Building Render Farms in the Cloud—Using Amazon EC2 for On-Demand Rendering

Alex Lorman – TITAN Salvage

VI5718-R

Not everyone can afford either the cost or infrastructure of a permanently installed server farm used for completing projects. This course will teach users the most effective methodologies for quickly creating a server farm (based on the Backburner application) using Amazon.com, Inc.'s, Elastic Compute Cloud (EC2) servers, which are paid on an on-demand basis. We will cover basic use of Amazon's system, and we will focus on how to configure specific parameters within the Backburner app so that rendering can run successfully on a virtualized on-demand network.

Learning Objectives

At the end of this class, you will be able to:

- Know the basic operation of the Amazon EC2 control panel
- Know the differences between deploying the Backburner application locally and remotely
- Be able to troubleshoot issues between computers on the Amazon EC2 farm
- Activate an entire farm on Amazon EC2 on demand

About the Speaker

Alex Lorman earned a BS in architecture from the Catholic University of American in 2011, and he worked in architecture until he became bored and managed to talk TITAN Salvage's managing director, Rich Habib, into hiring him on a freelance basis. He has worked on many TITAN projects over the last 2 years, including the ongoing removal of the Costa Concordia from the rocks in Italy. Alex uses any and all software that can help him to do his job with increased ease, quickness, and accuracy, and he specializes in taking ideas from conception through their construction in steel—on time, on budget, and to specification, by whatever means necessary. Whether he's in front of a computer or in coveralls with a welding rig, large-scale projects and short deadlines are just parts of the challenge. Great software can always make it better.

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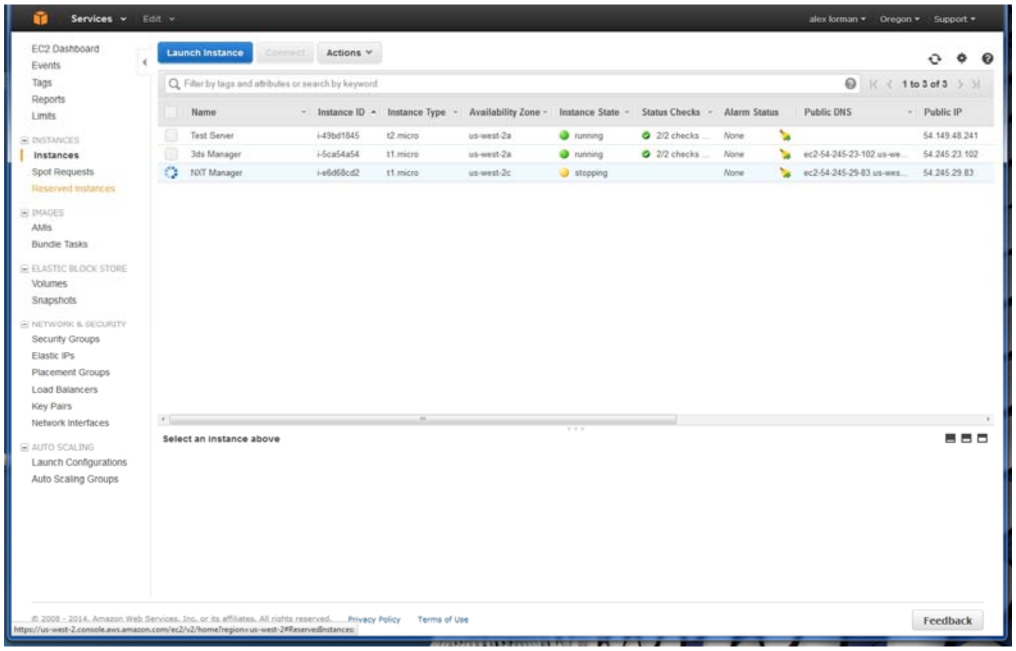
This outline assumes a basic knowledge of the following concepts and thus they are not covered in full detail:

- *Virtual Machine terminology*
- *Remote Desktop Connection Usage in Windows*
- *Installation of the Backburner and Associated software on machines*.
- *Usage of Backburner on a local LAN*

The EC2 Control Panel

The EC2 Panel is the web interface provided by Amazon to allow for control of groups of virtual machines. ***These virtual machines are known in Amazon terminology as Instances.***



Name	Instance ID	Instance Type	Availability Zone	Instance State	Status Checks	Alarm Status	Public DNS	Public IP
Test Server	i-49bd1845	t2.micro	us-west-2a	running	2/2 checks ...	None		54.149.48.241
3ds Manager	i-5ca54a54	t1.micro	us-west-2a	running	2/2 checks ...	None	ec2-54-245-23-102.us-we...	54.245.23.102
NXT Manager	i-e6d68cd2	t1.micro	us-west-2c	stopping		None	ec2-54-245-29-83.us-wes...	54.245.29.83

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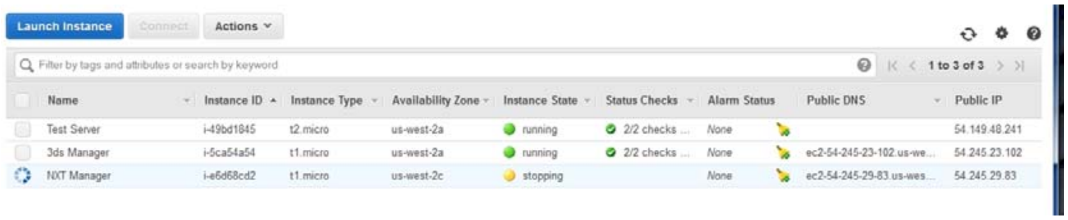
https://us-west-2.console.aws.amazon.com/ec2/v2/home?region=us-west-2#ReservedInstances:

Above: This shows the basic EC2 control panel when viewed in a web browser. This screen shows three instances in existence with two running and one powering off.



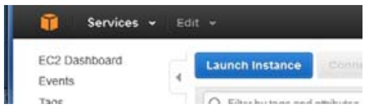
Name	Instance ID	Instance Type	Availability Zone	Instance State	Status Checks	Alarm Status	Public DNS	Public IP
Test Server	i-49bd1845	t2.micro	us-west-2a	running	2/2 checks ...	None		54.149.48.241
3ds Manager	i-5ca54a54	t1.micro	us-west-2a	running	2/2 checks ...	None	ec2-54-245-23-102.us-we...	54.245.23.102
NXT Manager	i-e6d68cd2	t1.micro	us-west-2c	stopping		None	ec2-54-245-29-83.us-wes...	54.245.29.83

We can also see the instances above are listed as either t2.micro or t2.micro. This refers to the specification of the hardware associated with the given Instance.

