

Hadoop on Azure Virtual Machines

Hortonworks HDP Edition

This framework will automate many of the steps for creating a Hadoop cluster on Windows Azure Virtual Machines. This framework is designed to deploy Hortonworks HDP on Linux using Ambari.

This framework will automate the generation of the Azure based infrastructure, and walk through the manual steps to configure the environment. The framework is a blend of Azure CLI, bash scripts coupled with manual configuration.

The following instructions were tested on Oracle Linux 6 and CentOS 6.3/6.4. Ambari installation will fail with CentOS 6.5 at the time of this document.

This document will be used by those who prefer using Linux or Mac for deploying HDP on Windows Azure Linux VMs.

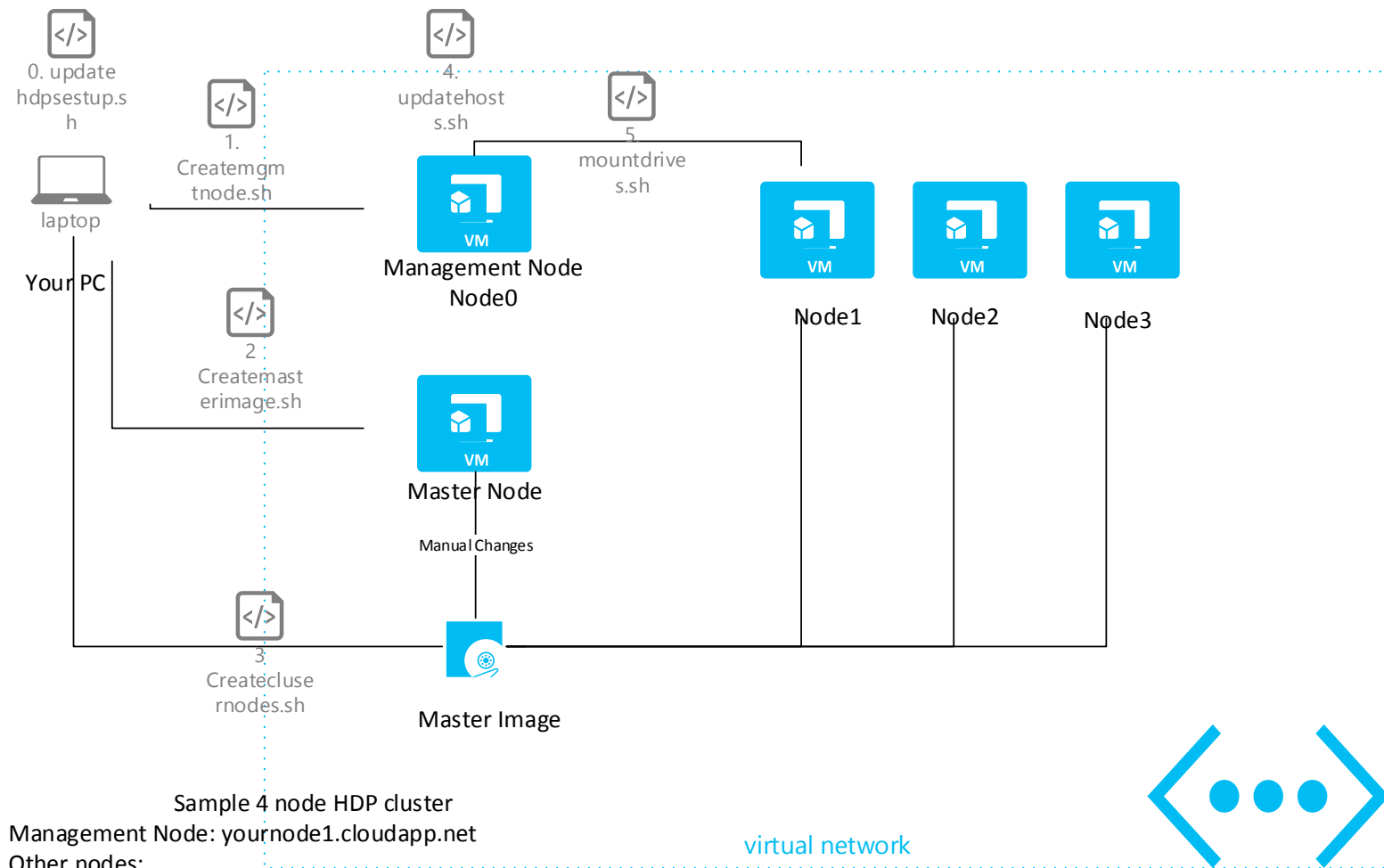
Requirements

- Windows Azure Cross Platform Command Line Tools: <http://www.windowsazure.com/en-us/documentation/articles/xplat-cli/>
- SSH client.
- Windows Azure Subscription. Steps below assist with creating the storage account and containers.

Overview

1. Update the hdpsetup.sh file with information about your HDP setup
2. Execute createmgmtnode.sh
 - a. Create the storage account
 - b. Create the Affinity Group
 - c. Create the Virtual Network
 - d. Create the Management Node
3. Execute createmasterimage.sh. This step is only necessary if you are creating a new customer image for your nodes.
 - a. Create the Master Node
4. Manually configure the Management
 - a. Attach disk
 - b. Set root passwords
 - c. Set up passwordless SSH between the Management Node and the Master Node
 - d. Set various server configurations to meet HDP requirements
 - e. Update host files
5. Manually configure the Master Node
 - a. Attach disk (Management Node only)
 - b. Set root passwords
 - c. Set up passwordless SSH between the Management Node and the Master Node
 - d. Set various server configurations to meet HDP requirements
 - e. Update host files
6. Prepare the Master Node for provisioning
 - a. Update waagent.conf (Master Node only)
 - b. Run waagent --deprovision (Master Node only)
7. Create the Windows Azure Image
 - a. Stop the Master Node
 - b. Capture an image
8. Update hdpsetup.sh nodeImageName with the name of the captured image.
9. Execute createclusternode.sh
