Hadoop on Azure Virtual Machines

Hortonworks HDP Edition

The 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.

The 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 PowerShell based automation coupled with manual configuration.

The following instructions were tested on Ubuntu 12.04.3 LTS, Oracle Linux 6 and CentOS 6.3/6.5.

Requirements

- Windows Azure PowerShell: http://www.windowsazure.com/en-us/documentation/articles/install-configure-powershell/
- PuTTY or another SSH tool: http://www.putty.org
- WinSCP or another tool to transfer files to the Linux image: http://winscp.net/eng/index.php
- Windows Azure Subscription with Storage Account. Steps below assist with creating the storage account and containers.
    - Create a public container in the account and move the st.pl perl script to the container

Overview

1. Create the Management Node: Execute 1_Management_Node.ps1
    a. Create the Affinity Group (if it doesn't exist)
    b. Create the Virtual Network (if it doesn't exist)
    c. Create the Storage Account (if it doesn't exist)
    d. Create the Management virtual machine
2. Create the Clone Node: Execute 2_Clone_Node.ps1
3. Manually configure the Management and Clone nodes
    a. Set root passwords
    b. Set up passwordless SSH between the Management Node and the Clone Node
    c. Set various server configurations to meet HDP requirements
    d. Add disk mount script
4. Prepare the Clone Node for provisioning
    a. Update waagent.conf
    b. Run waagent –deprovision
5. Create the Windows Azure Clone Image
    a. Stop the Clone Node
    b. Capture an image
6. Execute 3_Cluster_Nodes
    a. Creates multiple Windows Azure Virtual Machines using the Clone Node image
7. Update hosts and mount drives
8. Install Ambari on Management Node
9. Install HDP on cluster using Ambari

Installing HDP on Windows Azure Virtual Machines

Preparation

Windows Azure PowerShell

Download and install Windows Azure PowerShell: http://www.windowsazure.com/en-us/downloads/.

Follow online instructions for setting up the subscription with Windows Azure PowerShell: http://www.windowsazure.com/en-us/documentation/articles/install-configure-powershell/.

The PowerShell ISE (Integrated Scripting Environment) is often easier to use when developing and testing script execution. If you are in the traditional Windows Azure PowerShell interface, type ISE to open the PowerShell ISE.

Configure Windows Azure PowerShell Environment

Set PowerShell defaults for the new storage account. In the PowerShell ISE execute the following command.

```
Set-AzureSubscription –SubscriptionName $subscriptionName
     –CurrentStorageAccount $clusterStorageAccount
```

PuTTY

Download and install PuTTY or another SSH tool: http://www.putty.org

WinSCP

Download and install WinSCP: http://winscp.net/eng/index.php

Virtual Network Configuration Files

The way that the network is created depends on whether you have existing virtual networks defined. If your subscription has existing networks defined, you can merge the new network configuration into the existing configuration. If your subscription does not have existing networks defined, you can create the entire network from scratch. The 1_Management_Node.ps1 script in the following step automatically detects which scenario you have and acts accordingly.

The scripts assume that the virtual network subnet does not already exist. If you are using an existing virtual network and subnet, comment out the "create virtual network" sections from the 1_Management_Node.ps1 script.

> **Known issue**
>
> The virtual network create commands are called from both the 1_Management_Node.ps1 and 2_Clone_Node.ps1 script, and may produce errors if the network was already created. These errors may be ignored for the current version.

You will create two files as defined below. The script will use these files to add the new Virtual Network configuration settings.

1) Save the following XML block into a file named "C:\Temp\NetworkDef.xml". Replace "*insert network address*" with the appropriate network address.

```
<VirtualNetworkSite name="placeholder-network" AffinityGroup="placeholder-
affinitygroup">
```

```
    <AddressSpace>
      <AddressPrefix>insert network address</AddressPrefix>
    </AddressSpace>
    <Subnets>
      <Subnet name="App">
        <AddressPrefix>insert network address</AddressPrefix>
      </Subnet>
    </Subnets>
</VirtualNetworkSite>
```

