

Rochester Institute of Technology

RIT Digital Institutional Repository

Theses

2010

The Development and deployment of a remote virtual lab based on Amazon Cloud for networking courses

Emilio Nunez

Follow this and additional works at: <https://repository.rit.edu/theses>

Recommended Citation

Nunez, Emilio, "The Development and deployment of a remote virtual lab based on Amazon Cloud for networking courses" (2010). Thesis. Rochester Institute of Technology. Accessed from

This Thesis is brought to you for free and open access by the RIT Libraries. For more information, please contact repository@rit.edu.

The Development and Deployment of a Remote Virtual Lab based on Amazon Cloud for Networking Courses

By

Emilio Nunez

Thesis submitted in partial fulfillment of the requirements for the
degree of Master of Science in Networking and Systems
Administration

**Rochester Institute of Technology
B. Thomas Golisano College
Of
Computing and Information Sciences**

April 2010

Rochester Institute of Technology
B. Thomas Golisano College
Of
Computing and Information Sciences

Master of Science in Networking and Systems Administration

Thesis Approval Form

Student Name: Emilio Nunez

Thesis Title: The Development and Deployment of a Remote Virtual Lab based on Amazon Cloud for Networking Courses

MS Thesis Committee

Name	Signature	Date
Prof. Charles Border		4/22/2010
<hr/>		
Chair		
Prof. Luther Troell		4/22/2010
<hr/>		
Committee		
Prof. Arlene Estevez		4/22/2010
<hr/>		
Committee		

Thesis Reproduction Permission Form

Rochester Institute of Technology

**B. Thomas Golisano College
of
Computing and Information Sciences**

**Master of Science in
Networking and Systems Administration**

**The Development and Deployment of a Remote Virtual
Lab based on Amazon Cloud for Networking Courses.**

I, Emilio Nunez, hereby grant permission to the Wallace Library of the Rochester Institute of Technology to reproduce my thesis in whole or in part. Any reproduction must not be for commercial use or profit.

Date: _____

Signature of Author: _____

© Copyright 2010 Emilio Nunez

All Rights Reserved

Abstract

Remote virtual laboratories had been implemented using different approaches. Universities have adopted such model mostly for the distance learners. Furthermore, such systems have been implemented internally and used in conjunction with their physical hands-on labs. Nevertheless, the introduction of Cloud Computing and the virtual platform environment offered by it can serves for the creation of new type of services. This thesis aims to use this new technology and develop a remote virtual laboratory that can be used by students for doing their hands-on lab in the networking courses at PUCMM.

For this purpose the services used were the Amazon Elastic Compute Cloud (Amazon EC2) as an infrastructure provider and the VMLogix Lab Manager as the management software for the use of the laboratory.

The paper includes the development and deployment of two labs one in Windows and the other in Linux. Furthermore, the problems encountered and the outcomes are documented to serve as a base implementation guide for future laboratories using the Amazon Cloud Computing platform.

Table of Contents

1. Introduction.....	1
2. Thesis Statement	2
3. Related Work	2
4. Technology overview.....	5
4.1 Network Connections in the Cloud.....	6
5. Proof of Concept.....	8
6. Remote Virtual Lab: Development of Laboratories.....	10
6.1 Student's Guide to VMLogix Lab Manager	11
6.2 The Development of the Linux Laboratory	15
6.2.1 Translated Linux Laboratory Guide.....	17
6.2.2 Linux Laboratory in Action	20
6.3 The Development of the Windows Laboratory.....	32
6.3.1 Translated Windows Laboratory Guide	34
6.3.2 Windows Laboratory in Action.....	37
7. Laboratories Experiences.....	56
8. Some Costs Considerations.....	57
9. Future Works	59
10. Conclusions.....	60
11. References.....	61
12. Appendix A – Instance Types and OS in EC2.....	63
13. Appendix B – VMLogix Lab Manager Features	65
14. Appendix C – AWS Account Creation Process.....	68
15. Appendix D – Instance Creation in AWS Console.....	71
16. Appendix E - Windows Image Creation with AWS Console.....	76
17. Appendix F - Guía de Estudiantes para VMLogix Lab Manager	81
18. Appendix G – Guía de Laboratorio de Linux	85
19. Appendix H – Guía de Laboratorio de Windows.....	88
20. Appendix I – Amazon Web Services Statements	92

Table of Figures

Figure 1 - HTTPS Access to VMLogix Lab Manager.....	7
Figure 2 - Network Connections of the Instances in the Cloud	7
Figure 3 - Login box for VMLogix Lab Manager	11
Figure 4 - Accessing Configurations Menu within Lab Manager.....	12
Figure 5 - Deploy a Lab Configuration.....	12
Figure 6 - Accessing the Workspace	13
Figure 7 - Accessing Active Jobs.....	13
Figure 8 - Console Methods.....	14
Figure 9 - Accessing an instance with Remote Desktop.....	14
Figure 10 - Active Jobs Undeploy options.....	15
Figure 11 - Network Diagram of the Linux Lab Network Connections	20
Figure 12 - VMLogix Lab Manager Login Screen (Linux Lab).....	21
Figure 13 - Lab Manager Main Screen (Linux Lab).....	21
Figure 14 - Lab Configurations (Linux Lab)	22
Figure 15 - Begin Job Deployment (Linux Lab).....	22
Figure 16 - Job Deployment (Linux Lab)	23
Figure 17 - Job Deployment Steps (Linux Lab)	23
Figure 18 - Checking for VSFTPD (Linux Lab).....	24
Figure 19 - Access to Linux Server through SSH Java Console (Linux Lab)	24
Figure 20 - Getting VSFTPD package	25
Figure 21 - Installing VSFTPD.....	25
Figure 22 - Verifying Anonymous Access (Linux Lab)	26
Figure 23 - Internal IP Address of the Linux Server.....	26
Figure 24 - Local Test of the FTP Service (Linux Lab)	27
Figure 25 - Accesssing Windows Client through RDP (Linux Lab)	27
Figure 26 - Logon into Windows-Client (Linux Lab)	28
Figure 27 - Testing FTP Service through Windows-Client (Linux Lab).....	28
Figure 28 - Checking for HTTPD Service (Linux Lab).....	29
Figure 29 - Getting HTTPD package (Linux Lab)	29
Figure 30 - Installing HTTPD Package (Linux Lab)	30
Figure 31 - Login to Windows-Client to Test HTTP Server (Linux Lab).....	30

Figure 32 - Accessing HTTP Server through Internet Explorer (Linux Lab).....	31
Figure 33 - Undeploying Linux Lab from the Workspace.....	31
Figure 34 - Network Diagram of Windows Lab Network Connections	38
Figure 35 - Logon to VMLogix Lab Manager (Windows Lab).....	38
Figure 36 - VMLogix main screen (Windows Lab)	39
Figure 37 - Deploying the Windows Lab in the Configurations screen	39
Figure 38 - Deployment process of Windows Lab	40
Figure 39 - Accessing Windows-Server through RDP (Windows Lab)	40
Figure 40 - Login to Windows-Server (Windows Lab).....	41
Figure 41 - Accessing the Manage Your Server (Windows Lab).....	41
Figure 42 - Adding a Role Wizard (Windows Lab).....	42
Figure 43 - Selecting Application Server Role for installation (Windows Lab).....	42
Figure 44 - Selecting Additional Tools for the Application Server (Windows Lab).....	43
Figure 45 - Summary of Selection before installing Application Server (Windows Lab).....	43
Figure 46 - Installing and Configuring IIS (Windows Lab)	44
Figure 47 - Asking for the Windows Installation Discs (Windows Lab)	44
Figure 48 - Selecting Windows Installation Discs folder (Windows Lab)	45
Figure 49 - Browsing for the Installation Discs (Windows Lab).....	45
Figure 50 - Completing Installation of IIS (Windows Lab).....	45
Figure 51 - Finish Installation of Application Server (Windows Lab)	46
Figure 52 - Access the Manage Application Server (Windows Lab)	46
Figure 53 - Accessing the Default Web Site Properties (Windows Lab).....	47
Figure 54 - Default Web Site port (Windows Lab)	47
Figure 55 - Default Documents of the Default Web Site (Windows Lab).....	48
Figure 56 - Home Directory of the Default Web Site (Windows Lab).....	48
Figure 57 - Windows-Server Internal IP Address (Windows Lab).....	49
Figure 58 - Login to Windows-Client (Windows Lab).....	49
Figure 59 - Using Internet Explorer to access the HTTP Server (Windows Lab)	50
Figure 60 - Accessing the Add/Remove Programs (Windows Lab).....	51
Figure 61 - Add/Remove Windows Components - Application Server (Windows Lab).....	51
Figure 62 - Adding FTP Service (Windows Lab).....	52
Figure 63 - Accessing IIS Manager (Windows Lab)	52
Figure 64 - Default FTP Site State (Windows Lab).....	53

Figure 65 - FTP Site default port (Windows Lab)	53
Figure 66 - Home Directory of the Default FTP Site (Windows Lab)	54
Figure 67 - Access Security of the Default FTP Site (Windows Lab).....	54
Figure 68 - Access Restrictions of the Default FTP Site (Windows Lab).....	55
Figure 69 - Logon to Windows-Client (Windows Lab).....	55
Figure 70 - Testing FTP Server (Windows Lab)	56

1. Introduction

Universities have successfully implemented hands-on labs for many years especially in their IT related courses. These physical labs had proven to provide the necessary laboratory experience that those students have required. Nevertheless, the physical labs have limitations in terms of availability, performance and costs (Stackpole). Furthermore, a physical lab is useless when doing distance learning courses.

Different approaches have been successfully implemented to overcome these limitations and provide to the students a laboratory experience using remote virtual labs (Border; Leitner and Cane; Lahoud and Tang). Moreover, the use of a remote lab is not limited to distance learning students but also can be used by local students which can benefit from the availability and performance of this type of system. Even so, these methods require space, some costs (not as expensive as physical labs) and support personnel to maintain the physical servers.

In recent years a new environment and services have been emerged to offer virtualization as a service. This environment is called Cloud Computing which delivers remotely accessible Virtual computers through the Internet.

One of the Cloud Computing providers is Amazon Web Services (AWS) which developed a product called Amazon Elastic Compute Cloud (Amazon EC2), which “presents a true virtual computing environment, allowing you to use web service interfaces to launch instances with a variety of operating systems, load them with your custom application environment, manage your network’s access permissions, and run your image using as many or few systems as you desire” (Amazon Web Services).

The Amazon EC2 service offers a platform infrastructure for virtual computers (instances) that can be easily deployed and managed. Also, this infrastructure is

complemented by a robust product called Amazon Simple Storage Service (Amazon S3), which provides storage as a web service that is available from anywhere at any time (Amazon Web Services). This serves as a storage foundation to the virtual computers infrastructure within Amazon EC2.

All these technologies are complemented by the use of product called VMLogix Lab Manager Cloud Edition. This product offers a lab management solution for the Cloud. Moreover, allows the management of users and creation of multiple lab configurations easily accessible (VMLogix).

This thesis created the foundation for the development and deployment of a Remote Virtual Laboratory environment based on Amazon Web Services and VMLogix Lab Manager for the use in the networking labs at PUCMM.

2. Thesis Statement

This thesis developed and deployed a Remote Virtual Lab, based on Amazon Web Services and VMLogix to provide hands-on laboratories for the Networking Courses at PUCMM.

3. Related Work

Border (2007) in his paper, “The Development and Deployment of a Multi-User, Remote Access Virtualization System for Networking, Security, and System Administration Classes” presented the development and implementation of their Remote Laboratory Emulation System (RLES). The main idea behind this thesis was the creation of Virtual Labs for distance students. For this purpose they developed a multi user environment consisting of Terminal Services to provide the remote access and VMWare Workstation to create virtual machines that were used by the students for the labs. They proved that

this method was very useful for distance learning but also they found that local students were taking distance classes instead of local courses because of the convenience for accommodating their time for work and study.

This thesis provided a remote laboratory using Cloud Computing based in Amazon EC2 and VMLogix Lab Manager Cloud Edition. Furthermore, the system was tested by students from the Data Switching Lab Course at PUCMM. Moreover, the students were satisfied by using such system because of the advantages it presents (Diaz).

According to Corter et al (2007) in their “Constructing Reality: A Study of Remote, Hands-on and Simulated Laboratories” they made a large scale study to determine not only the student preferences but also their learning outcomes. Furthermore, they created labs for hands-on, simulated and remote laboratories to assess the students learning in each case and their understanding of the subject. Moreover, they created surveys to determine the level of satisfaction and the preference of the students.

The results from the Corter research showed the importance of the remote labs thus the lab created in the Cloud Computing not only delivered the same experience to students but also with added advantages in terms of management and cost.

The use of a remote virtual laboratory not only provide access to students without time restrictions but also permits in the case of PUCMM to provide more complex and real like environment for the students. According to Lawson and Stackpole (2006) in their “Does a Virtual Networking Laboratory Result in Similar Student Achievement and Satisfaction?” they conducted a research using two groups of students with a mix of experience using physical labs and virtualization to measure the level of satisfaction and achievement of students. They found that there was not big difference in the student’s achievement and the issues related to the use of technology like virtualization does not significantly affect the student’s satisfaction.

This achievement and satisfaction result was not altered by the use of the Remote Virtual lab developed and according to Diaz (2010) research the students were satisfied using the cloud virtual laboratory.

Another important aspect with the use of virtualized environments is the possibilities of exploring new pedagogies methods that professors can explore to enhance the students learning, Gaspar, Langevin (2008). In their research Gaspar et al explore the new possibilities that the use of virtualization can provide to the professors. Furthermore, they research was more a qualitative approach to research the benefits provided to instructors with the use of new technologies like virtualization. In this research the more important aspect was the ability of the students to work with this Cloud Environment while successfully doing their regular labs and reports. Nevertheless, this platform offers more possibilities for instructors to develop more complex and richer lab experience to students.

According to Krichen and Lahoud (2008) in their “Remote Labs in the Online Environment: Indicators for Success” made a study of the preferences of students using remote labs or simulated labs. Their study investigates how these methods can improve or maintain the same level of satisfaction and outcomes to students. They mix students with different experience related to the use of simulation in at least one course or previous experience with remote labs. They found that depending on the experience of students they prefer one or another.

One key factor in this research was the actual experience of students at PUCMM. They have never used a virtual lab or remote lab before. While they had some knowledge of virtualization technology they only perform physical labs and simulated labs in the campus. Nevertheless, the important part of the study was to introduce the students to new alternatives in the lab environment that could allow the use of more complex environments.

4. Technology overview

Amazon Web Services (AWS) provided IT Infrastructure like compute power, storage and databases on demand (Amazon Web Services). These services can be accommodated depending on the business needs. This makes sense for the use of Virtual Labs in Universities. Furthermore, these services are paid in accordance with the use. For example, a lab could take two hours to be completed by each student. If the number of students is twenty, they will use forty hours of the service and that's the base cost the university will incur.

Among the services offered by AWS is the Amazon Elastic Compute Cloud (Amazon EC2) which provides the creation and use of virtual computers (Amazon Web Services). A virtual computer is called an instance in the EC2 service.

Amazon EC2 offers different type of instances to accommodate the different CPU, memory and storage requirements. The instance type is selected at the time of the creation. Also, the image that will be executed inside the instance has to be selected. This image is called an Amazon Machine Image (AMI) and is basically an image of an Operating System pre-configured to execute in the EC2 environment. See appendix A for instance type and images details.

Another service provided by AWS is the Amazon Simple Storage (S3) which provides storage accessible through web services allowing the store of data information (Amazon Web Services). This service allowed the creation and storage of customized AMIs for the virtual labs providing a simple but robust storage subsystem for the laboratories. Furthermore, this storage can be used for the creation of snapshots of virtual computers thus made possible for students to pause and continue their work later on.

The services offered by AWS are the infrastructure for the resources required by the student's labs. Nevertheless, they still need an easy accessible form to interact with all

these services. This limitation was overcome by the use of a virtual lab manager product, called VMLogix Lab Manager Cloud Edition which was created as an instance within Amazon EC2. This product provided a web environment to access the lab and permitted the management of the Amazon EC2 platform as a virtual laboratory (VMLogix).

Among the features provided by VMLogix Lab Manager is the centralized user management which allows the professors to assign resources to students. Furthermore, these resources can be just the images in the form of templates to be used in the lab but also a complete virtual lab configured with specific resources for immediate use. Moreover, VMLogix uses the AWS services platform to allow the creation of customized templates of AMI's which are stored in the Amazon S3 and the creation of snapshots so students can stop their work and continue later on. See Appendix B for a complete list of features.

All these technologies working together provided an ideal environment for the creation of Virtual Laboratories for students working remotely.

4.1 Network Connections in the Cloud

For the interaction with this technology in the cloud two web interfaces were used. The first one was provided by Amazon EC2 to manage the instances. This interface was not appropriate for the use of students but offers some advantages in the creation of the images for the laboratories. The other interface was provided by the VMLogix Lab Manager which allowed the use of the EC2 service for doing laboratories. This Lab Manager software was running in a Windows instance within EC2. The access to the interface was through a secure SSL connection. See image below.

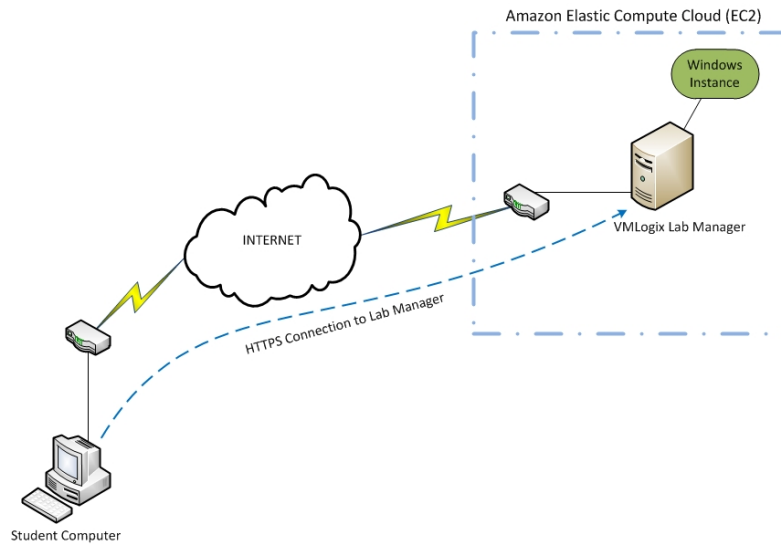


Figure 1 - HTTPS Access to VMLogix Lab Manager

Another important aspect was the network connection of the instances within EC2. The instances are connected through a Network Address Translation (NAT) process that makes the environment more secure. Furthermore, the instances are assigned two addresses one internal private address and one external public address. This permitted the use of an Access Control Lists (ACL) with security rules to allow access to the instances. See image below for a network connections diagram.

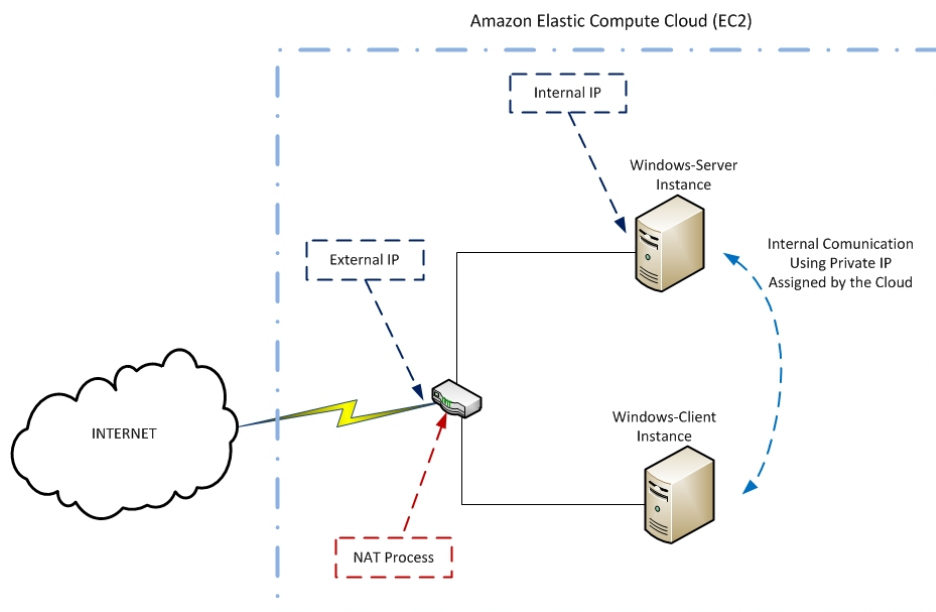


Figure 2 - Network Connections of the Instances in the Cloud

5. Proof of Concept

The creation of the remote virtual lab, using Amazon Web Services and VMLogix, required several steps. The first step was the account creation which served to register the services we wanted to use. After registering with AWS and getting the account then we registered the EC2 and S3 services for the use with the lab. The use of the services required that the account has credits. These credits were provided by AWS to the account for one complete year because it was for educational purposes. With the account, the services and the credit in the AWS system the next step was the registration for the VMLogix Lab Manager. They provided one year of evaluation because was for educational purpose. See Appendix C for details of AWS Account creation process.

When the process was completed VMLogix created an instance in EC2 in order to install their Lab Manager solution. Furthermore, they provided the web address and a Remote Desktop connection to access the server instance. VMLogix also stated that this instance cannot be terminated or shutdown, because the termination of an instance in EC2 will erase all the configurations that were in it. Nevertheless, we can restart the server in a case that the Lab Manager services were not working properly.

The setup of the AWS and the VMLogix took around two weeks to be completed, because the university email used was with problems and the credits for the AWS didn't get through it. Nevertheless, with all services activated and with enough credit the infrastructure was in place for the creation of the Labs.

The first step was to create an instance using the AWS console interface to test how this environment works. This provided a sense of how big the AWS Infrastructure was and the amount of images offered to create virtual servers. Furthermore, most of the images publically available were already customized with different applications or services. Moreover, this result in the first issue to consider which image was the base one to be used. In the case of the Linux Lab several options were available. The selection included

CentOS, Fedora, Ubuntu, among others. See Appendix D for Instance Creation details using AWS Console¹.

The use of the AWS console for the initial test required the knowledge of private key certificates and others concepts this made the console a complex environment for students to make the Labs. Furthermore, the console was only accessible through the account created which gives full access to the environment. Those concerns didn't allow the use of the console for the Labs. Nevertheless, the administrative control provided and the simple steps required to create Windows Images made it an ideal environment for the development of the Lab images. See Appendix E for images creation through AWS Console.

The VMLogix environment was tested and proved more suitable for student's labs. This one offered more control over student's access. The students were separated by groups in the Lab Manager thus each student had access to different labs within the system. Furthermore, this access control feature provided the ability to allow access to selected images to each group. For example, a group of students could be working on labs based on Windows Server 2003 and only has access to that image. This provided a security layer that doesn't allowed the students to run Virtual Machines with other images.

Nevertheless, the Lab Manager environment uses different terminologies than AWS which resulted with some misunderstandings when was used for the first time. For example, the environment used the word templates for referring to the Images (AMI). Furthermore, a lab environment was created by making Configurations. These Configurations had Roles; each role represented an Instance in EC2. However, the templates resulted into a simple form for students make their labs because they only provided imported AMI's from AWS EC2. Moreover, it was easier for students to find

¹ Instance Creation can also be made using EC2 API command line tools (Amazon EC2 API Tools)

the image to be used for a lab in the templates than have to browse thousands of images in EC2 repository.

6. Remote Virtual Lab: Development of Laboratories

The idea behind the labs were that as simple as possible provided an environment for students to learn something from real world network server applications. For this purpose the labs created were used by students of the Data Switching Lab course at PUCMM. This provides a real user environment to test the labs. Furthermore, the class consisted in sixteen students with some knowledge of networking and operating systems from previous courses. Nevertheless, this was the first time these students at PUCMM were exposed to a remote virtual lab.

The use of modern operating systems and services like FTP and Web Server provided an introduction for students into enterprise server application environment. The first lab created was based in Linux more specifically CentOS 5.3 to provide an FTP Server and a Web Server. The selection of CentOS was made because of the Enterprise focus that it have. This OS uses the same free sources as other Enterprise OS in the market (CentOS Project) making this Linux Distribution very stable. In this environment the students installed and configured VSFTP for the FTP Server and Apache for the Web Server.

The second lab environment was created using Windows Server 2003. This version was the only Windows Server image available when the lab was developed². The students installed and configured IIS for providing Web and FTP services.

² More recently, AWS had made available the Windows Server 2008 image for use within EC2. Check <http://aws.amazon.com/ec2/#os> for OS and software images availability within EC2.

One important part of the labs was the Student's Guide to VMLogix Lab Manager which provided the steps required by the students to login and successful work with the Lab Environment. See below for the translated Student's Guide; for the original Spanish version check appendix F.

6.1 Student's Guide to VMLogix Lab Manager

This guide will show step by step how to manage the Virtual Lab for using the Virtual Machines configurations already created by the Professor/Administrator

1- Login into the Lab Manager through the Web.

- We have to go to the main web page of the Lab Manager.

The address is: <https://ec2-174-129-125-107.compute-1.amazonaws.com:8443>

- In this page we have to enter our username and password. Both were provided by the profesor at the begining of the course. After entering the login and password we have to click in the Login button. (See image)

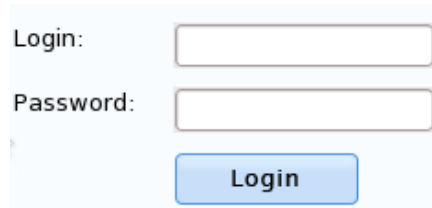


Figure 3 - Login box for VMLogix Lab Manager

2- Show the current available Configurations.

- After entering into the Lab Manager select the option Configurations from the left menu pane in the web page. (See image)

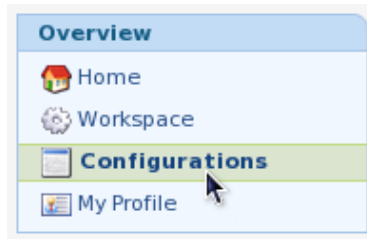


Figure 4 - Accessing Configurations Menu within Lab Manager

- A list of Virtual Machines configurations will be displayed. This is the list of the current configurations that we have access. We need to deploy the configuration that is specified in the lab guide. For this we have to put the mouse over the name and select the Deploy with defaults option. Take in consideration that the deployment of a configuration could take a few minutes. (See image)

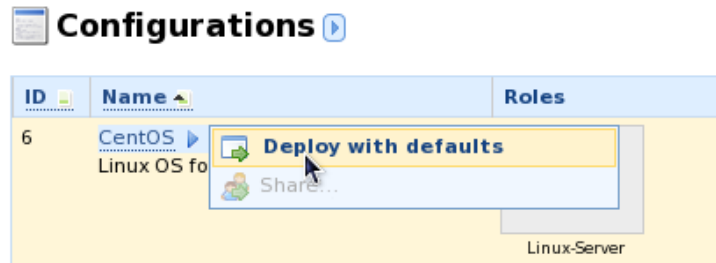


Figure 5 - Deploy a Lab Configuration

3- Accessing the Deployed/Saved Configurations.

- When we deploy the configuration it can be accessed through the Workspace. The Workspace is the area where the active configurations that are deployed can be accessed. Furthermore, Saved and pending configurations can also be accessed. The Workspace can be accessed through the Overview panel at the left of the page. See image below.



Figure 6 - Accessing the Workspace

- For accessing the a specific Virtual Machine from the Active Jobs we only need to click in the name of the configuration or in the small square image of the console near the name. See image below.

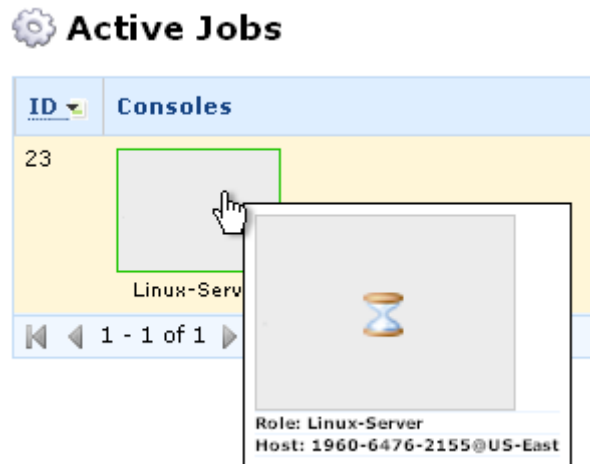


Figure 7 - Accessing Active Jobs

- After getting inside of the selected Virtual Machine console we can access the Console Methods to get the options available to connect to the console of the Virtual Machine. For example, SSH Console and Guest-VNC app. See image below.

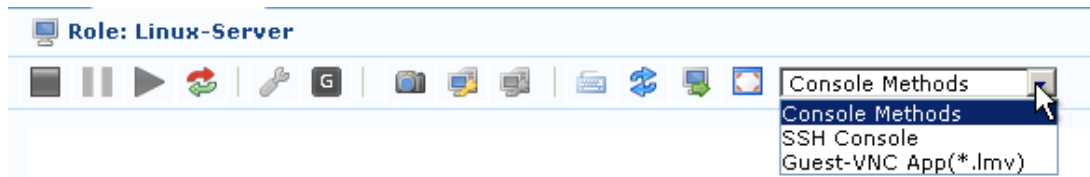


Figure 8 - Console Methods

- If we select the SSH Console method to access the Virtual Machine then a Java Terminal SSH console is displayed.
- If we select the VNC or the RDP method we have to download a file for making the connection to the console. In the case of the VNC the file extension is an .lmv with the address for connection. The RDP method uses an .rdp file with the address for the connection. See image below.

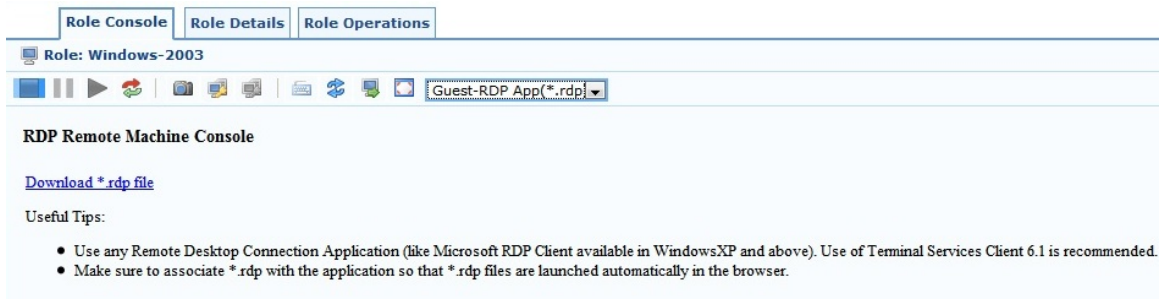


Figure 9 - Accessing an instance with Remote Desktop

- For accessing the Virtual Machine we should have the appropriate client installed. The VNC requires the use of UltraVNC for Windows or we can use any other VNC client. For the RDP there is a client installed in Windows and we can download a RDP client for Linux.

4- Saving or Undeploying a Configuration

- We can save the state of the Configuration just by moving the mouse over the configuration name and a small window will show different options that we can

do. One option is the Save & Continue which allow us to save a snapshot of the Configuration Virtual Machines and we can continue our work. The second option is the Save & Undeploy which allow us to save the state of the Configuration Virtual Machines and Undeploy the Configuration. The last option allows the Undeploy and Discard the Virtual Machines in the Configuration. See image below.