 - a. Creates multiple Windows Azure Virtual Machines using the Master Node image
 - b. Creates the script mountdrive.sh which mounts data drives on each node in the cluster

- c. Creates the script `updatehosts.sh` which updates `/etc/hosts` file on each node in the cluster
- 10. Run the script `updatehosts.sh` to update `/etc/hosts`
- 11. Run the script `mountdrive.sh`
- 12. Install Ambari on Management Node
- 13. Install HDP using Ambari



Sample 4 node HDP cluster
 Management Node: yournode1.cloudapp.net
 Other nodes:
 yournode2.cloudapp.net
 yourndoe2.cloudapp.net
 yournode3.cloudapp.net

Installing HDP on Windows Azure Virtual Machines

Preparation

Windows Azure Cross Platform Command Line Tools

This section provides steps for setting up your development PC to leverage Windows Azure command line tools for deployments.

MAC OSX Mavericks

For Mac you need to install brew. It can be installed by running the command shown below from the terminal window. Detailed instructions are here at <http://brew.sh/>

Install node by executing `brew install node`

Install Azure CLI by executing `npm install -g azure-cli`

Test that Azure CLI was installed by executing `azure -v`

You should see version 0.7.4 or greater

```
ruby -e "$(curl -fsSL https://raw.githubusercontent.com/Homebrew/homebrew/go/install)"  
brew update  
brew doctor  
brew install node  
npm install -g azure-cli  
azure -v  
brew install jq
```

Jq is a light weight command line json processor available for many platform.

Ubuntu

Here are the instructions for install Azure CLI on Ubuntu. For a different flavor of Linux, some of the set up commands will need the corresponding changes.

Install node.js

```
sudo apt-get install -y python-software-properties python g++ make
sudo add-apt-repository ppa:chris-lea/node.js
sudo apt-get update
sudo apt-get install nodejs
```

For reference, see

<http://askubuntu.com/questions/49390/how-do-i-install-the-latest-version-of-node-js>

[Installing-Node.js-via-package-manager.](#)

Install CLI

```
sudo npm install -g azure-cli

# check version to ensure CLI is properly installed
azure -v # should be 0.7.4 or greater
```

Once Azure CLI has been installed the rest of the instructions are same for MAC and Linux.