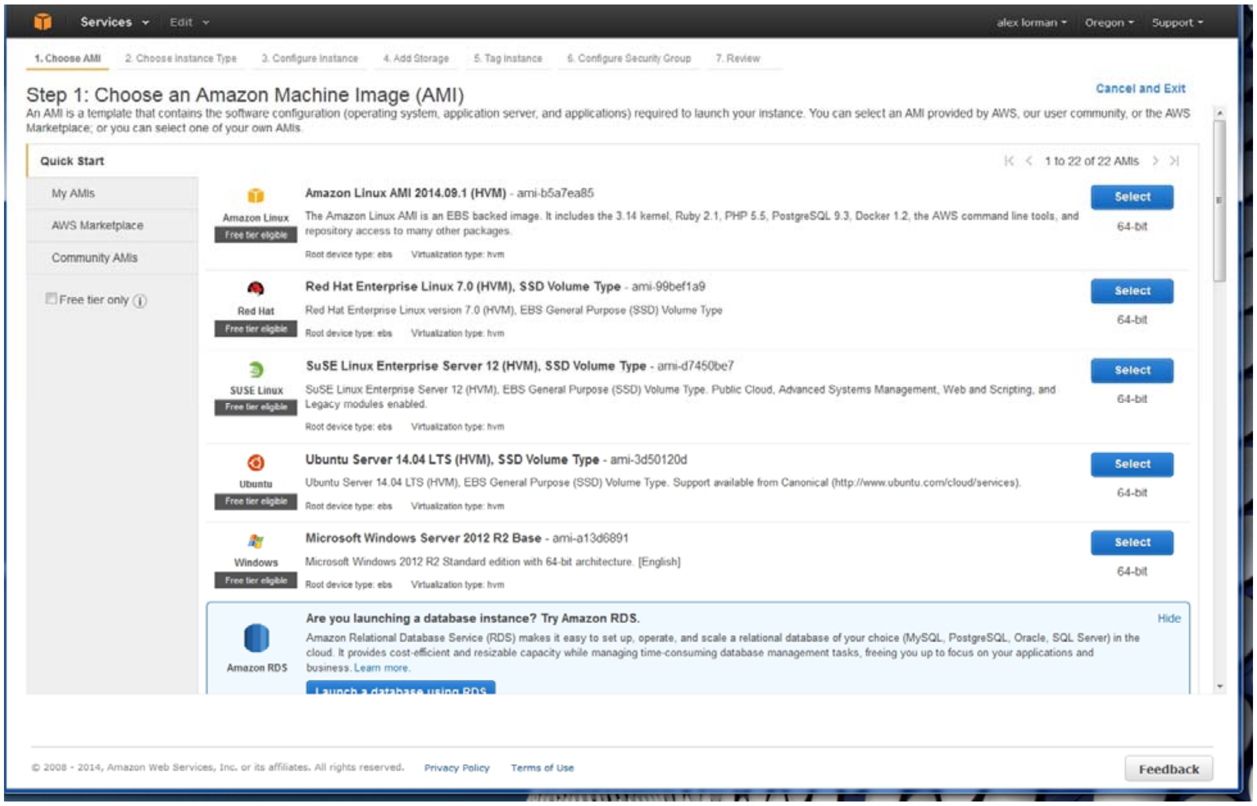
Instances can also be renamed using the name field. We can see that these are named "Test Server" et al.

Launching an Instance

To create a new Instance press the Launch Instance button



You are then presented with the following selection to determine both the OS configuration and power specifications of the new machine.



Services | Edit | alex lorman | Oregon | Support

1. Choose AMI | 2. Choose Instance Type | 3. Configure Instance | 4. Add Storage | 5. Tag Instance | 6. Configure Security Group | 7. Review

Step 1: Choose an Amazon Machine Image (AMI)

Cancel and Exit

An AMI is a template that contains the software configuration (operating system, application server, and applications) required to launch your instance. You can select an AMI provided by AWS, our user community, or the AWS Marketplace; or you can select one of your own AMIs.

Quick Start | My AMIs | AWS Marketplace | Community AMIs | Free tier only

1 to 22 of 22 AMIs

Amazon Linux — Free tier eligible
Amazon Linux AMI 2014.09.1 (HVM) - ami-b5a7ea85
The Amazon Linux AMI is an EBS backed image. It includes the 3.14 kernel, Ruby 2.1, PHP 5.5, PostgreSQL 9.3, Docker 1.2, the AWS command line tools, and repository access to many other packages.
Root device type: ebs Virtualization type: hvm
Select — 64-bit

Red Hat — Free tier eligible
Red Hat Enterprise Linux 7.0 (HVM), SSD Volume Type - ami-99bef1a9
Red Hat Enterprise Linux version 7.0 (HVM), EBS General Purpose (SSD) Volume Type
Root device type: ebs Virtualization type: hvm
Select — 64-bit

SUSE Linux — Free tier eligible
SuSE Linux Enterprise Server 12 (HVM), SSD Volume Type - ami-d7450be7
SuSE Linux Enterprise Server 12 (HVM), EBS General Purpose (SSD) Volume Type. Public Cloud, Advanced Systems Management, Web and Scripting, and Legacy modules enabled.
Root device type: ebs Virtualization type: hvm
Select — 64-bit

Ubuntu — Free tier eligible
Ubuntu Server 14.04 LTS (HVM), SSD Volume Type - ami-3d50120d
Ubuntu Server 14.04 LTS (HVM), EBS General Purpose (SSD) Volume Type. Support available from Canonical (http://www.ubuntu.com/cloud/services).
Root device type: ebs Virtualization type: hvm
Select — 64-bit

Windows — Free tier eligible
Microsoft Windows Server 2012 R2 Base - ami-a13d6891
Microsoft Windows 2012 R2 Standard edition with 64-bit architecture. [English]
Root device type: ebs Virtualization type: hvm
Select — 64-bit

Amazon RDS
Are you launching a database instance? Try Amazon RDS. Hide
Amazon Relational Database Service (RDS) makes it easy to set up, operate, and scale a relational database of your choice (MySQL, PostgreSQL, Oracle, SQL Server) in the cloud. It provides cost-efficient and resizable capacity while managing time-consuming database management tasks, freeing you up to focus on your applications and business. Learn more.
Launch a database using RDS

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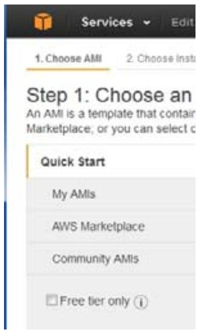
Above we can see that we can create a new instance in almost any OS. We will be using Windows Server exclusively for Backburner. ***These machines are all "bare-metal" setups, they contain nothing but the operating system***. We would use these when creating a Server or Manager machine from scratch. If we already had configured a machine and wanted to simply create more instances of it we would use the "My AMIs" tab.