2) Save the following XML block into a file named "C:\Temp\NetworkDef-Full.xml". Replace "*insert network address*" with the appropriate network address.

```
<NetworkConfiguration xmlns:xsd="http://www.w3.org/2001/XMLSchema"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns="http://schemas.microsoft.com/ServiceHosting/2011/07/NetworkConfiguration">
  <VirtualNetworkConfiguration>
    <Dns />
    <VirtualNetworkSites>
      <VirtualNetworkSite name="placeholder-network" AffinityGroup="placeholder-
affinitygroup">
        <AddressSpace>
          <AddressPrefix>insert network address</AddressPrefix>
        </AddressSpace>
        <Subnets>
          <Subnet name="App">
            <AddressPrefix>insert network address</AddressPrefix>
          </Subnet>
        </Subnets>
      </VirtualNetworkSite>
    </VirtualNetworkSites>
  </VirtualNetworkConfiguration>
</NetworkConfiguration>
```

Create the Management Node

Execute the 1_Management_Node.ps1 script in Windows Azure PowerShell Integrated Shell Environment (ISE).

The script requires the following parameters representing the environment settings.

Parameter name	Purpose
$imageName	The name of the Windows Azure image which will be used for provisioning the virtual machines.
$adminPassword	The password that will be generated in the virtual machines for the administrator of the virtual machines.
$adminUserName	The user name of the administrator account that will be created on the virtual machines.
$instanceSize	The size of the Windows Azure Virtual Machines (ie Small, Medium, Large, ExtraLarge, etc). Virtual machine sizes are detailed online: http://msdn.microsoft.com/en-us/library/windowsazure/dn197896.aspx. Large or ExtraLarge are recommended.
$diskSizeInGB	The size of the disk to attach to the virtual machines.
$numofDisks	The number of disks to attach to the virtual machines.
$vmNamePrefix	Naming convention for the virtual machines. All virtual machines will be named based on this prefix.

$cloudServicePrefix	Naming convention for the cloud services. In general, this will be the same as the $vmNamePrefix for ease of management.
$affinityGroupLocation	The Windows Azure data center where the virtual machines will be deployed. Choose a data center that is the same location as the storage account with the data to analyze. Execute Get-AzureLocation from PowerShell or "azure vm location list" from the Azure Command Line to the the complete list of locations.
$affinityGroupName	The name of the affinity group (must be unique in your subscription).
$affinityGroupDescription	The description for the affinity group.
$affinityGroupLabel	The label for the affinity group.
$virtualNetworkName	The name for the virtual network (must be unique in your subscription).
$virtualNetworkName	The name for the virtual network (must be unique in your subscription).
$virtualSubnetName	The name of the virtual subnet.
$storageAccountName	The name of the storage account that will be used or created.
$installerPort	Port number for the distribution installer. On HDP this is default 8080.
$hostsfile	The location of the hosts file that is generated during the cluster creation. This is optional, with a default of ".\hosts.txt"
$mntscript	The location of the mountdrive file that is generated during the cluster creation. This is option, with a default of ".\mountdrive.sh"

Sample Execution Script

```
.\1_Management_Node.ps1 –imageName "Oracle Linux 6.4.0.0.0" –adminUserName
"clusteradmin" –adminPassword "Password.1" –instanceSize "Large" –
diskSizeInGB 100 –numOfDisks 2 –vmNamePrefix "HDPNode" –cloudServicePrefix
"HDPNode" –affinityGroupLocation "East US" –affinityGroupName "AGHDP" –
affinityGroupDescription "Affinity Group used for HDP on Azure VM" –
affinityGroupLabel "Hadoop on Azure VM AG HDP" –virtualNetworkName "Hadoop-
NetworkHDP" –virtualSubnetname "App" –storageAccountName "hdpstorage"
```

Create the Clone

Execute the 2_Clone_Node.ps1 script in Windows Azure PowerShell Integrated Shell Environment (ISE).

The script requires the following parameters representing the environment settings.

Parameter name	Purpose
$imageName	The name of the Windows Azure image which will be used for provisioning the virtual machines.

$adminPassword	The password that will be generated in the virtual machines for the administrator of the virtual machines.
$adminUserName	The user name of the administrator account that will be created on the virtual machines.
$instanceSize	The size of the Windows Azure Virtual Machines (ie Small, Medium, Large, ExtraLarge, etc). Virtual machine sizes are detailed online: http://msdn.microsoft.com/en-us/library/windowsazure/dn197896.aspx. Medium or larger is recommended.
$diskSizeInGB	The size of the disk to attach to the virtual machines.
$numofDisks	The number of disks to attach to the virtual machines.
$vmNamePrefix	Naming convention for the virtual machines. All virtual machines will be named based on this prefix.
$cloudServicePrefix	Naming convention for the cloud services. In general, this will be the same as the $vmNamePrefix for ease of management.
$affinityGroupLocation	The Windows Azure data center where the virtual machines will be deployed. Choose a data center that is the same location as the storage account with the data to analyze. Execute Get-AzureLocation from PowerShell or "azure vm location list" from the Azure Command Line to the the complete list of locations.
$affinityGroupName	The name of the affinity group (must be unique in your subscription).
$affinityGroupDescription	The description for the affinity group.
$affinityGroupLabel	The label for the affinity group.
$virtualNetworkName	The name for the virtual network (must be unique in your subscription).
$virtualNetworkName	The name for the virtual network (must be unique in your subscription).
$virtualSubnetName	The name of the virtual subnet.
$storageAccountName	The name of the storage account that will be used or created.