Authenticate using Certificate

The development machine will use a certificate (self-signed) to authenticate against Windows Azure Management services. For details, see [How to install the Windows Azure Cross-Platform Command-Line Interface.](#)

```
azure account download
```

A browser will pop up and prompt for login. After a successful login, you will be prompted to download and save a file with file name extension .publishsettings. This publish-settings file contains the certificate with private key, and will be used in the next step. Please note that a new management certificate is automatically created using this step. The details of this newly created certificate can also be viewed in the portal under Settings/Management Certificates section.

If the development machine is a server without a UI (user interface), the URL will be displayed on the Unix prompt along with an informational message; see below.

```
$ azure account download
info: Executing command account download
info: Launching browser to http://go.microsoft.com/fwlink/?LinkId=254432
help: Save the downloaded file, then execute the command
help: account import <file>
info: account download command OK
```

Copy the URL and use and go to a different machine which does have a browser enabled. Login using a browser and download the publish-settings file. In this case, the publish-settings file will have to be copied over to the development machine before proceeding to the next step.

```
azure account import <path-to-publish-settings-file>
```

If everything goes through well up to this point, you should see a hidden folder .azure in your current working directory on the development machine. This directory should contain a certificate in .pem format and other files for connecting to your Azure subscription. For example:

```
ls -la .azure
total 20
drwxrw-r-- 2 azureuser azureuser 4096 Jan 29 21:26 ./
drwxr-xr-x 8 azureuser azureuser 4096 Jan 29 21:26 ../
-rw-rw-r-- 1 azureuser azureuser 105 Jan 29 21:26 config.json
-rw----- 1 azureuser azureuser 2740 Jan 29 21:26 managementCertificate.pem
-rw----- 1 azureuser azureuser 3962 Jan 29 21:26 publishSettings.xml
```

If you logon to the Windows Azure Management Portal using a browser, and navigate to Settings → Management Certificates page, you should see a certificate (with public key) already installed there. At this point the development machine is configured for interacting with the Windows Azure Subscription.

To verify that connectivity has been established, run the command shown below to list the Account/Subscription that will be accessible from this machine.

```
azure account list
```

Cluster Configuration

Development PC

Get all the scripts and files from GitHub <https://github.com/devopscloudorg/azure-hdp/tree/master/bash>

You will need to edit the hdpsetup.sh in a text editor. This file contains all the settings necessary to create a HDP cluster.

Affinity Group

Affinity Group help you deploy your compute and storage account together. You need to specify a name as well as the region where the affinity group should be created.

```
#Affinty group helps you keep your storage and compute in the same region
export affinityGroupName=youreasthdpag
#Name the region where affinity group should be created.
#choices are valid values are "East US", "West US", "East Asia", "Southeast Asia", "North Europe", "West Europe"
export affinityGroupLocation="East US"
```

Azure Storage Account

Define the name of your storage account. This name has be globally unique as it is the public DNS for your storage account.


```
#name of the storage account here your virtual machines will be stored.  
export storageAccount=yourhdpstorage
```

Management Node Image Name

Windows Azure provides virtual machine images that are supported by Microsoft or other vendors.

If you need to get a list of which images are available you can run the command

Azure vm image list

In this example we are select Oracle Linux 6 image

```
#Name of the image you will use to create your virtual machines  
#export imageName=b39f27a8b8c64d52b05eac6a62ebad85__Ubuntu_DAILY_BUILD-precise-12_04_3-LTS-amd64-  
server-20140204-en-us-30GB  
export imageName=c290a6b031d841e09f2da759bbabe71f__Oracle-Linux-6
```

Management Node Configuration

This will configure various settings related to management node.

```
#Size of the Virtual machine. Valid sizes are extrasmall, small, medium, large, extralarge, a5, a6, a7
export instanceSize=extralarge

#Size of the data disk you want to attach to the VM you are creating. You will typically attach at least 1 disk
export diskSizeInGB=5

#Number of disks you want to attach. Small VM can have 2 disks, medium can have 4, Large can have 8 and extralarge can have 8 data disks
export numOfDisks=1

#virtual machine settings. We will generate names of all the VM from these names
export vmNamePrefix=yourbdhdp
export cloudServicePrefix=yourbdhdp
#user name and password for the virtual machine you are creating
export adminUserName=azureuser
#Azure CLI enforces strong passwords uppercase, lower case and special characters
export adminPassword=Password.1!
```

Virtual Network Setting

Virtual machines in a Hadoop cluster need to communicate with each other. We recommend putting all the virtual machines in the same virtual network. Virtual network can have one or more subnets.