Figure 10 - Active Jobs Undeploy options

6.2 The Development of the Linux Laboratory

The development of the Linux Lab required the use of an AMI with the base Linux OS without any Web or FTP service. Furthermore, in the EC2 image catalog were so many different images of the same OS modified by different companies to include their own services or applications available to the public. Nevertheless, there were some base images of different OS including a base version of CentOS 5.3. This image was imported into the Templates of the Lab Manager and used as a test environment for the Lab.

The image was tested and successfully provided the Lab environment required for doing the lab. Moreover, this was a real base image without any FTP or Web service installed just the OS with minimal services. Also, with this image available and tested within the Lab Manager the process of creating the Lab Guide for the students was ready to begin.

The first step was to decide the type of guide for the use of students; as a result the development of a step by step guide with some task that required the investigation of the

students was chosen. The first part of the Linux Lab was the installation and configuration of the FTP server based on VSFTPD. This required the students' to first install the FTP Service using the Yum package installer. Furthermore, the instance in AWS had full Internet connection thus allowed the students to download any package that they needed to complete the lab.

It was required for the students to download, install and start the VSFTPD daemon in the lab. Also, they had to configure the service using the .conf files of the application to allow anonymous access to the FTP and made use of the service for uploading and downloading files. Those steps were among others like the investigation of the difference between active and passive mode in a FTP connection.

The second part of the Lab was the installation and configuration of the Web Server using Apache. The Apache web server is the most used server in the Internet according to Netcraft. This made it an ideal Web server application for the students to learn in the Lab.

This required the students to download and install it using the Yum Package installer and check the content of the .conf file of the HTTPD daemon. Furthermore, the students had to start the service and created an html file that replaced the default website that came with Apache. Moreover, they were required to create a virtual directory that used the port 8330. Below is the translated Linux Lab Guide, for the original Spanish version see appendix G.

6.2.1 Translated Linux Laboratory Guide

**PONTIFICIA UNIVERSIDAD CATOLICA MADRE Y MAESTRA
FACULTAD DE CIENCIAS DE LA INGENIERIA
DEPARTAMENTO DE INGENIERIA TELEMATICA**

Course: ITT-427 – Data Switching Laboratory

Title: Web and FTP Services in a Linux Server

Time Required: 2 Hours

Report:

Submit the report next week. Show screenshots of the lab steps.

In this lab the students will install and configure a Web and FTP services. These services are essentials in today's enterprise network. The server will have installed a CentOS Linux Distribution. Furthermore, the FTP services will use VSFTPD and the Web server will use APACHE.

Read the Students' Guide to VMLogix Lab Manager to access the Linux Lab Virtual Machines

PART I:

A. Configure an FTP Server using VSFTPD in Linux (CentOS)

1. Connect to the console of the Linux Virtual Machine using SSH
2. Verify if *vsftpd* is installed
 - *which vsftpd*
3. For installing *vsftpd* execute the following command:
 - *yum install vsftpd*

4. Verify the configuration file of the **vsftpd** and allow anonymous access to the FTP server
 - Edit the file */etc/vsftpd/vsftpd.conf*
5. Start the FTP Service using the following command:
 - *service vsftpd start*
6. Verify that the FTP server is working
 - Check the IP Address of the server running “*ifconfig*”
 - *ftp (IP Address of the Server)*
 - Use the username “*anonymous*” password: “*Your email address*”
7. Connect to the console of the Windows Server 2003 Virtual Machine using Remote Desktop (RDP)
 - Use the following credentials
 - Username: *Administrator*
 - Password: *netsys*
8. Open a command console
 - *start → run → cmd*
9. Connect to the FTP Server
 - *ftp (IP Address of the Server)*
 - Use the username “*anonymous*” and password: “*your email address*”

B. Research and answer the following

1. Put a Welcome Banner in the FTP Server
2. Create a user that can have Write permission in the FTP Server
3. Create a user that have Read Only permission in the FTP Server
4. Upload a file to the FTP Server
5. Download a file from the FTP Server
6. Explain the difference between the ASCII mode and the Binary mode for FTP file transfers.

7. Explain the difference between the Active and Passive mode FTP. ¿What is the advantage of using Passive Mode?

PART II:

A. Configure a Web Server using Apache in Linux (CentOS)

1. Connect to the Linux Virtual Machine console via SSH.
2. Verify if *Apache* is installed
 - *which httpd*
3. For installing *Apache* execute the following command:
 - *yum install httpd*
4. Verify the configuration file of the Web Server
 - Edit the file */etc/httpd/conf/httpd.conf*
5. Start the Web Server using the following command:
 - *service httpd start*
6. Verify that the Web Server is working
 - Check the IP Address of the server running “*ifconfig*”
 - Connect to the Windows Server 2003 console via RPD
 - Open a browser and access the address *http://IP Address of the Server*

B. Research and answer the following

1. Change the default Webpage of the Server
2. Configure the Web server to use a different port than the default port 80
3. Create a virtual directory that use the port 8330
4. Explain the different methods available to host multiple websites in the same Web Server.

6.2.2 Linux Laboratory in Action

The Linux lab was tested after the development. This test was made to ensure that the guide and the lab configuration worked. The network connection to the lab was made by accessing the Web interface of the Lab Manager. Furthermore, the steps stated in the Student's Guide were followed to deploy and access the virtual computers required to make the lab. Below is a network diagram of the connections.

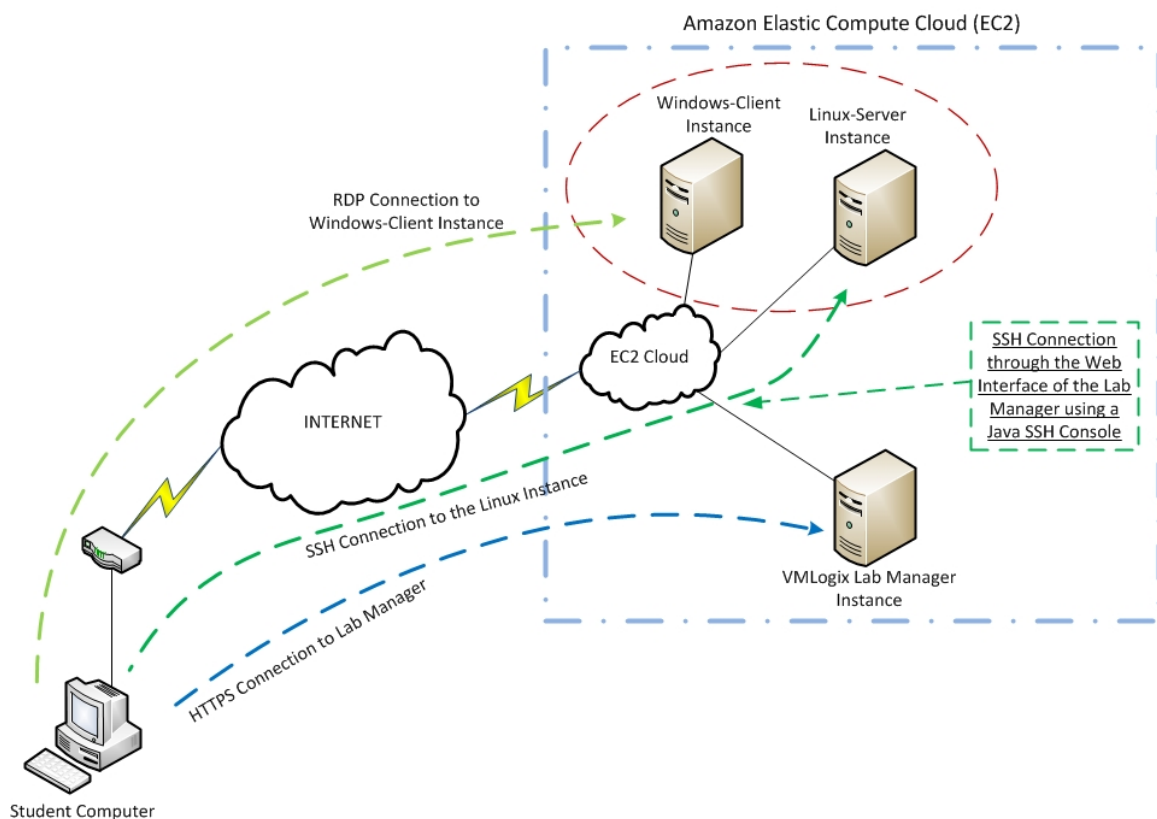


Figure 11 - Network Diagram of the Linux Lab Network Connections

The connections showed in the figure represent how the students were connected to the lab. The first connection that needs to be made is an HTTPS connection to the Lab Manager Web Interface. The web interface required a username and a password to allow students to login. See image below of the logon page.

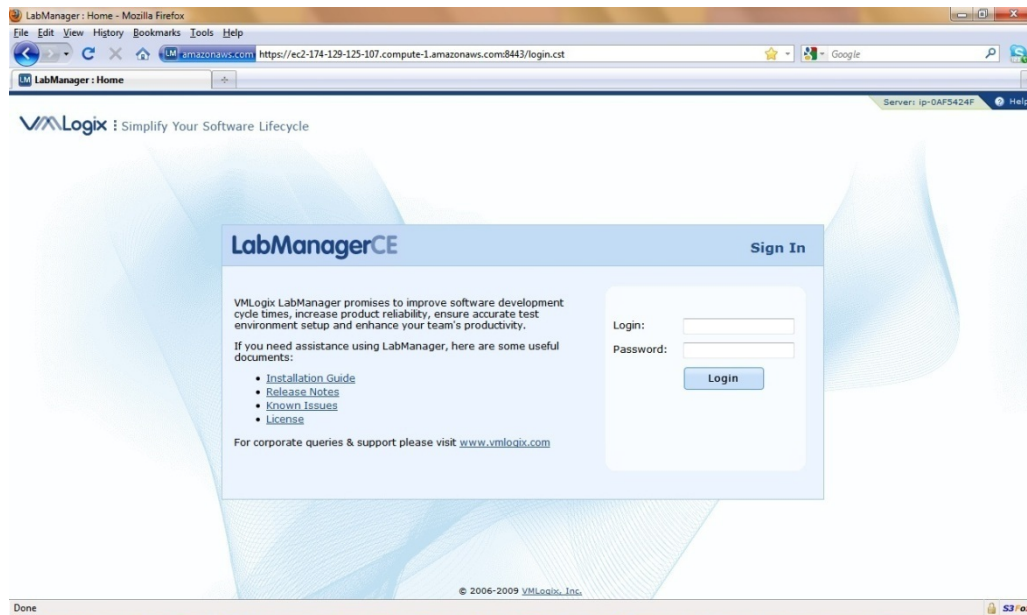


Figure 12 - VMLogix Lab Manager Login Screen (Linux Lab)

After entering the Lab Manager the main screen appears showing the home page of the user. This page shows the statistics of the server and the status of active jobs of the user. Furthermore, a menu panel is displayed in the left with the configurations option from where the students deployed the lab. See images below.

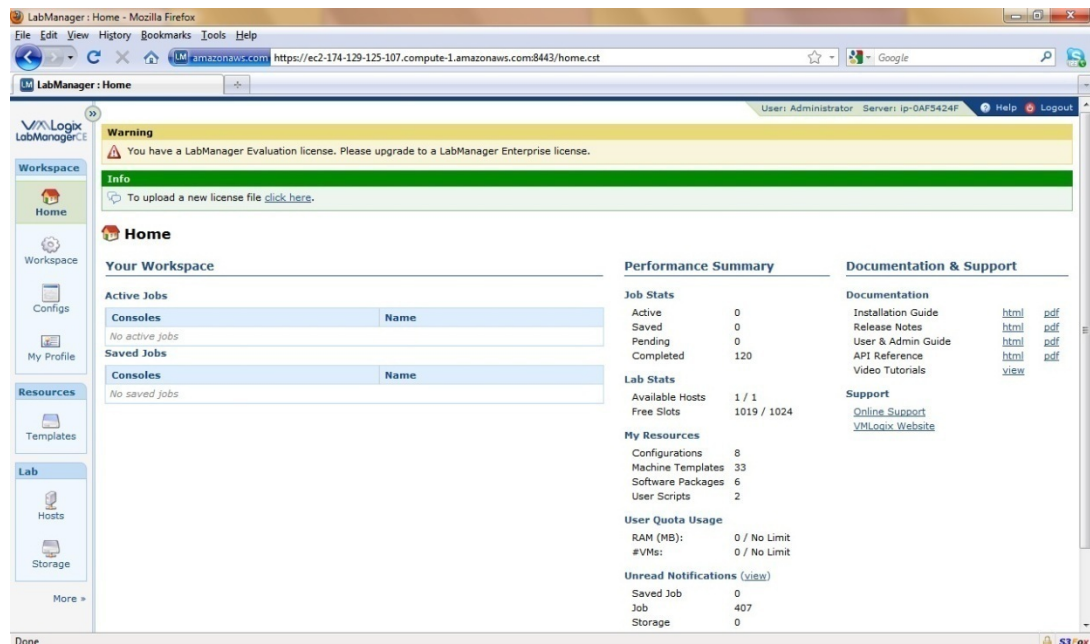


Figure 13 - Lab Manager Main Screen (Linux Lab)

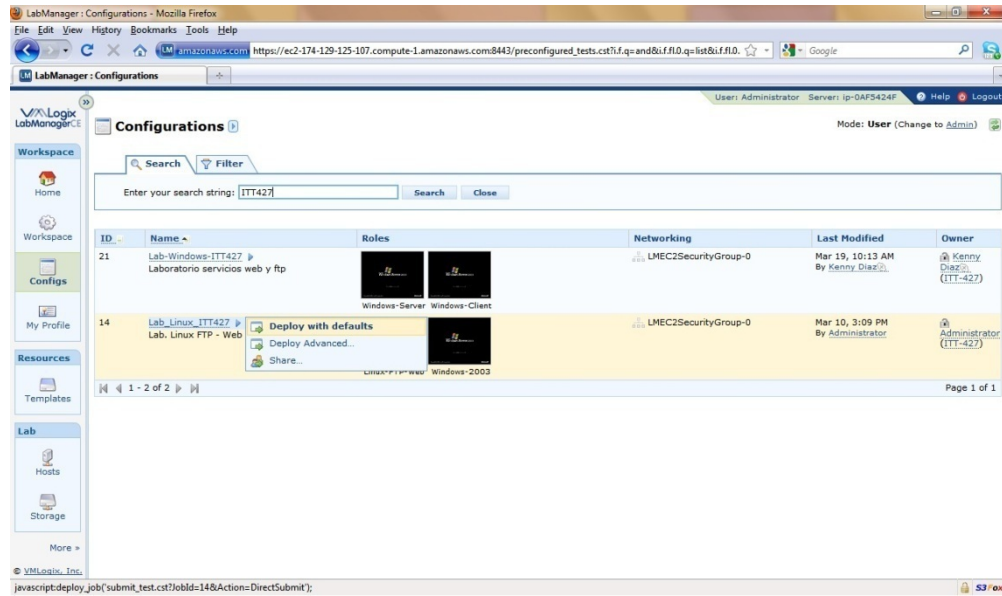


Figure 14 - Lab Configurations (Linux Lab)

The deployment of a lab configuration took from ten to fifteen minutes. In this time the Lab Manager requested the creation of the two instances for the lab to the EC2 system. Moreover, this time appeared to be very long for the deployment of two Instances. Nevertheless, the creation of those instances required the use of images stored in S3 that need to be moved to the resources allocated dynamically for the instances. See below some images of the deployment phase.

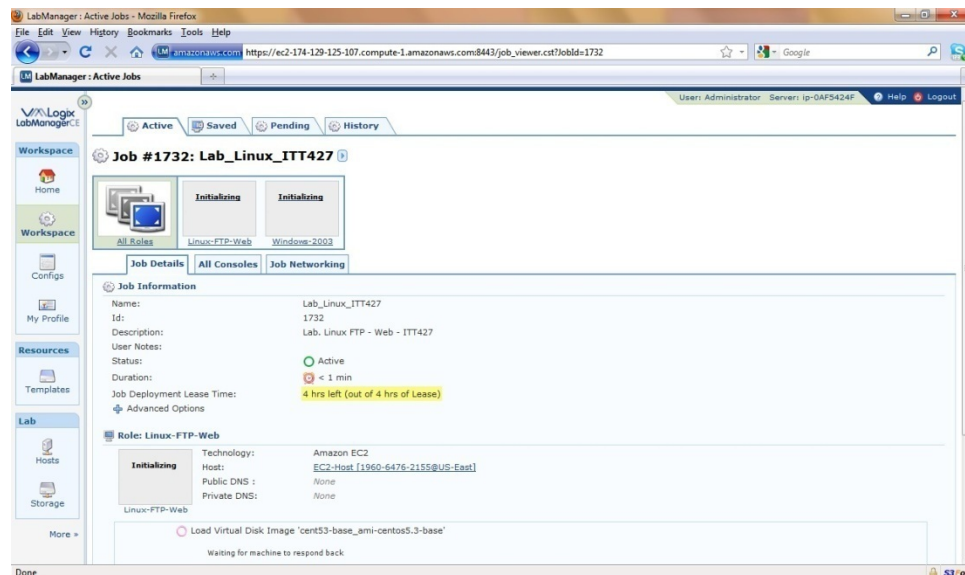


Figure 15 - Begin Job Deployment (Linux Lab)

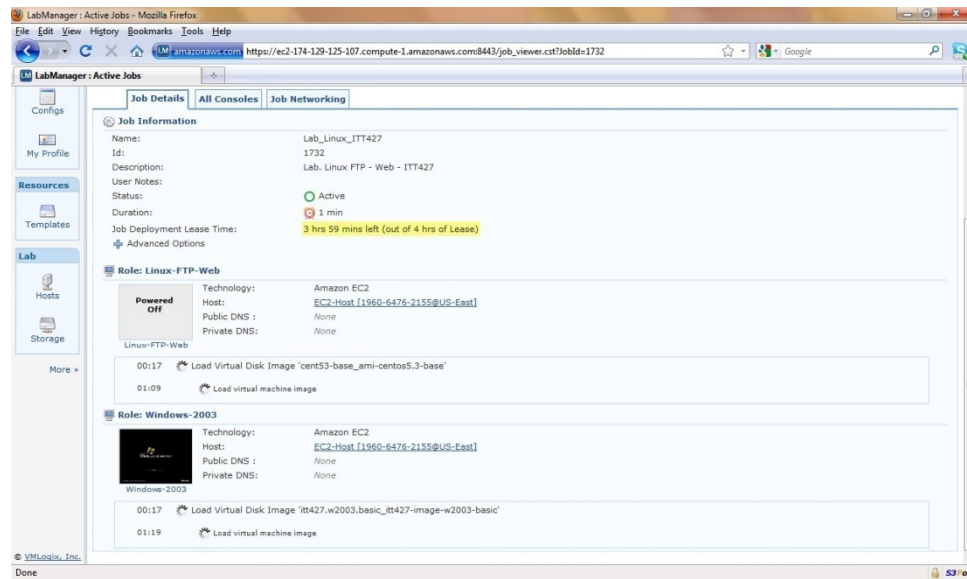


Figure 16 - Job Deployment (Linux Lab)

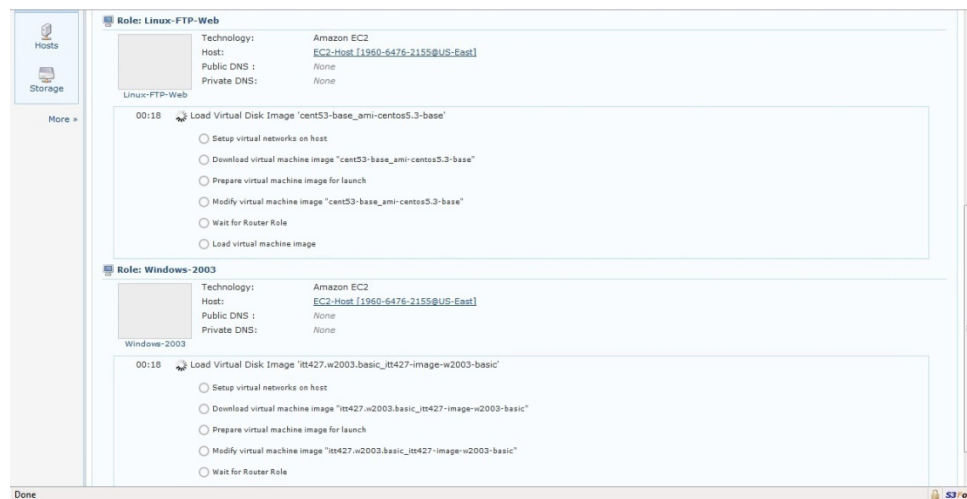


Figure 17 - Job Deployment Steps (Linux Lab)

When the configuration was deployed the Linux instance was accessed using the Lab Manager SSH interface to begin doing the laboratory. The first part of the lab required the installation of the VSFTPD ftp service. Furthermore, the first command used from the lab guide was to verify that the service was not already installed. After this verification the installation and the configuration were performed. See images below.

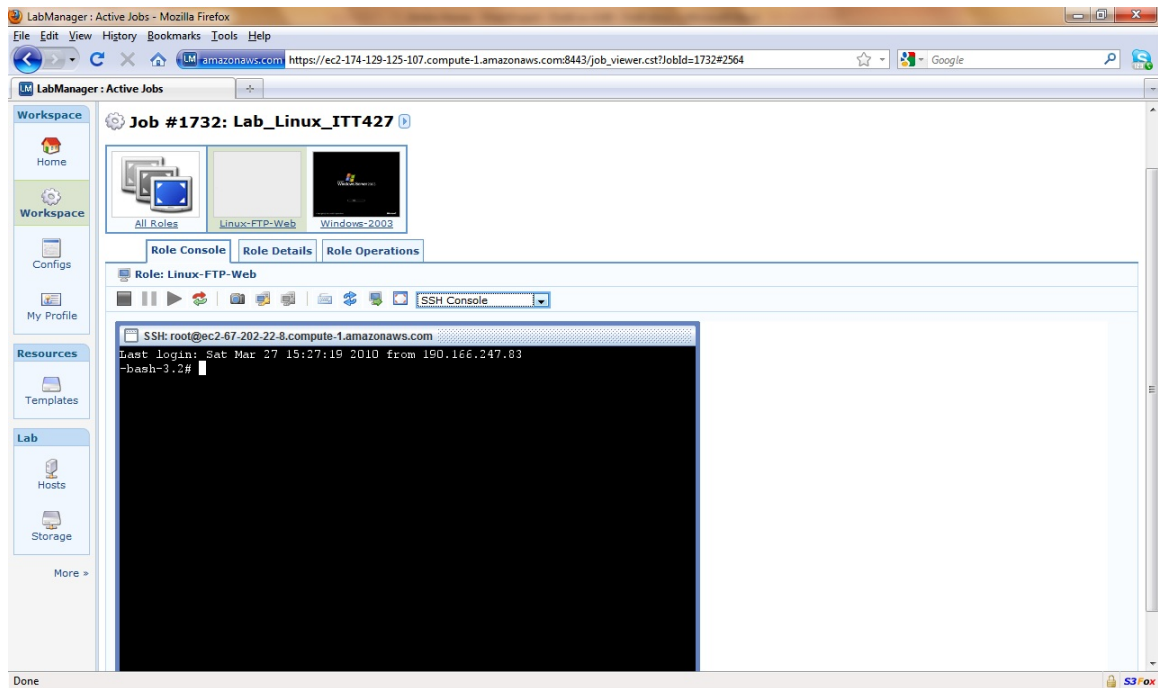


Figure 18 - Access to Linux Server through SSH Java Console (Linux Lab)

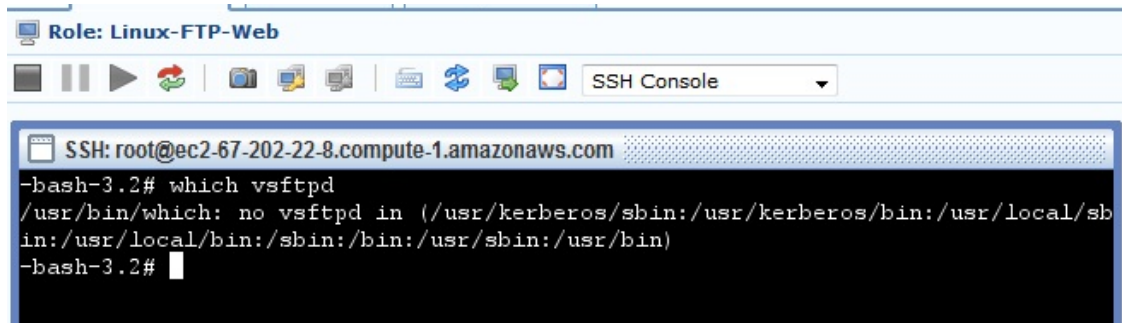
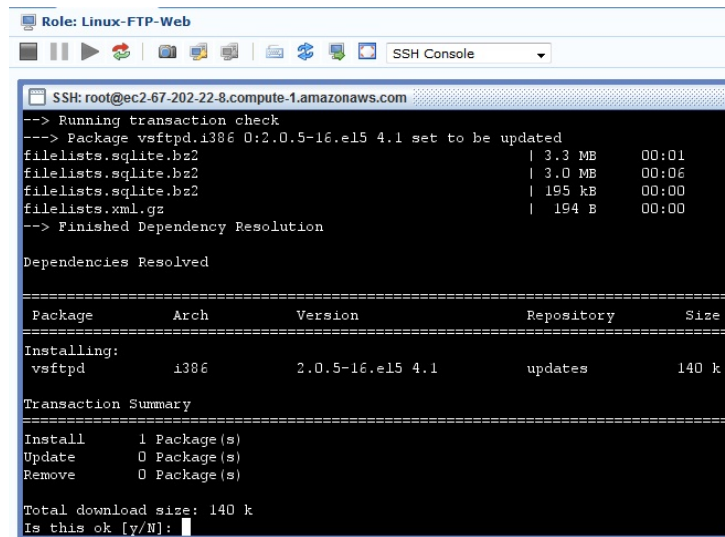


Figure 19 - Checking for VSFTPD (Linux Lab)



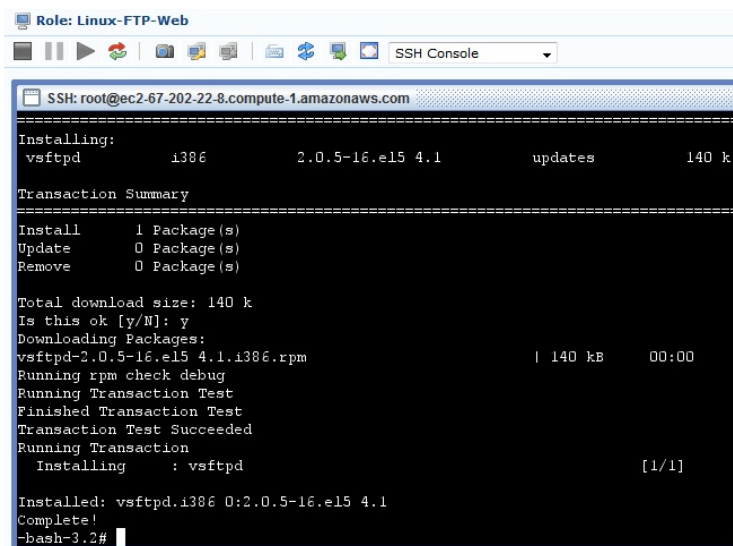
```
SSH: root@ec2-67-202-22-8.compute-1.amazonaws.com
--> Running transaction check
--> Package vsftpd.i386 0:2.0.5-16.el5 4.1 set to be updated
filelists.sqlite.bz2 | 3.3 MB 00:01
filelists.sqlite.bz2 | 3.0 MB 00:06
filelists.sqlite.bz2 | 195 kB 00:00
filelists.xml.gz | 194 B 00:00
--> Finished Dependency Resolution

Dependencies Resolved

=====
Package Arch Version Repository Size
=====
Installing:
vsftpd i386 2.0.5-16.el5 4.1 updates 140 k
=====
Transaction Summary
=====
Install 1 Package(s)
Update 0 Package(s)
Remove 0 Package(s)

Total download size: 140 k
Is this ok [y/N]:
```

Figure 20 - Getting VSFTPD package



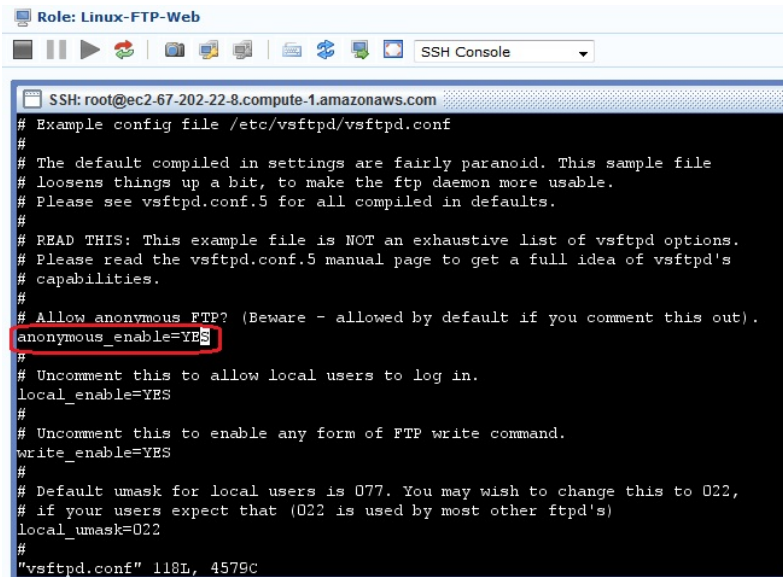
```
SSH: root@ec2-67-202-22-8.compute-1.amazonaws.com
=====
Installing:
vsftpd i386 2.0.5-16.el5 4.1 updates 140 k
=====
Transaction Summary
=====
Install 1 Package(s)
Update 0 Package(s)
Remove 0 Package(s)

Total download size: 140 k
Is this ok [y/N]: y
Downloading Packages:
vsftpd-2.0.5-16.el5 4.1.i386.rpm | 140 kB 00:00
Running rpm check debug
Running Transaction Test
Finished Transaction Test
Transaction Test Succeeded
Running Transaction
Installing : vsftpd [1/1]

Installed: vsftpd.i386 0:2.0.5-16.el5 4.1
Complete!
-bash-3.2#
```

Figure 21 - Installing VSFTPD

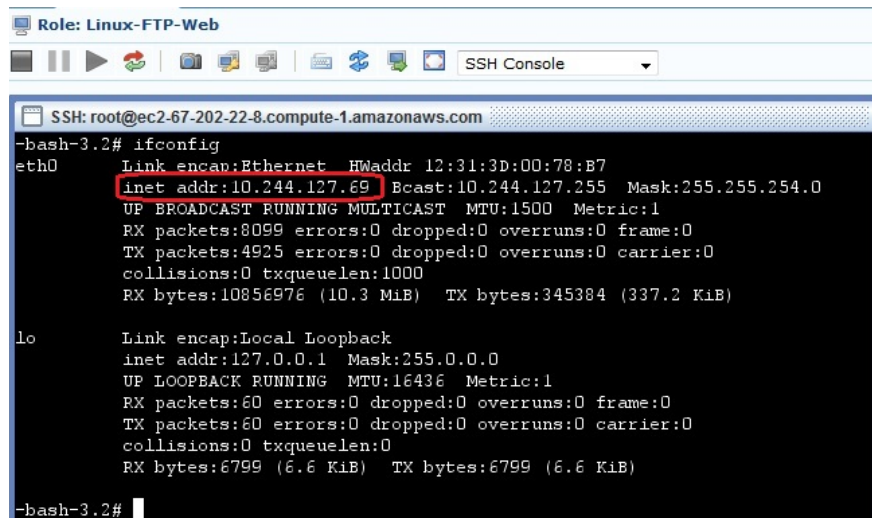
After successfully installed the VSFTPD service the next step in the lab guide was the verification of the anonymous access in the config file of the service. See image below.



```
Role: Linux-FTP-Web
SSH Console
SSH: root@ec2-67-202-22-8.compute-1.amazonaws.com
# Example config file /etc/vsftpd/vsftpd.conf
#
# The default compiled in settings are fairly paranoid. This sample file
# loosens things up a bit, to make the ftp daemon more usable.
# Please see vsftpd.conf.5 for all compiled in defaults.
#
# READ THIS: This example file is NOT an exhaustive list of vsftpd options.
# Please read the vsftpd.conf.5 manual page to get a full idea of vsftpd's
# capabilities.
#
# Allow anonymous FTP? (Beware - allowed by default if you comment this out).
anonymous_enable=YES
#
# Uncomment this to allow local users to log in.
local_enable=YES
#
# Uncomment this to enable any form of FTP write command.
write_enable=YES
#
# Default umask for local users is 077. You may wish to change this to 022,
# if your users expect that (022 is used by most other ftpd's)
local_umask=022
#
"vsftpd.conf" 118L, 4579C
```

Figure 22 - Verifying Anonymous Access (Linux Lab)

The next step after the verification of the anonymous access was the test of the service. Furthermore, a local test was made first then a remote test from the Windows Instance. Both test required the use of the internal IP address of the Linux instance. See images below.



```
Role: Linux-FTP-Web
SSH Console
SSH: root@ec2-67-202-22-8.compute-1.amazonaws.com
-bash-3.2# ifconfig
eth0      Link encap:Ethernet  HWaddr 12:31:3D:00:78:B7
          inet addr:10.244.127.69  Bcast:10.244.127.255  Mask:255.255.254.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:8099 errors:0 dropped:0 overruns:0 frame:0
          TX packets:4925 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:10856976 (10.3 MiB)  TX bytes:345384 (337.2 KiB)

lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          UP LOOPBACK RUNNING  MTU:16436  Metric:1
          RX packets:60 errors:0 dropped:0 overruns:0 frame:0
          TX packets:60 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:6799 (6.6 KiB)  TX bytes:6799 (6.6 KiB)

-bash-3.2#
```

Figure 23 - Internal IP Address of the Linux Server

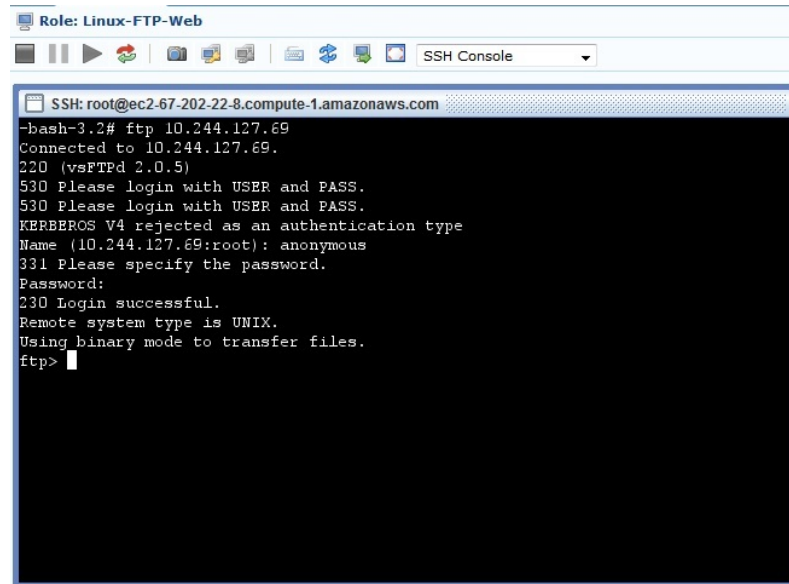


Figure 24 - Local Test of the FTP Service (Linux Lab)

The second test was made from the Windows Instance and required the students to logon into the Windows Server 2003 via Remote Desktop (RDP). Within this instance an FTP session was initiated to the internal IP address of the Linux Server. See images below.