Sample Execution Script

```
.\2_Clone_Node.ps1 -imageName "Oracle Linux 6.4.0.0.0" -adminUserName
"clusteradmin" -adminPassword "Password.1" -instanceSize "Large" -
diskSizeInGB 100 -numOfDisks 2 -vmNamePrefix "HDPNode" -cloudServicePrefix
"HDPNode" -affinityGroupLocation "East US" -affinityGroupName "AGHDP" -
affinityGroupDescription "Affinity Group used for HDP on Azure VM" -
affinityGroupLabel "Hadoop on Azure VM AG HDP" -virtualNetworkName "Hadoop-
NetworkHDP" -virtualSubnetname "App" -storageAccountName "hdpstorage"
```

Known issue

> The virtual network create commands are called from both the 1_Management_Node.ps1 and 2_Clone_Node.ps1 script, and may produce errors if the network was already created. These errors may be ignored for the current version.

Manually configure the Management and Clone nodes

The Management Node is named $vmNamePrefix followed by 0, and the Clone Node is named $vmNamePrefix followed by "c". You will use PuTTY to configure these nodes.

In addition to the DNS name, you may need the Management Node private IP and the Clone Node private IP to proceed with this section. The virtual machine IP addresses can be found by viewing the properties of the virtual machine in the Windows Azure Management Portal.
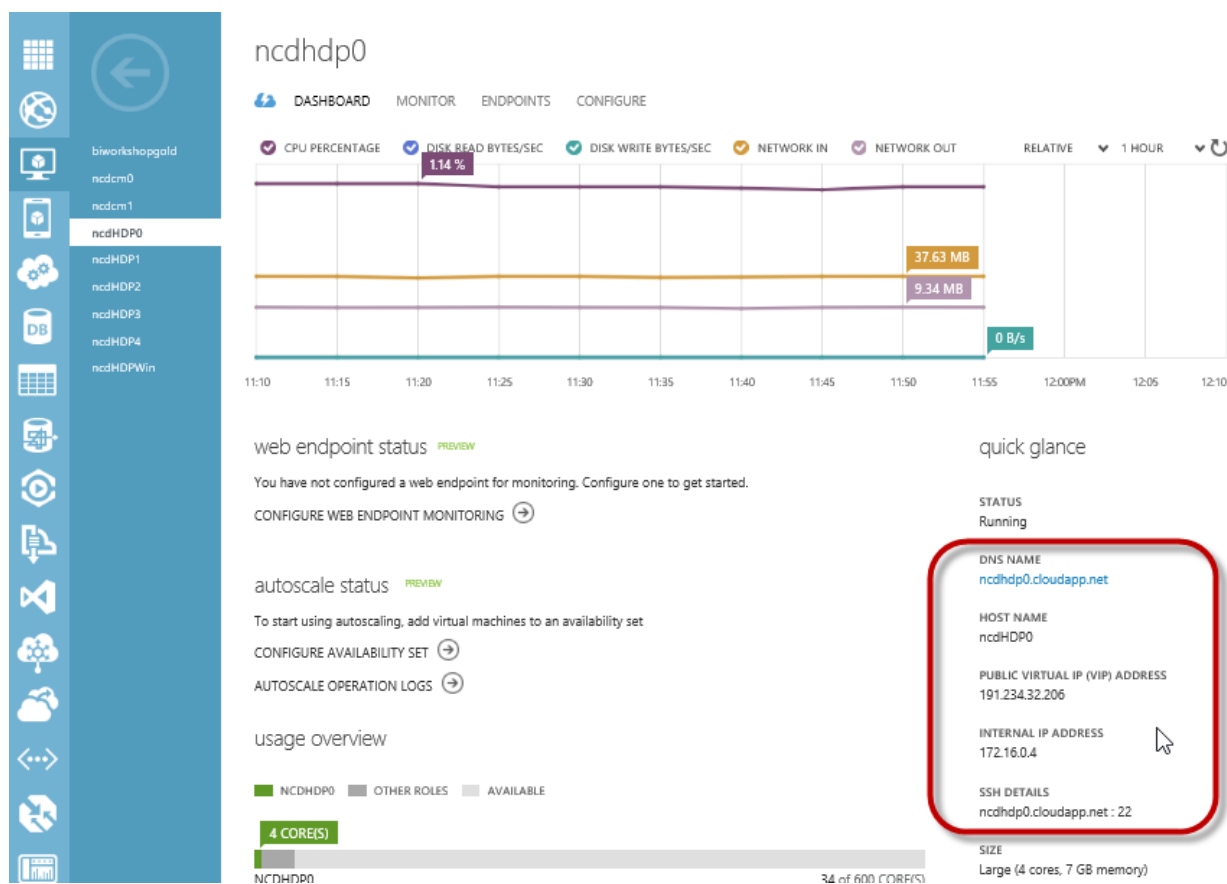
Open PuTTY and input port 22 with the Management Node public IP address or the DNS name. Click Open.
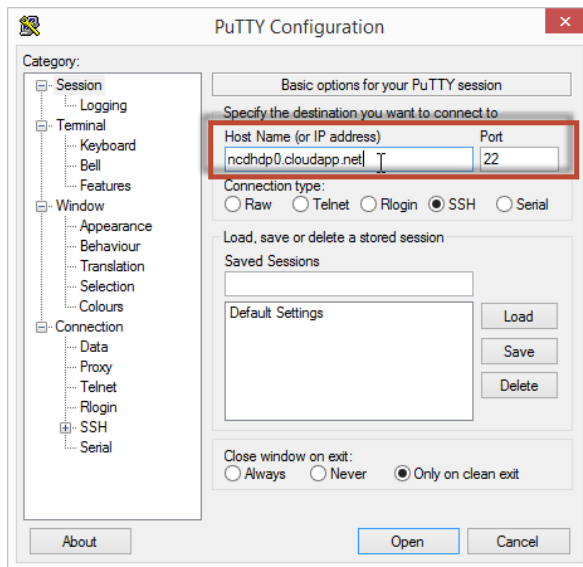
You will be prompted for a login and password. Enter the value used in the parameter $adminUserName with the password you provided for the parameter $adminPassword.