You can learn more about Azure Virtual Network here <http://www.windowsazure.com/en-us/documentation/services/virtual-network/>

vnetName defines a name of the virtual network

vnetAddressSpace defines the address space for the entire virtual network. We chose IP address range 172.16.0.0/16

You can create one or more subnets in a virtual network. In this example we configured one subnet named mysubnet. The address space used by this subnet is 172.16.1.0/24

```
#setting related to virtual network
export vnetName=youreasthdpvnet
#address space allows 192.168.0.0, 10.0.0.0 and 172.16.0.0 ip address ranges
#virtual network faq is here http://msdn.microsoft.com/en-us/Library/windowsazure/dn133803.aspx
export vnetAddressSpace=172.16.0.0
export vnetCidr=16
export subnetName=mysubnet
export subnetAddressSpace=172.16.1.0
export subnetCidr=24
```

Cluster Node Settings

You will need to create customized image for the nodes in your cluster. After you have created the image you will need to update the setting `nodeImageName` with the name of your customized image.

`nodeCount` is the number of nodes in your HDP cluster.

nodeSize is the size of each node. Size will depend on the type of your workload. For compute intensive workloads you may need to select a larger instance size.

```
#These settings are for nodes in the HDP cluster  
#Name of the custom image you will use to create your cluster nodes  
#After you have create your master node image replace the value of nodeImageName wiht the image you created  
export nodeImageName=c290a6b031d841e09f2da759bbabe71f__Oracle-Linux-6  
#Number of nodes in your HDP cluster  
export nodeCount=10  
#Size of the nodes in the hadoop cluster. Valid sizes are extrasmall, small, medium, large, extralarge, a5, a6, a7  
export nodeSize=small
```

Create the Infrastructure

From your PC run the bash script create createmgmtnode.sh and createmasternode.sh

This script will use the settings defined in hdpsetup.sh to create your virtual machine. Upon successful completion this script will display detailed information about management node.

Sample Execution Script

```
#On your Development PC  
createmgmtnode.sh  
createmasterimage.sh
```

Manually configure the Management Node

The Management Node is named \$vmNamePrefix followed by 0. You will use ssh client to configure this node.

Use your ssh client to log into the management node. In our example we used

ssh azureuser@yourbdhdp0.cloudapp.net

You will be prompted for password. Enter the value of \$adminPassword you defined in hdpsetup.sh file.

Set root passwords

The first steps will be to set the root passwords on both the Management and Master Nodes. You are currently connected to the Management Node.

Elevate to root. Enter the password for the \$adminUserName when prompted. Update the root password. Enter the new password when prompted.

```
sudo -s
```

```
passwd
```

Install wget

```
yum install wget
```

Update Kernel-Header

If you are using the gallery image "Oracle Linux 6.4.0.0.0", the following steps must be executed for a successful installation of HDP.

Update the yum conf file. Comment out the line "exclude=kernel-uek-headers"

```
vi /etc/yum.conf
```

```
# exclude=kernel-uek-headers
```

Update kernel headers.

```
yum install kernel-headers
```

Mount Disks Script

The disks will be mounted based on a startup script.

