ~/.ssh directory. The permissions should be adjusted as follows:

mv <browser\_download\_dir>/em-provisioning-key-pair.pem \

~/.ssh/em-provisioning-private-key.pem

chmod go-rwx ~/.ssh/em-provisioning-private-key.pem

For more details about how em uses the access keys, see “Instance Access Key Pairs” section.

### Configure the NFS File Server Internal IP

This is an optional step that is only required if you intend to use the newly installed em to manage an already existing Amazon EC2 environment. If you plan to create a completely new environment, you may skip this step.

Write the internal IP address of the existing environment’s NFS server into the em local configuration file ${HOME}/.em/em.conf, as follows:

nfs\_server\_internal\_ip=<nfs-server-internal-ip-address>

You can get the address by running em status and applying heuristics to figure out which instance is the NFS server. If the instances were named following the conventions offered by this manual, the NFS server’s name should start with “nfs”.

### 

### Test the Installation

Reload your environment to make sure the path is updated, and then execute:

em version

and then:

em status

If the environment was previously used, you will get the list of instances already created in the environment:

em status

name state id public-ip private-ip

f01 stopped i-db0ab82d 172.31.25.44

b01 stopped i-55397ea3 172.31.16.215

b02 stopped i-fe014408 172.31.30.67

If no instance were previously created with em, the command should still succeed and produce something similar with:

em status

no instances

# Building a Basic Environment

## Basic Environment Overview

### The NFS File Server

A basic environment consists in an NFS fileserver, which will serve as environment configuration keeper and shared file keeper, and other instances.

At the time of this writing, any environment *needs* a file server. In the future, we may add support for HTTP-only based environments.

The fileserver does not need significant resources. We routinely use reasonably large environments – tens of instances – served by a t2.micro NFS server, provided that the client instances prefer “local” storage to the shared file space.

The shared file space should only be used for installation kits and configuration, and it should be mostly read by the client instances.

The NFS file server should be kept around (i.e. not terminated) for the life of the environment. It is the only non-expendable – and this just for the useful life of the environment – instance of the environment. Provided that key state on its file system has been backed up, the NFS file server can be terminated, the restored, though we don’t recommend this approach.

### Other Instances

An environment can have an arbitrary number of expendable instances, which can be created and then terminated arbitrarily.

The typical use for “ephemeral environments” is large instance-count load tests. An environment comprising hundreds of instances can be created, and then load can be generated and applied within the environment, data collected and finally, all instances discarded.

Provided that Amazon EC2 bills for storage space even if the instance is stopped, and instances need at least some local storage, this will result in significant bill savings. If you don’t care about this part, environments can be kept around in stopped state – or even in running state – for as long as you wish.

## Create an NFS Server Security Group



## Building the NFS Server

Conventionally, the instances of an environment are named using letters and digits that give a hint on their function in the environment. Following this convention, the only NFS file server of an environment could be named “nfs01”:

em create --group <nfs-server-security-group> nfs01

**IMPORTANT:** The security group that allows NFS clients to connect to the NFS server must be created in advance. The group ID must then be specified on the command line following the “--group" option when creating the NFS server instance, otherwise the NFS server will be inaccessible. For more details on Amazon EC2 security groups, see “Security Groups”.

The NFS server security group to use with Nova Ordis test cloud is “sg-16481073”.

To discover more options available to you when running the “create” command, execute:

em –h create

Run with --verbose and determine the ami\_type, availability-zone, subnet and block-device-mapping. Adjust values accordingly.

A few seconds after creation, the NFS server non-configured instance should be available in the “em status” query:

nombp1:~ ovidiu$ em status

name state id public-ip private-ip

...

nfs01 running i-1086b9e6 52.25.189.47 172.31.16.246

...

At this point, the instance is not yet accessible for log in by the regular users, because it was configured with a key that can be only used for installation. The instance will become accessible after completing the overlay process:

em sync

em overlay nfs-server nfs01

**IMPORTANT:** The nfs-overlay does not start the NFS server (temporary technical difficulties: the attempt to start the NFS server during the installation failed. The section is commented out in linux.shlib# setup-nfs-server. Figure out what happened and restore it). Until this is fixed, it is important to stop and then start the newly created NFS instance. This is also a good test to see if the NFS starts correctly at boot.

em stop nfs01  
  
em start nfs01

When this step completes successfully, the NFS server should be available for login:

em sync

nfs01

ec2-user@nfs01>

All logins are executed by default as ec2-user.