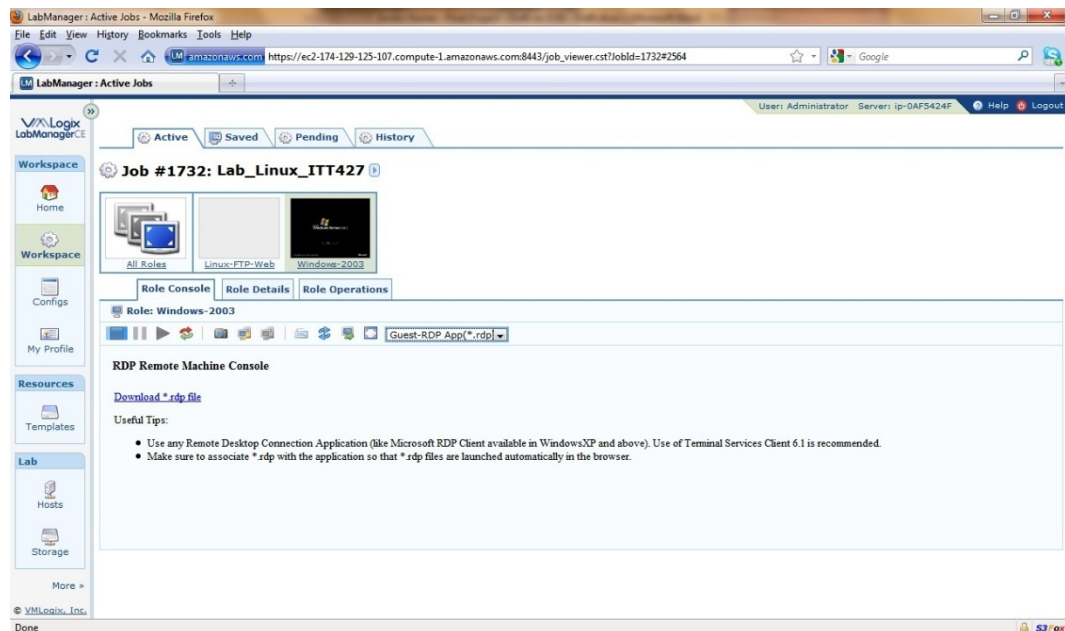


Figure 25 - Accesssing Windows Client through RDP (Linux Lab)

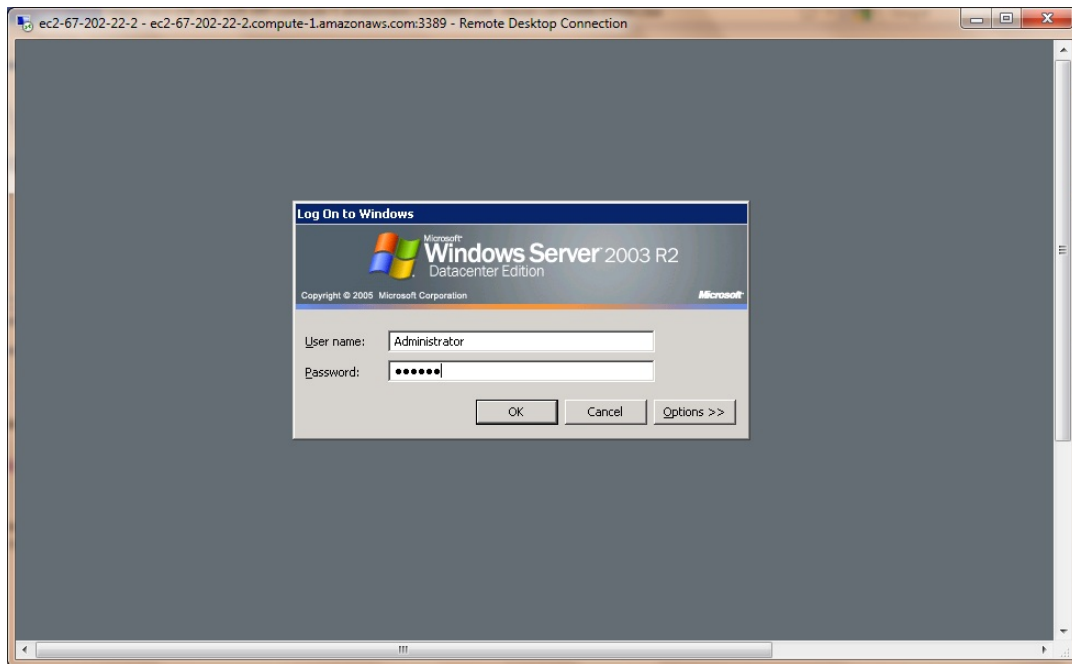


Figure 26 - Logon into Windows-Client (Linux Lab)

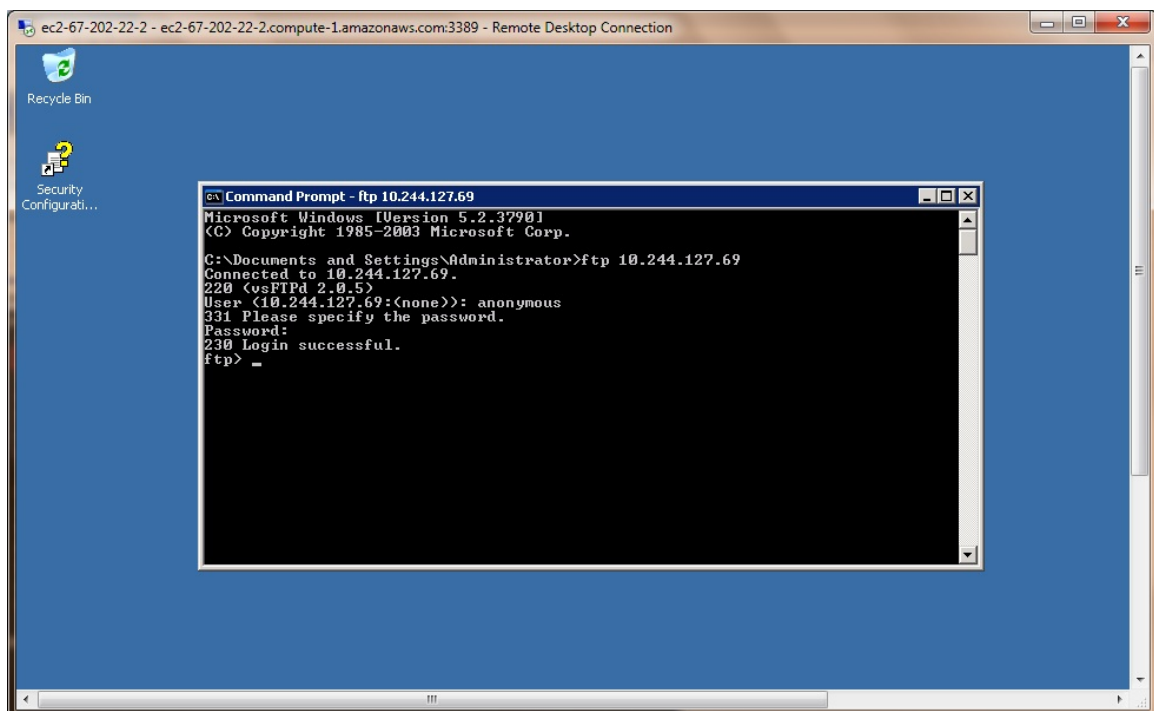
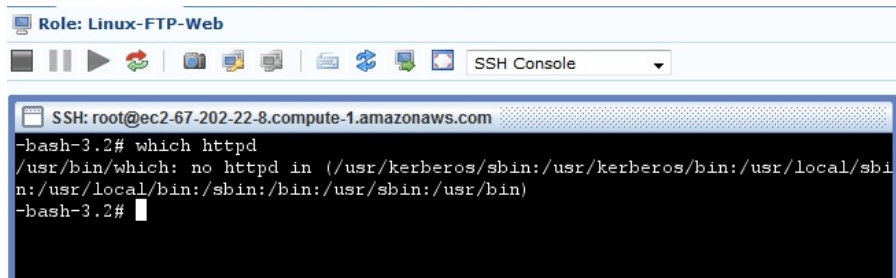


Figure 27 - Testing FTP Service through Windows-Client (Linux Lab)

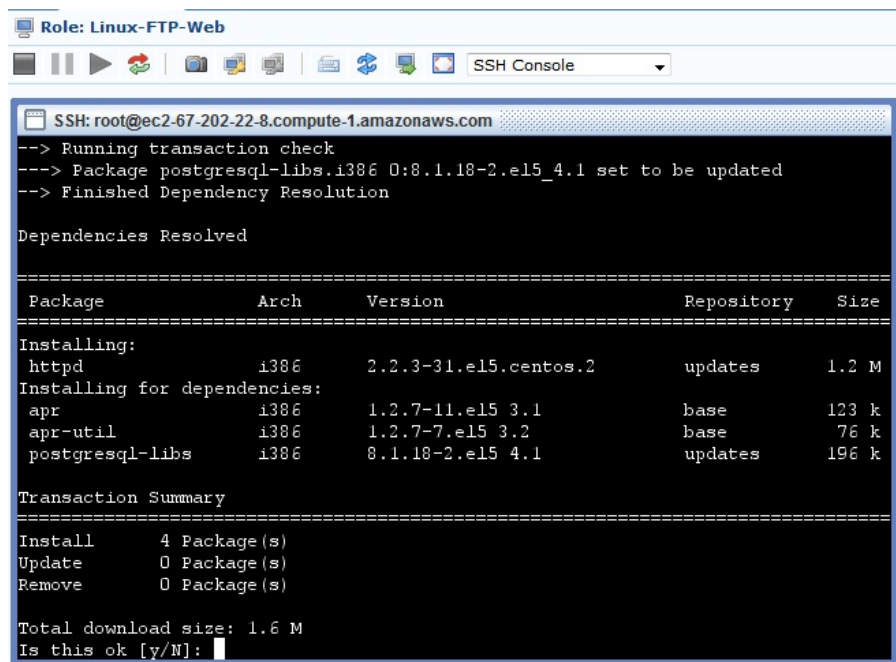
The second part consisted in the installation and configuration of the HTTPD service. The first command used was to verify if the service was already installed in the system. After this verification the installation and configuration was performed. See images below.



```

Role: Linux-FTP-Web
SSH Console
SSH: root@ec2-67-202-22-8.compute-1.amazonaws.com
-bash-3.2# which httpd
/usr/bin/which: no httpd in (/usr/kerberos/sbin:/usr/kerberos/bin:/usr/local/sbin:/usr/local/bin:/sbin:/bin:/usr/sbin:/usr/bin)
-bash-3.2#
  
```

Figure 28 - Checking for HTTPD Service (Linux Lab)



```

Role: Linux-FTP-Web
SSH Console
SSH: root@ec2-67-202-22-8.compute-1.amazonaws.com
--> Running transaction check
--> Package postgresql-libs.i386 0:8.1.18-2.el5_4.1 set to be updated
--> Finished Dependency Resolution

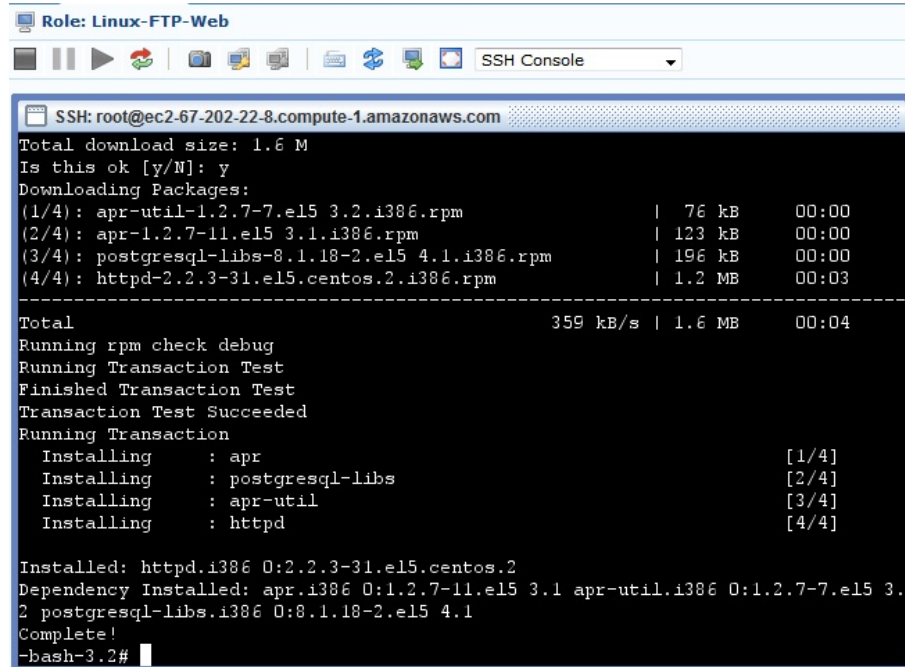
Dependencies Resolved

=====
Package                Arch      Version                Repository    Size
=====
Installing:
httpd                   i386      2.2.3-31.el5.centos.2  updates     1.2 M
Installing for dependencies:
apr                     i386      1.2.7-11.el5 3.1       base        123 k
apr-util                i386      1.2.7-7.el5 3.2       base         76 k
postgresql-libs         i386      8.1.18-2.el5 4.1       updates     196 k

Transaction Summary
=====
Install      4 Package(s)
Update      0 Package(s)
Remove      0 Package(s)

Total download size: 1.6 M
Is this ok [y/N]:
  
```

Figure 29 - Getting HTTPD package (Linux Lab)



```
Role: Linux-FTP-Web
SSH Console
SSH: root@ec2-67-202-22-8.compute-1.amazonaws.com
Total download size: 1.6 M
Is this ok [y/N]: y
Downloading Packages:
(1/4): apr-util-1.2.7-7.el5 3.2.i386.rpm | 76 kB 00:00
(2/4): apr-1.2.7-11.el5 3.1.i386.rpm | 123 kB 00:00
(3/4): postgresql-libs-8.1.18-2.el5 4.1.i386.rpm | 196 kB 00:00
(4/4): httpd-2.2.3-31.el5.centos.2.i386.rpm | 1.2 MB 00:03
-----
Total | 359 kB/s | 1.6 MB 00:04
Running rpm check debug
Running Transaction Test
Finished Transaction Test
Transaction Test Succeeded
Running Transaction
Installing : apr [1/4]
Installing : postgresql-libs [2/4]
Installing : apr-util [3/4]
Installing : httpd [4/4]

Installed: httpd.i386 0:2.2.3-31.el5.centos.2
Dependency Installed: apr.i386 0:1.2.7-11.el5 3.1 apr-util.i386 0:1.2.7-7.el5 3.1
postgresql-libs.i386 0:8.1.18-2.el5 4.1
Complete!
-bash-3.2#
```

Figure 30 - Installing HTTPD Package (Linux Lab)

The next step after completing the installation was the use of the Windows instance to test the HTTPD service. For this purpose a Remote Desktop connection was made to the Windows instance and then the Internet Explorer browser was used to navigate to the Linux server. See images below.

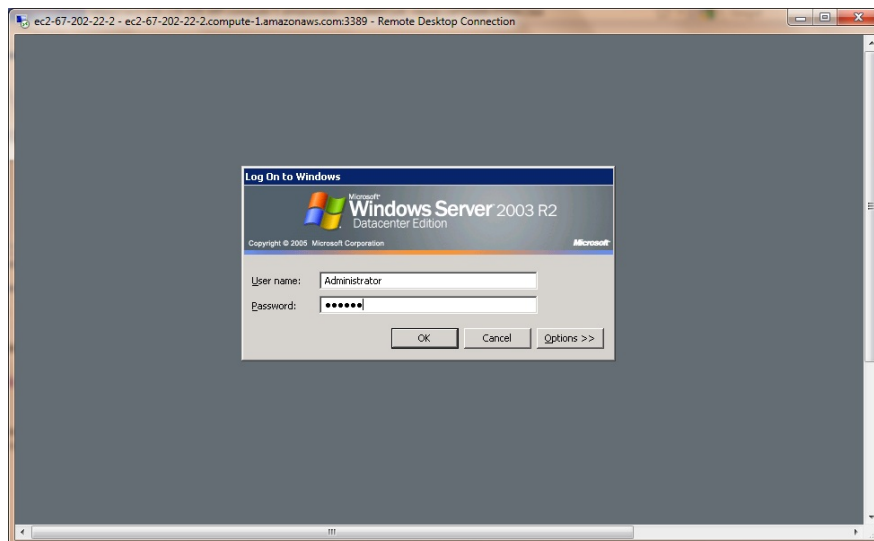


Figure 31 - Login to Windows-Client to Test HTTP Server (Linux Lab)

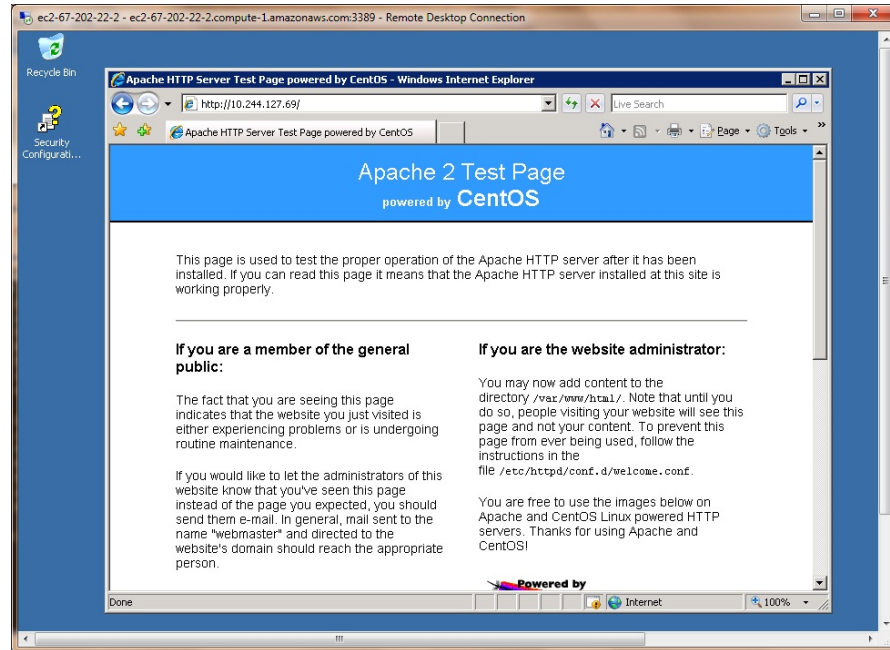


Figure 32 - Accessing HTTP Server through Internet Explorer (Linux Lab)

The last step was the un-deployment of the lab configuration and release of the resources in use. This was performed from the workspace in the Lab Manager. See images below.

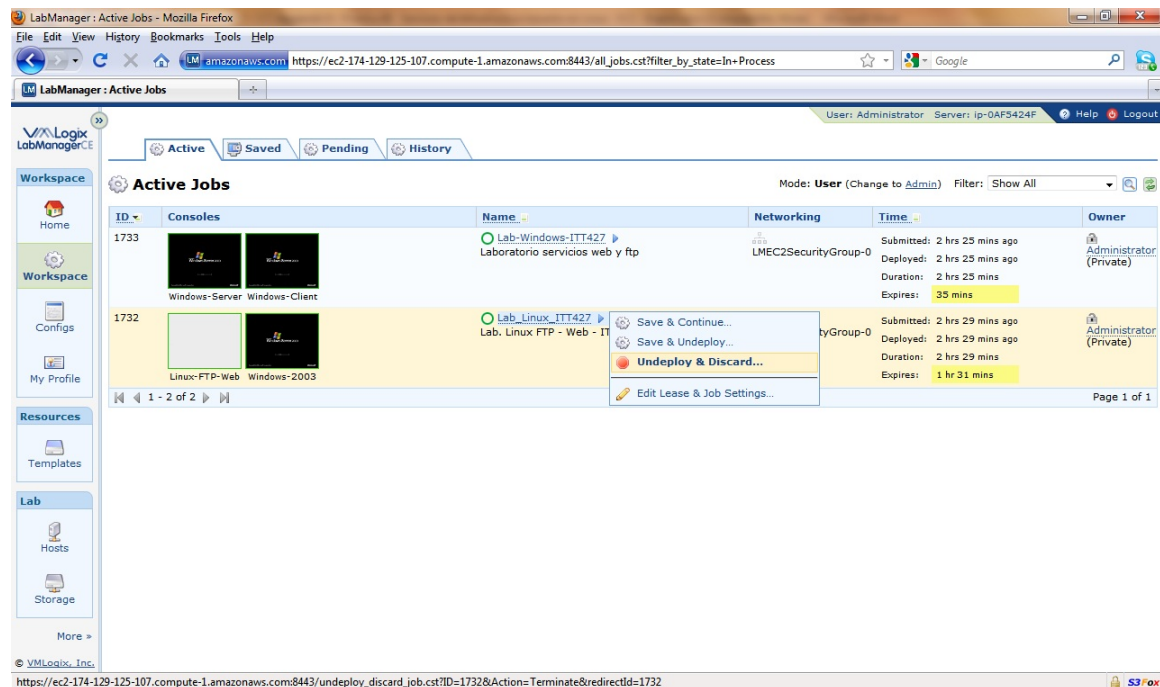


Figure 33 - Undeploying Linux Lab from the Workspace

6.3 The Development of the Windows Laboratory

This Lab required the use of Windows Server 2003 base image so students interacted with the OS as if it was recently installed. Furthermore, the development of the Windows lab required a different approach than the Linux lab. For example, in the Linux environment installing an application to a server that has Internet access is very simple because the package manager searches for the application installer in the Internet repositories. Nevertheless, with Windows if we are going to install a Windows Component that comes with the OS, like the IIS, we need the Windows installation discs. Furthermore, in the EC2 environment there is a snapshot of the Windows Server 2003 installation discs that was available from EC2 (Amazon Web Services) but not from the Lab Manager. This complicated the Lab development so the base image was modified within EC2 to include the Windows installation discs in the image.

The creation of the image of Windows Server 2003 was made using the AWS Console which provided the tools needed. Firstly, an Instance was created with the basic image of Windows Server 2003 and then an EBS³ (Elastic Block Storage) was created using the snapshot of the Windows Installation discs. Furthermore, with the Instance running the EBS was attached to it thus making the storage device available to the Instance. Moreover, within the Instance the installation files were copied to a folder in the C: drive and also changed the Administrator password to *netsys*. At that point, the Instance had all the necessary software and configurations for the Lab and the creation of the image was possible. This was made through the AWS console using the “Create Bundle” function.

The bundle was actually the creation of an AMI (Amazon Machine Image) based on the Instance that was running.

³ EBS is a storage block device available to the EC2 instances. This storage device can be attached to instances while running.

The last step, after the creation of the bundle, was the registration of the image. This process was necessary because the image was stored in S3 when the “Create Bundle” had finished but the image was not visible to any account because it was not registered.

The new AMI was tested, within AWS Console, with the creation of an Instance to check the availability of the Windows Installers and the change in the administrator password. Furthermore, the Instance worked with the *netsys* password and the installation files were available in the C: drive. Moreover, the IIS was installed successfully and tested with the default web page. See appendix E for Windows Image Creation process details.

The inclusion of the image into the Lab Manager was simple. Nevertheless, the image was not available in the imports function of the templates immediately; it took about six hours to be available. According to VMLogix the image was supposed to be available immediately. A bug report was created to VMLogix so they could further investigate the problem.

The lab guide was developed to make the students install and configure the IIS. Furthermore, the students were requested to change the default web page and the web server port. Moreover, they had to investigate how the IIS could host multiple websites.

The second part of the lab the students were required to add the FTP service to the IIS. Also, they had to check the service status and how the service was configured by default. Moreover, students had to test the service uploading and downloading files. See below the translated Windows Lab Guide, for the original Spanish version see Appendix H.

6.3.1 Translated Windows Laboratory Guide

**PONTIFICIA UNIVERSIDAD CATOLICA MADRE Y MAESTRA
FACULTAD DE CIENCIAS DE LA INGENIERIA
DEPARTAMENTO DE INGENIERIA TELEMATICA**

Course: ITT-427 – Data Switching Laboratory

Title: Web and FTP services in a Windows Server

Time Required: 2 Hours

REPORT:

Submit the report next week. Show screenshots of the lab steps.

In this lab the students will install and configure a Web and FTP services. These services are essentials in today's enterprise network. This server will have installed a Windows Server 2003. Furthermore, the Web and FTP service will be provided installing and configuring IIS.

PART I:

A. Installing IIS in Windows Server 2003

1. Connect to the console of the Windows Virtual Machine via Remote Desktop.
 - *Username: Administrator*
 - *Password: netsys*
2. For installing IIS do the following:
 - *start -> Manage Your Server*

- *Add Role -> Next*
 - *Select Application Server (IIS, ASP .NET) -> Next*
 - *Use the default parameters click next until the installation begins.*
 - *When the installation ask for the Windows Installers click Browse -> My Computer -> Local Disk (C:) -> Win2003 Sources -> Disc1 -> I386 -> Open -> OK*
 - *This last step must be repeated for each time the Installation ask for the Windows Installer files.*
 - *At the end just click Finish.*
3. Open the IIS console to verify that it was installed
 - *Click Manage this Application Server*
 - *Open IIS Manager*
 - *Local Computer -> Web Sites -> Default Web Site*
 4. Verify the configuration information of the default Web Site
 - *Right Click on Default Web Site -> Properties*
 - *Identify the port number of the WebSite, check the Home Directory and the default documents.*
 5. Verify that the Web Server is working
 - *Obtain the IP Address of the server by opening a command console: Cmd -> “ipconfig”*
 - *Connect to the second Windows Virtual Machine and open a Web Browser*
 - *Go to: http://IP Address of the Server (The default web page should open)*

B. Research and answer the following

1. Creates a Website that uses the port 8330 and put a web page in it.
2. Explain the different methods that exist to have multiple websites in the same webserver using IIS. (Explain how to configure them)

PART II:

A. Install the FTP service in IIS

1. Connect to the console of the Windows Virtual Machine via Remote Desktop.
 - *Username: Administrator*
 - *Password: netsys*
2. Add the FTP Service to IIS
 - *Start -> Control Panel -> Add or Remove Programs*
 - *Add or Remove Windows Components*
 - *Select **Application Server** and click **Details***
 - *Select **Internet Information Services (IIS)** and click **Details***
 - *Select **File Transfer Protocol (FTP) Service** and click **OK, OK, Next***
 - *When the installation ask for the Windows Installers click Browse -> My Computer -> Local Disk (C:) -> Win2003 Sources -> Disc1 -> I386 -> Open -> OK*
 - *At the end just click **Finish***
3. Verify that the FTP server was installed
 - *Start -> Administrative Tools -> Internet Information Services (IIS) Manager*
 - *FTP Sites*
 - *Check the state of the FTP Service.*
4. Check the Configuration information of the FTP
 - *Expand **FTP Sites** and Right Click in **Default FTP Site***
 - *Identify the Port Number, Check the Home Directory and Verify the security configuration of the FTP*
5. Verify that the FTP server is working

- Obtain the IP Address of the server by opening a command console: *start → run → cmd -> “ipconfig”*
- *Connect to the second Windows Virtual Machine via Remote Desktop (RDP)*
- Open a command console
- *start → run → cmd*
- Connect to the FTP Server
- *ftp (IP address of the server)*
- *Username “anonymous” password: “Your email address”*

B. Research and answer the following

1. Change the Welcome Banner of the FTP Server
2. Create a user that can Write to the FTP Server
3. Create a user with Read Only access to the FTP Server.
4. Upload a file to the FTP Server
5. Download a file from the FTP Server
6. ¿What we have to do to execute multiple FTP Servers in the same host?