Copy the makefilesystem.sh script from your development PC to Management node. You can use scp to copy this file as shown below.

```
scp makefilesystem.sh azureuser@management node hostname.cloudapp.net:makefilesystem.sh
```

On your management node.

```
mkdir /root/scripts
```

```
mv makefilesystem.sh /root/scripts
```

```
chmod 755 /root/scripts/makefilesystem.sh
```

Update Server Configuration Settings

Type the following commands to configure the server settings for HDP prerequisites.

```
#disable iptables
```

```
chkconfig iptables off
```

```
/etc/init.d/iptables stop
```

```
setenforce 0
```

```
#start ntp service
```

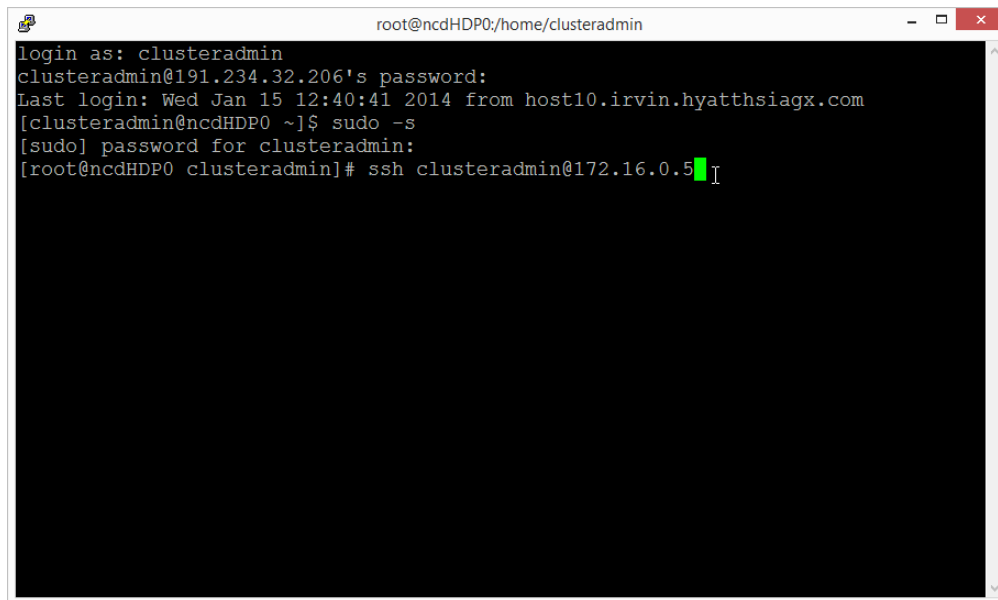
```
chkconfig ntpd on
```

```
ntpdate pool.ntp.org
```

Manually Configure Master Node

Enter the following to move to the Master Node. Enter the password for the adminUserName when prompted.

```
ssh <adminUserName>@<Master Node Hostname>.cloudapp.net
```

A terminal window titled 'root@ncdHDP0:/home/clusteradmin' with standard window controls. The terminal text shows a login for 'clusteradmin' at IP 191.234.32.206, followed by a 'sudo -s' command. A password prompt is shown, and the prompt changes to root. The root user then enters an 'ssh' command to connect to 172.16.0.5, with a green cursor at the end of the command.

```
login as: clusteradmin
clusteradmin@191.234.32.206's password:
Last login: Wed Jan 15 12:40:41 2014 from host10.irvin.hyatthsiagx.com
[clusteradmin@ncdHDP0 ~]$ sudo -s
[sudo] password for clusteradmin:
[root@ncdHDP0 clusteradmin]# ssh clusteradmin@172.16.0.5
```

Elevate to root. Enter the password for the \$adminUserName when prompted.

Update the root password. Enter the new password when prompted.

```
sudo -s
```

```
passwd
```

With both root passwords set we can now configure the nodes for the cluster.

[Update Kernel-Header](#)

If you are using the gallery image “Oracle Linux 6.4.0.0”, the following steps must be executed for a successful installation of HDP.

Update the yum conf file. Comment out the line “exclude=kernel-uek-headers”

```
vi /etc/yum.conf
```

```
# exclude=kernel-uek-headers
```

Update kernel headers.

```
yum install kernel-headers
```

Mount Disks Script

The disks will be mounted based on a startup script.