## NFS Server Termination Protection

em is not yet capable of specifying termination protection on instance creation. Since the NFS server is critical for the environment, you should enable termination protection from the web interface by right-clicking on the instance, and then -> Instance Settings -> Change Termination Protection -> Enable.

## Building a Basic Instance

TODO (lessons trying to use em after a relatively long time)

1. If the provisioning key has been regenerated, make sure to install the provisioning public key on the NFS server.
2. Create a ~/.em/em.conf and add the following:

The environment’s NFS server must be up and running when a new instance is being built.

Remember that you need to correlate the load that the instance will be running with the instance type. The default instance type is “t2.micro”. Also, if the instance is supposed to run any services that should be accessible from outside it, you may want to use a different security group, as the default one does not allow inbound connections.

Use the --ami\_id, --group, --instance-type, --storage-size and --subnet “create” command options to qualify the instance.

em create test01

You may also consider using the --dry-run flag to simulate the instance creation process without actually creating anything.

The underlying ec2-run-instance command will be invoked in a manner similar to:

ec2-run-instances ami-4dbf9e7d --instance-count 1 --key em-provisioning-key-pair --group sg-bb3222de --instance-type t2.micro --availability-zone us-west-2b --tenancy default --subnet subnet-53993c24 --instance-initiated-shutdown-behavior stop --associate-public-ip-address true --block-device-mapping /dev/sda1=:10

After creation, sync and apply the basic overlay:

em sync

em overlay basic test01

Successful basic configuration output:

em overlay basic test01

applying overlay basic to test01 ...

The authenticity of host '52.25.237.21 (52.25.237.21)' can't be established.

RSA key fingerprint is b6:dc:bf:3b:dd:af:cb:28:9e:86:4c:30:23:06:ec:e8.

Are you sure you want to continue connecting (yes/no)? yes

hostname successfully set to test01

installing package zip ...

zip successfully installed

installing package unzip ...

unzip successfully installed

cursor configured in /root/.bashrc

alias h='history' configured in /root/.bashrc

alias r='sudo su -' configured in /root/.bashrc

alias nfs='cd /nfs' configured in /root/.bashrc

environment configured for ec2-api-tools

cursor configured in /home/ec2-user/.bashrc

alias h='history' configured in /home/ec2-user/.bashrc

alias r='sudo su -' configured in /home/ec2-user/.bashrc

alias nfs='cd /nfs' configured in /home/ec2-user/.bashrc

environment configured for ec2-api-tools

removed requiretty from /etc/sudoers

The authenticity of host '172.31.17.11 (172.31.17.11)' can't be established.

ECDSA key fingerprint is f3:6e:2d:fa:ca:34:6b:ff:1d:d3:2e:0a:1d:d7:1b:b7.

Are you sure you want to continue connecting (yes/no)? yes

Warning: Permanently added '172.31.17.11' (ECDSA) to the list of known hosts.

NFS server identity successfully configured

installing package nfs-utils ...

created NFS mount point /nfs

NFS client successfully configured

installed ovidiu@nombp1 key into ec2-user's authorized\_keys file

Connection to 52.25.237.21 closed.

## Starting a Basic Instance

## Logging into a Basic Instance

em start test01

em sync

test01

ec2-user@test01>

## Stopping a Basic Instance

em stop test01

## Terminating a Basic Instance

em terminate test01

Note that you don’t need to stop an instance to terminate it. An instance can be terminated directly from a running state.

# Building a Java-enabled Instance

A java-enabled instance can be built from scratch, or an already existing “basic” instance can be upgraded to “java-enabled”. In both cases, the procedure is the same. You will need to apply the “java” overlay (the “java” overlay depends on the “basic” overlay, so all configuration applied there is also applied to a “java” instance).

When creating the instance, make sure to allocate resources appropriate to the future load (memory, CPUs) by choosing the appropriate instance type.

Also, if the instance is supposed to expose services to other instances, you may want to change the security group, as the security group a basic instance is built with does not allow inbound connections.