Set root passwords

The first steps will be to set the root passwords on both the Management and Clone Nodes. You are currently connected to the Management Node.
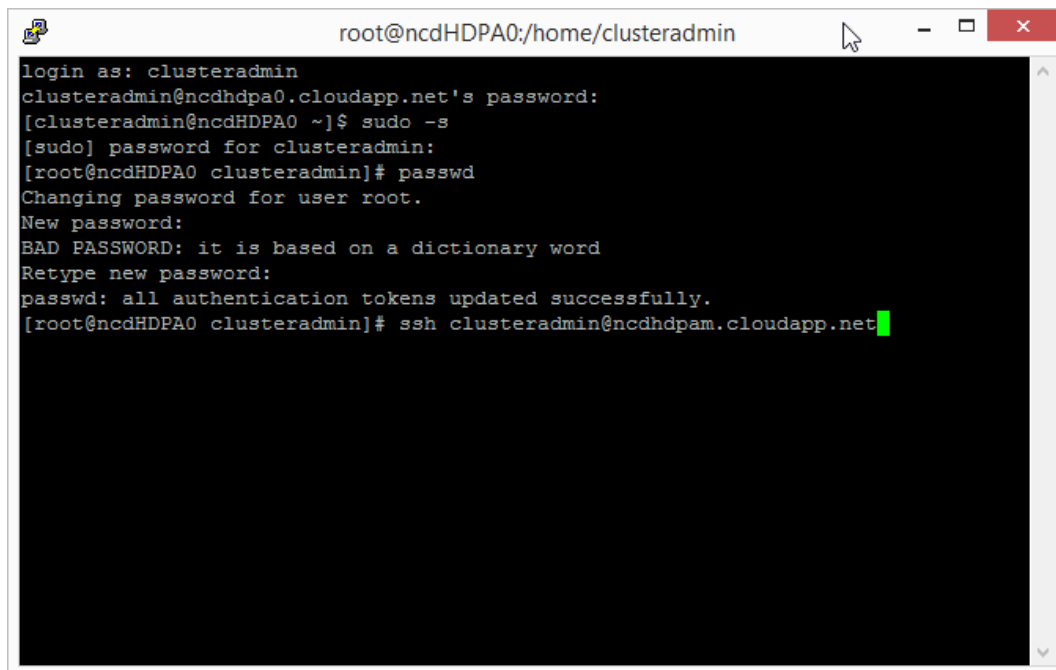
Elevate to root. Enter the password for the $adminUserName when prompted. Update the root password. Enter the new password when prompted.

```
sudo –s

passwd
```