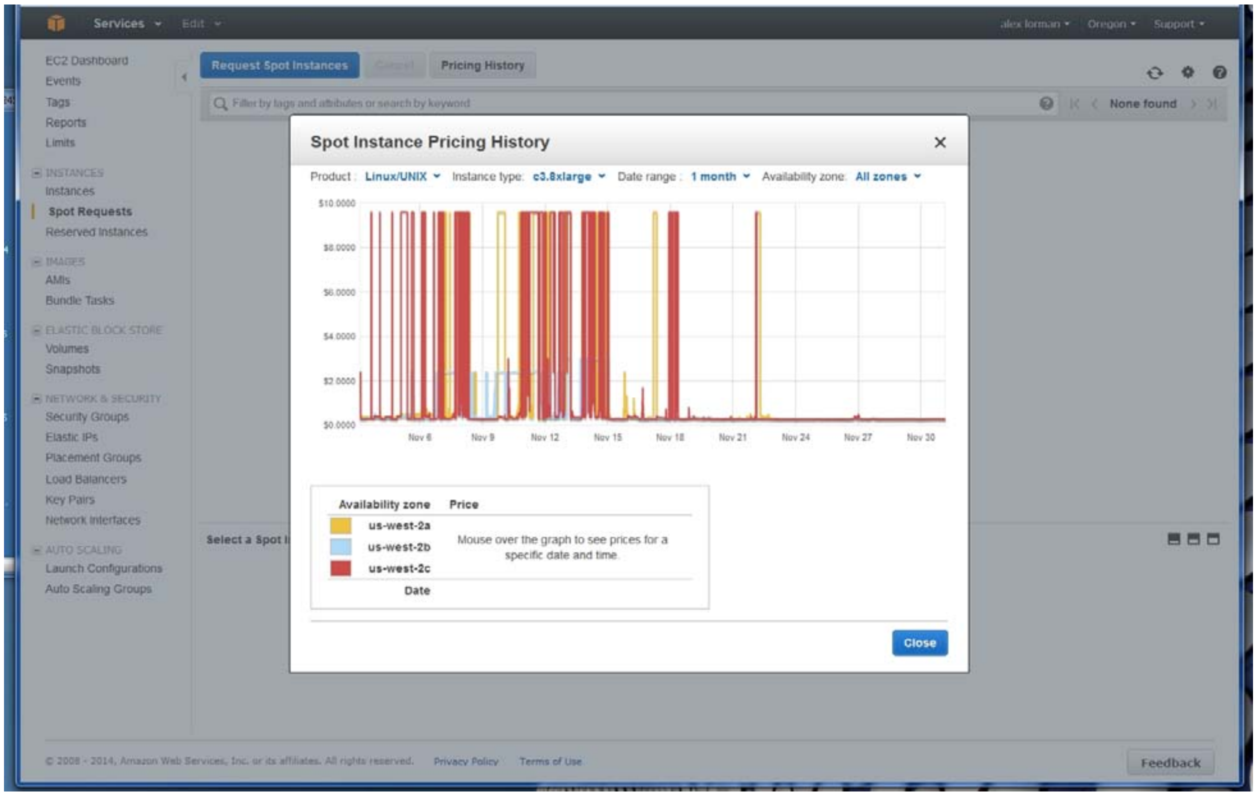


The next screen will guide us on to Specifications of the Instance.

NB: For Backburner, the Compute Optimized will work the best for CPU heavy rendering.

Instance Pricing

Instances are priced in two ways; On-Demand and Spot. On-Demand Instances are priced substantially higher per hour (all EC2 time is billed by the hour, rounded up the nearest full hour) however is guaranteed for uptime and availability. Spot Instances are a way of bidding on the unused computing capacity EC2 may have at a given time, ***however if your pricing instructions will not go above a certain point your Instances may be terminated.***



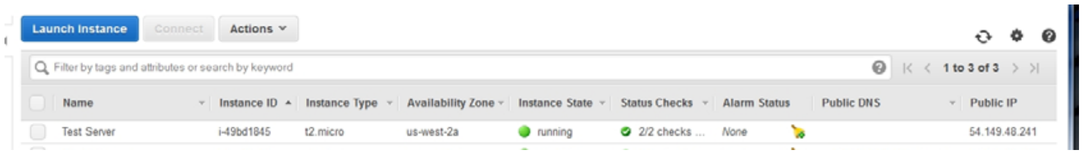
Product : Linux/UNIX   Instance type: c3.8xlarge   Date range : 1 month   Availability zone: All zones

Availability zone	Price
🟨 us-west-2a	Mouse over the graph to see prices for a specific date and time.
🟦 us-west-2b	
🟥 us-west-2c	
Date	

The above shows the price fluctuations of a Computer Optimized Instance over a given time frame. Clearly the pricing is market driven.

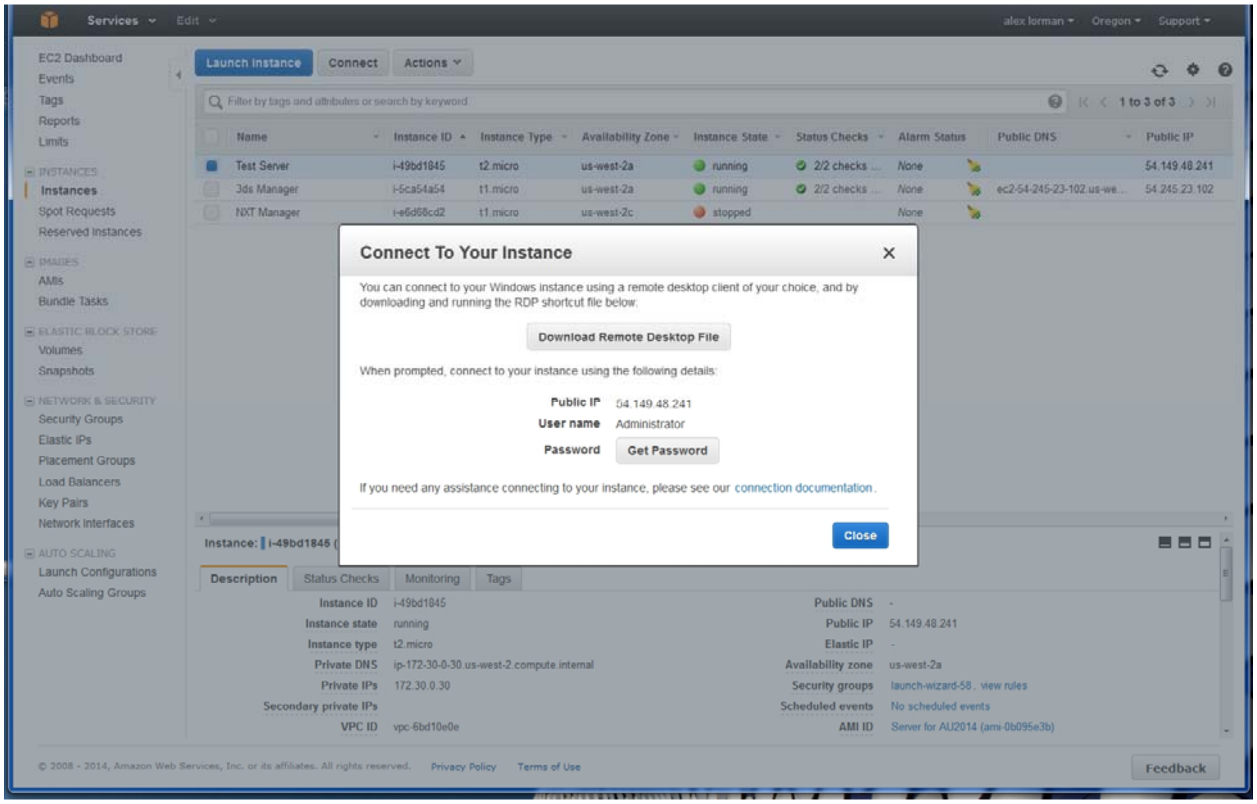
Connecting to your Instances

Once you have launched and Instance and it has gone through the preflight checks it will display like the below;



Name	Instance ID	Instance Type	Availability Zone	Instance State	Status Checks	Alarm Status	Public DNS	Public IP
Test Server	i-49bd1845	t2.micro	us-west-2a	running	2/2 checks ...	None		54.149.48.241

Highlight the Instance and press "Connect" and the following screen will appear



Name	Instance ID	Instance Type	Availability Zone	Instance State	Status Checks	Alarm Status	Public DNS	Public IP
Test Server	i-49bd1845	t2.micro	us-west-2a	running	2/2 checks ...	None		54.149.48.241
3ds Manager	i-5ca54a54	t1.micro	us-west-2a	running	2/2 checks ...	None	ec2-54-245-23-102.us-we...	54.245.23.102
NXT Manager	i-e6d68cd2	t1.micro	us-west-2c	stopped		None		

Connect To Your Instance

You can connect to your Windows instance using a remote desktop client of your choice, and by downloading and running the RDP shortcut file below.

Download Remote Desktop File

When prompted, connect to your instance using the following details:

Public IP	54.149.48.241
User name	Administrator
Password	Get Password

If you need any assistance connecting to your instance, please see our connection documentation.