The “java” overlay needs a Java SDK archive in the environment’s repository. The name of the template is specified in the environment’s configuration file /nfs/environment/environment.conf as “java\_template”. The corresponding file must exist under /nfs/environment/repository.

em overlay java test01

# Building an AMQ Cluster

## Create the AMQ Cluster Security Group



## Build the AMQ Instances

Clustered JBoss AMQ brokers can be built by applying the “amq-broker” overlay. Each EC2 instance should run a single broker instance, but the broker instances will be connected via network bridges that are automatically setup by the overlay.

When creating the instance, make sure to allocate resources (memory, CPUs) appropriate to the load the instance is expected to run. Start by choosing the appropriate instance type.

**IMPORTANT:** The security group that allows AMQ clients to connect to the AMQ server must be created in advance. The group ID must then be specified on the command line following the “--group" option when creating the AMQ server instance, otherwise the AMQ server will be inaccessible. For more details on Amazon EC2 security groups, see “Security Groups”. The AMQ server security group to use with Nova Ordis test cloud is “sg-f8257e9d”.

**IMPORTANT:** The “amq-broker” overlay needs an AMQ template in the environment’s repository. The name of the template is specified in the environment’s configuration file /nfs/environment/environment.conf as “amq\_template”. The corresponding file must exist under /nfs/environment/repository.

Note that because the AMQ instances need Java, all considerations described in the “Building a Java-enabled Instance” section apply (we need a Java SDK, etc.).

Create all AMQ cluster instances at the same time, before applying the overlays. This will allow the overlay to correctly resolve all instance names.

em create --instance-type c4.2xlarge \

--group sg-f8257e9d --storage-size 15 b01

em create --instance-type c4.2xlarge \

--group sg-f8257e9d --storage-size 15 b02

Before applying the “amq-broker” overlay, update the broker configuration (memory, sizes, and especially the cluster membership).

How do I portably do that, currently the only way is to modify the overlay.

em sync

em overlay amq-broker b01

em overlay amq-broker b02

em stop b01 b02

em start b01 b02

The “amq-broker” overlay configures the instance to start the AMQ broker at boot .

## Testing the Installation

Start all instances and make sure the bridges connect to each other.

# Building a JBoss Domain

JBoss domains can be built by with the “jboss-hc” and “jboss-dc” overlays: the domain controllers are built first with “jboss-dc”. Once the domain controllers are up and running, the subordinated host controllers and nodes are built with “jboss-hc”.

The overlays work both with EAP and WildFly.

Note that at least one domain controller for the environment must be up and running when building the subordinated host controllers, because em interacts with the domain controller when building and configuring the host controllers.

The following commands show how to build a domain consisting of one domain controller and two subordinated host controllers, each host controller controlling an arbitrary number of nodes.

The domain controller runs on the host “dc1” and the host controllers runs on the hosts “n1” and “n2”.

## Environment Configuration

Before installing the controller and the subordinated host controllers, configure the common elements in /nfs/environment/environment.conf:

#

# The environment configuration

#

jboss\_template=jboss-eap-6.4.0.zip

## Doman Controller

The environment’s NFS server must be up and running.

em create \

--ami\_id ami-775e4f16 \

--group sg-3b64b65c \

--storage-size 10 \

dc1

em sync

em overlay jboss-dc --server-groups=web:ha,messaging-backend:full dc1

em stop dc1

em start dc1 # since each JBoss instance is configured to start at boot

# this insures the Domain Controller is up and running

# during the installation of the subordinate host

# controllers

## Subordinate Host Controller

The environment’s NFS server and the domain controller must be up and running.

Empty “topology” string is acceptable; it means the host.xml <servers> section will be cleared.

em create \

--ami\_id ami-775e4f16 \

--group sg-3b64b65c \

--storage-size 10 \

h1

em sync

em overlay jboss-hc \

--domain-controller=dc1 \

--servers=w1:web,m1:messaging-backend \

h1

em stop h1

em start h1

**TODO**

* CLI invocation into the domain controller use hardcoded admin/admin123 and port 9999. Need to expose the user as argument (or use subordinate host controller server identity, which is probably better)

# Standalone JBoss Node

The environment’s NFS server must be up and running.