Enter the following to move to the Clone Node, or open a second PuTTY window to connect to the Clone Node. Enter the password for the adminUserName when prompted.

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

```
root@ncdHDPA0:/home/clusteradmin

login as: clusteradmin
clusteradmin@ncdhdpa0.cloudapp.net's password:
[clusteradmin@ncdHDPA0 ~]$ sudo -s
[sudo] password for clusteradmin:
[root@ncdHDPA0 clusteradmin]# passwd
Changing password for user root.
New password:
BAD PASSWORD: it is based on a dictionary word
Retype new password:
passwd: all authentication tokens updated successfully.
[root@ncdHDPA0 clusteradmin]# ssh clusteradmin@ncdhdpam.cloudapp.net
```

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.

Management Node Configuration

Return to the Management Node. Enter the *root* password when prompted.

ssh <Management Node Hostname>.cloudapp.net

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

If you are new to vi, type i to enter insert mode. Navigate to the correct line in the file and update.
Press Esc to exit insert mode, type :wq to save changes and return to the command prompt.

Update kernel headers.

yum install kernel-headers

Set up passwordless SSH between the Management Node and the Clone Node
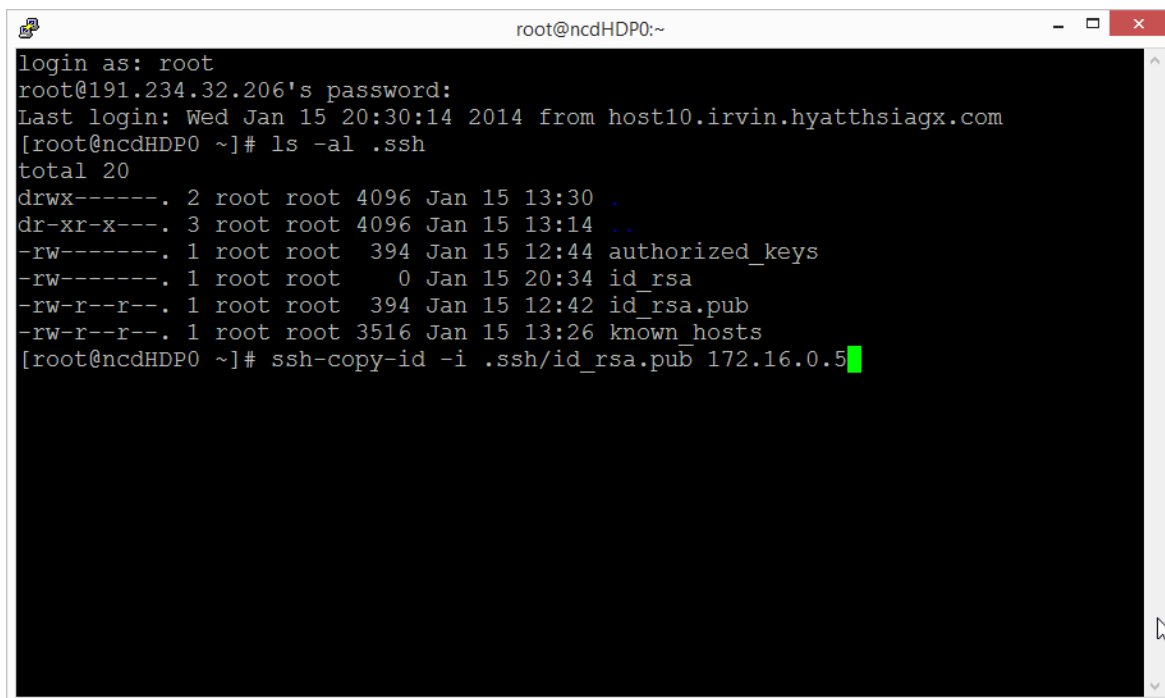In the Management Node generate the key.

      `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 Clone Node to enable passwordless ssh.