Close

Instance: i-49bd1845 (

Instance ID	i-49bd1845	Public DNS	-
Instance state	running	Public IP	54.149.48.241
Instance type	t2.micro	Elastic IP	-
Private DNS	ip-172-30-0-30.us-west-2.compute.internal	Availability zone	us-west-2a
Private IPs	172.30.0.30	Security groups	launch-wizard-58 . view rules
Secondary private IPs		Scheduled events	No scheduled events
VPC ID	vpc-6bd10e0e	AMI ID	Server for AU2014 (ami-0b095e3b)

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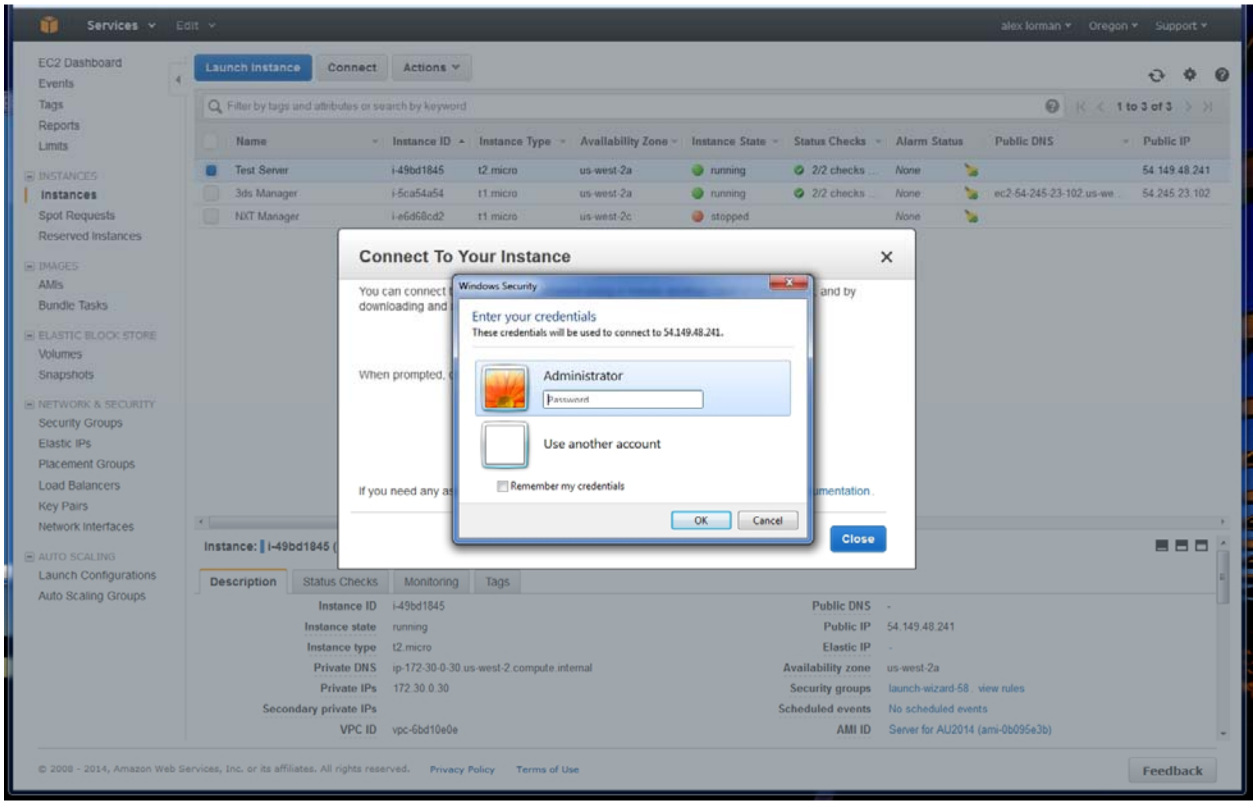
Downloading the remote desktop file is by far the easiest way to connect. It will then auto-launch Windows Terminal Services Client and behave exactly like a traditional remote server.

You will then be asked to log in via MSTSC.



Name	Instance ID	Instance Type	Availability Zone	Instance State	Status Checks	Alarm Status	Public DNS	Public IP
Test Server	i-49bd1845	t2.micro	us-west-2a	running	2/2 checks ...	None		54.149.48.241
3ds Manager	i-5ca54a54	t1.micro	us-west-2a	running	2/2 checks ...	None	ec2-54-245-23-102.us-we...	54.245.23.102
NXT Manager	i-e6d68cd2	t1.micro	us-west-2c	stopped		None		

Connect To Your Instance

You can connect ... and by downloading and ...

When prompted, ...

If you need any as... umentation.

Windows Security

Enter your credentials

These credentials will be used to connect to 54.149.48.241.

Administrator

Password

Use another account

Remember my credentials

Instance: i-49bd1845 (

Instance ID	i-49bd1845	Public DNS	-
Instance state	running	Public IP	54.149.48.241
Instance type	t2.micro	Elastic IP	-
Private DNS	ip-172-30-0-30.us-west-2.compute.internal	Availability zone	us-west-2a
Private IPs	172.30.0.30	Security groups	launch-wizard-58 . view rules
Secondary private IPs		Scheduled events	No scheduled events
VPC ID	vpc-6bd10e0e	AMI ID	Server for AU2014 (ami-0b095e3b)

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There are several different ways to deal with passwords on Instances.

- Key pairs – Amazon has a facility within the EC2 environment that can allow the machines to decrypt a password, on the fly, from an encryption key provided by the used to the web interface. Amazon will walk you through this process. This way the password is different for each machine although very secure.
- Hard coded passwords – Although less secure since any instance launched from the same AMI (images, mentioned in just a moment) will have the same hard-coded password, for something such as a render farm where the machines are likely to be all the same and to be used fairly ephemerally this is an easy optoion,
- No Password – This may or may not work with MSTSC (since sometimes it requires a password) and is not recommended in either case.

What are AMIs?