Copy the makefilesystem.sh script from your development PC to Management node. You can use scp to copy this file as shown below.

```
scp makefilesystem.sh azureuser@master\_node\_hostnane.cloudapp.net:makefilesystem.sh
```

On your management node.

```
mkdir /root/scripts
```

```
mv makefilesystem.sh /root/scripts
```

```
chmod 755 /root/scripts/makefilesystem.sh
```

Update Server Configuration Settings

Configure the server settings for HDP prerequisites.

```
#disable iptables
```

```
chkconfig iptables off
```

```
/etc/init.d/iptables stop
```

```
setenforce 0
```

```
#start ntp service
```

```
chkconfig ntpd on
```

```
ntpdate pool.ntp.org
```


Set up passwordless SSH between the Management Node and the Master Node

In the Management Node log in as root and generate the key.

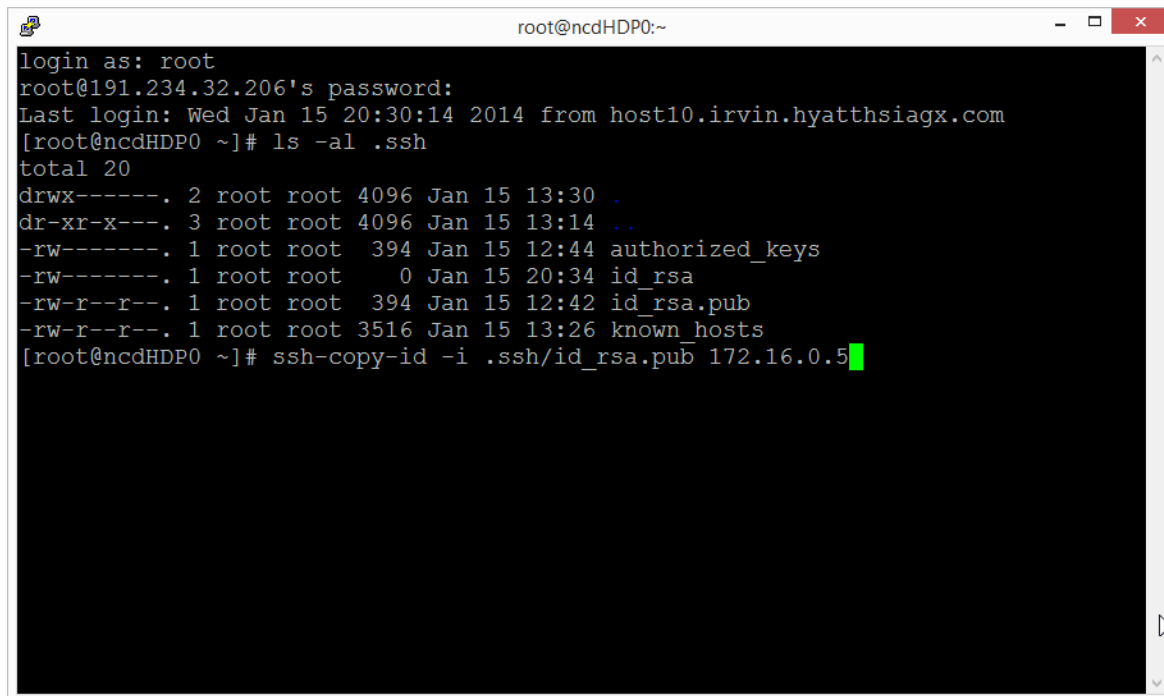
ssh-keygen

Accept the default file location when prompted (press enter). Press enter to create the key without a passphrase. The public key is stored in `.ssh/id_rsa.pub`, and the private key is `id_rsa`. You will use the private key later during the HDP installation. At this time you will copy the public key to the Master Node to enable passwordless ssh.

Copy the key to the Master node and Management Node (self-referencing), enter the root password when prompted.

```
ssh-copy-id -i /root/.ssh/id_rsa.pub root@<Master Node Hostname>.cloudapp.net
```

```
ssh-copy-id -i /root/.ssh/id_rsa.pub root@<Management Node Hostname>.cloudapp.net
```