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

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

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

```
                                    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 <Clone Node Hostname>.cloudapp.net`

> Note that the passwordless ssh is not reciprocal. You will be prompted for a password when you are returning to the Management Node from the Clone Node.
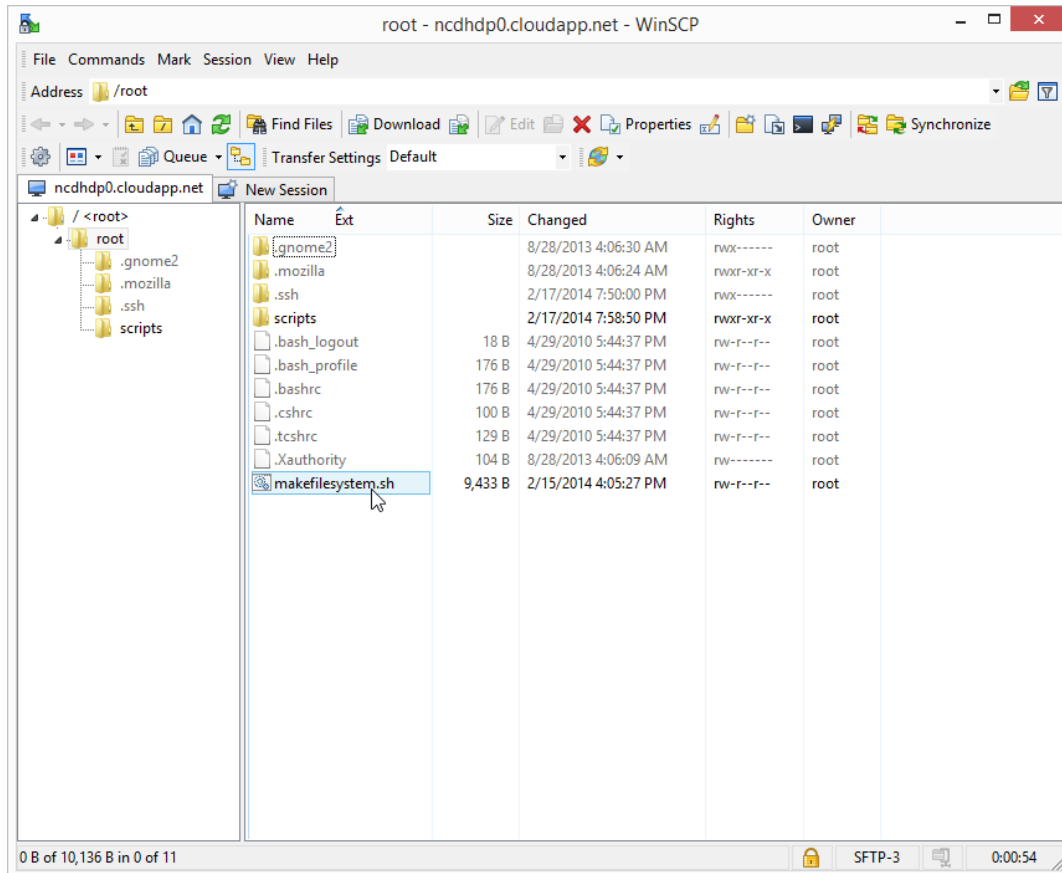
Return to the Management Node to configure the final settings.

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

Add Script to Mount Disks

The disks will be mounted later in the process. Load the script to the image.

Open WinSCP and connect to the Management Node. Drag and drop the makefilesystm.sh script from the framework source files to the Management Node root folder.

Update Server Configuration Settings

Using PuTTY connect to the Management Node and Clone Node to configure the nodes. Execute the following to move and secure the script, install and use dos2unix to convert makefilesystem.sh file to a Linux friendly format. The final steps will configure prerequisite server settings.

CentOS, Oracle[LR1]