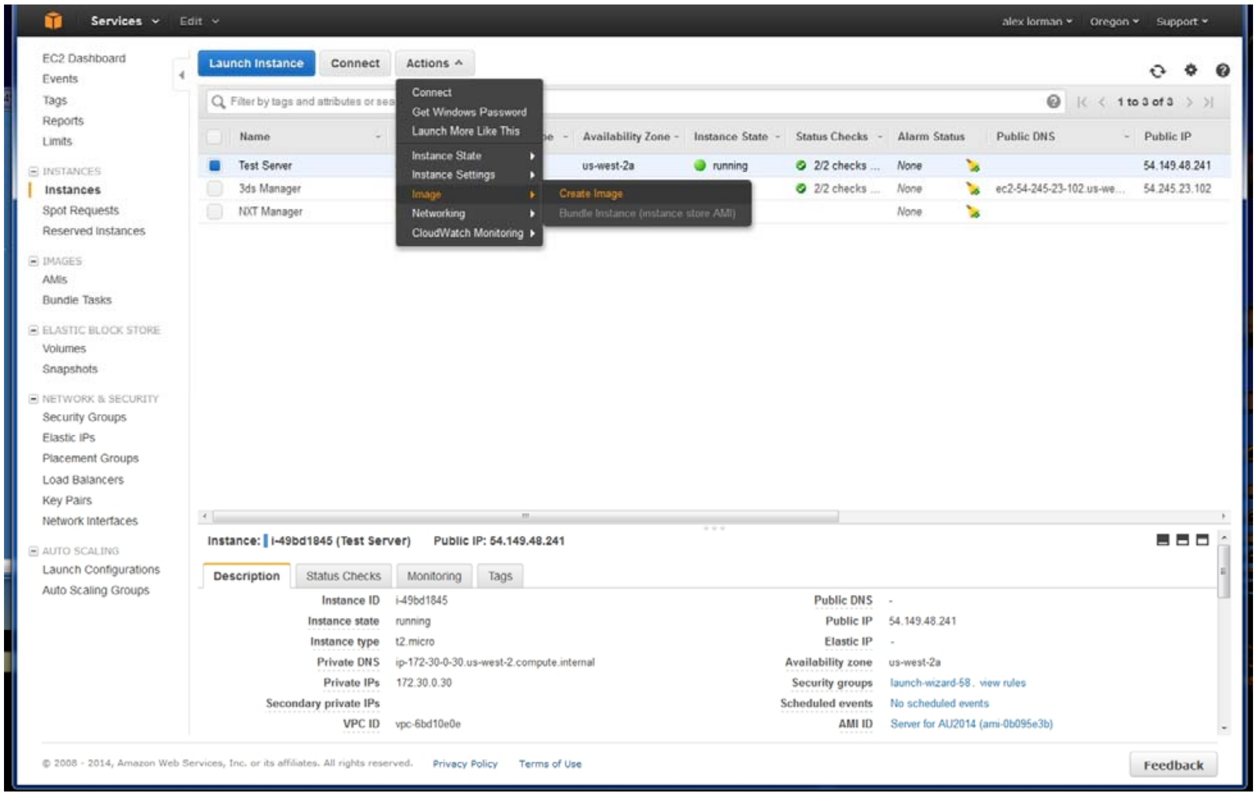
AMIs (in Amazon parlance) are system images that have been captured from built-up Instances and can be then poured into a new Instance as requested. ***These function exactly like images or snapshots taken from traditional hard drives***. The easiest workflow to creating machines that can be re-used with no additional setup is as follows;

- Create a new Instance (easiest and cheapest to have it be a Micro Instance while building up the system)
- Install needed software
- Change setting as desired

- Capture machine as an AMI
- Re-Launch as many clones from that AMI as needed.

Creating an AMI

Once you have built a machine to your satisfaction you can click on it and create an AMI through the following screen;



Name	Availability Zone	Instance State	Status Checks	Alarm Status	Public DNS	Public IP
Test Server	us-west-2a	running	2/2 checks ...	None		54.149.48.241
3ds Manager			2/2 checks ...	None	ec2-54-245-23-102.us-we...	54.245.23.102
NXT Manager				None		

Instance: i-49bd1845 (Test Server)   Public IP: 54.149.48.241

Instance ID	i-49bd1845	Public DNS	-
Instance state	running	Public IP	54.149.48.241
Instance type	t2.micro	Elastic IP	-
Private DNS	ip-172-30-0-30.us-west-2.compute.internal	Availability zone	us-west-2a
Private IPs	172.30.0.30	Security groups	launch-wizard-58 . view rules
Secondary private IPs		Scheduled events	No scheduled events
VPC ID	vpc-6bd10e0e	AMI ID	Server for AU2014 (ami-0b095e3b)

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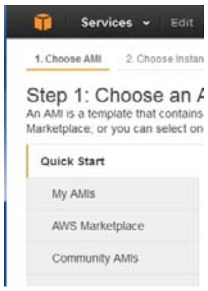
This takes just a few minutes but does involve a system reboot.

Launching Instances based on AMIs

When configuring new Instances and you wish to use the instance you have created (i.e. one with Backburner configured properly) you need simply press the following button when launching a new Instance.



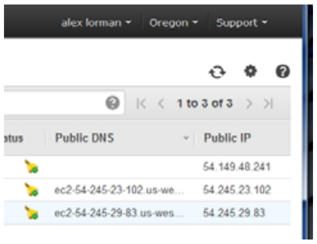
Snapshots, AMIs and Volumes

A small point of clarification;

- AMIs represent an entire virtual machine, in a ready-to-run state. If set up, an AMI can contain multiple drives of varying sizes.
- Snapshots are created peridocially and automatically and are simply a snapshot of a specific drive. These can be OS based drives or storage based drives. Snapshots cannot be used to launch Instances.
- Volumes are simply Amazon's way of referring to drives. Again these can be for storage or OS use and can be of arbitrary size. They are generally priced by the GB.

Elastic IPs and Instances

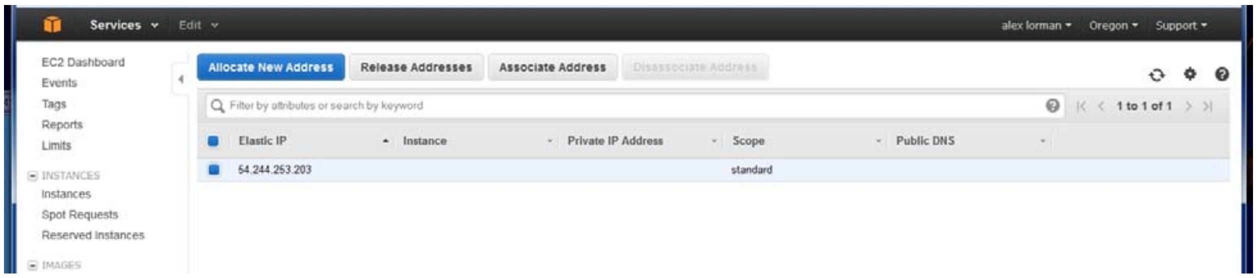
When creating instances it is important they be reachable on the correct ports so that RDC and similar services can connect. All Instances have a Public DNS address that can be used to connect by RDC. This address, however, can change at any time. By default firewalling and port forwarding in enabled for remote access to the machines.



tus	Public DNS	Public IP
		54.149.48.241
	ec2-54-245-23-102.us-we...	54.245.23.102
	ec2-54-245-29-83.us-wes...	54.245.29.83