6.3.2 Windows Laboratory in Action

The Windows Lab required some effort to make the configuration. Nevertheless, after completing the lab configuration the lab was tested to check the guide and the proper functioning of it. The students were required to connect to the Lab Manager to deploy the Lab Configuration. After successfully deploying the lab, a Remote Desktop access was available to connect to the Virtual Instances. See below a network diagram of the connections to the Windows Lab.

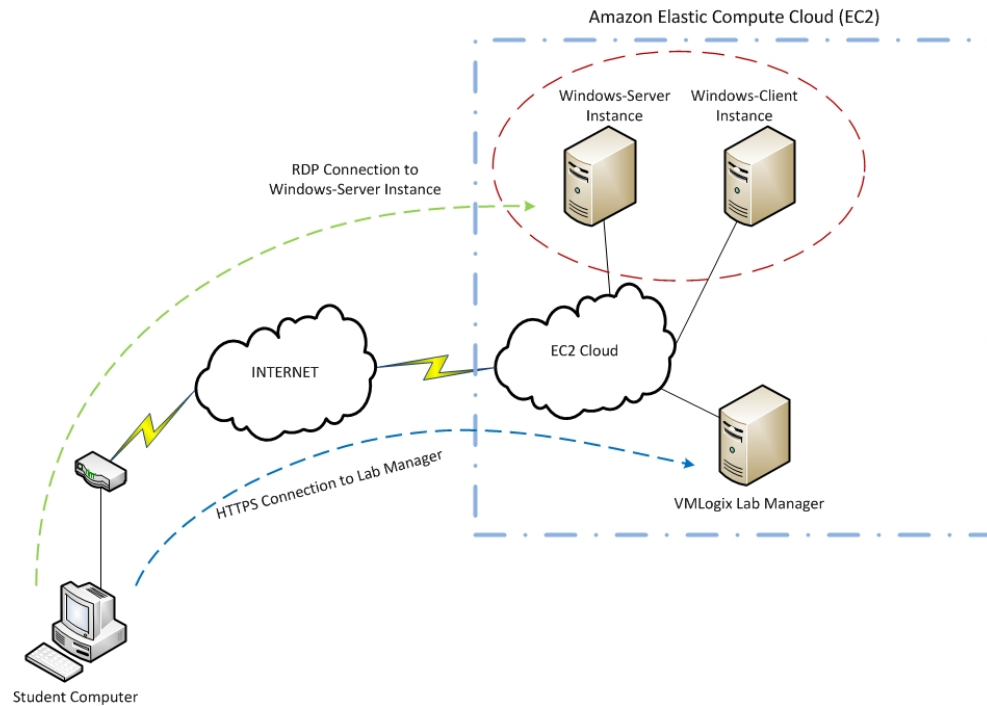


Figure 34 - Network Diagram of Windows Lab Network Connections

The first step was the connection to the Lab Manager and login into the web page. Furthermore, inside the Lab Manager the lab configuration was deployed so the lab virtual instances were created. See images below.

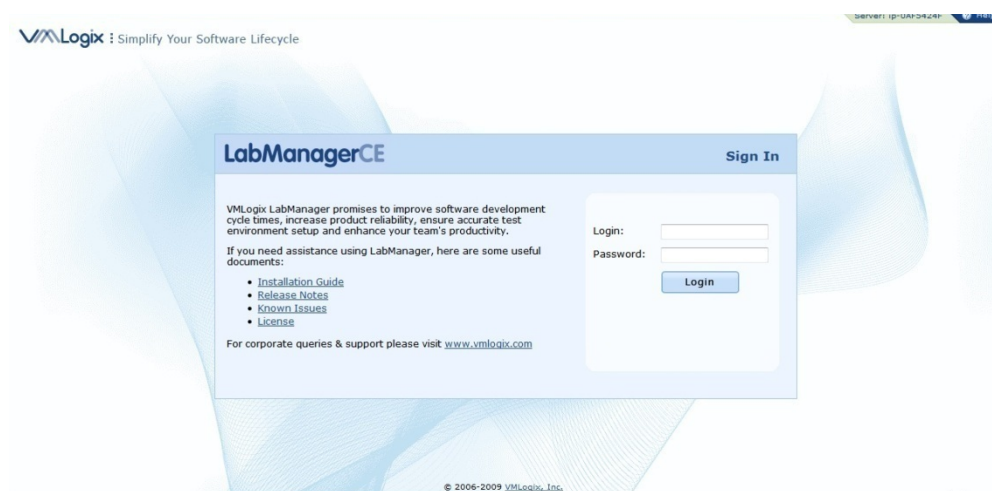


Figure 35 - Logon to VMLogix Lab Manager (Windows Lab)

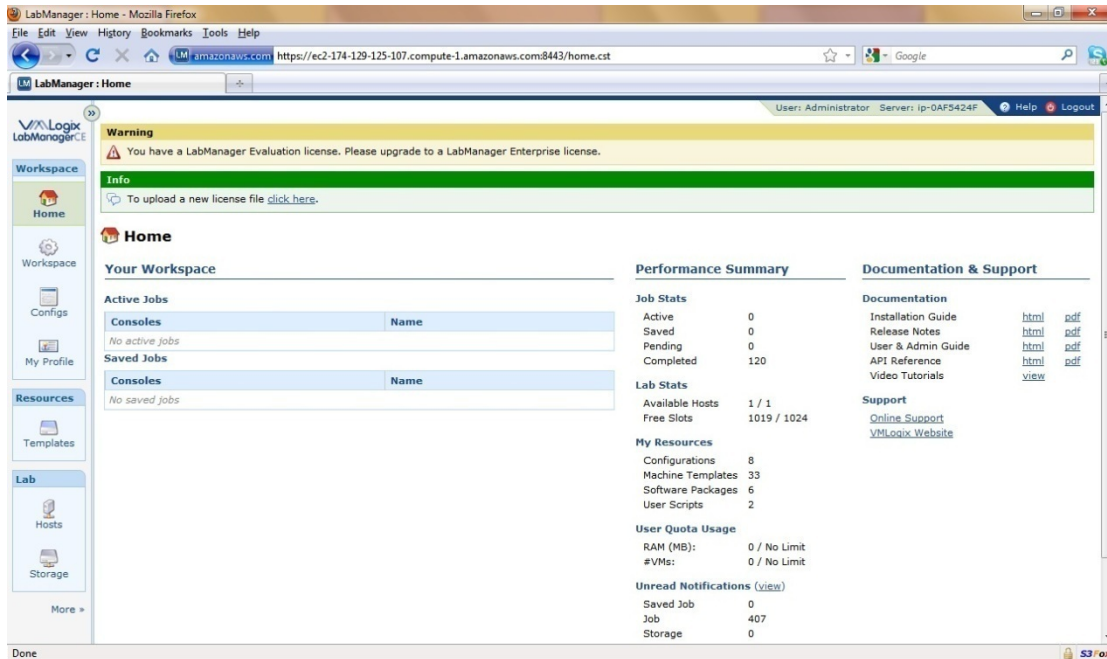


Figure 36 - VMLogix main screen (Windows Lab)

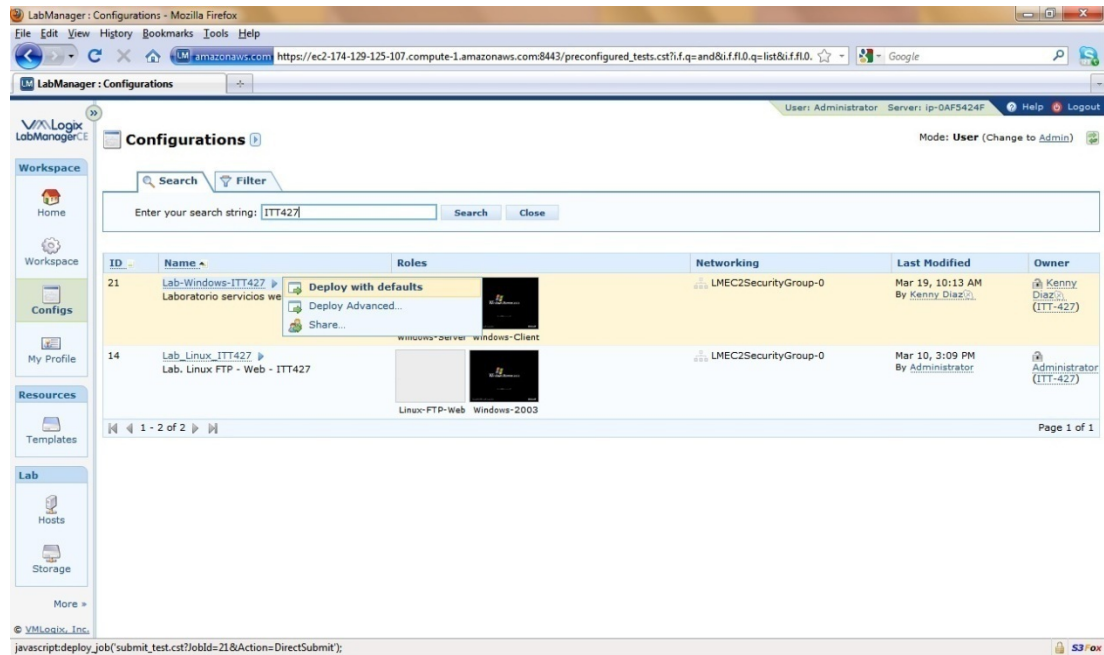


Figure 37 - Deploying the Windows Lab in the Configurations screen

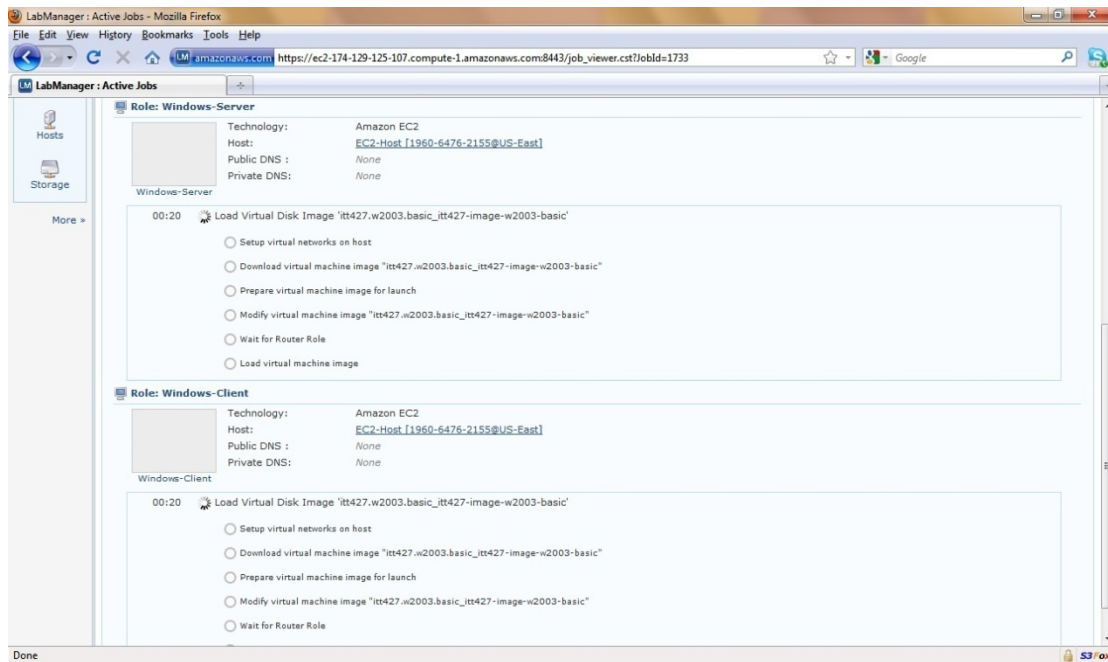


Figure 38 - Deployment process of Windows Lab

After deploying the lab configuration the guide was followed to begin the laboratory. The first part of the lab was the configuration of the Web Server (IIS) this was accomplished by accessing the Windows-Server instance using Remote Desktop (RDP). See images below.

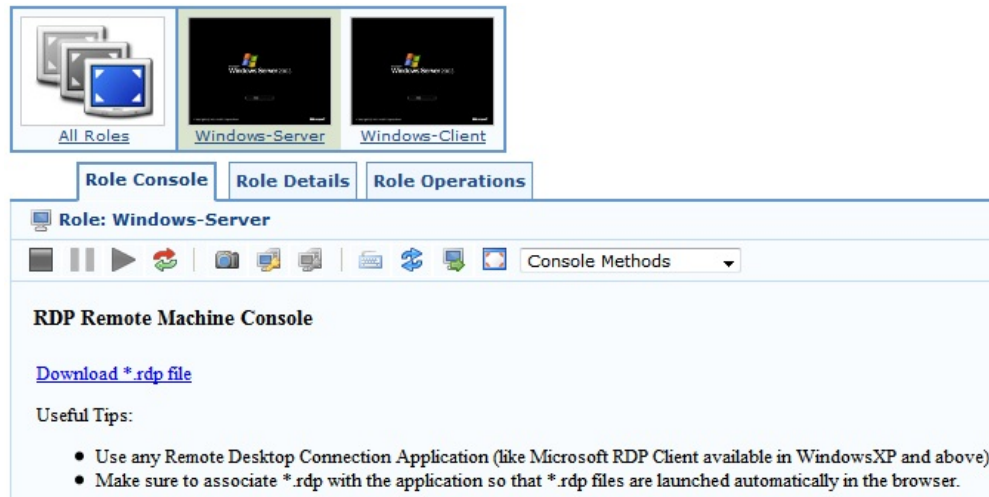


Figure 39 - Accessing Windows-Server through RDP (Windows Lab)



Figure 40 - Login to Windows-Server (Windows Lab)

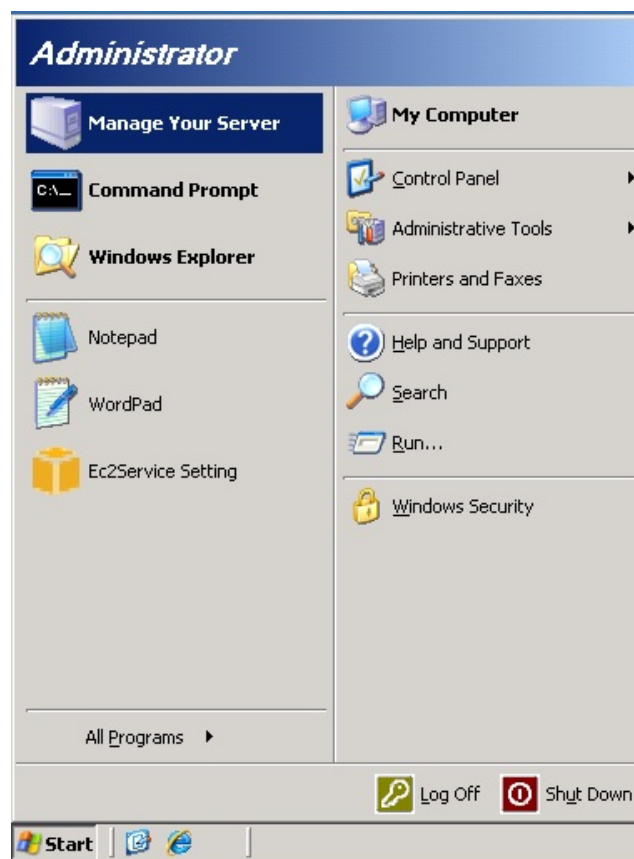


Figure 41 - Accessing the Manage Your Server (Windows Lab)

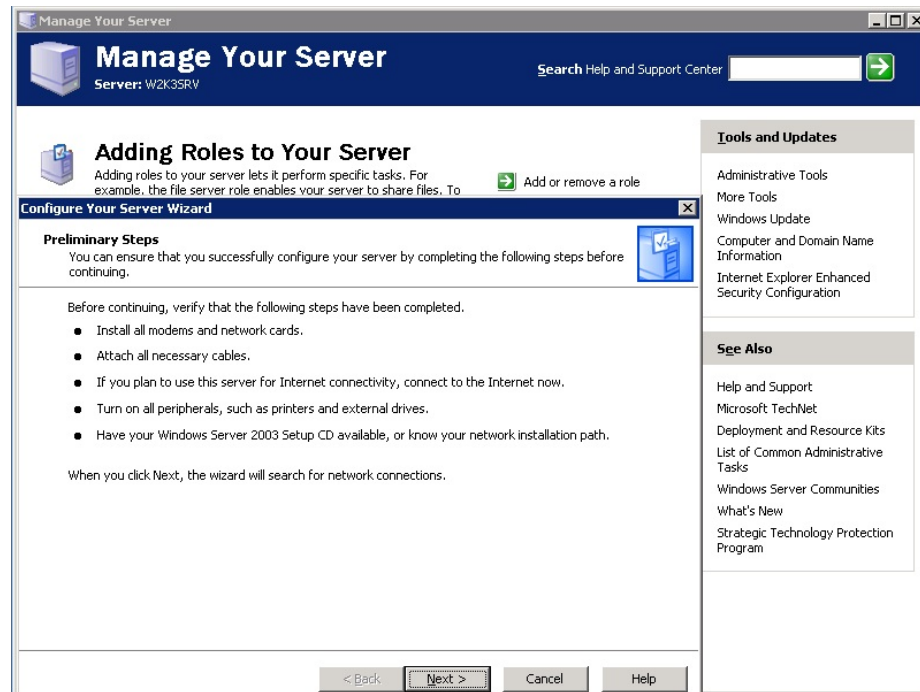


Figure 42 - Adding a Role Wizard (Windows Lab)

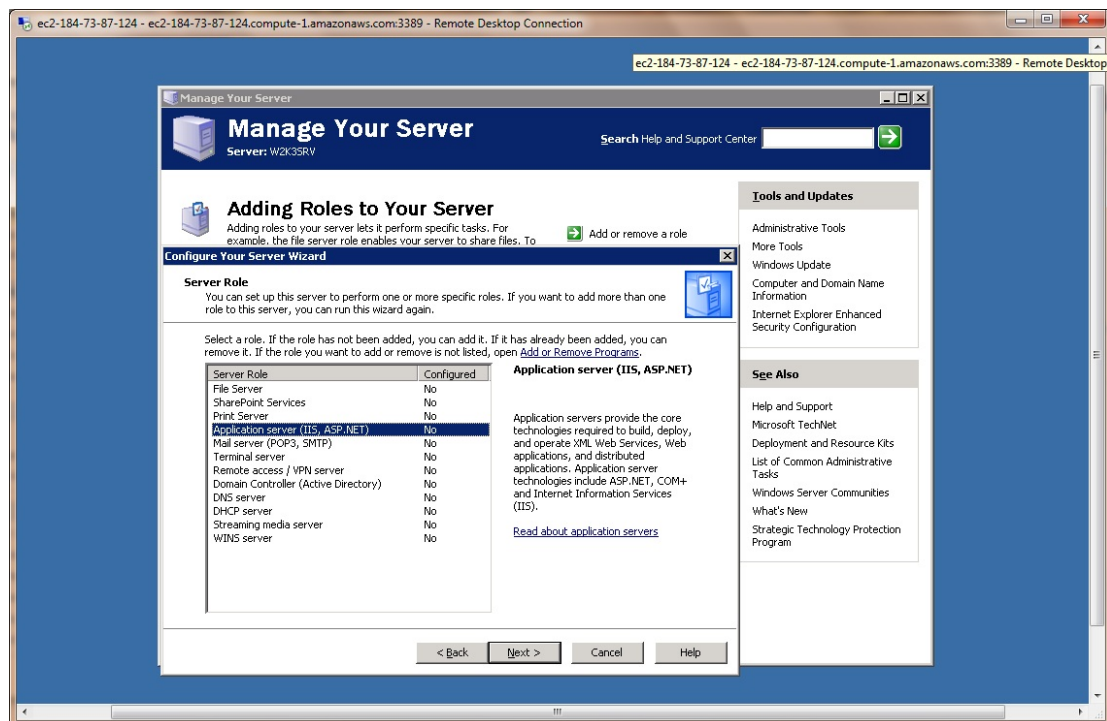


Figure 43 - Selecting Application Server Role for installation (Windows Lab)

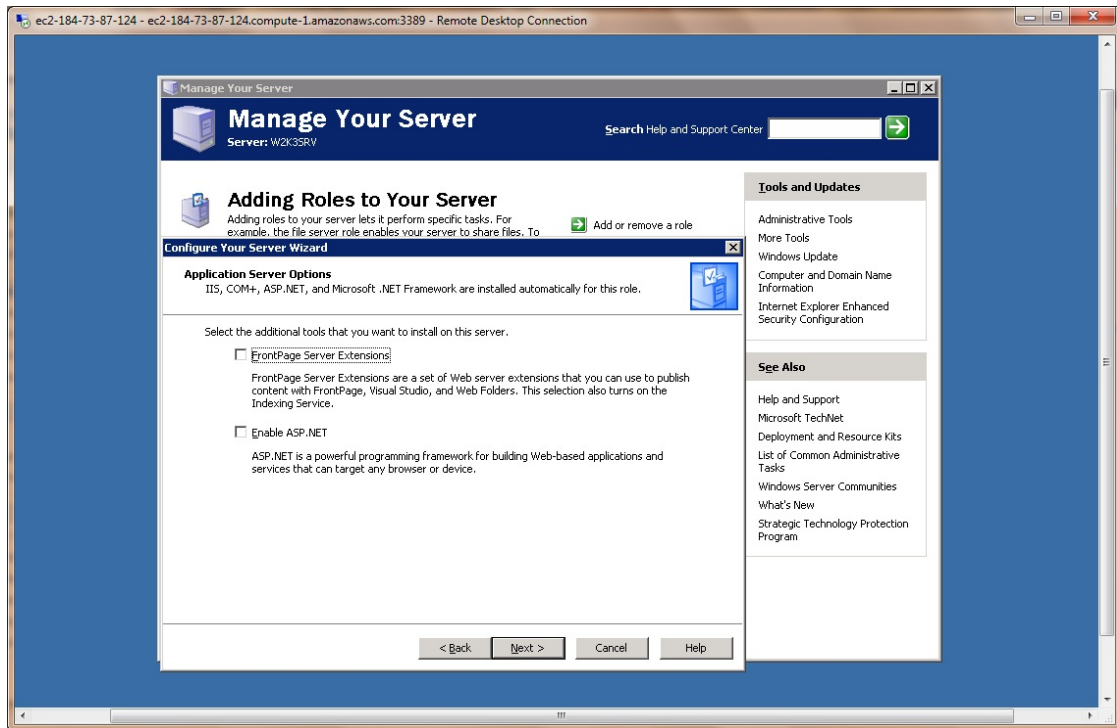


Figure 44 - Selecting Additional Tools for the Application Server (Windows Lab)

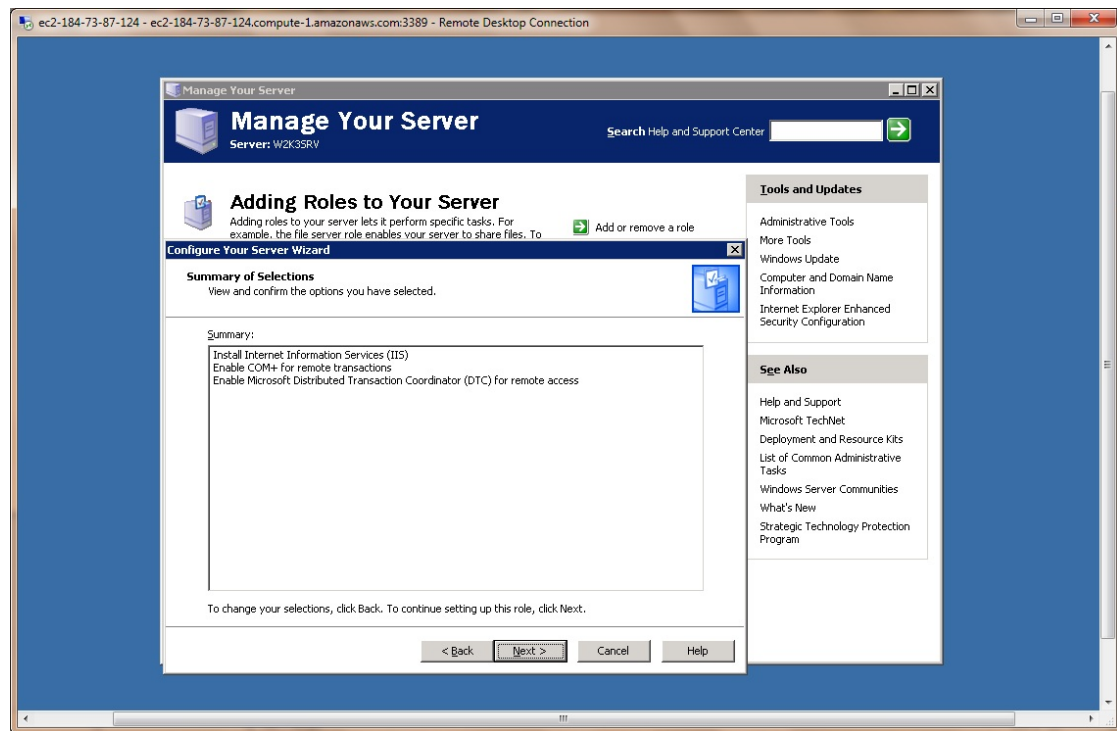


Figure 45 - Summary of Selection before installing Application Server (Windows Lab)

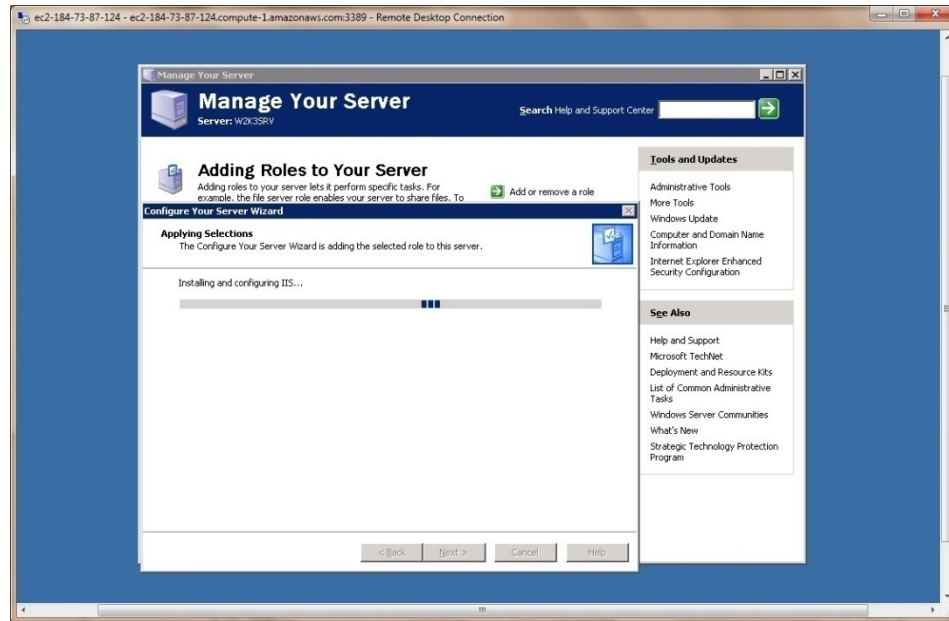


Figure 46 - Installing and Configuring IIS (Windows Lab)

The installation of the IIS required the installation discs of Windows Server 2003 that were copied in the image C: drive so can be accessed to finish the installation process. See images below.