```
mkdir /root/scripts

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

chmod 755 /root/scripts/makefilesystem.sh

yum -y install dos2unix
```

```
dos2unix /root/scripts/makefilesystem.sh
/root/scripts/makefilesystem.sh

#disable iptables

chkconfig iptables off

/etc/init.d/iptables stop

setenforce 0

#start ntp service

yum -y install ntp

chkconfig ntpd on

ntpdate pool.ntp.org

echo "0" > /proc/sys/vm/swappiness

sed -i 's/SELINUX=enforcing/SELINUX=disabled/g'
/etc/selinux/config
```

Ubuntu

```
mkdir /root/scripts

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

chmod 755 /root/scripts/makefilesystem.sh

apt-get -y install dos2unix

dos2unix /root/scripts/makefilesystem.sh
/root/scripts/makefilesystem.sh

#disable firewall

ufw disable

#start ntp service

apt-get -y install ntp

chkconfig ntpd on

ntpdate pool.ntp.org

echo "0" > /proc/sys/vm/swappiness

sed -i 's/SELINUX=enforcing/SELINUX=disabled/g'
/etc/selinux/config
```

Clone Node Windows Azure Linux Agent

Connect to the Clone Node using PuTTY. **This will not be run on the Management Node!** Set up the
virtual machine for provisioning as an image. Open the waagent.conf file.

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

If you are new to vi, type i to enter insert mode. Navigate to the correct line in the file and update.
Press Esc to exit insert mode, type :wq to save changes and return to the command prompt.

Change the following settings by typing i to enter insert mode:

```
Provisioning.DeleteRootPassword=n
```

```
Provisioning.RegenerateSshHostKeyPair=n
```

Press esc to exit insert mode. Type :wq and press enter to save and close the file.

Run the Windows Azure Linux Agent.

```
waagent –deprovision
```

Return to the Management Node.

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

Capture the Clone Image

Open the Windows Azure Management Portal and navigate to the dashboard of the Clone Node virtual
machine. Shut down the Clone node virtual machine. After the machine is stopped, click Capture to
create an image.

Create the Cluster

Open the 3_Cluster_Nodes.ps1 script in Windows Azure PowerShell Integrated Shell Environment (ISE).

Execute the script with the parameters representing the appropriate environment settings.

Parameter name	Purpose
$imageName	The name of the Clone Node image which will be used for provisioning the virtual machines.
$adminPassword	The password that will be generated in the virtual machines for the administrator.
$adminUserName	The user name of the administrator account.
$instanceSize	The size of the Windows Azure Virtual Machines (ie Small, Medium, Large, ExtraLarge, etc). Virtual machine sizes are detailed online: http://msdn.microsoft.com/en-us/library/windowsazure/dn197896.aspx. Large or ExtraLarge are recommended, depending on the size of your cluster and the services you plan to employ.
$diskSizeInGB	The size of the disk to attach to the virtual machines.
$numofDisks	The number of disks to attach to the virtual machines
$vmNamePrefix	Naming convention for the virtual machines. All virtual machines will be named based on this prefix.
$cloudServicePrefix	Naming convention for the cloud services. In general, this will be the same as the $vmNamePrefix for ease of management.

$numNodes	The total number of virtual machines to create for the cluster.
$affinityGroupLocation	The Windows Azure data center where the virtual machines will be deployed.
$virtualNetworkName	The name for the virtual network (must be unique in your subscription).
$virtualSubnetName	The name of the virtual subnet.
$storageAccountName	The name of the storage account to use for the VHD storage.
$hostsfile	The location of the hosts file that is generated during the cluster creation. This is optional, with a default of ".\hosts.txt"
$mntscript	The location of the mountdrive file that is generated during the cluster creation. This is option, with a default of ".\mountdrive.sh"

Sample Execution Script