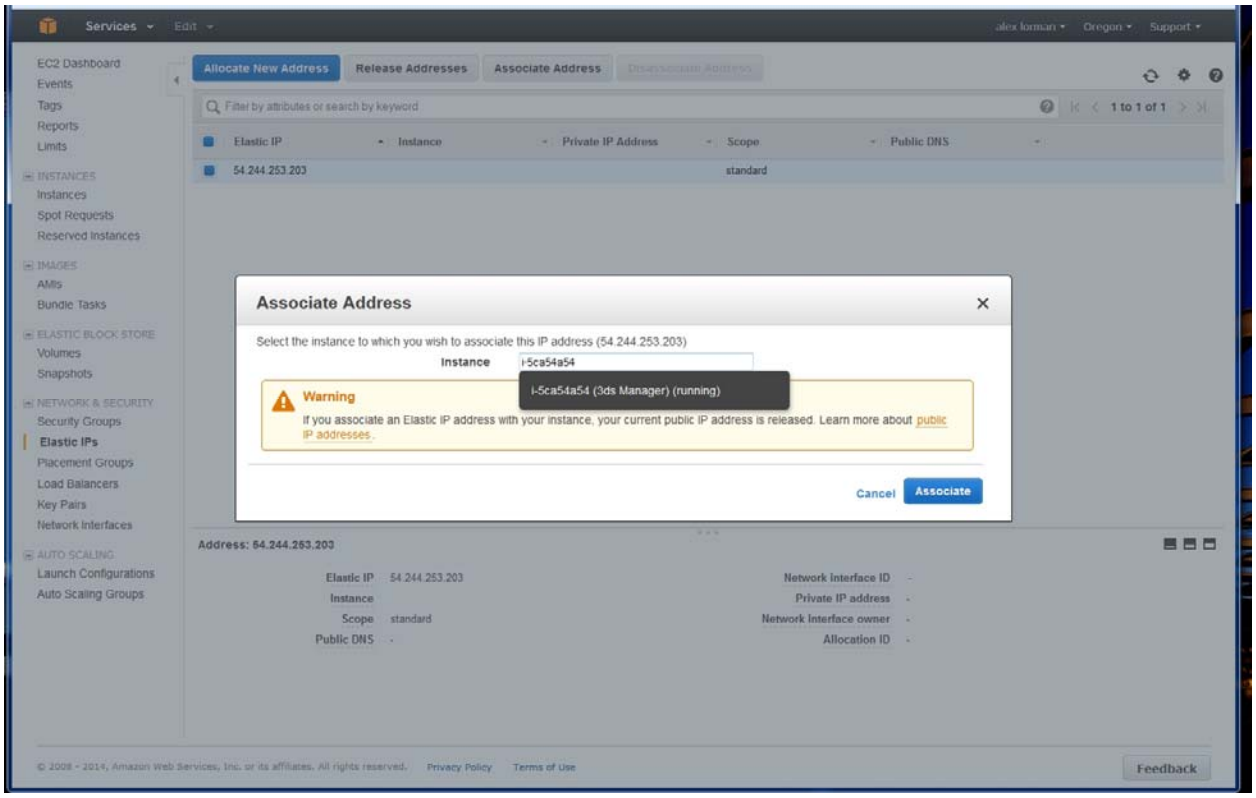
Sometimes it becomes either necessary or far easier to have a computer have a traditional IPV4 external facing IP address. This serves as a permeant way of calling the machine by that address and while can be changed between machines will not expire or be arbitrary.

Here we can see the one Allocated Address that we have although it is not currently associated with an Instance.



Elastic IP	Instance	Private IP Address	Scope	Public DNS
54.244.253.203			standard	

Associating it with a running Instance is quite easy;



Elastic IP	Instance	Private IP Address	Scope	Public DNS
54.244.253.203			standard	

Associate Address

Select the instance to which you wish to associate this IP address (54.244.253.203)

Instance: i-5ca54a54

i-5ca54a54 (3ds Manager) (running)

Warning

If you associate an Elastic IP address with your instance, your current public IP address is released. Learn more about public IP addresses.

Address: 54.244.253.203

Elastic IP	54.244.253.203	Network Interface ID	-
Instance		Private IP address	-
Scope	standard	Network Interface owner	-
Public DNS	-	Allocation ID	-

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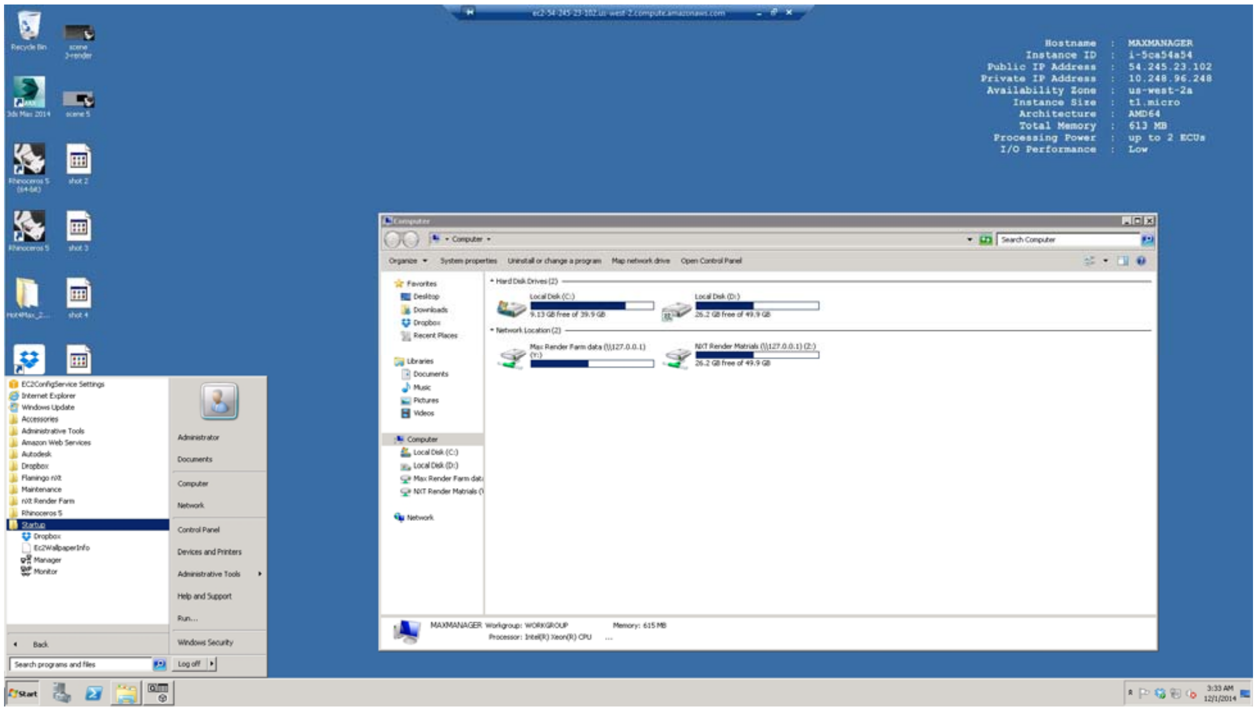
NB. I have found it works best to associate an Elastic IP with the manager machine then call that machine using that address within all Backburner uses, rather than having the Servers look for a machine. The only caveat with this is that Amazon will only allow you 6 Elastic IP addresses without further approval, so running multiple farms on the same network might be a challenge.

Deploying Backburner on Instances

Once bare-metal Instances are set up installing Backburner on them is relatively straightforward. Once the installer is on the Instance it is simply a matter of running as one would a normal server.

Below is a desktop capture of a running Instance with Backburner installed.



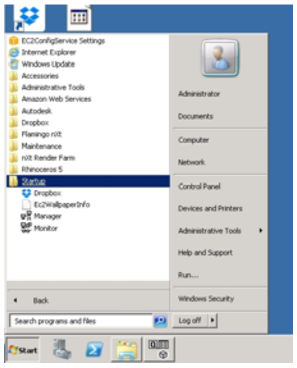
```
          Hostname  :  MAXMANAGER
       Instance ID  :  i-5ca54a54
 Public IP Address  :  54.245.23.102
Private IP Address  :  10.248.96.248
 Availability Zone  :  us-west-2a
     Instance Size  :  t1.micro
      Architecture  :  AMD64
      Total Memory  :  613 MB
  Processing Power  :  up to 2 ECUs
   I/O Performance  :  Low
```

Setting up the Manager

The Manager machine will be a slightly different configuration than the Server nodes and a few considerations need to be taken into account. The Manager computer, in this case, will also be our source of storage for the returning images and base render files.

When building Manager from an Instance (or building fresh) be sure to equip it with an extra drive of suitable size. This will then be a logical drive in windows and be shared as normal.

After you have installed Backburner (at Startup, rather than as a system service) make sure that Manager (and Monitor) are in the Startup folder so that they will run on windows startup.