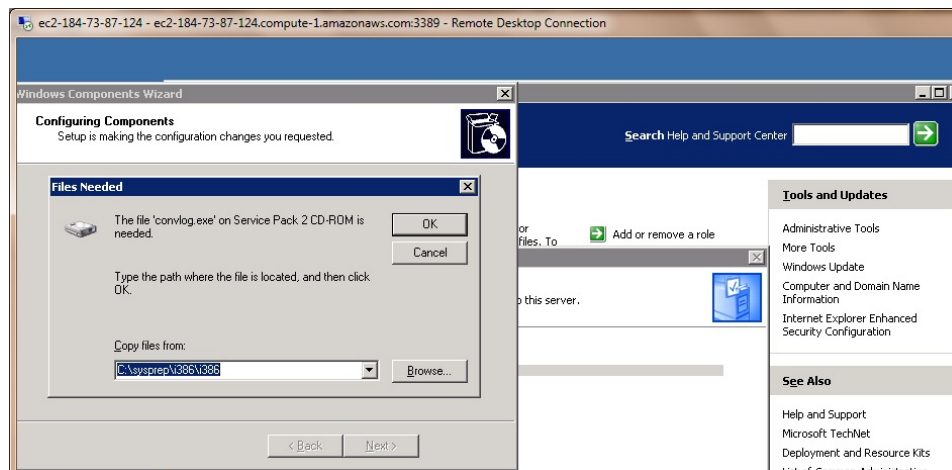


Figure 47 - Asking for the Windows Installation Discs (Windows Lab)

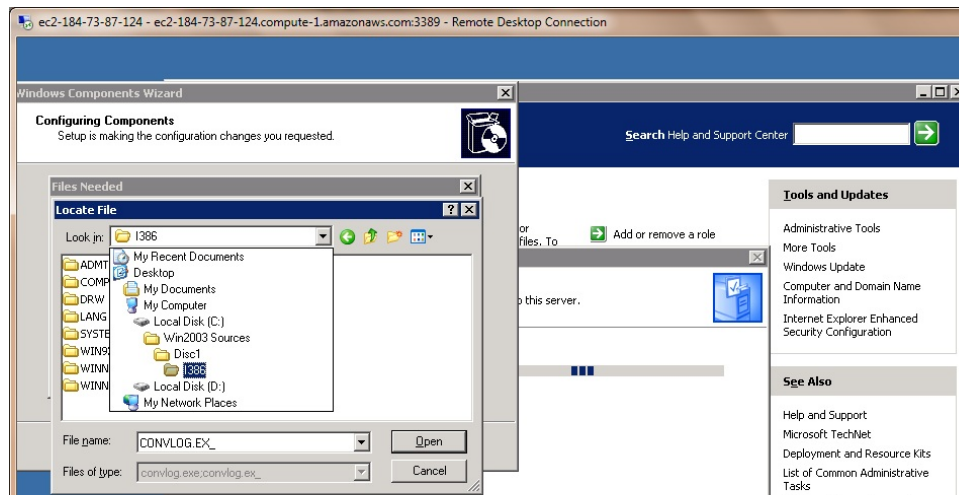


Figure 49 - Browsing for the Installation Discs (Windows Lab)

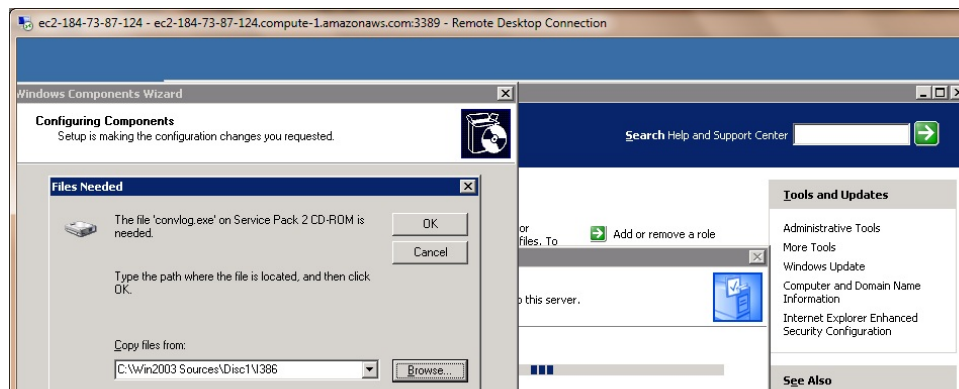


Figure 48 - Selecting Windows Installation Discs folder (Windows Lab)

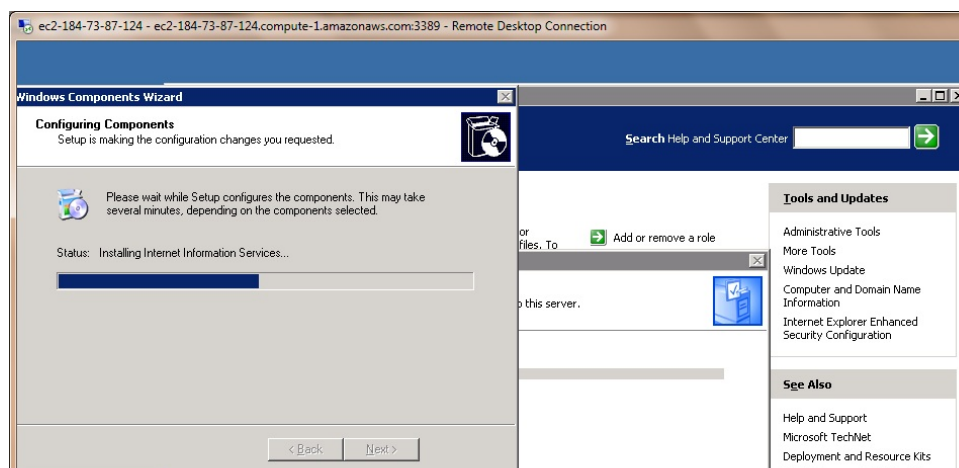


Figure 50 - Completing Installation of IIS (Windows Lab)

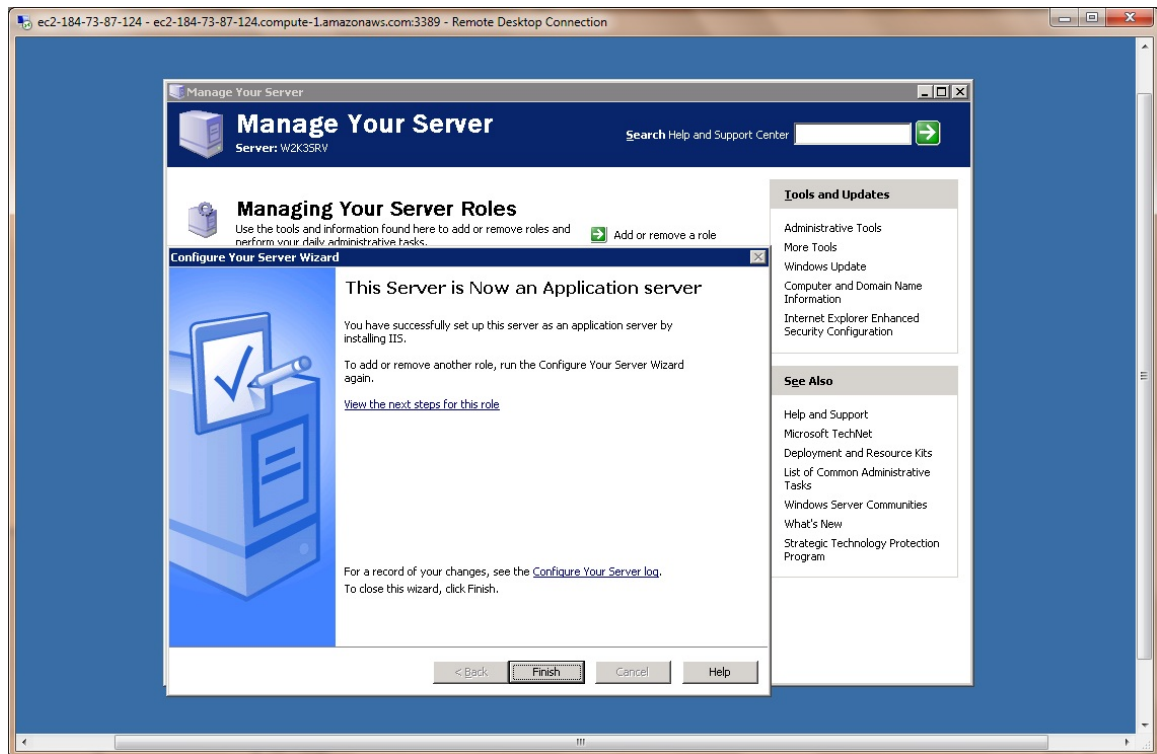


Figure 51 - Finish Installation of Application Server (Windows Lab)

After the installation of IIS was finished, the next step was to check the default configuration of the Web Server. See images below.

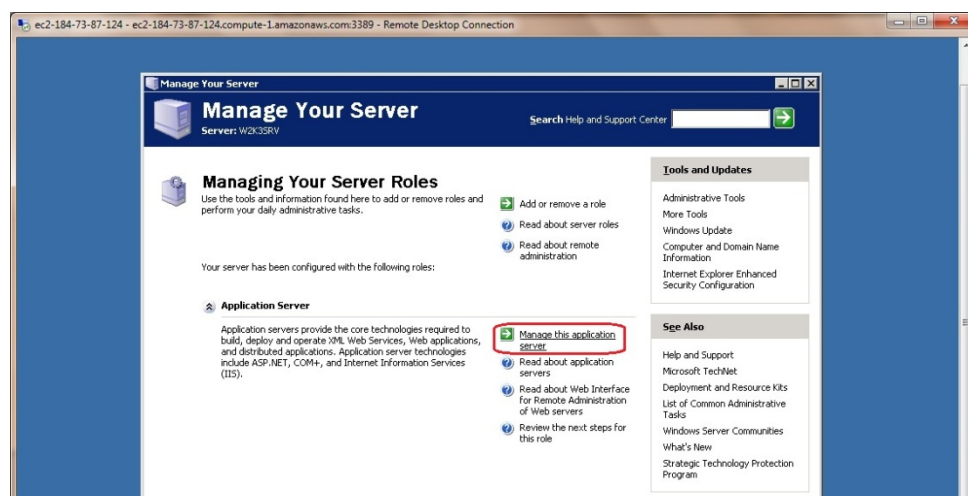


Figure 52 - Access the Manage Application Server (Windows Lab)

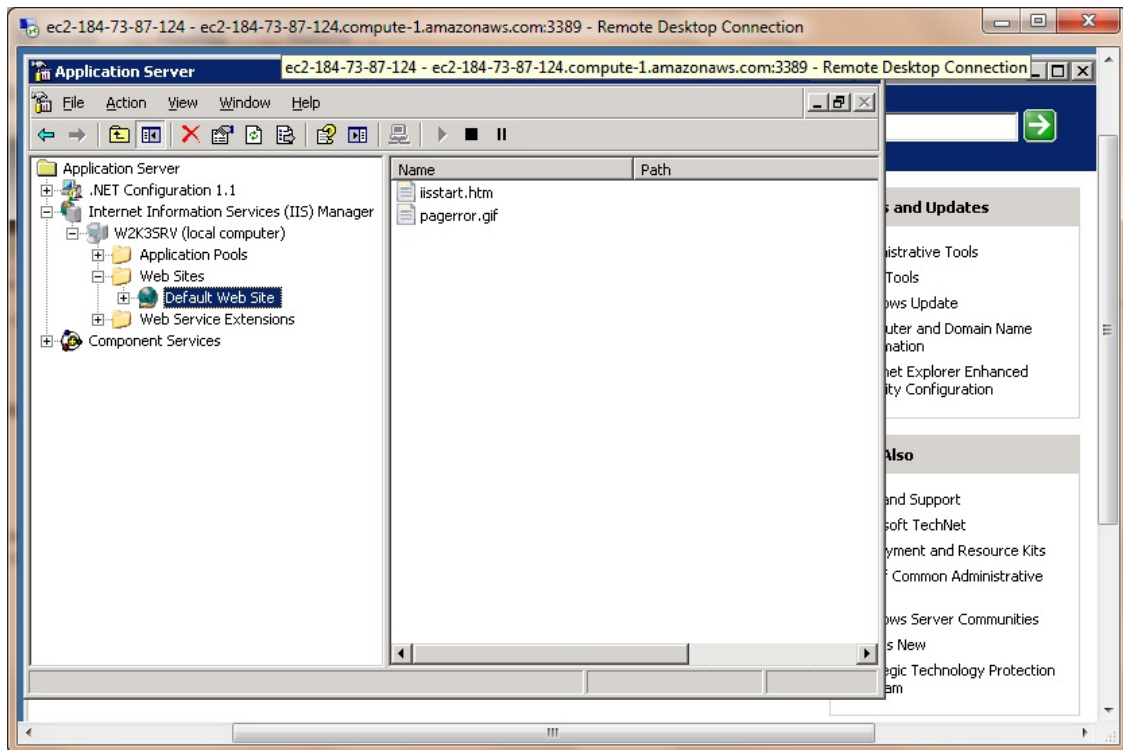


Figure 53 - Accessing the Default Web Site Properties (Windows Lab)

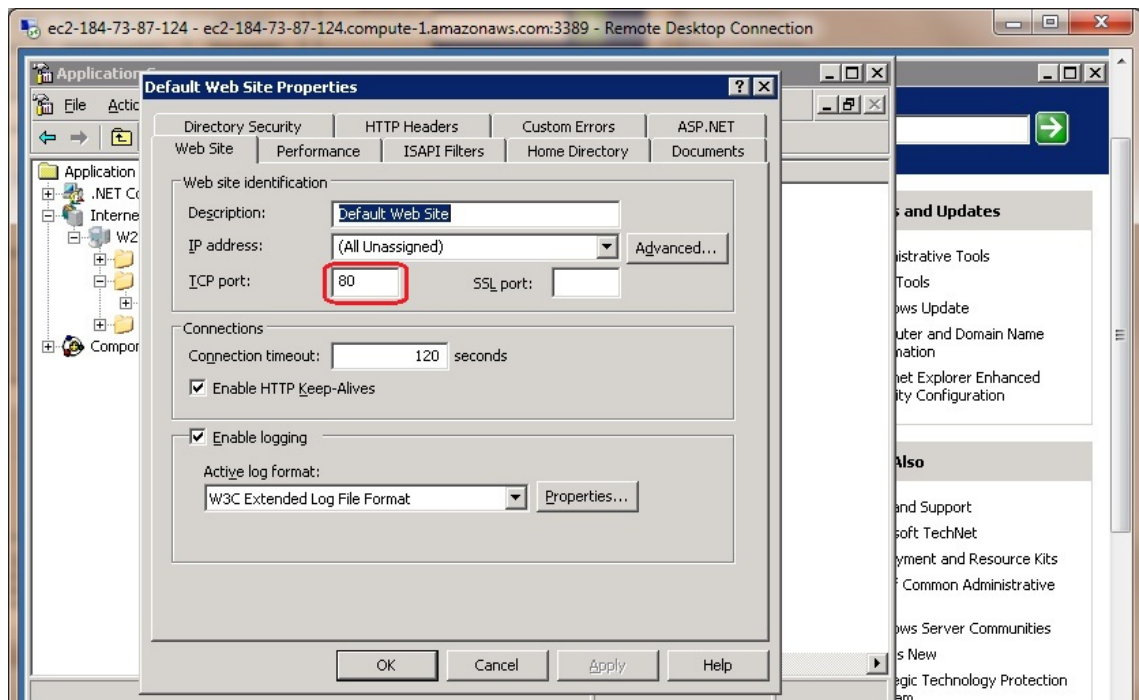


Figure 54 - Default Web Site port (Windows Lab)

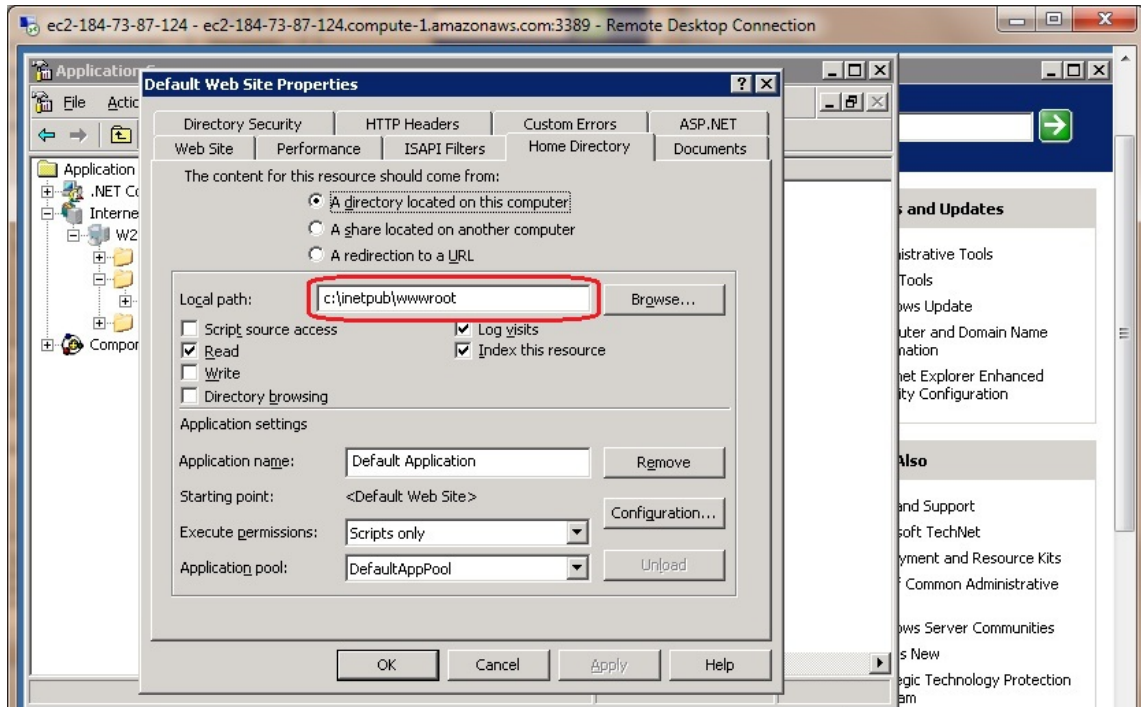


Figure 56 - Home Directory of the Default Web Site (Windows Lab)

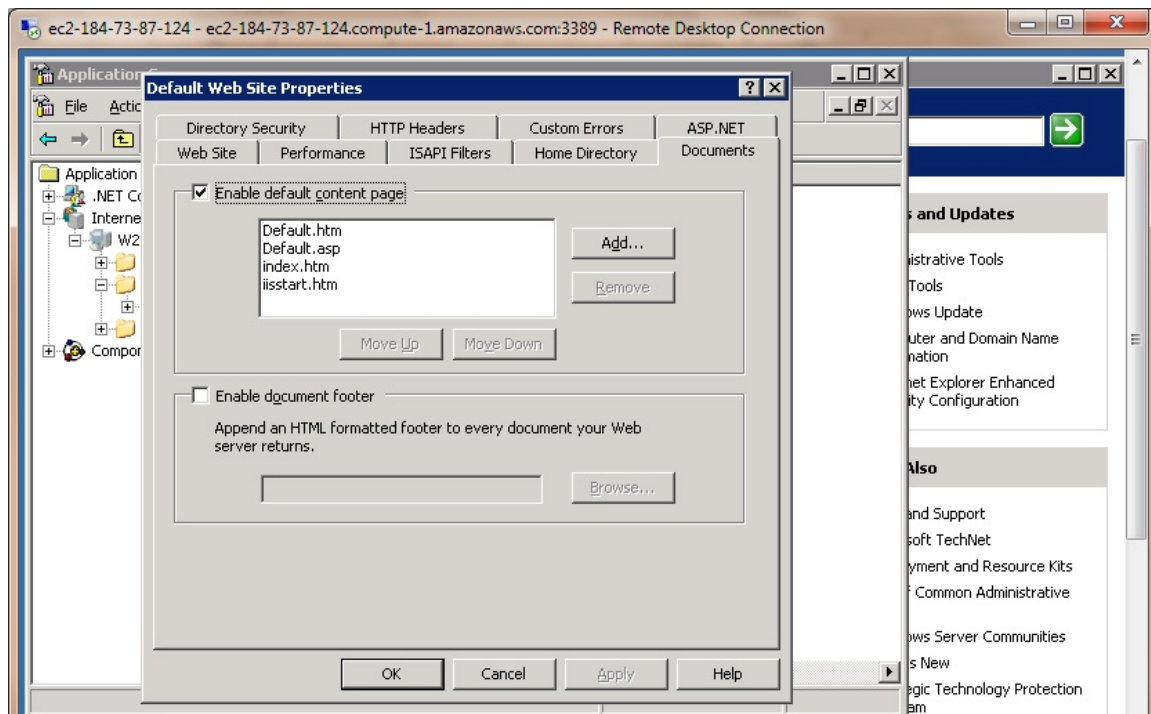


Figure 55 - Default Documents of the Default Web Site (Windows Lab)

After checking the default configuration the Web Server was ready to be tested. This task was accomplished by login into the Windows-Client instance and connecting to the Web Server internal IP address with the Internet Explorer web browser. See images below.

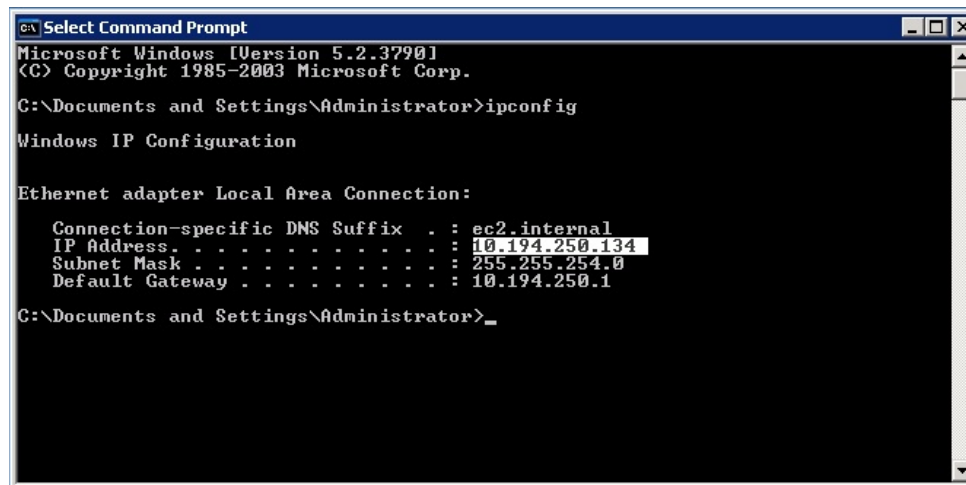


Figure 57 - Windows-Sever Internal IP Address (Windows Lab)

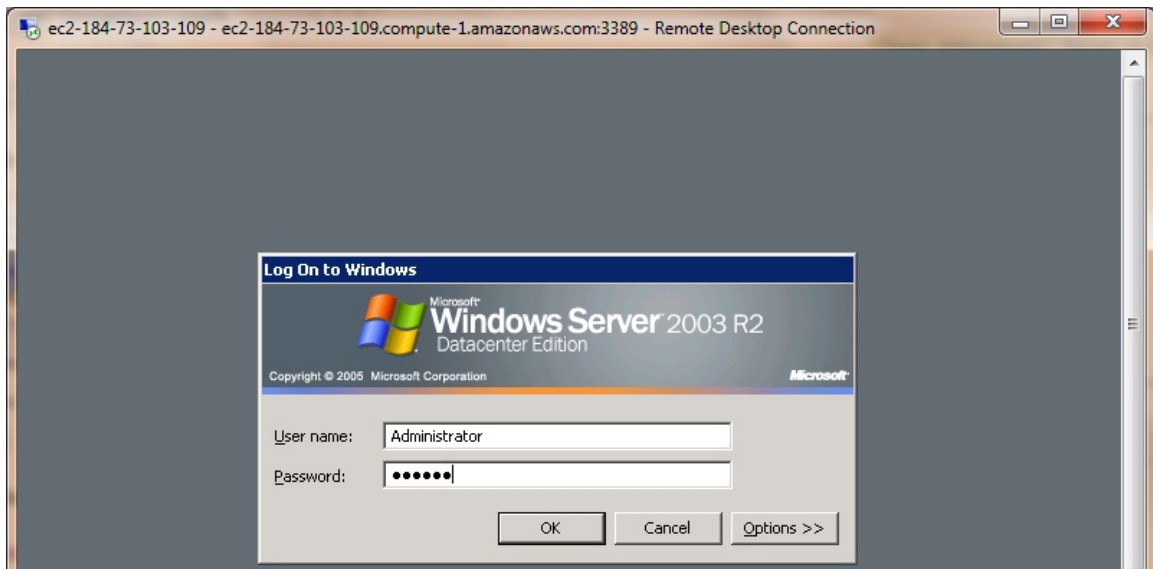


Figure 58 - Login to Windows-Client (Windows Lab)

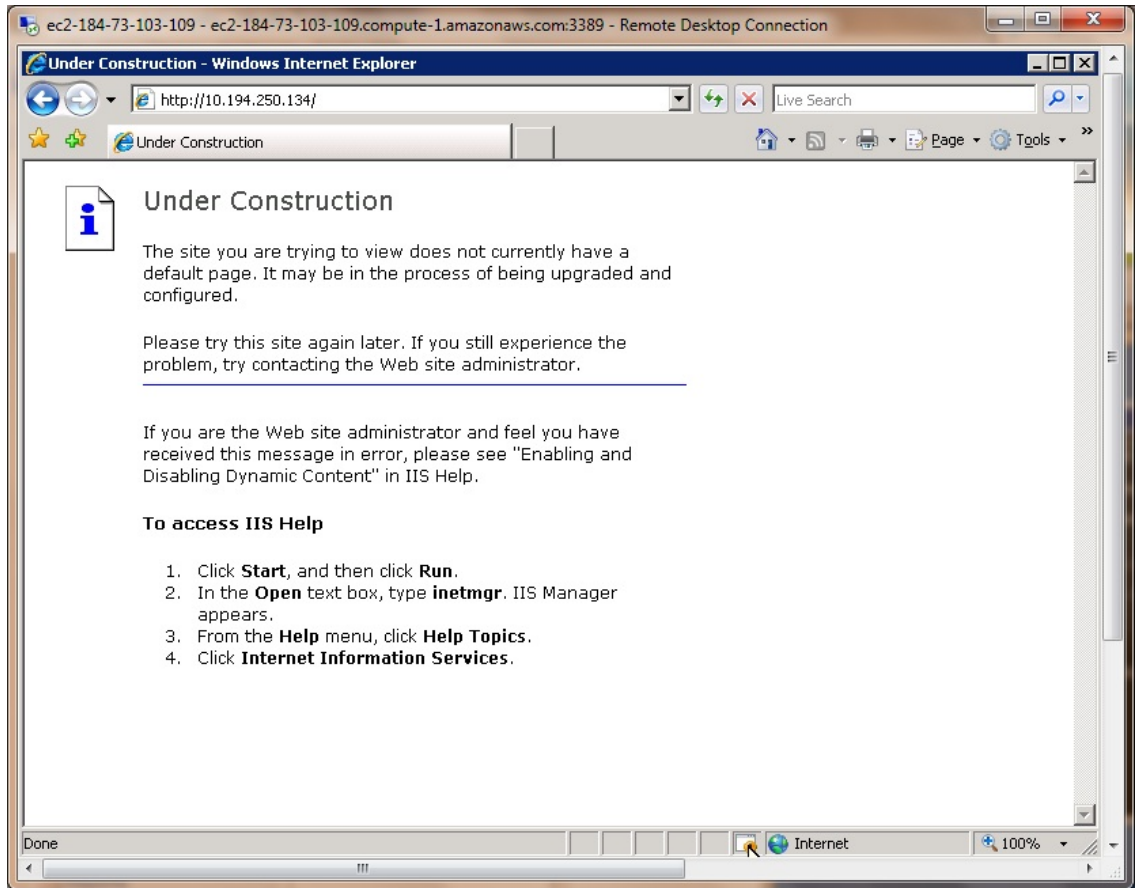


Figure 59 - Using Internet Explorer to access the HTTP Server (Windows Lab)

The second part of the lab required the installation of an FTP server in IIS. This was made by modifying the default installation of IIS to add the FTP server. This also required the installation discs of Windows Server 2003 available in the C: drive of the instance. See images below.

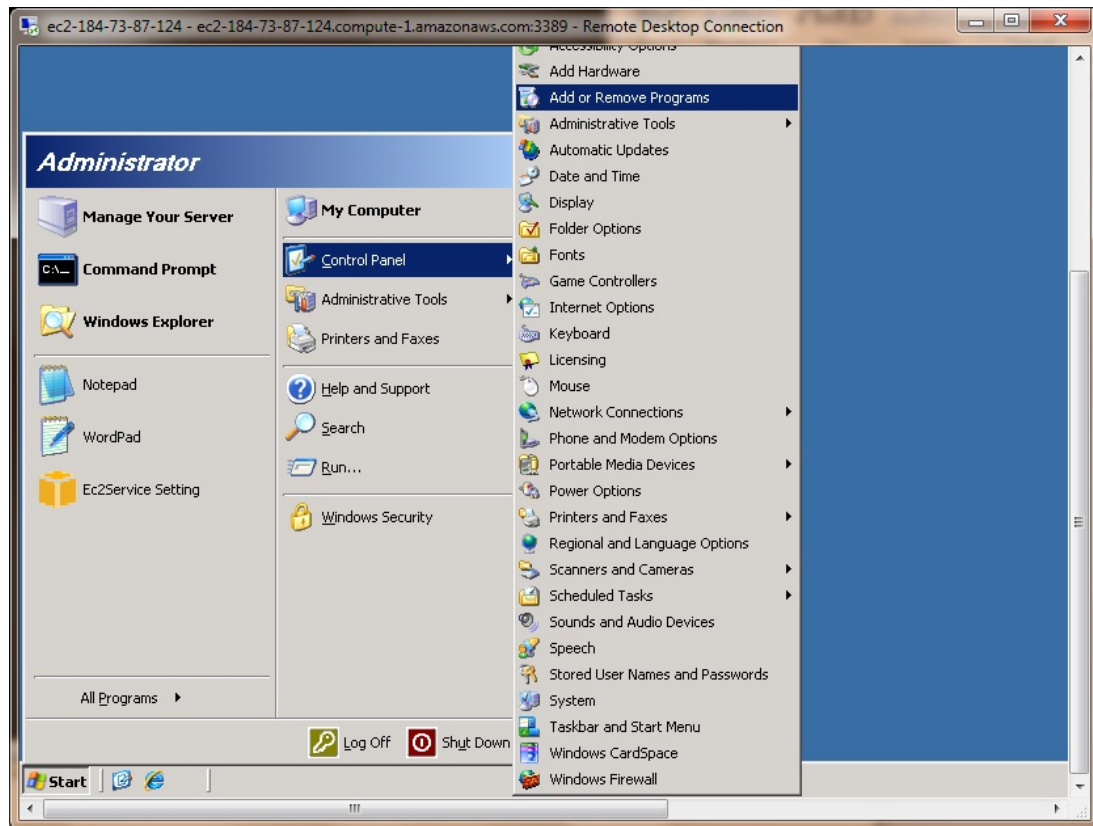


Figure 60 - Accessing the Add/Remove Programs (Windows Lab)

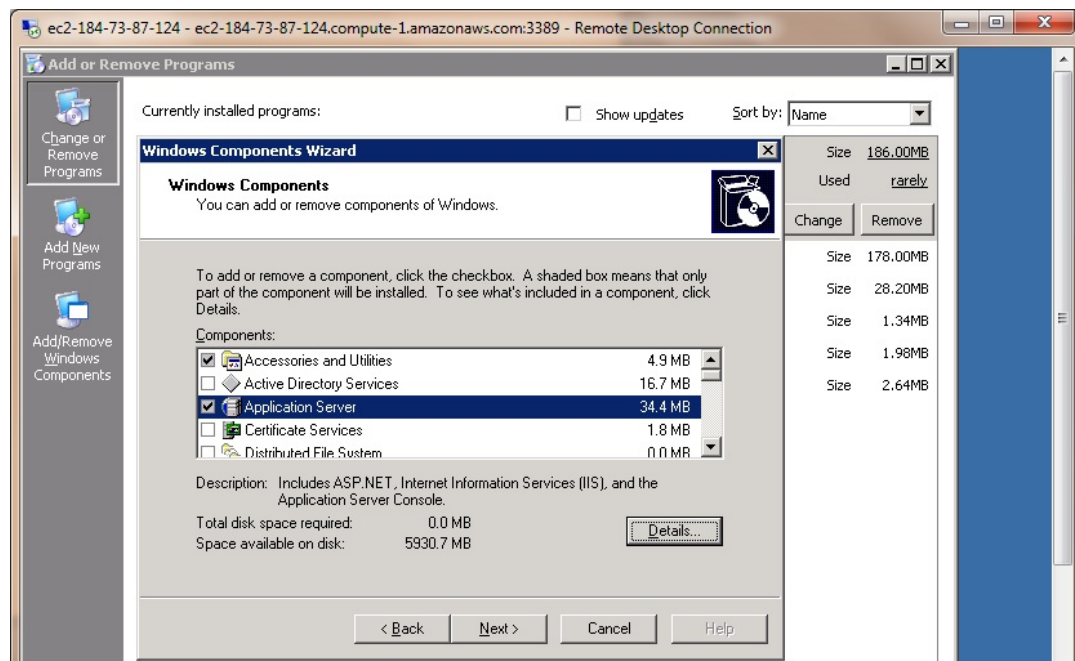


Figure 61 – Add/Remove Windows Components - Application Server (Windows Lab)

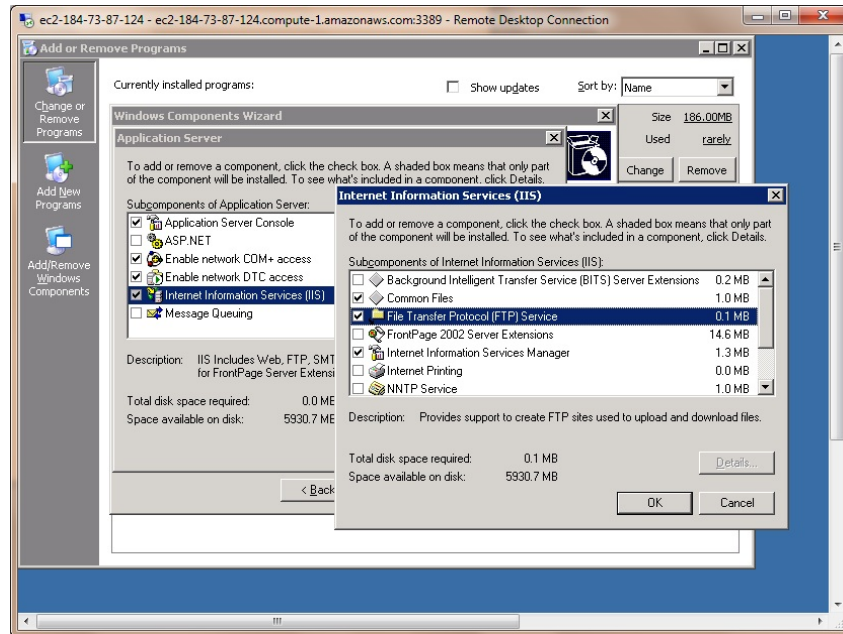


Figure 62 - Adding FTP Service (Windows Lab)

After installing the FTP service the default configuration was checked. This was made from the IIS Manager which can manage both, the Web server and the FTP server. See images below.