```
.\3_Cluster_Nodes.ps1 –imageName "hdpnodem" –adminUserName "clusteradmin" –
adminPassword "Password.1" –instanceSize "ExtraLarge" –diskSizeInGB 100 –
numofDisks 2 –vmNamePrefix " HDPNode" –cloudServicePrefix " HDPNode" –
numNodes 8 –affinityGroupName "AGHDP" –virtualNetworkName "Hadoop-NetworkHDP"
–virtualSubnetname "App" –storageAccountName "App" –hostsfile ".\hosts.txt" –
mntscript ".\mountdrive.sh"
```

At the completion of the script, you will have a set of virtual machines on which to install Hadoop.

To test the virtual machines were generated correctly, open a PuTTY connection from the Management node and connect to a few of the machines to verify the host name and to verify passwordless ssh is working:

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

> **hostname**

Update Cluster Machines
Use WinSCP to copy the following files to root directory of the Management Node: hosts.txt, mountdrive.sh, updatehosts.sh.
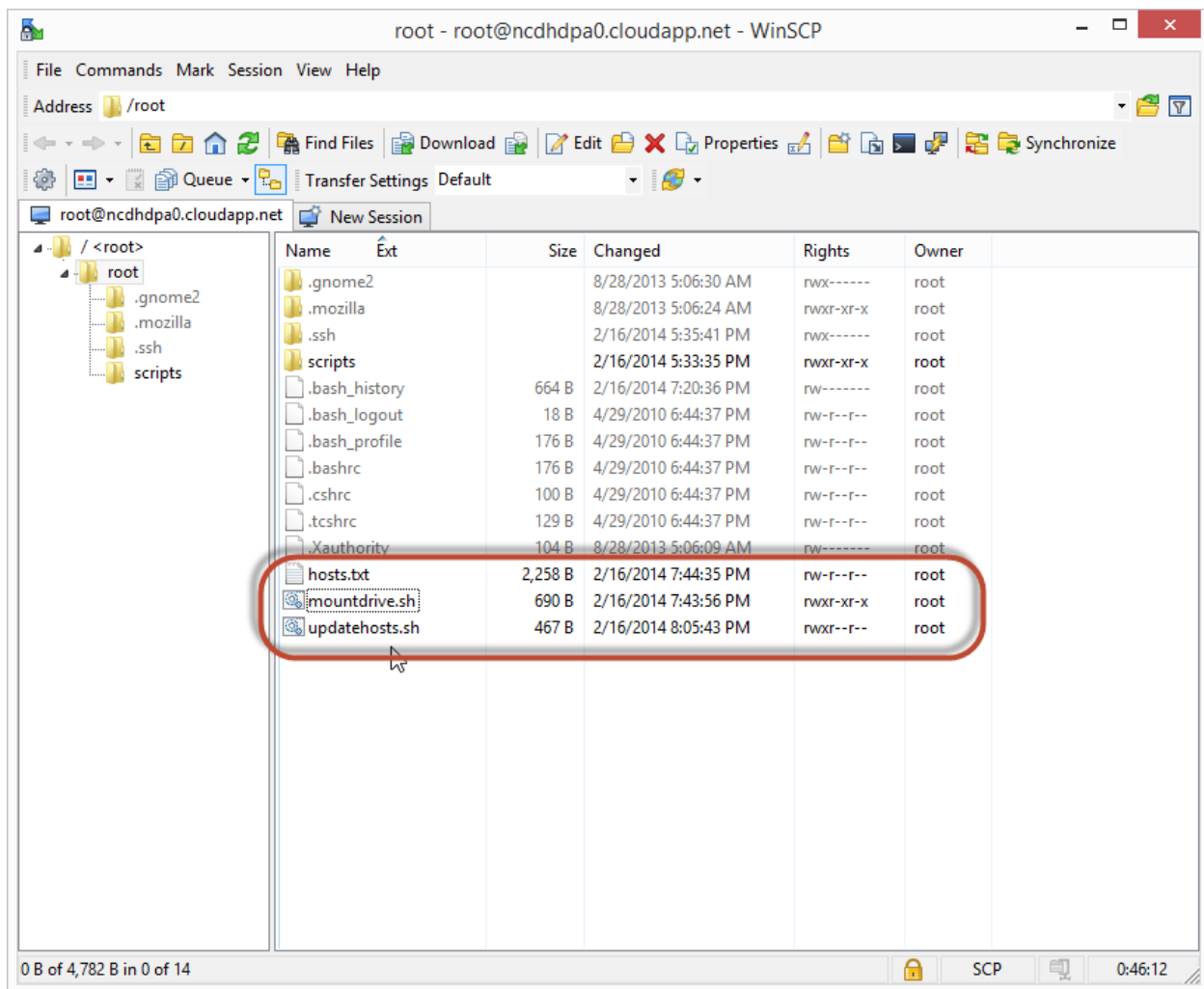
Run the conversion of the files with dos2unix. After the files are loaded in the Management Node, secure the files.

```
dos2unix hosts.txt hosts.txt

dos2unix mountdrive.sh mountdrive.sh

dos2unix updatehosts.sh updatehosts.sh

chmod 755 updatehosts.sh

chmod 755 mountdrive.sh
```

Execute updatehosts.sh to update /etc/hosts with the information from the hosts.txt file. Execute mountdrive.sh to mount the drives on all machines in the cluster.

```
./updatehosts.sh

./mountdrive.sh
```

Install Ambari

Open an SSH session in PuTTY to the Management Node.

If you are using the gallery image "Oracle Linux 6.4.0.0.0" install wget.

```
yum install wget
```

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
```

Verify Ambari is started. Execute the following command on the Management Node in PuTTY:

```
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.