Edit nfs01:/nfs/environment/environment.conf, update jboss\_template definition accordingly.

em create \

--ami\_id ami-775e4f16 \

--group sg-3b64b65c \

--storage-size 10 \

s1

em sync

em overlay jboss-standalone --profile=ha [--max-memory=512] s1

em stop s1

em start s1

After building the node, you may want to patch it. See “JBoss Patching” section.

# JBoss Patching

em is capable of patching an existing EAP instance provided that the patch ZIP file is available in the environment’s repository.

The patching logic is idempotent – it won’t apply a patch that is already applied.

The VM needs to be running, but the JBoss node does not need to be up, it will be started as needed.

em overlay jboss-patch --level=8 eap1

# JBoss Configuration

## Standalone Mode – JGroups TCP-based stack

Build all the hosts in the cluster and install the JBoss baselines. All hosts need to be known to the EC2, this way we can translate the name to the internal IP address. They do not need to be configured, just created with “em create”. JBoss instances must be “runnable”, the overlay will start the instance, if not already started, because it will connect with CLI to apply configuration changes.

em overlay jboss-configuration

--subsystem=jgroups

--default-stack=tcp

--initial-hosts="jgh1[7600],jgh2[7600],jgh3[7600]" jgh1

The initial hosts value may contain the port values or not. If the port values are not identified, “[7600]” is appended by default.

Repeat the procedure for jgh2, jgh3

## Standalone Mode – JDG external cache for HTTP session replication

em overlay jboss-configuration –-procedure=jdg-remote-cache \

--cache-container=jdg-remote \

--cache=default \

--jdg-cache=jdg-http \

--jdg-host=jdg-a-2 \

[--jdg-port=11222] \

eap1

where:

--cache-container – the name of the cache container to create or use. This cache container is located on the instance about to be configured.

--cache – the name of the cache that will be backed by the JDG remote store. This cache is located on the instance about to be configured.

--jdg-cache – the name of the remote jdg-cache (usually in the “clustered” container).

--jdg-host – the name of the initial JDG hotrod server

--jdg-port – if not specified, default is 11222.

## Connecting to a mod\_cluster Load Balancer

The load balancer node must be created when the configuration is applied, so the name can be translated to address by the EC2 layer. It does not necessarily have to be configured or running.

em overlay jboss-configuration \

–-procedure=mod-cluster-backend --load-balancer=lb1 eap1

## NFS-based HornetQ HA

The NFS server must be up and running. The domain must be already built, and the domain controller must be up and running.

em overlay jboss-configuration hornetq-ha dc1

At the time of the writing this logic is not implemented.

# Patching JBoss

Not implemented yet, implement it next time I need it.

em overlay jboss-patch node1

# JDG Node

The current version of em only supports building JDG nodes that cluster over JGroups/TCP. In the future we’ll add support for multicast or local instances.

When building the JDG cluster, we first need to create all VMs that will run cluster nodes. This is because the names should be resolvable to addresses when the TCP cluster is configured. Note that the nodes do not need to be configured in any way, just created with “em create”. TODO: more user friendly solution if the hosts do not exist.

For all nodes:

em create \

--ami\_id ami-775e4f16 \

--group sg-3b64b65c \

--storage-size 10 \

jdg1

em sync

Build the JDG nodes by applying the “jdg” overlay and specifying the node membership with “--cluster=node1,node2,…” This initial membership will be used to configure the JGroups “initial\_host” value.

The environment’s NFS server must be up and running.

Edit nfs01:/nfs/environment/environment.conf, update jboss\_template definition accordingly.

Then, for each node (jdg1, jdg2, jdg3):

em overlay jdg --cluster=jdg1,jdg2,jdg3 [--max-memory=768] jdg1

em stop jdg1

em start jdg1

After installation, the JDG can be started/stopped locally as follows:

systemctl start|stop jboss-datagrid

# Running Arbitrary Shell Commands Across the Environment

em run p001 p002 p003 -- uptime

# Miscellaneous

## In-Line Documentation

em –h|--help <command>

## Verbose Execution

Verbose execution is usually helpful if something goes wrong and you need more details on what happens while the command is executed:

em –v|--verbose <command>

# Extending em

## Overlays

Overlays must be developed in such a way that they are idempotent.