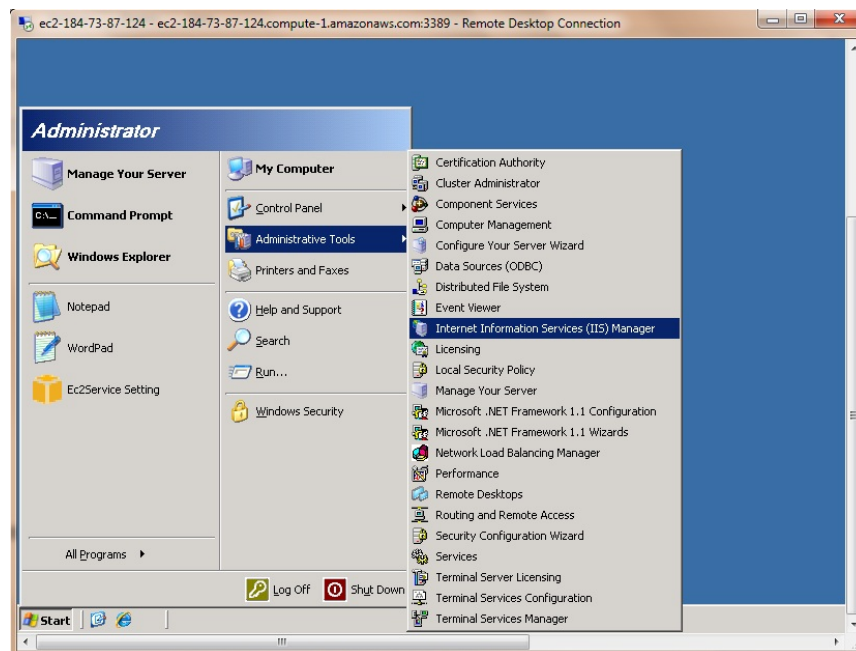


Figure 63 - Accessing IIS Manager (Windows Lab)

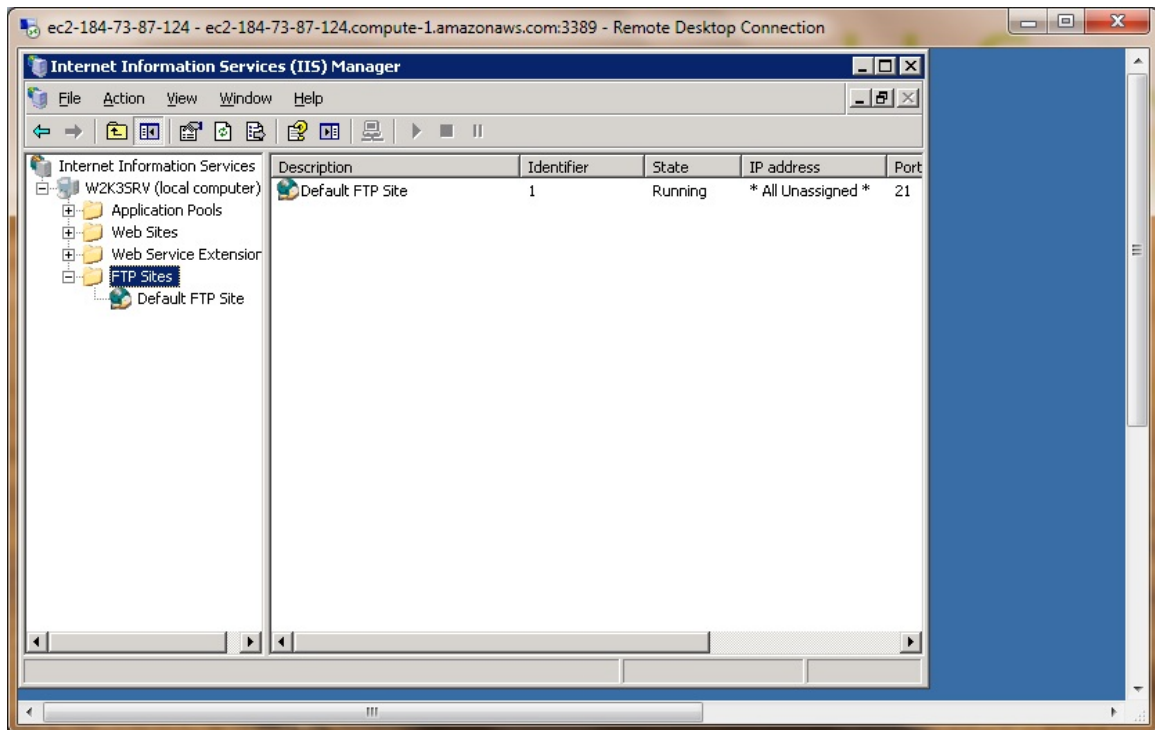


Figure 64 - Default FTP Site State (Windows Lab)

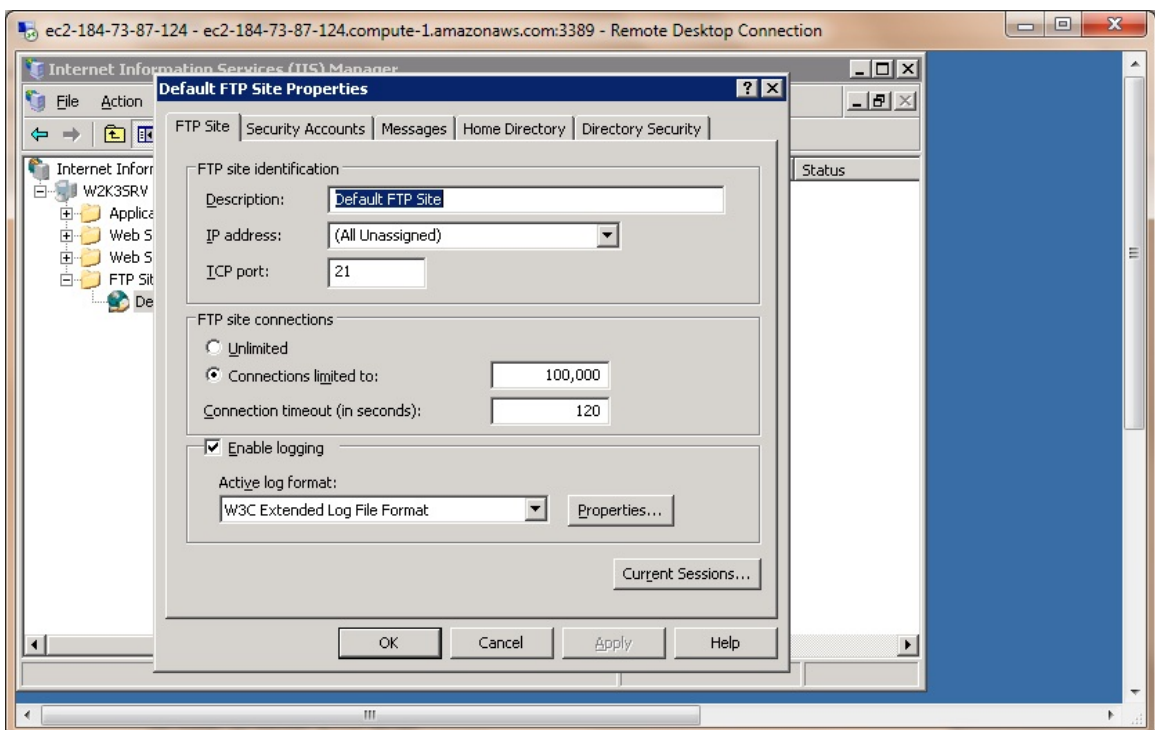


Figure 65 - FTP Site default port (Windows Lab)

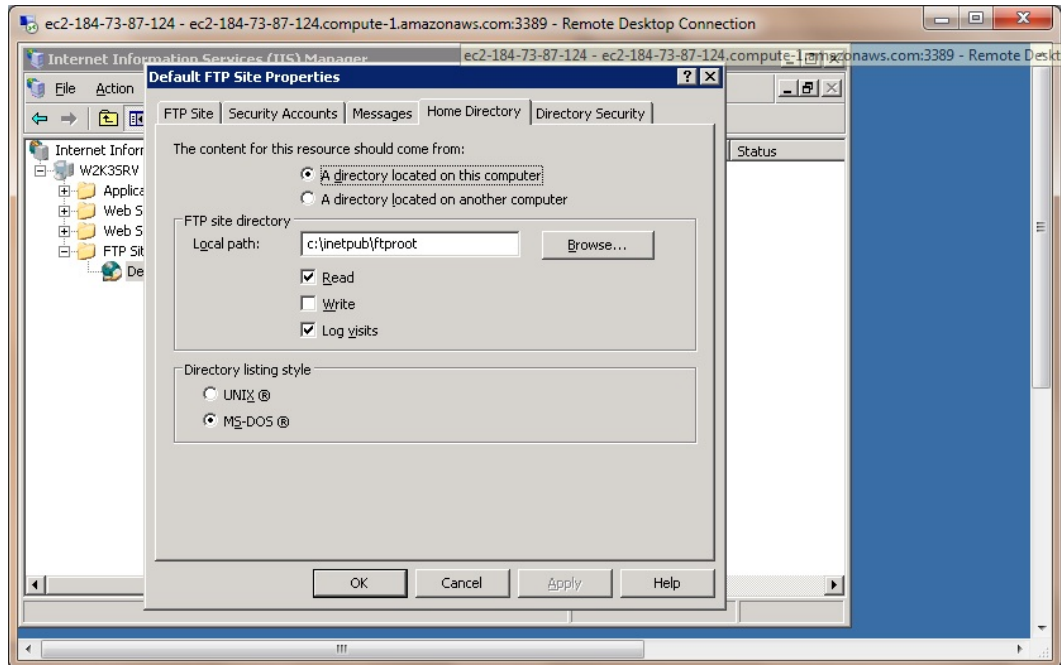


Figure 66 - Home Directory of the Default FTP Site (Windows Lab)

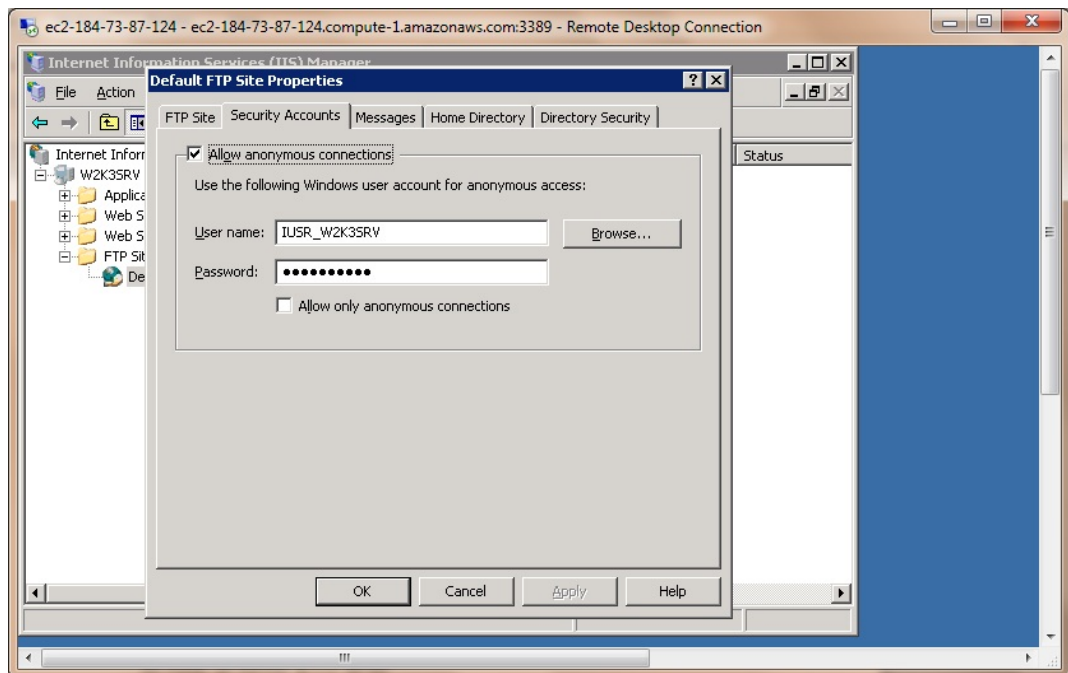


Figure 67 - Access Security of the Default FTP Site (Windows Lab)

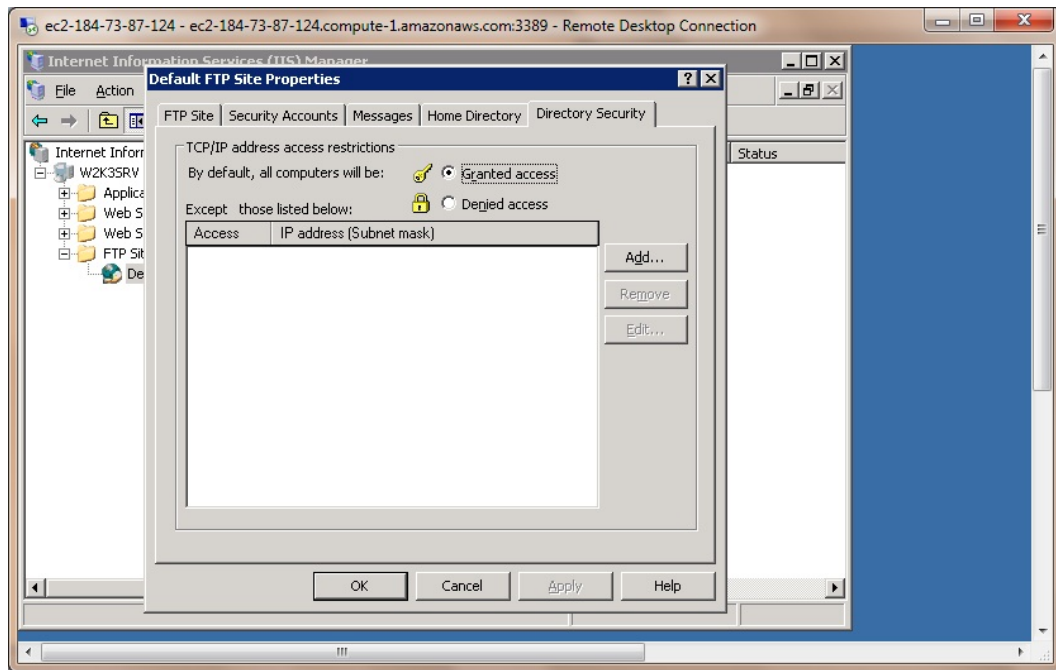


Figure 68 - Access Restrictions of the Default FTP Site (Windows Lab)

The last step of the second part was to test the FTP server from the Windows-Client instance. Furthermore, the command tool “ftp” was used to test the FTP server. See images below.

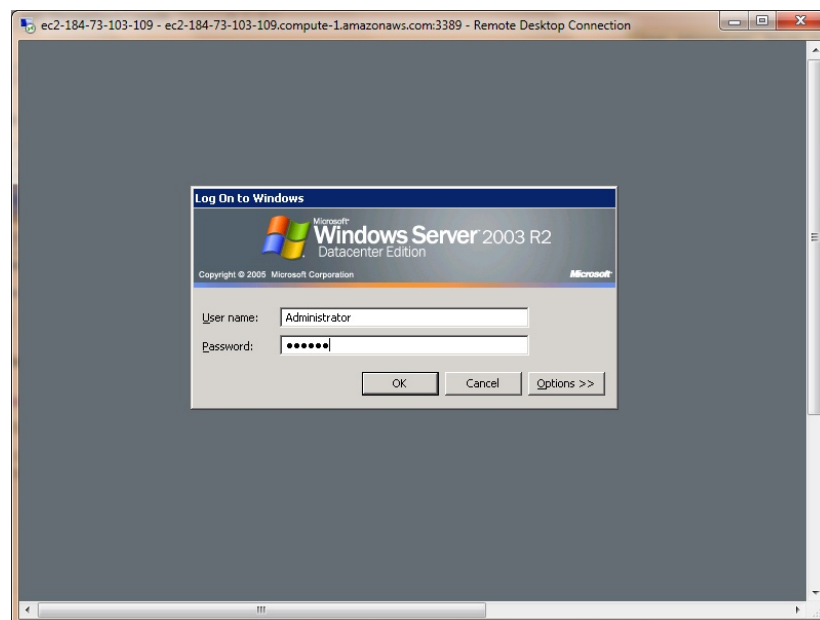


Figure 69 - Logon to Windows-Client (Windows Lab)

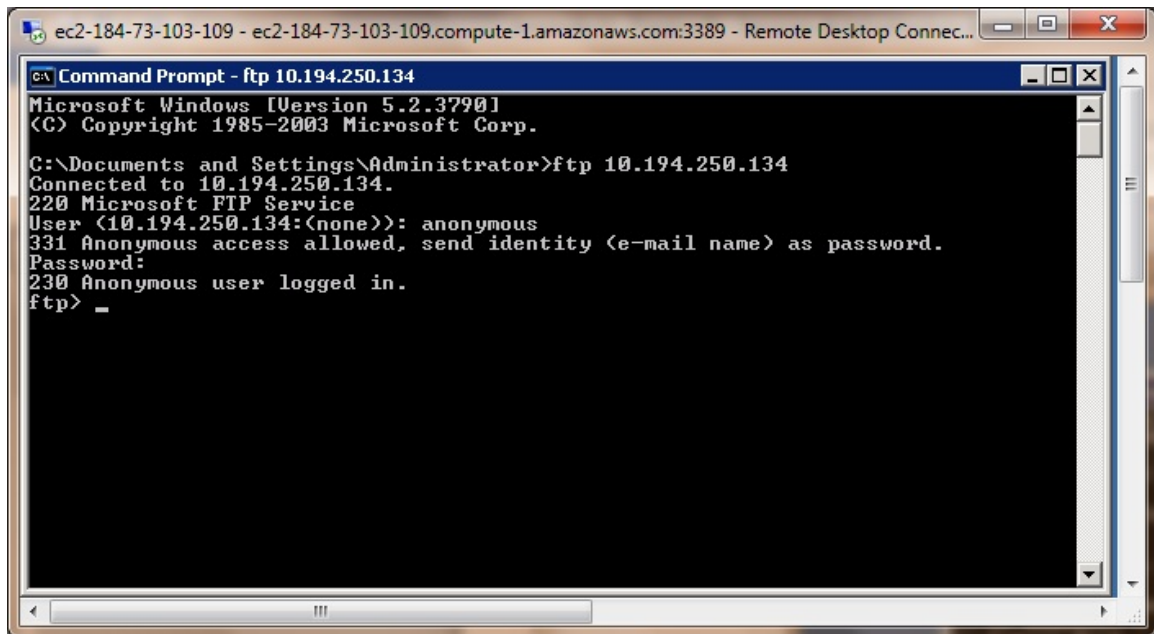


Figure 70 - Testing FTP Server (Windows Lab)

7. Laboratories Experiences

The Amazon EC2 platform and the tools provided by it permitted the creation of the virtual lab infrastructure. Furthermore, the use of VMLogix Lab Manager as the interface for managing the labs provided a simple interface for the students to access their remote virtual laboratories. Nevertheless, the creation of the labs required more knowledge of the technologies involved. For example, the windows lab required the creation of an image with the installation discs in a folder. This image was created using the tools provided by Amazon EC2 and it was necessary to follow several steps.

The Linux lab was easier to develop than the Windows because it was not necessary to make any modifications to the image. Nevertheless, students' access to the SSH console was more difficult due to some incompatibilities with the Java console. Also, The access was problematic where sometimes after the deployment it didn't provide the SSH as a console method and the students had to go back to the workspace and get back into the active job again to have access to the SSH console.

Also, according to Diaz in his “Students’ Satisfaction When Using a Remote Virtual Lab based on Amazon EC2 for Networking Courses at PUCMM”, students’ found advantages in the use of this laboratory environment. For example, the availability of the lab was one of the advantages that students like most. This was because they used the lab from anywhere and at their most convenient time.

Another advantage that students’ found was that they don’t have to worry about physical connections that required time and effort.

The students were able to complete their lab assignment through the use of VMLogix Lab Manager and Amazon EC2. Furthermore, the issues found didn’t stop students to complete their lab work.

8. Some Costs Considerations

The use of the Lab Manager consumes resources in the Cloud. The most basic resource that consumes EC2 Instances was the Lab Manager server itself. This server was actually a Windows Instance powered on 24/7. The server was installed in a small Instance which cost US\$ 0.12 per hour. Furthermore, running only the Lab Manager server was consuming US\$ 2.88 per day that’s made a US\$ 86.4 a month (Amazon EC2) that will be divided by all users.

This only provides the interface for using the system. We have to add the space consumed in S3 for storing the images needed for the labs and also the usage of instances by the students to made the lab. Furthermore, there are charges for the data in and out of the AWS Cloud. Also, VMLogix provided their Lab Manager without costs and when asked for the price they didn’t want to give it. AWS also provided credits for the use of

the EC2 and S3 services. Those credits provided the ability to experiment and test with the Cloud for a complete year (AWS in Education).

The Linux lab requires the students to use a small Instance and does not required an image stored in our S3 account. Instead a publicly available image was used. Furthermore, the amount of time required was estimated in four hours so students could take screenshots to presents in their reports.

The Linux Lab Costs:

Number of Students	Number of Instances	Estimated Hours	Rate per Instance per Hour	Total per Instance	Total
1	2	4	US\$ 0.085	US\$ 0.34	US\$ 0.68

However, the windows labs costs were more expensive because was required to create an image with the Windows Installers included that was stored in S3. The windows image took 3.5 GB of storage in S3 with a cost of US\$ 0.10 per GB per month which adds up US\$ 0.40 (Amazon S3). Nevertheless, this image was accessed by all the students that participated in the lab.

The Windows Lab Costs:

Number of Students	Number of Instances	Estimated Hours	Rate per Instance per Hour	Total per Instance	Total
1	2	4	US\$ 0.12	US\$ 0.48	US\$ 0.96

If we assume that regular laboratory for PUCMM could have ten labs and the labs are mixed half using Linux and half using Windows.

The five Linux Lab Costs:

Number of Labs	Number of Instances per Lab	Estimated Hours per Lab	Rate per Instance per Hour	Total per Lab	Total (Five Labs)
5	2	4	US\$ 0.085	US\$ 0.68	US\$ 3.4

The five Windows Lab Costs:

Number of Labs	Number of Instances per Lab	Estimated Hours per Lab	Rate per Instance per Hour	Total per Lab	Total (Five Labs)
5	2	4	US\$ 0.12	US\$ 0.96	US\$ 4.8

This means that all ten labs per student could cost an estimate of 8.2 dollars per semester per student.

These estimates don't take in consideration the expenses for the VMLogix Instance and the storage used by the images required for the labs. See Appendix I for details of the AWS Statements while students were using the labs.

9. Future Works

While the Cloud environment represent a great advantage for universities in terms of costs and the computational power available in minutes. Furthermore, there are more networking applications labs that can be implemented in the cloud like DNS service, Active Directory, Terminal Services, Email Server, Mixed environments (Windows/Linux) among others. Moreover, there are other areas that can take advantage of the Cloud platform provided by AWS like the software development. For example, students could create complex enterprise environments with all the servers and develop their application to use those resources.

10. Conclusions

The AWS Cloud is very responsive and robust providing a great virtualization environment for almost all needs. Their systems were up 100% of the time while working in the development of the labs and when the students were doing it. Nevertheless, it required some time to understand the technology and terminology they used for their environment. Furthermore, the platform is not oriented for doing labs that's why the use of a third party software like VMLogix Lab Manager Cloud Ed which is a lab manager for the Amazon's virtual environment was necessary.

VMLogix provided all the tools for use the AWS as a lab for students. Nevertheless, there were some small issues that students had like a refresh problem when working with Linux instances or problems for deployment of the labs. However, those small issues didn't stop the students for successfully worked in their labs.

The advantage of using this remote system was the flexibility the students had in terms of the time they needed and the resources for accessing it. Furthermore, students worked most of their time from their homes and at night. This represented a major improvement so students didn't have to reserve a computer resource inside the University for doing the labs during the day.

The use of the AWS platform with the VMLogix software could improve the labs experience of the students. Nevertheless, this environment requires the development of each lab carefully so the images and the student's guide are thoroughly tested.

Improving the practical experience of students through the use of hands-on labs that simulates business configurations can led to more prepared professionals in the future. The use of technologies and the platform provided by AWS seems to be an ideal environment for students to experiment and acquire the required experience needed in today's business.

11. References

- Amazon Web Services. Amazon EC2 API Tools. n.d. 20 March 2010
<<http://developer.amazonwebservices.com/connect/entry.jspa?externalID=351&categoryID=251>>.
- . Amazon Elastic Compute Cloud (EC2). n.d. 31 January 2010 <<http://aws.amazon.com/ec2/>>.
- . Amazon Simple Storage Service (S3). n.d. 31 January 2010 <<http://aws.amazon.com/s3/>>.
- . Amazon Web Services. n.d. 31 January 2010 <<http://aws.amazon.com/what-is-aws/>>.
- . AWS in Education. n.d. 20 February 2010 <<http://aws.amazon.com/education/>>.
- . Configuring Windows Components on Amazon EC2. n.d. 31 January 2010
<<http://developer.amazonwebservices.com/connect/entry.jspa?externalID=1802>>.
- Armitage, William D. , Alessio Gaspar and Matthew Rideout. "Remotely Accessible Sandboxed Environment with Application to a Laboratory Course in Networking." Proceedings of the Special Interest Group for Information Technology Education. Destin: ACM, 2007.
- Border, Charles. "The Development and Deployment of a Multi-User, Remote Access Virtualization System for Networking, Security, and System Administration Classes." Proceedings of the 38th SIGCSE technical symposium on Computer science education. Covington: ACM, 2007.
- CentOS Project. The Community ENTERprise Operating System (CentOS). n.d. 31 January 2010
<<http://www.centos.org>>.
- Create Your Own Web Server With BIND And Apache On CentOS 5 (Simplified). n.d. 03 October 2009 <<http://www.howtoforge.com/creating-your-own-webserver-with-bind-and-apache-centos5>>.
- Diaz, Kenny. "Students' Satisfaction When Using a Remote Virtual Lab based on Amazon EC2 for Networking Courses at PUCMM." MS Thesis, Unpublished Work. B. Thomas Golisano College of Computing and Information Sciences, RIT, 2010.
- Gerdes, John and Scott Tilley. "A Conceptual Overview of the Virtual Networking Laboratory." Proceedings of the Special Interest Group for Information Technology Education. Destin: ACM, 2007.
- Gite, Vivek. Red Hat / CentOS VSFTPD FTP Server Configuration. n.d. 3 October 2009
<<http://www.cyberciti.biz/tips/rhel-fedora-centos-vsftpd-installation.html>>.

Lahoud, Hilmi A. and Xin Tang. "Information Security Labs in IDS/IPS for Distance Education." Proceedings of the Special Interest Group for Information Technology Education. Minneapolis: ACM, 2006.

Leitner, Lee J and John W. Cane. "A Virtual Laboratory Environment for Online IT Education." Proceedings of the Special Interest Group for Information Technology Education. Newark: ACM, 2005.

Microsoft Corporation. Installing IIS (IIS 6.0). n.d. 3 October 2009
<<http://www.microsoft.com/technet/prodtechnol/WindowsServer2003/Library/IIS/750d3137-462c-491d-b6c7-5f370d7f26cd.msp?mfr=true>>.

Netcraft. Web Server Survey. n.d. 31 January 2010
<http://news.netcraft.com/archives/web_server_survey.html>.

Stackpole, Bill. "The Evolution of a Virtualized Laboratory Environment." Proceedings of the Special Interest Group for Information Technology Education. Cincinnati: ACM, 2008.

VMLogix. VMLogix LabManager Cloud Edition. n.d. 31 January 2010
<<http://www.vmlogix.com/LabManager-Cloud-Edition-Features/>>.

12. Appendix A – Instance Types and OS in EC2

Instance Types (Amazon Web Services)

Standard Instances

Instances of this family are well suited for most applications.

- Small Instance (Default) 1.7 GB of memory, 1 EC2 Compute Unit (1 virtual core with 1 EC2 Compute Unit), 160 GB of local instance storage, 32-bit platform
- Large Instance 7.5 GB of memory, 4 EC2 Compute Units (2 virtual cores with 2 EC2 Compute Units each), 850 GB of local instance storage, 64-bit platform
- Extra Large Instance 15 GB of memory, 8 EC2 Compute Units (4 virtual cores with 2 EC2 Compute Units each), 1690 GB of local instance storage, 64-bit platform

High-Memory Instances

Instances of this family offer large memory sizes for high throughput applications, including database and memory caching applications.

- High-Memory Double Extra Large Instance 34.2 GB of memory, 13 EC2 Compute Units (4 virtual cores with 3.25 EC2 Compute Units each), 850 GB of local instance storage, 64-bit platform
- High-Memory Quadruple Extra Large Instance 68.4 GB of memory, 26 EC2 Compute Units (8 virtual cores with 3.25 EC2 Compute Units each), 1690 GB of local instance storage, 64-bit platform

High-CPU Instances

Instances of this family have proportionally more CPU resources than memory (RAM) and are well suited for compute-intensive applications.

- High-CPU Medium Instance 1.7 GB of memory, 5 EC2 Compute Units (2 virtual cores with 2.5 EC2 Compute Units each), 350 GB of local instance storage, 32-bit platform
- High-CPU Extra Large Instance 7 GB of memory, 20 EC2 Compute Units (8 virtual cores with 2.5 EC2 Compute Units each), 1690 GB of local instance storage, 64-bit platform

EC2 Compute Unit (ECU) – One EC2 Compute Unit (ECU) provides the equivalent CPU capacity of a 1.0-1.2 GHz 2007 Opteron or 2007 Xeon processor.

Operating Systems

Below is the list of OS currently supported by EC2 (Amazon Web Services):

Red Hat Enterprise Linux, Windows Server 2003/2008, Oracle Enterprise Linux
OpenSolaris, openSUSE Linux, Ubuntu Linux
Fedora, Gentoo Linux, Debian

13. Appendix B – VMLogix Lab Manager Features

VMLogix Lab Manager Features (VMLogix)

- **Web Portal for Self Service**

- **Self Service Web Management Console**

Distributed development teams can easily create, manage, share, and deploy multi-machine configurations on the public cloud based on self-service policies, quotas, leases and user permissions. Users have transparent access to the virtual machine console from within the browser without needing to work through the Amazon key specifications.