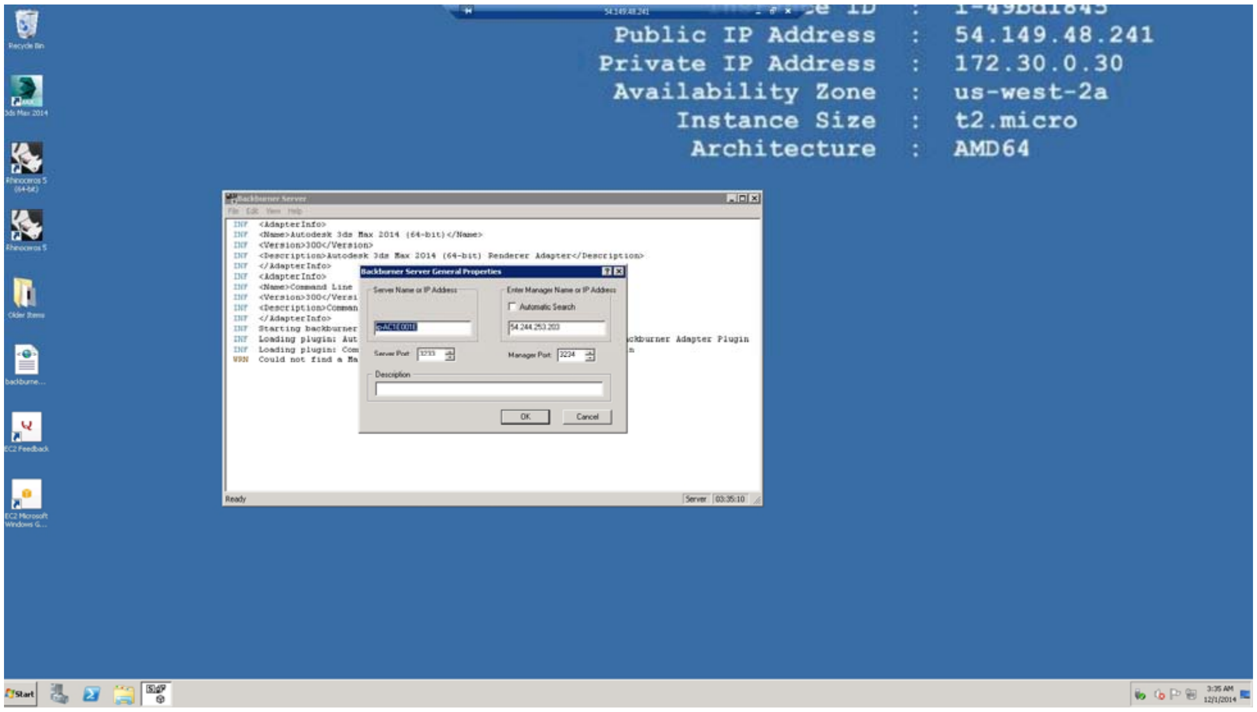
The stock settings for Manger should be sufficient here, although any specific requirements will be known to you when doing your own setup.

NB; Be sure to set up a network share of the storage drive and allow Read and Write access so that the Server machines read and write to it. This is more of a general Backburner discussion rather than something specific to EC2

Setting up the Server Nodes

Once a Manager machine has been set up, the next step is to launch another bare-metal Instance and configure it to be the Server. This involves installing Backburner as normal except configuring Server to start at startup instead of Manager.

After installing Server the configuration panel should look like this:



```
     Public IP Address  :  54.149.48.241
    Private IP Address  :  172.30.0.30
     Availability Zone  :  us-west-2a
         Instance Size  :  t2.micro
          Architecture  :  AMD64
```

```
INF  <AdapterInfo>
INF  <Name>Autodesk 3ds Max 2014 (64-bit)</Name>
INF  <Version>300</Version>
INF  <Description>Autodesk 3ds Max 2014 (64-bit) Renderer Adapter</Description>
INF  </AdapterInfo>
INF  <AdapterInfo>
INF  <Name>Command Line
INF  <Version>300</Versi
INF  <Description>Comman
INF  </AdapterInfo>
INF  Starting backburner
INF  Loading plugin: Aut                                                  ckburner Adapter Plugin
INF  Loading plugin: Com                                                  n
WRN  Could not find a Ma
```

Backburner Server General Properties

Server Name or IP Address: ip-AC1E001E

Enter Manager Name or IP Address: [ ] Automatic Search; 54.244.253.203

Server Port: 3233

Manager Port: 3234

Description:

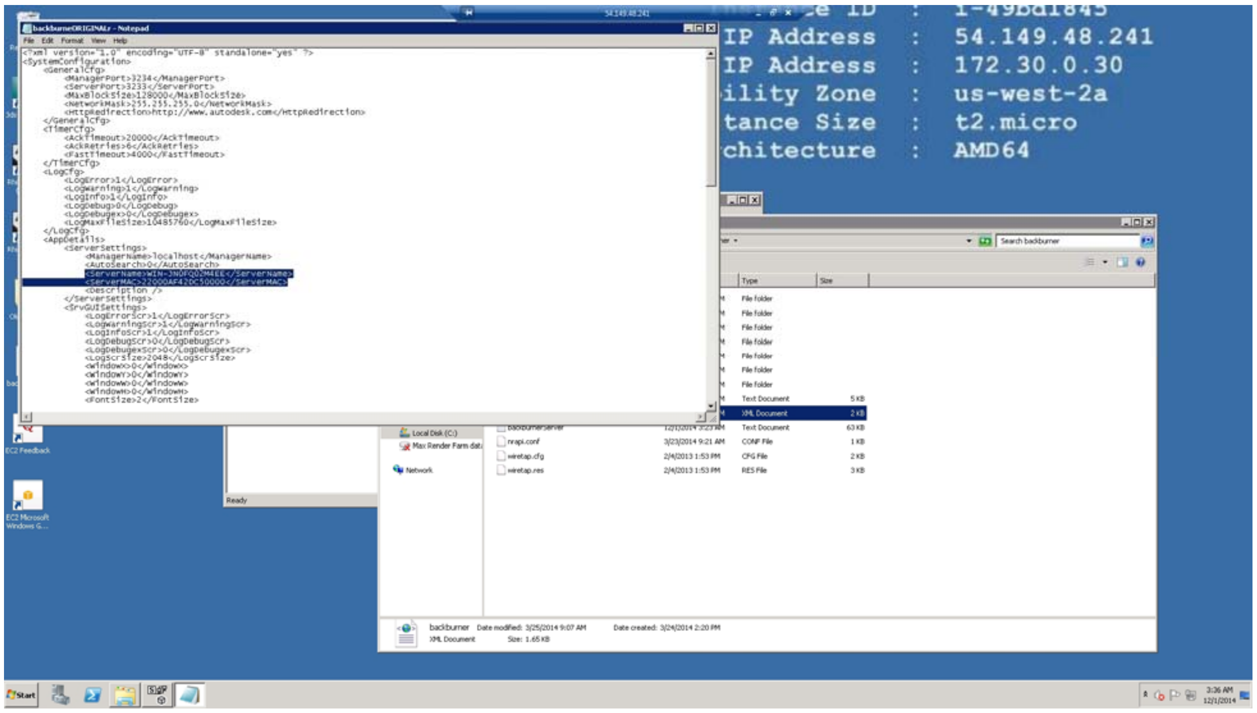
The Manager name, in this case, is hard coded into the configuration so that it will most easily find it.

NB The one key difference between configuring Server on a single Instance and cloning that Instance onto other machines becomes Machine naming. Machines created from the same AMI will, by default, have the same Computer Name in Windows. This creates problems in Manager since it will not detect the different machine names.