A terminal window titled 'root@ncdHDP0:~' showing the process of generating an SSH key and copying it to a remote host. The user logs in as root, and the terminal shows the last login time and source. The user then runs 'ls -al .ssh' to list the files in the .ssh directory. The output shows the files 'authorized_keys', 'id_rsa', 'id_rsa.pub', and 'known_hosts'. Finally, the user runs 'ssh-copy-id -i .ssh/id_rsa.pub 172.16.0.5', which is partially visible at the bottom of the terminal window.

```
root@ncdHDP0:~  
login as: root  
root@191.234.32.206's password:  
Last login: Wed Jan 15 20:30:14 2014 from host10.irvin.hyatthsiagx.com  
[root@ncdHDP0 ~]# ls -al .ssh  
total 20  
drwx-----. 2 root root 4096 Jan 15 13:30 .  
dr-xr-x---. 3 root root 4096 Jan 15 13:14 ..  
-rw-----. 1 root root 394 Jan 15 12:44 authorized_keys  
-rw-----. 1 root root 0 Jan 15 20:34 id_rsa  
-rw-r--r--. 1 root root 394 Jan 15 12:42 id_rsa.pub  
-rw-r--r--. 1 root root 3516 Jan 15 13:26 known_hosts  
[root@ncdHDP0 ~]# ssh-copy-id -i .ssh/id_rsa.pub 172.16.0.5
```

To test the keys were set up correctly, type the following and validate that you are not prompted for a password.

```
ssh <Management Node Hostname>.cloudapp.net
```

```
ssh <Master Node Hostname>.cloudapp.net
```

Create Image of the Master Node

Windows Azure Linux Agent

Set up the master node virtual machine for provisioning as an image. Open the waagent.conf file.

```
vi /etc/waagent.conf
```

Change the following settings:

```
Provisioning.DeleteRootPassword=n
```

```
Provisioning.RegenerateSshHostKeyPair=n
```

Run the Windows Azure Linux Agent.

```
waagent -deprovision
```

Open the Windows Azure Management Portal and navigate to the dashboard of the Master Node virtual machine. Shut down the machine.

After the machine is stopped, click Capture to create an image.

Update the hdpsetup.sh file nodeImageName with the value of image you created.

Create the Cluster

On your development PC run the bash script createclusternodes.sh. It create the virtual machines. It also creates hosts.txt and mountdrives.sh.

SCP updatehosts.sh, hosts.txt and mountdrives.sh to the management node.

Execute UpdateHosts.sh as it reads the hosts.txt and update /etc/hosts file.

Mountdrives.sh executes makefilesystem.sh on each node in the cluster to mount the data drives on them. Also updates /etc/hosts

Sample Execution Script

```
#On your dev PC
createclusternodes.sh
scp hosts.txt root@<Management Node Hostname>.cloudapp.net:hosts.txt
scp mountdrive.sh root@<Management Node Hostname>.cloudapp.net:mountdrive.sh
scp updatehosts.sh root@<Management Node Hostname>.cloudapp.net:updatehosts.sh
scp hdpsetup.sh root@<Management Node Hostname>.cloudapp.net:hdpsetup.sh

#On your management node logged in as root
chmod 755 mountdrive.sh
chmod 755 updatehosts.sh

#Reads the hosts.txt and updates /etc/hosts file on the management node
UpdateHosts.sh

#This script executes st.pl on all the nodes in HDP cluster to mount the drive
#It also update the hosts file on each node in the cluster
mountdrive.sh
```

To test the virtual machines were generated correctly verify that password less ssh is working correctly.

```
ssh <Machine Hostname>.cloudapp.net
```

Install Ambari

Open an SSH session in PuTTY to the Management Node.

Download and install Ambari:

```
wget http://public-repo-1.hortonworks.com/ambari/centos6/1.x/updates/1.4.2.104/ambari.repo
cp ambari.repo /etc/yum.repos.d
yum install ambari-server
```

After the installation has completed, run the setup:

```
ambari-server setup
```

After the management node is restarted, verify Ambari is started. Connect to the Management Node in PuTTY and execute the following command:

```
ambari-server start
```

Install HDP

Open the browser and navigate to <http://<Management Node Hostname>:8080>

When prompted, log in as admin with password admin.

In general, follow the prompts to install. The only tricky part I would point out is in the install screen to input hosts and the key. You will paste the private key from the Management Node:

```
cat .ssh/id_rsa
```

Highlight the full key and press enter to copy to the clipboard. You will then paste this in the web interface.