- **Synchronized Multi-Machine Deployments**

Deploy and synchronize multi-machine test scenarios without user intervention. Launch, capture, snapshot, revert, reset and shutdown these deployments as a single encapsulated unit.

- **Advanced Automation**

Automate construction of production-like environments with end-to-end configuration of operating systems and applications. Use guest operating system operations and pre-packaged integrations with source code, build and test management tools to further reduce manual user effort.

- **Centralized lab management over a public infrastructure as a service provider Cloud Support**

Create a virtual lab on Amazon Web Services (Amazon public cloud infrastructure)

- **Manage Multi-Machine Configurations**

Build and re-build multi-machine test configurations on-demand without manual user intervention.

- **Shared Snapshots and Lab Artefacts**

Capture and share (with scoped permissions) multi-machine configurations from the configuration library. Allow other users to share lab artefacts – through view/edit/delete permissions.

- **Advanced Job Scheduling**

VMLogix LabManagerCE offers several options to manage multi-machine configuration deployments. Users can specify the priority of the job, specify the number of times a job is to be deployed, lease duration for a job and schedule a wait in the job deployment (i.e., a time after which the deployment is to occur)

- **Image Builder**

Build and rebuild multi-machine test configurations on-demand without manual user intervention.

- **Software and ISO Library**

Use a central repository of operating systems and software to provision virtual machines.

- **License Management**

Monitor and enforce compliance of software and operating system license usage on build and test machines.

- **Global Collaboration**

- **User and Persona Management**

Define personas to control product functionality available to individuals and teams.

- **Global Multi-Site Development Support**

Share configuration libraries and lab resources for users accessing the virtual lab in the cloud from many global locations. Use fine-grained access controls to scope resource ownership by user, team, business unit, or company.

- **Remote Multi-Machine Console Viewers**

View and interact with multi-machine test environments using VNC in a single browser window or Microsoft Remote Desktop.

- **Security Controls and Audit Trails**

Ensure system integrity with strict authentication, role-based access control and comprehensive audit trails.

- **LabLink**

Share a saved configuration from the library with other lab users as a single web URL, which other users can use to deploy the configuration.

- **Integration and Extensibility**

- **Build and Test Automation**

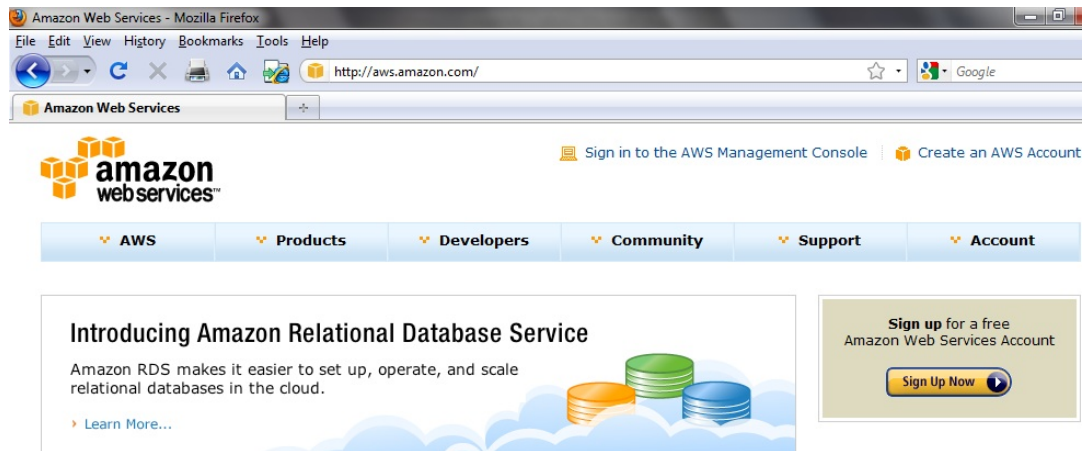
Automate build and test execution by leveraging advanced configuration of software, tools, scripts and data at the guest operating system level.

- **Automation APIs**

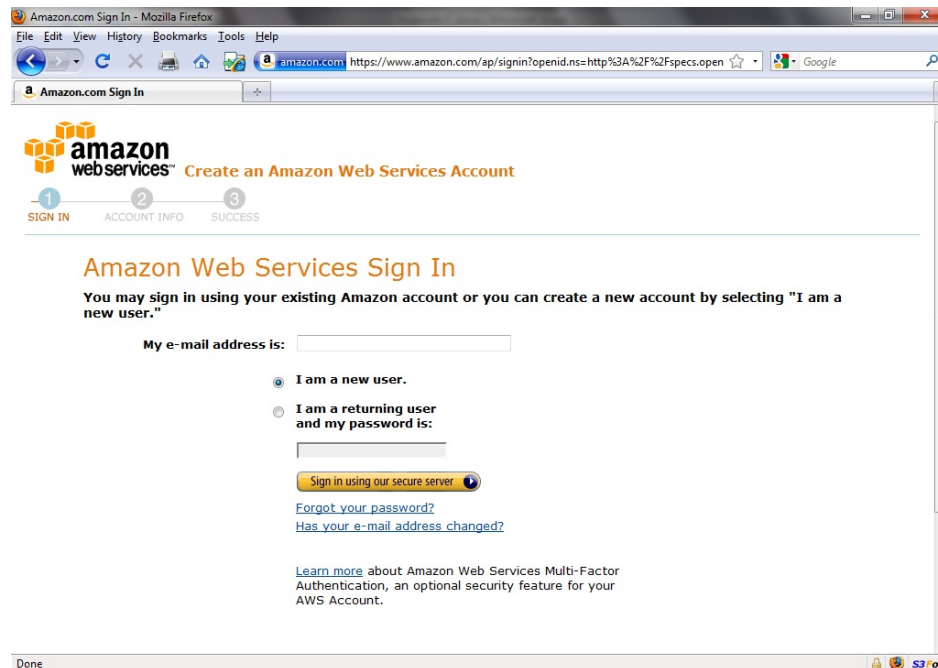
Integration of LabManager-Cloud Edition with existing tools and programmatically controls all operations using XML/RPC.

14. Appendix C – AWS Account Creation Process

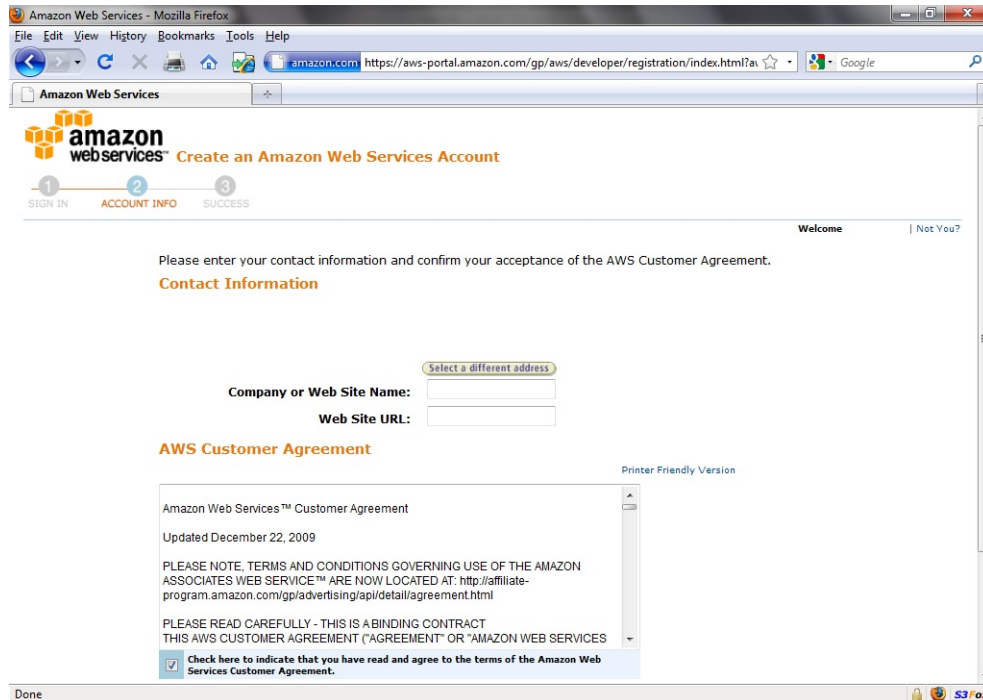
The first step in the creation of an AWS Account is entering into their web page at: <http://aws.amazon.com/> and click in the button **Sign Up Now**. See image below.



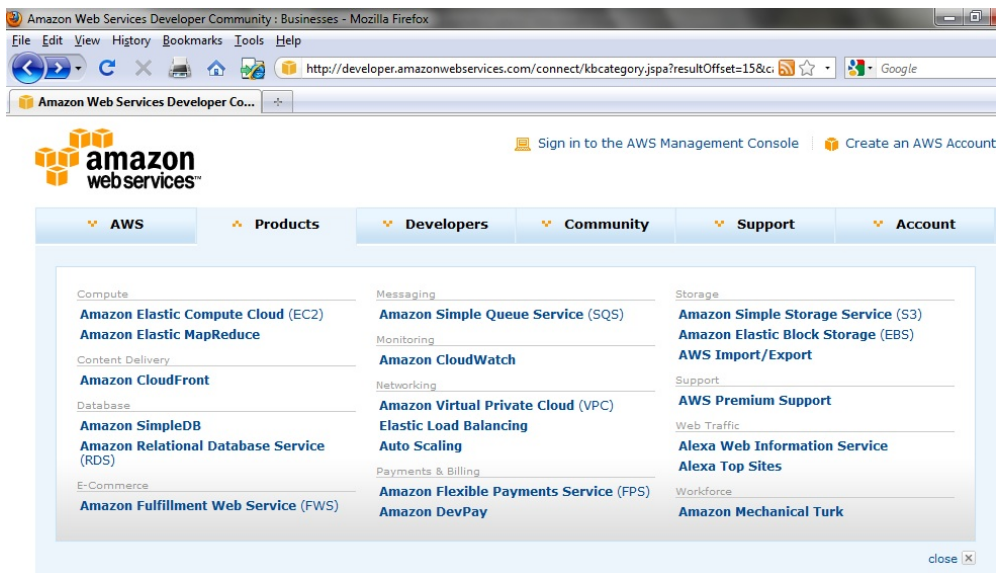
The **Sign Up Now** led us to an account sign up page where we can use our existing Amazon account or we can create a new account for AWS. See image below.

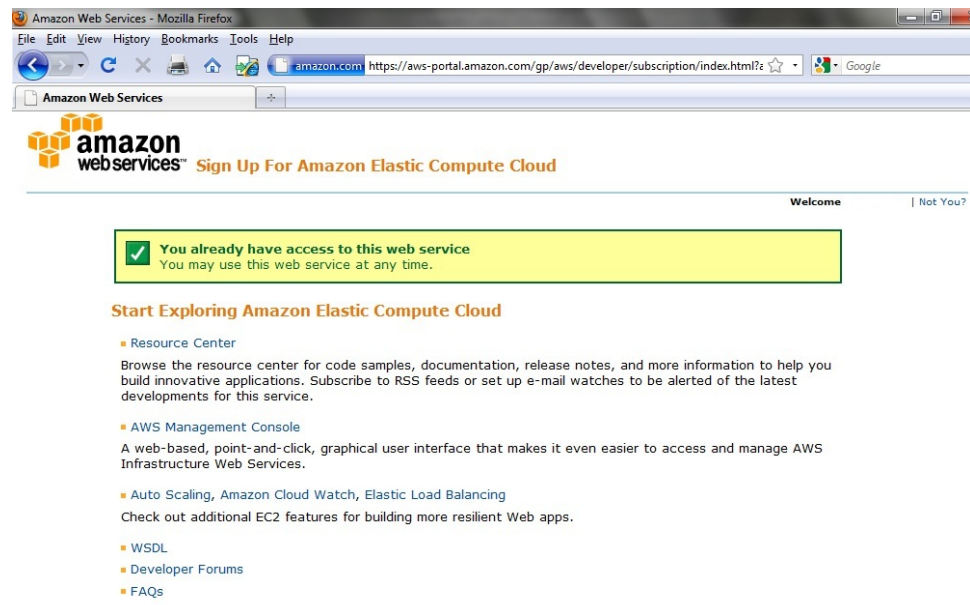
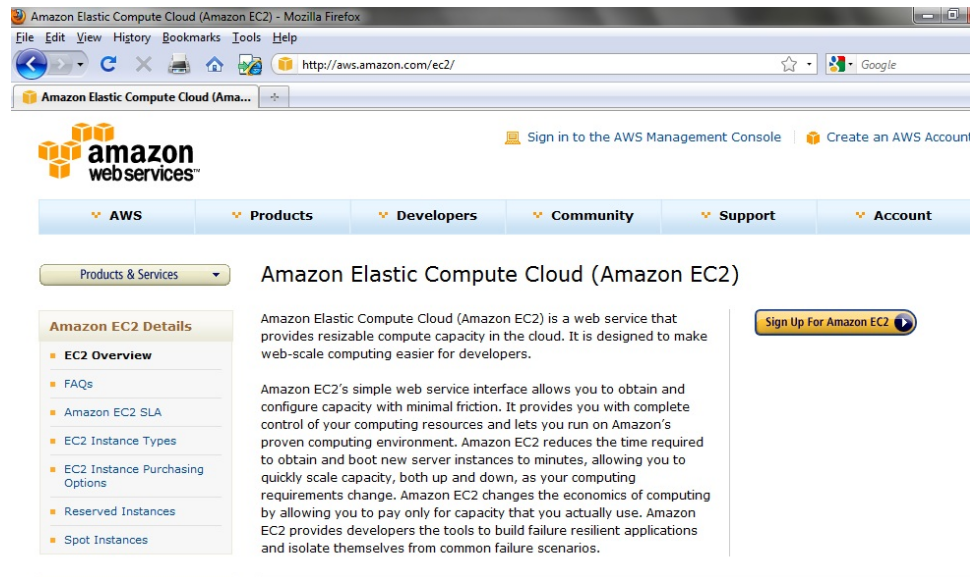


After we enter our email address we proceed to the account information and the AWS Customer Agreement that we have to accept. See image below.



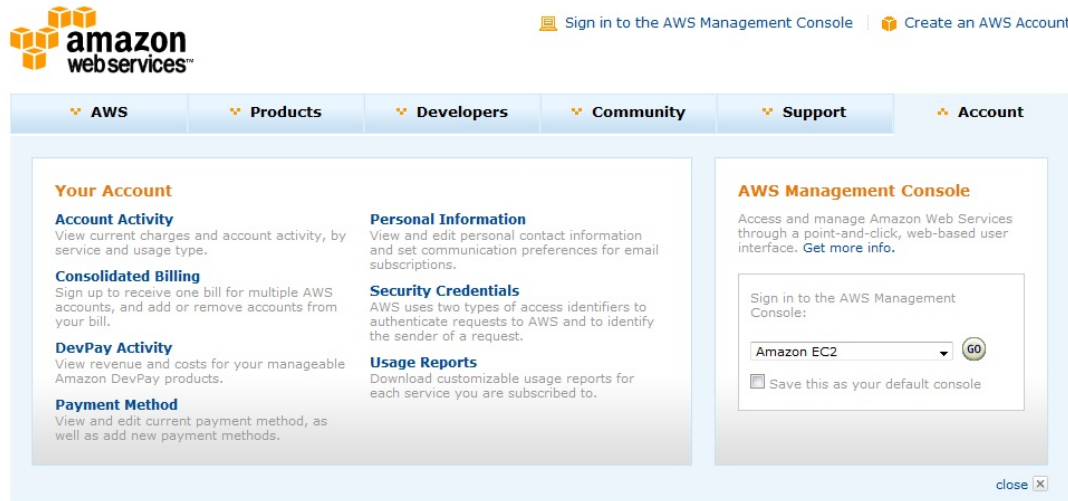
When the creation of the account finished we have to sign up for the services we wanted to use. The first service was the Elastic Compute Cloud (EC2) then we registered the Simple Storage Service (S3).



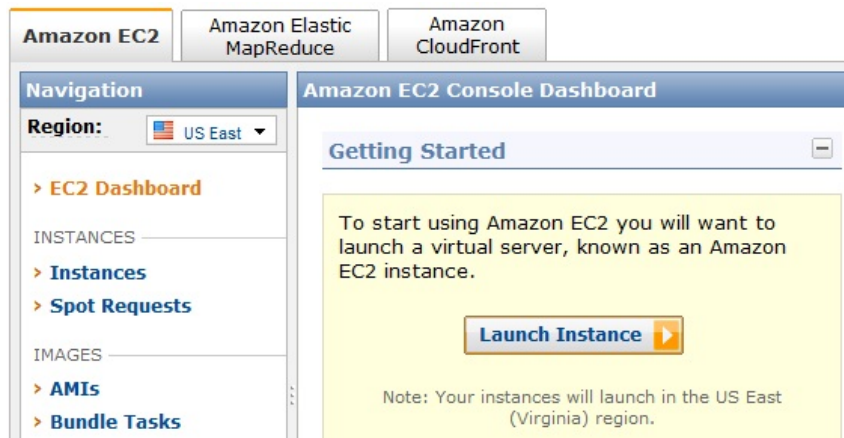


15. Appendix D – Instance Creation in AWS Console

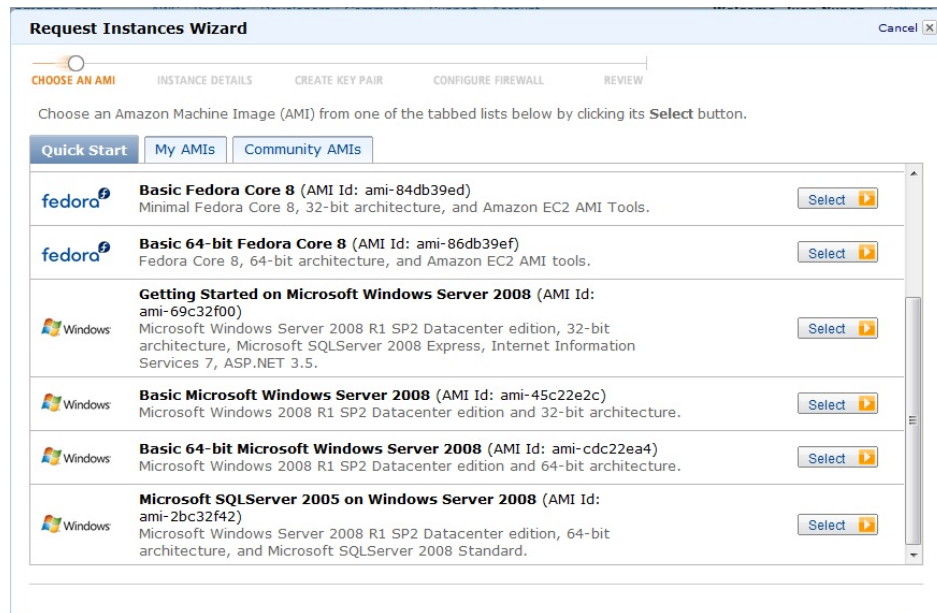
The instance in EC2 can be created either by using the EC2 Command Line Tools or by using the AWS Management Console. Nevertheless, the Management Console was easier to use and simple because was graphical. The first step was to login into the console.



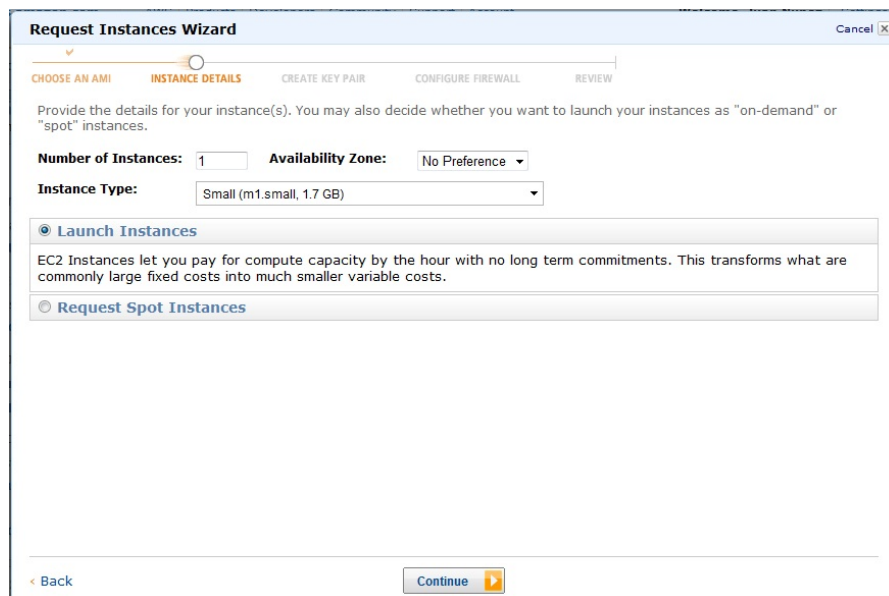
After the login we got to the main dashboard page of the console. From this main page we clicked Launch Instance to begin the Instance creation process.



The Instances Wizard showed up and asked for the AMI to be used for the Instance creation. This was an image of already stored in S3. In this case a basic Windows Server 2008 was select for test purpose.



The next step in the Instance creation process was the selection of the number of instances and type. The selection of the type of instance was important because it determines how powerful the instance will be.



Furthermore, EC2 provided more advance options for the instance creation that are aimed to help with compatibility issues that may arise with some operating systems.

The screenshot shows the 'Request Instances Wizard' in the AWS Management Console, specifically the 'INSTANCE DETAILS' step. The wizard has five steps: CHOOSE AN AMI, INSTANCE DETAILS, CREATE KEY PAIR, CONFIGURE FIREWALL, and REVIEW. The 'INSTANCE DETAILS' step is currently active. It shows 'Number of Instances: 1' and 'Availability Zone: No Preference'. Under 'Advanced Instance Options', there are fields for 'Kernel ID' and 'RAM Disk ID', both set to 'Use Default'. There is a checkbox for 'Monitoring' with the label 'Enable CloudWatch Monitoring for this instance (additional charges will apply)'. Below this is a 'User Data' text area with a 'base64 encoded' checkbox. At the bottom, there are 'Back' and 'Continue' buttons.

The next step was the selection or creation of Key Pairs. The Key Pairs allowed the connection with the instance we had created.

The screenshot shows the 'Request Instances Wizard' in the AWS Management Console, specifically the 'CREATE KEY PAIR' step. The wizard has five steps: CHOOSE AN AMI, INSTANCE DETAILS, CREATE KEY PAIR, CONFIGURE FIREWALL, and REVIEW. The 'CREATE KEY PAIR' step is currently active. It provides instructions: 'Public/private key pairs allow you to securely connect to your instance after it launches. To create a key pair, enter a name and click Create & Download your Key Pair. You will then be prompted to save the private key to your computer. Note, you only need to generate a key pair once - not each time you want to deploy an Amazon EC2 instance.' Below the instructions are three radio button options: 'Choose from your existing Key Pairs' (selected), 'Create a new Key Pair', and 'Proceed without a Key Pair'. Under the selected option, there is a dropdown menu labeled 'Your existing Key Pairs*' with 'LabManager Key' selected. At the bottom, there are 'Back' and 'Continue' buttons.

Finally, the creation of the firewall rules that defined the ports available for connection from the Internet was required to complete the configuration of the Instance.

Request Instances Wizard Cancel

CHOOSE AN AMI INSTANCE DETAILS CREATE KEY PAIR **CONFIGURE FIREWALL** REVIEW

Security groups determine whether a network port is open or blocked on your instances. You may use an existing security group, or we can help you create a new security group to allow access to your instances using the suggested ports below. Add additional ports now or update your security group anytime using the Security Groups page. All changes take effect immediately.

☐ Choose one or more of your existing Security Groups

☒ Create a new Security Group

1. Name your Security Group

2. Describe your Security Group

3. Define allowed Connections

Application	Transport	Port	Source Network (IPv4 CIDR)	Actions
RDP	tcp	3389	All Internet	Remove
Select...	-	-	All Internet Change	Add Rule

[< Back](#) [Continue](#)

The last step was the review of all the setting already selected. When the Launch button was clicked the instance was deployed. The process took around fifteen minutes to have the Instance available for connection.

Request Instances Wizard Cancel

CHOOSE AN AMI INSTANCE DETAILS CREATE KEY PAIR CONFIGURE FIREWALL **REVIEW**

Please review the information below, then click **Launch**.

AMI: Windows AMI ID ami-45c22e2c (i386)
Name: Basic Microsoft Windows Server 2008
Description: Microsoft Windows 2008 R1 SP2 Datacenter edition and 32-bit architecture. [Edit AMI](#)

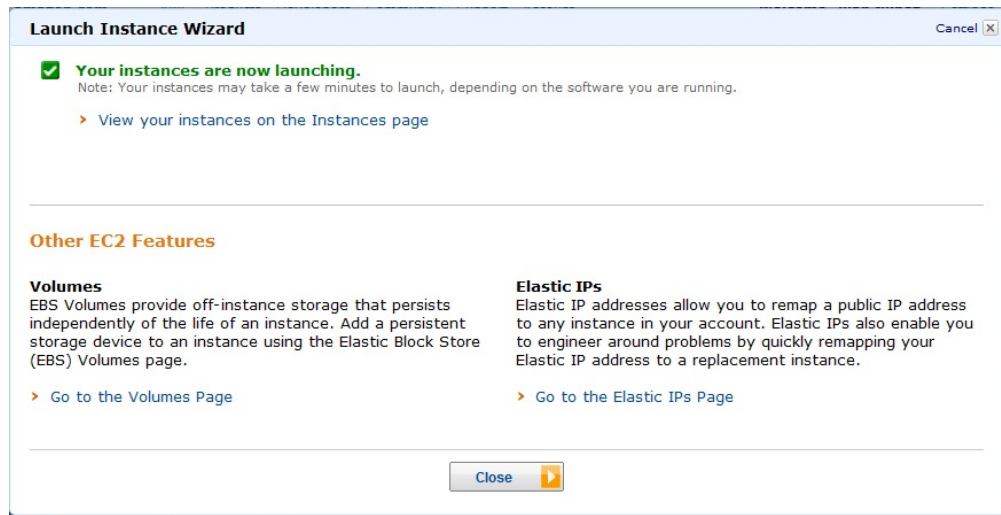
Number of Instances: 1
Availability Zone: No Preference
Monitoring: Disabled
Instance Type: Small (m1.small)
Instance Class: On Demand [Edit Instance Details](#)

Kernel ID: Use Default
Ramdisk ID: Use Default
User Data: [Edit Advanced Details](#)

Key Pair Name: Labmanager [Edit Key Pair](#)

Security Group(s): LabManager [Edit Firewall](#)

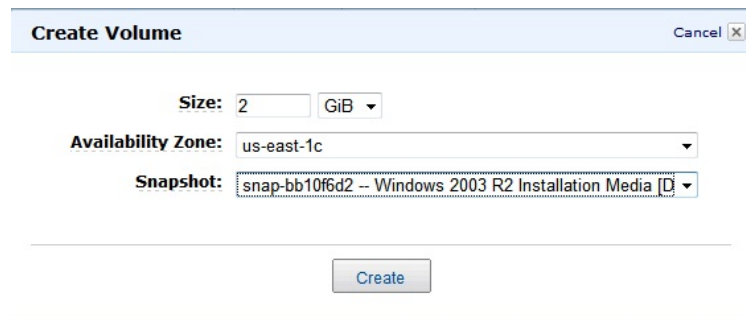
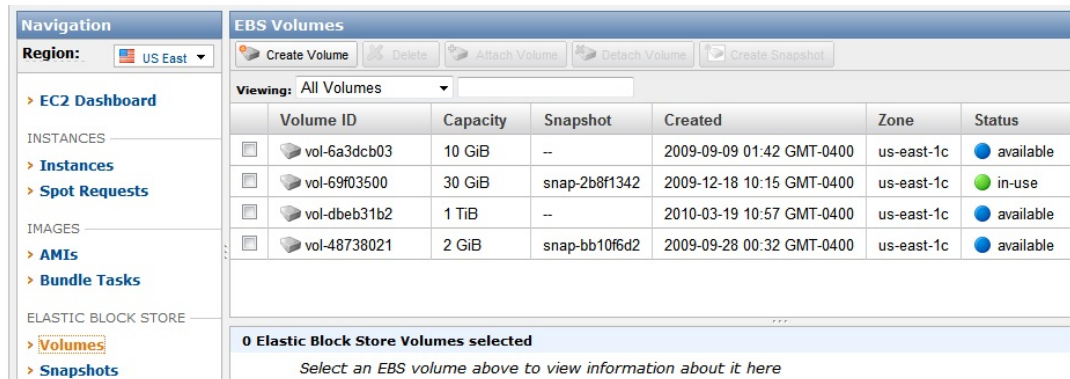
[< Back](#) [Launch](#)



16. Appendix E - Windows Image Creation with AWS Console

An instance in EC2 can be customized and configured with the desired applications or services to meet specific needs of a lab. Furthermore, this customization requires the creation of a new image so the changes become permanent. The Windows Lab required the use of the Windows Installation Discs to be available to the instance. According to AWS the installation discs of Windows Server 2003 were available as a Snapshot that could be used to create a Volume to attach to the Instance⁴.

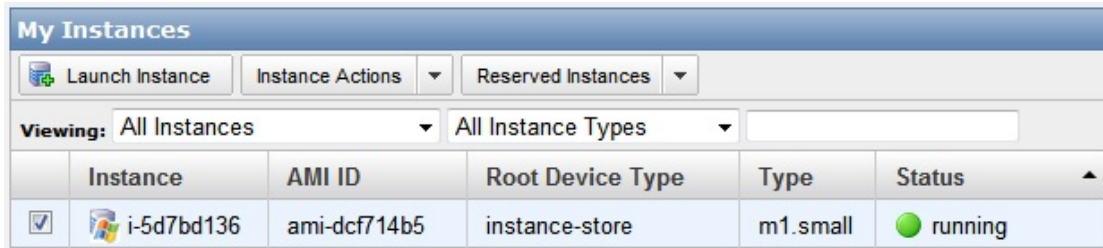
The first step was the creation of the Volume. According to AWS the Snapshot was called *snap-bb10f6d2*. From AWS Console Navigation Pane -> select Volumes -> Create Volume. See image below.



⁴ Configuring Windows Components in EC2.

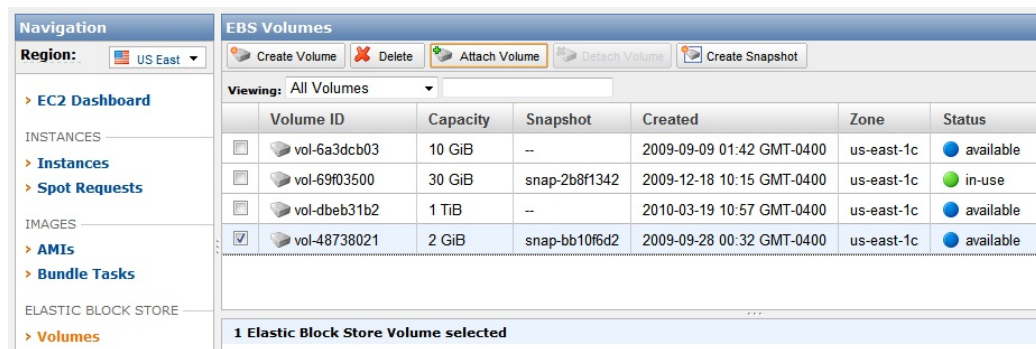
<http://developer.amazonwebservices.com/connect/entry!default.jspx?categoryID=174&externalID=1802&fromSearchPage=true>

With the Volume created the Instance to be modified must be identify by its ID to attach the Volume. First go to AWS Console Navigation Pane, select Instances and take note of the Instance name. In the image below it was i-5d7bd136.