To change the above problem you need to open and edit the Backburner.xml file. Located in C:>Users>XX>AppData>Local>Backburner>Backburner.xml

(Where XX is the given user. Generally Administrator)

Seen here the following lines need to be deleted..



```
<?xml version="1.0" encoding="UTF-8" standalone="yes" ?>
<SystemConfiguration>
    <GeneralCfg>
        <ManagerPort>3234</ManagerPort>
        <ServerPort>3233</ServerPort>
        <MaxBlockSize>128000</MaxBlockSize>
        <NetworkMask>255.255.255.0</NetworkMask>
        <HttpRedirection>http://www.autodesk.com</HttpRedirection>
    </GeneralCfg>
    <TimerCfg>
        <AckTimeout>20000</AckTimeout>
        <AckRetries>6</AckRetries>
        <FastTimeout>4000</FastTimeout>
    </TimerCfg>
    <LogCfg>
        <LogError>1</LogError>
        <LogWarning>1</LogWarning>
        <LogInfo>1</LogInfo>
        <LogDebug>0</LogDebug>
        <LogDebugex>0</LogDebugex>
        <LogMaxFileSize>10485760</LogMaxFileSize>
    </LogCfg>
    <AppDetails>
        <ServerSettings>
            <ManagerName>localhost</ManagerName>
            <AutoSearch>0</AutoSearch>
            <ServerName>WIN-JN0FQ02M4EE</ServerName>
            <ServerMAC>22000AF42DC50000</ServerMAC>
            <Description />
        </ServerSettings>
        <SrvGUISettings>
            <LogErrorScr>1</LogErrorScr>
            <LogWarningScr>1</LogWarningScr>
            <LogInfoScr>1</LogInfoScr>
            <LogDebugScr>0</LogDebugScr>
            <LogDebugexScr>0</LogDebugexScr>
            <LogScrSize>2048</LogScrSize>
            <WindowX>0</WindowX>
            <WindowY>0</WindowY>
            <WindowW>0</WindowW>
            <WindowH>0</WindowH>
            <FontSize>2</FontSize>
```

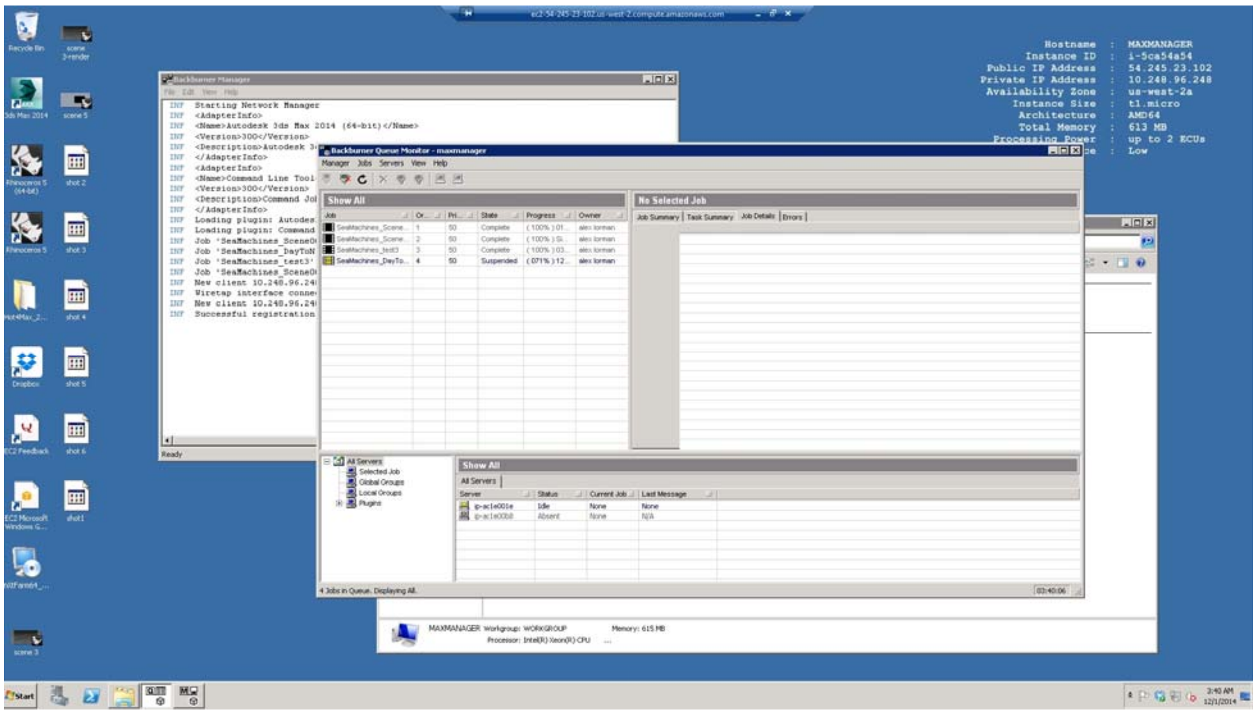
```
IP Address        :  54.149.48.241
IP Address        :  172.30.0.30
ility Zone        :  us-west-2a
tance Size        :  t2.micro
chitecture        :  AMD64
```

Then re-save the file and create and AMI before restarting Backburner. This will allow each machine, when started, to write in their own unique machine name and will allow them to communicate properly with Manager

When configuring the Server nodes, before creating the final AMI make sure to have connected the network drives to the manger so that they load when the machine launches. This will allow it to write the data back to Manager Machine.

Activating a Farm

Once Manger and Server have both been imaged and launched the server should register with the Manager as normal and you should see a screen similar to this on the Monitor



```
          Hostname  :  MAXMANAGER
       Instance ID  :  i-5ca54a54
 Public IP Address  :  54.245.23.102
Private IP Address  :  10.248.96.248
 Availability Zone  :  us-west-2a
     Instance Size  :  t1.micro
      Architecture  :  AMD64
      Total Memory  :  613 MB
  Processing Power  :  up to 2 ECUs
                ce  :  Low
```

```
INF   Starting Network Manager
INF   <AdapterInfo>
INF   <Name>Autodesk 3ds Max 2014 (64-bit)</Name>
INF   <Version>300</Version>
INF   <Description>Autodesk 3
INF   </AdapterInfo>
INF   <AdapterInfo>
INF   <Name>Command Line Tool
INF   <Version>300</Version>
INF   <Description>Command Jol
INF   </AdapterInfo>
INF   Loading plugin: Autodes
INF   Loading plugin: Command
INF   Job 'SeaMachines_SceneO
INF   Job 'SeaMachines_DayToN
INF   Job 'SeaMachines_test3'
INF   Job 'SeaMachines_SceneO
INF   New client 10.248.96.24
INF   Wiretap interface conne
INF   New client 10.248.96.24
INF   Successful registration
```

Job	Or...	Pri...	State	Progress	Owner
SeaMachines_Scene...	1	50	Complete	(100%) 01...	alex lorman
SeaMachines_Scene...	2	50	Complete	(100%) 5l...	alex lorman
SeaMachines_test3	3	50	Complete	(100%) 03...	alex lorman
SeaMachines_DayTo...	4	50	Suspended	(071%) 12...	alex lorman

Server	Status	Current Job	Last Message
ip-ac1e001e	Idle	None	None
ip-ac1e00b8	Absent	None	N/A

4 Jobs in Queue. Displaying All.

MAXMANAGER Workgroup: WORKGROUP Memory: 615 MB
Processor: Intel(R) Xeon(R) CPU ...

From here you are in a position to launch as my of your Server AMIs as you deem needed for the rendering job. Either using Spot or Normal Instance pricing depending on your needs.

From here jobs are managed as normal within Backburner and jobs should render normally on as many machines as you have launched.