	Instance	AMI ID	Root Device Type	Type	Status
<input checked="" type="checkbox"/>	i-5d7bd136	ami-dcf714b5	instance-store	m1.small	running

With the Instance name go back to Volumes and select the Volume. Then Select Attach Volume. See image below.



	Volume ID	Capacity	Snapshot	Created	Zone	Status
<input type="checkbox"/>	vol-6a3dcb03	10 GiB	--	2009-09-09 01:42 GMT-0400	us-east-1c	available
<input type="checkbox"/>	vol-69f03500	30 GiB	snap-2b8f1342	2009-12-18 10:15 GMT-0400	us-east-1c	in-use
<input type="checkbox"/>	vol-dbeb31b2	1 TiB	--	2010-03-19 10:57 GMT-0400	us-east-1c	available
<input checked="" type="checkbox"/>	vol-48738021	2 GiB	snap-bb10f6d2	2009-09-28 00:32 GMT-0400	us-east-1c	available

1 Elastic Block Store Volume selected



Attach Volume [Cancel]

Volume: vol-48738021 in us-east-1c

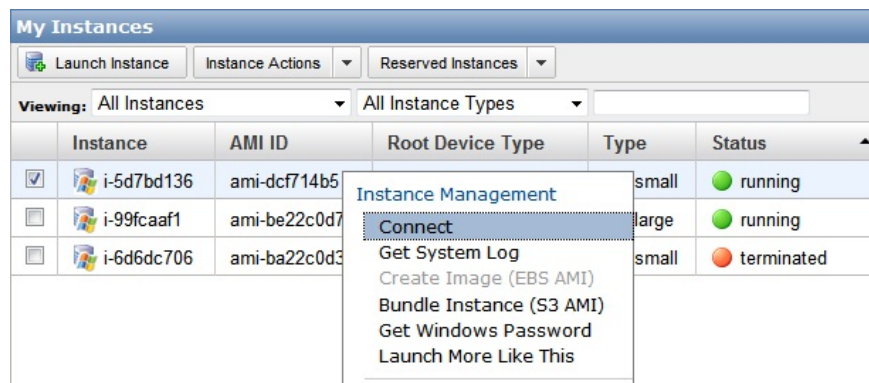
Instances: i-5d7bd136 in us-east-1c

Device: xvdf

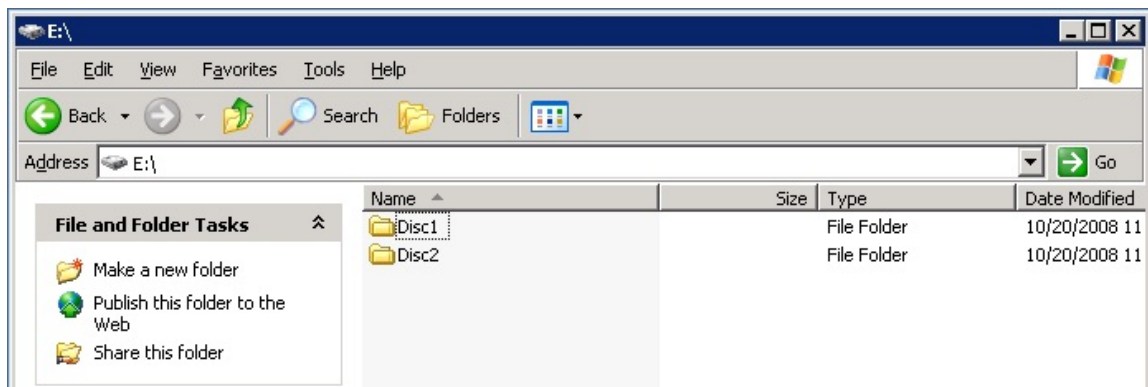
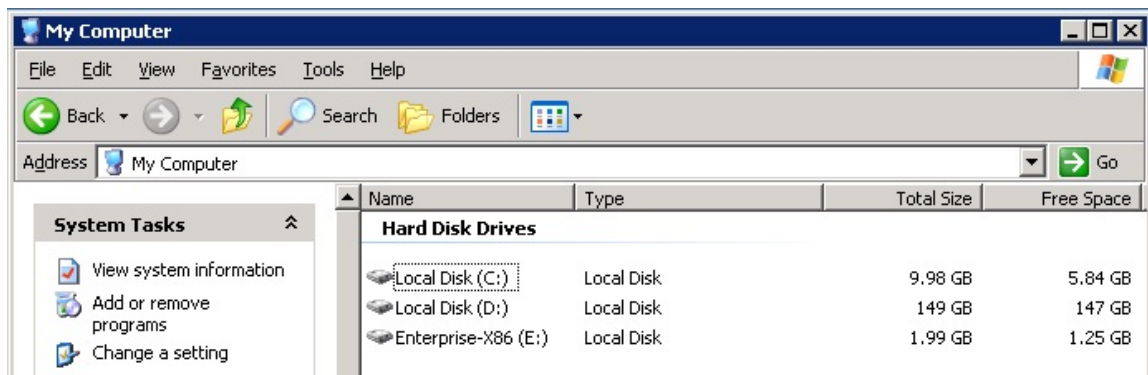
Windows Devices: xvdf through xvdp
Linux Devices: /dev/sdf through /dev/sdp

[Attach]

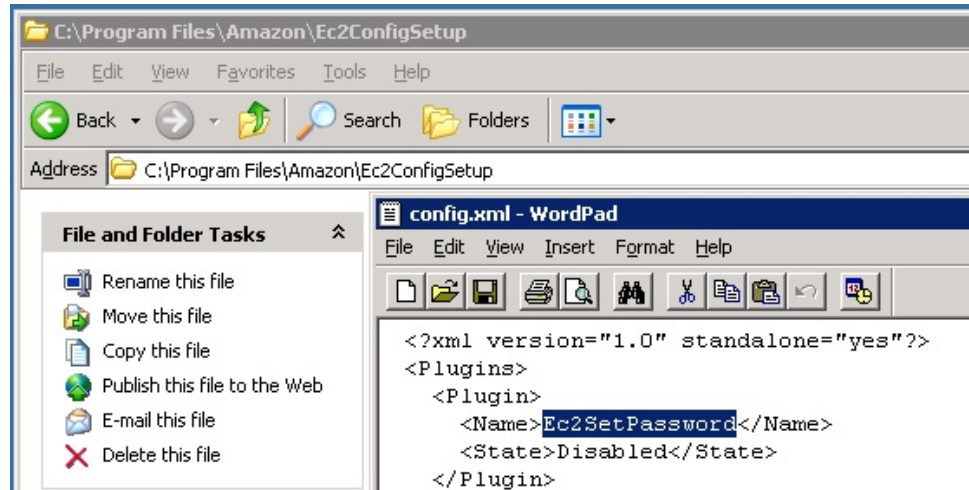
The Instances can be customized by adding the Windows installer files inside it. Select the Instance and connect to it using Remote Desktop. See image below.



From the Desktop go to My Computer and look inside the E: Drive (Attached Volume) to check the installation discs. See image below.



The next step is to copy the files from the E: drive to the C: drive of the Instance. This is the only drive that is saved by the image creation process. Also, assigning a password to the administrator requires the modification of the config.xml file to disable the EC2Password setting which will set a new password every time the image is deployed. See image below⁵.

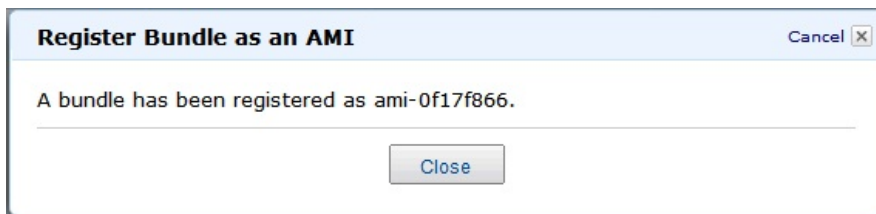
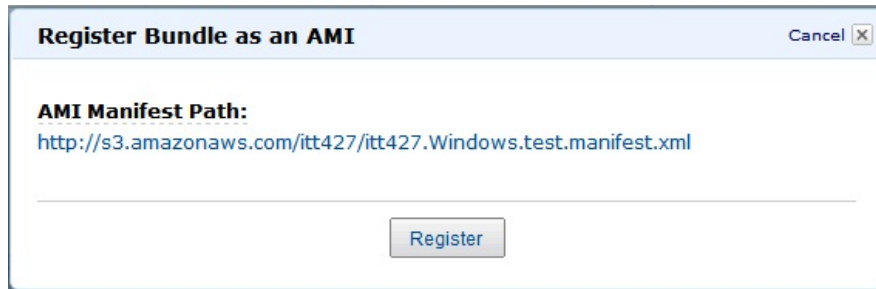


The last step is the image creation within AWS Console. This process is called “Bundle Instance” within EC2. Access the AWS Console and Select the Instance then Right Clicked to see the menu and select “Bundle Instance”. This process will take some time depending in the amount of data in the Instance but can be monitored in the Bundle Tasks screen available in the Navigation Pane. See image below.

Bundle Tasks					
<input type="button" value="Register as an AMI"/> <input type="button" value="Cancel"/>					
Viewing: All BundleTasks					
	Bundle ID	Instance ID	Status	Started	Progress
	bun-d509edbc	i-5d7bd136	bundling	2010-03-19 12:16 GMT-0400	<div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> </div> 50%

⁵ The file is located in the “C:\Program Files\Amazon\Ec2ConfigSetup” and the State needs to be changed from “Enable” to “Disabled”

When the bundle process finishes the only process needed to make this image available is the registration of the image. This can be done in the Bundle Tasks selecting the bundle and then clicking the “Register as an AMI” button.

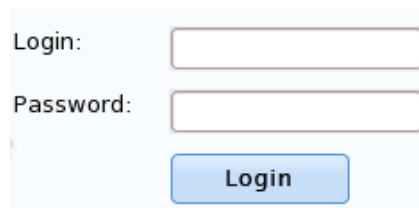


17. Appendix F - Guía de Estudiantes para VMLogix Lab Manager

Esta guía pretende enseñar, en breves pasos, como manipular el laboratorio virtual utilizando las máquinas virtuales necesarias las cuales fueron previamente ingresadas por el profesor/administrador del laboratorio virtual.

Paso 1: Ingresar al manejador del Laboratorio vía Web.

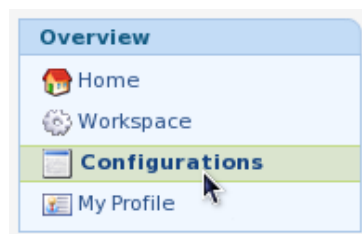
- Se debe ingresar a la página web del manejador del laboratorio, a través de su página web <https://ec2-174-129-125-107.compute-1.amazonaws.com:8443>
- Esta página nos solicitara un usuario (login) y una contraseña, las cuales fueron provistas por el profesor al inicio de clases. Estos deberán ser introducidos y luego se procederá a presionar el botón “Login” para ingresar. (Ver imagen)



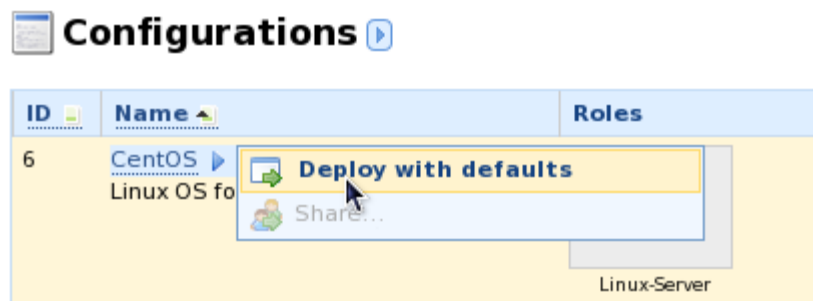
A login form with a light blue background. It contains two input fields: the first is labeled 'Login:' and the second is labeled 'Password:'. Below the password field is a blue button with the text 'Login' in white.

Paso 2: Desplegar las Configuraciones/Máquinas Existentes.

- Luego de ingresar al manejador del laboratorio, se deberá ir a la opción “Configurations” ubicada en el menú del lado izquierdo de la página web. (Ver imagen)

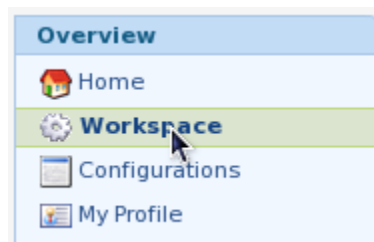


- Dentro de esta opción “Configurations” se encuentran las máquinas virtuales que fueron creadas y compartidas por el Administrador/Profesor para este laboratorio. Luego de ver las maquinas existentes, se deberán desplegar las maquinas necesarias para realizar este laboratorio. Para desplegarlas, es necesario señalar con el puntero del mouse el nombre de la máquina que deseamos desplegar y luego se deberá elegir la opción “Deploy with defaults” que aparecerá (esta operación puede tardar varios minutos). (Ver imagen).

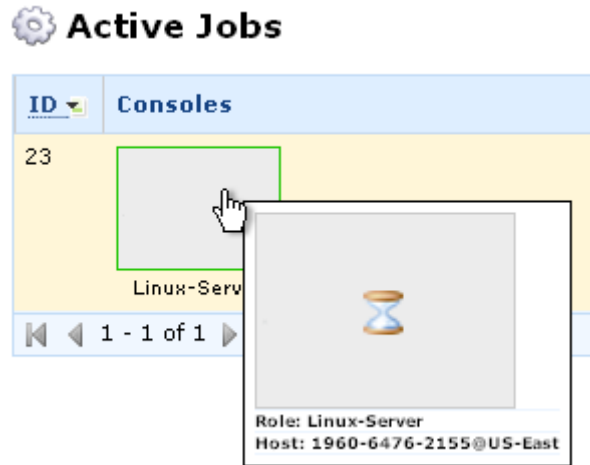


Paso 3: Ingresar las Configuraciones/Máquinas Desplegadas y/o Salvadas.

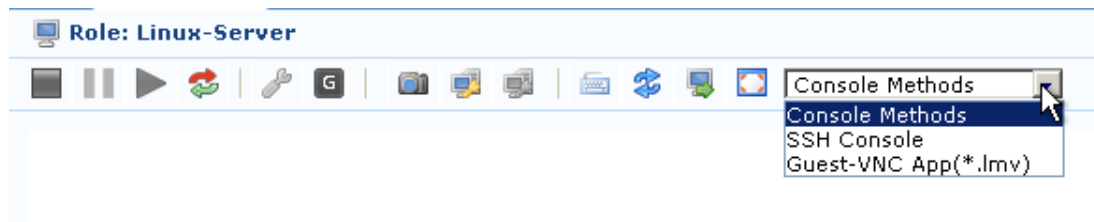
- Una vez desplegadas las máquinas virtuales, podrán ser acezadas a través del espacio de trabajo a donde fueron trasladados estos despliegues. En este espacio de trabajo, es en donde se encuentra todas las maquinas activas (desplegadas) y salvadas por el usuario. Para acezar el espacio de trabajo se deberá elegir la opción “Workspace” ubicada en el menú del lado izquierdo de la página web. (Ver imagen)



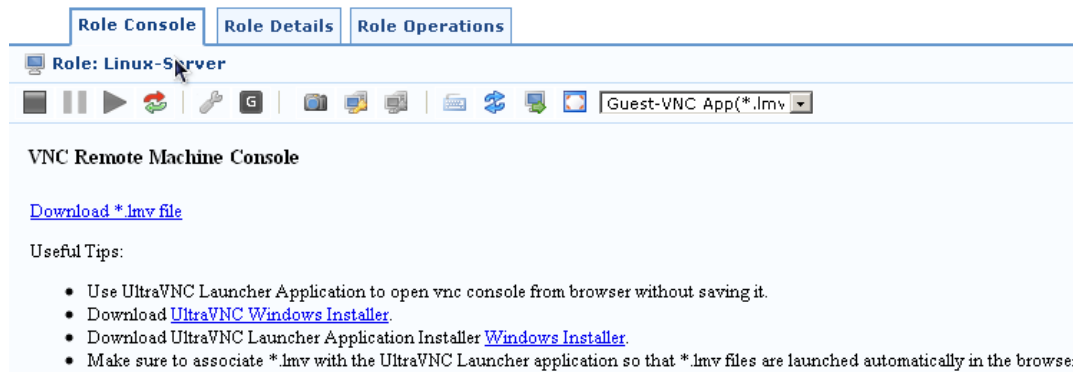
- Luego de ingresar al espacio de trabajo, para acesar una máquina virtual en específico, se deberá hacer clic en el nombre de la misma. (Ver imagen)



- Al hacer clic en la máquina virtual deseada, estamos entrando al menú de aceso a la misma. Aquí encontraremos dos métodos de consola para aceso a la misma: SSH y VNC. (Ver imagen)



- Si elegimos el método de consola SSH, tendremos acceso a una terminal de la máquina virtual.
- Si elegimos el método de consola VNC nos presentara un aviso indicando que debemos descargar un cliente VNC (puede ser RealVNC, entre otros) y descargar un archivo .lmv el cual contiene un certificado con las credenciales y direcciones que nos permitirán acesar a la máquina virtual. (Ver imagen)



- Para poder ingresar a la máquina debemos cargarle el archivo .lmv descargado al cliente VNC que instalemos.

Paso 4: Salvar o Terminar un Estado de una Configuración

- Para salvar un estado de una máquina virtual activa, debemos ir a la opción “Workspace”, ubicada en el menú del lado izquierdo de la página web.
- Luego de ingresar al espacio de trabajo, para salvar un estado de una máquina virtual en específico, se deberá hacer clic en el nombre de la misma. Al hacer clic sobre el nombre aparecerán dos opciones. La primera, “Save and Continue”, nos salva el estado de la máquina y nos deja continuar trabajando en la misma. La segunda opción, “Save and Undeploy”, nos salva el estado de la máquina virtual y manda a desactivar la misma. (Ver imagen)



- Para ingresar a un estado salvado de determinada máquina virtual, ver Paso 3.

18. Appendix G – Guía de Laboratorio de Linux

PONTIFICIA UNIVERSIDAD CATOLICA MADRE Y MAESTRA FACULTAD DE CIENCIAS DE LA INGENIERIA DEPARTAMENTO DE INGENIERIA TELEMATICA

Materia: ITT-427 – Lab. Conmutación de Datos

Título práctica: Servicios de Infraestructura basados en Linux Server

Tiempo aprox. elaboración: 2 Horas

REPORTE:

Entregar reporte la siguiente semana. Mostrar con capturas de pantalla los pasos dados para realizar la práctica.

En esta práctica se pondrán a funcionar los servicios de FTP y Web los cuales son básicos en cualquier infraestructura empresarial hoy en día. Estas configuraciones serán realizadas en un servidor basado en CentOS 5 en el cual se instalarán y configurarán los servicios antes mencionados. Para el FTP utilizarán el VSFTPD el cual provee servicios FTP en Linux y es muy versátil. El servicio Web será provisto por APACHE el cual es el servidor web más utilizado en el mundo.

PARTE I:

A. Configurar servidor FTP (VSFTP) en Linux (CentOS)

1. Conectese a la consola de la máquina virtual de Linux via SSH.
2. Verifique si *vsftpd* está instalado
 - *which vsftpd*
3. Para instalar *vsftpd* ejecute el siguiente comando:
 - *yum install vsftpd*
4. Verificar la información de configuración para permitir el acceso anónimo al servidor FTP.

- Editar el archivo */etc/vsftpd/vsftpd.conf*
- 5. Iniciar el servicio de FTP con el siguiente comando:
 - *service vsftpd start*
- 6. Verificar que el servicio de FTP esté funcionando
 - ver IP Address servidor “*ifconfig*”
 - *ftp (IP servidor)*
 - *usar usuario “anonymous” password: “un correo electrónico”*
- 7. Conectese a la consola de la maquina con Windows 2003 via Remote Desktop (RDP)
- 8. Abrir un command console
 - *start → run → cmd*
- 9. conectarse al servidor FTP
 - *ftp (IP Servidor)*
 - *usar usuario “anonymous” password: “un correo electrónico”*

B. Investigue y Realice

1. Poner un Banner al FTP Server
2. Crear un usuario para FTP que pueda escribir al FTP Server
3. Crear un usuario para el FTP que tenga solo permiso de Lectura.
4. Hacer upload de un archivo al FTP Server
5. Hacer un Download de un archivo desde el FTP Server
6. Explicar la diferencia entre el modo ASCII y el modo Binario para transferencias en FTP.
7. Explicar la diferencia entre Active Mode y Passive Mode. ¿Qué ventaja tiene usar Passive Mode?

PARTE II:

C. Configurar Servidor Web (Apache) en Linux (CentOS)

1. Conectese a la consola de la máquina virtual de Linux via SSH.
2. Verifique si **Apache** está instalado
 - *which httpd*
3. Para instalar **Apache** ejecute el siguiente comando:
 - *yum install httpd*
4. Verificar la información de configuración del servidor Web
 - Editar el archivo */etc/httpd/conf/httpd.conf*
5. Iniciar el servicio Web con el siguiente comando:
 - *service httpd start*
6. Verificar que el servicio Web esté funcionando
 - ver IP Address servidor “*ifconfig*”
 - *En el equipo con Windows 2003 abrir un browser y dirigirse a :*
 - *http://IP servidor*

D. Investigue y Realice

1. Poner una página en el Website del Server
2. Configurar el Web server para que utilice un puerto diferente del 80
3. Crear un virtual directory que se pueda acceder por el puerto 8330.
4. Explique los métodos que existen para poder tener múltiples Websites en un solo web server.

19. Appendix H – Guía de Laboratorio de Windows

PONTIFICIA UNIVERSIDAD CATOLICA MADRE Y MAESTRA FACULTAD DE CIENCIAS DE LA INGENIERIA DEPARTAMENTO DE INGENIERIA TELEMATICA

Materia: ITT-427 – Lab. Conmutación de Datos

Título práctica: Servicios de Infraestructura basados en Windows Server

Tiempo aprox. elaboración: 2 Horas

REPORTE:

Entregar reporte la siguiente semana. Mostrar con capturas de pantalla los pasos dados para realizar la práctica.

En esta práctica se pondrán a funcionar los servicios de FTP y Web los cuales son básicos en cualquier infraestructura empresarial hoy en día. Estas configuraciones serán realizadas en un servidor basado en Windows 2003 en el cual se instalarán y configurarán los servicios antes mencionados. El servicio Web y el FTP serán provistos por IIS.

PARTE I:

A. Instalar IIS en Windows Server 2003

1. Conectese a la consola de la máquina virtual de Windows-Server via Remote Desktop.
 - *Usuario: Administrator*
 - *Password: netsys*
2. Para instalar IIS ir a:
 - *start -> Manage Your Server*
 - *Add Role -> Next*
 - *Select Application Server (IIS, ASP .NET) -> Next*

- *Dejar los parametros por defecto y darle Next hasta que inicie la instalación.*
 - *En la pantalla donde pide la ubicación de los archivos de Windows darle Browse -> My Computer -> Local Disk (C:) -> Win2003 Sources -> Disc1 -> I386 -> Open -> OK*
 - *Este último paso debe repetirse cada vez que Windows pregunte por algún archivo para la instalación.*
 - *Finish*
3. Entrar a la consola de IIS para verificar que esté instalado
 - *Darle a Manage this Application Server*
 - *Open IIS Manager*
 - *Local Computer -> Web Sites -> Default Web Site*
 4. Verificar la información de configuración del Web Site por defecto
 - *Right Click en Default Web Site*
 - *Identificar el Puerto del WebSite, ver cuál es el Home Directory y cuáles son los tipos de documentos por defecto.*
 5. Verificar que el servicio Web esté funcionando
 - *ver IP Address servidor “ipconfig”*
 - *En el equipo con Windows-client abrir un browser y dirigirse a :*
 - *http://IP servidor*

B. Investigue y Realice

1. Crear un Website en el puerto 8330 y ponerle una página en el Server
2. Explique los métodos que existen para poder tener múltiples Websites en un solo web server usando IIS. (Explique cómo se configuran en IIS)

PARTE II:

C. Instalar el servicio de FTP en IIS

1. Conectese a la consola de la máquina virtual de Windows-Server via Remote Desktop.
 - *Usuario: Administrator*
 - *Password: netsys*
2. Agregar el servicio FTP a IIS
 - *Start -> Control Panel -> Add or Remove Programs*
 - *Add or Remove Windows Components*
 - *Seleccionar **Application Server** y luego darle **Details***
 - *Seleccionar **Internet Information Services (IIS)** y luego darle **Details***
 - *Seleccionar **File Transfer Protocol (FTP) Service** y luego darle **OK, OK, Next***
 - *En la pantalla donde pide la ubicación de los archivos de Windows darle Browse -> My Computer -> Local Disk (C:) -> Win2003 Sources -> Disc1 -> I386 -> Open -> OK*
 - *Finish*
3. Verificar que el FTP este instalado
 - *Start -> Administrative Tools -> Internet Information Services (IIS) Manager*
 - *FTP Sites*
 - *Ver el estado del servicio (State).*
4. Verificar la información de configuración.
 - *Expandir **FTP Sites** y Right Click en **Default FTP Site** -> **Properties***
 - *Identificar el Puerto, ver cuál es el Home Directory y cuál es la configuración de seguridad del FTP.*
5. Verificar que el servicio de FTP esté funcionando
 - *ver IP Address servidor “ipconfig”*

- Conectese a la consola de la maquina con Windows-client via Remote Desktop (RDP)
- Abrir un command console
- *start → run → cmd*
- conectarse al servidor FTP
- *ftp (IP Servidor)*
- *usar usuario “anonymous” password: “un correo electrónico”*

D. Investigue y Realice

1. Poner un Banner al FTP Server
2. Crear un usuario para FTP que pueda escribir al FTP Server
3. Crear un usuario para el FTP que tenga solo permiso de Lectura.
4. Hacer upload de un archivo al FTP Server
5. Hacer un Download de un archivo desde el FTP Server
6. ¿Cómo se pueden tener varios servicios de FTP activos al mismo tiempo?


20. Appendix I – Amazon Web Services Statements

October Usage Costs

Billing Statement: November 1, 2009

The billing cycle for this report is October 1 - October 31, 2009 .

Expand All Services Collapse All Services		Printer Friendly Version
		Totals
Amazon Elastic Compute Cloud View/Edit Service		
Nunezcourses		
Credit		-390.13
		-390.13
US-East (Northern Virginia) Region		
Amazon EC2 running Linux/UNIX		
\$0.10 per Small Instance (m1.small) instance-hour (or partial hour)	1,095 Hrs	109.50
\$0.40 per Large Instance (m1.large) instance-hour (or partial hour)	95 Hrs	38.00
Amazon EC2 running Windows		
\$0.125 per Small Windows Instance (m1.small) instance-hour (or partial hour)	1,874 Hrs	234.25
\$0.50 per Large Windows Instance (m1.large) instance-hour (or partial hour)	9 Hrs	4.50
\$0.30 per High-CPU Medium Windows Instance (c1.medium) instance-hour (or partial hour)	2 Hrs	0.60
Amazon EC2 Bandwidth		
\$0.100 per GB Internet Data Transfer - all data transfer into Amazon EC2	3.457 GB	0.35
\$0.170 per GB Internet Data Transfer - first 10 TB / month data transfer out of Amazon EC2	4.489 GB	0.76
\$0.010 per GB Regional Data Transfer - in/out /between AZs or when using public or Elastic IPs or Elastic Load Balancing	0.413 GB	0.01
Amazon EC2 EBS		
\$0.10 per GB-month of provisioned storage	11.973 GB-Mo	1.20
\$0.10 per 1 million I/O requests	9,478,553 IOs	0.95
\$0.01 per 10,000 gets (when loading a snapshot)	314 Requests	0.01
		390.13

 Amazon Simple Storage Service View/Edit Service		
Nunezcourses	Credit	-11.73
		-11.73
US Standard Region		
\$0.150 per GB - first 50 TB / month of storage used	76.683 GB-Mo	11.50
\$0.170 per GB - first 10 TB / month data transfer out	0.007 GB	0.01
\$0.01 per 1,000 PUT, COPY, POST, or LIST requests	20,861 Requests	0.21
\$0.01 per 10,000 GET and all other requests	9,091 Requests	0.01
		11.73
Download Usage Report »		0.00
Taxes		0.00
Total Charges due on November 1, 2009		\$-0.00
Payment received November 1, 2009		-0.00
<small>All charges and prices are in US Dollars. All web services are sold by Amazon Web Services LLC</small>		

November Usage Costs

Billing Statement: December 1, 2009

The billing cycle for this report is November 1 - November 30, 2009 .

Expand All Services Collapse All Services		Printer Friendly Version
		Totals
Amazon Elastic Compute Cloud View/Edit Service		
Nunezcourses		Credit
		-445.25
		-445.25
US-East (Northern Virginia) Region		
Amazon EC2 running Linux/UNIX		
\$0.085 per Small Instance (m1.small) instance-hour (or partial hour)	1,774 Hrs	150.79
\$0.34 per Large Instance (m1.large) instance-hour (or partial hour)	78 Hrs	26.52
Amazon EC2 running Windows		
\$0.12 per Small Windows Instance (m1.small) instance-hour (or partial hour)	2,141 Hrs	256.92
\$0.48 per Large Windows Instance (m1.large) instance-hour (or partial hour)	1 Hrs	0.48
Amazon EC2 Bandwidth		
\$0.100 per GB Internet Data Transfer - all data transfer into Amazon EC2	0.791 GB	0.08
\$0.170 per GB Internet Data Transfer - first 10 TB / month data transfer out of Amazon EC2	6.110 GB	1.04
\$0.010 per GB Regional Data Transfer - in/out /between AZs or when using public or Elastic IPs or Elastic Load Balancing	0.021 GB	0.01
Amazon EC2 EBS		
\$0.10 per GB-month of provisioned storage	11.908 GB-Mo	1.19
\$0.10 per 1 million I/O requests	9,290,609 IOs	0.93
Elastic IP Addresses		
\$0.01 per non-attached Elastic IP address per complete hour	727 Hrs	7.27
\$0.00 per Elastic IP address remap - first 100 remaps / month	6 Count	0.00
Amazon CloudWatch		
\$0.015 per monitored instance-hour (or partial hour)	1 Hrs	0.02
		445.25
Download Usage Report »		-0.00

 Amazon Simple Storage Service View/Edit Service		
Nunezcourses	Credit	-22.74
		-22.74
US Standard Region		
\$0.150 per GB - first 50 TB / month of storage used	150.309 GB-Mo	22.55
\$0.100 per GB - all data transfer in	0.000069 GB	0.01
\$0.170 per GB - first 10 TB / month data transfer out	0.000116 GB	0.01
\$0.01 per 1,000 PUT, COPY, POST, or LIST requests	16,076 Requests	0.16
\$0.01 per 10,000 GET and all other requests	6,704 Requests	0.01
		22.74
Download Usage Report »		0.00
Taxes		0.00
Total Charges due on December 1, 2009		\$-0.00
Payment received December 1, 2009		-0.00
<small>All charges and prices are in US Dollars. All web services are sold by Amazon Web Services LLC</small>		