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*School of Computing and Information Sciences*

CIS 4911 - Senior Capstone Project

Software Engineering Focus

Final Deliverable

Virtual Labs 3.0

Guacamole for Virtual Labs

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***Abstract***

*The following document covers the current Virtual Labs system and how our proposed system changes and improves it. The sprints for this release are described in detail, covering what stories were implemented and which are still pending for future releases. In addition, there is an appendix that covers the user interface, UML diagrams, and other sprint information. A glossary is also included at the end to cover specific terms relevant to our development process and the system.*

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# 1 Introduction

This section is a brief introduction to the current system and it’s functionalities, as well as the purpose of building a new system.

## 1.1 Current System

Although this document is tailored towards the Guacamole for Virtual Labs implementation, the following two sections provide a broad spectrum view of the whole Virtual Labs system.

The current system was developed and maintained by Dr. Sadjadi and fellow students. The in production version provides an interface through Moodle that allows students to reserve different types of resources which include virtual labs, mentoring and certificate exams. At the moment the system utilizes Moodle to host the modules. This is an unnecessary hop since modules can be built within eFront itself. Also, Java applets are becoming outdated in most major browsers.

Virtual Labs: The main interface of Virtual Labs is built with jQueryUI and presents the user with tabs describing networking information as well as RDP sessions. At present the RDP session is established through Java applets and the virtual machines are hosted on VMware. Users can tinker with the desktops without leaving the virtual labs module.

Quota System: The main interface of the Quota System is built with jQueryUI and smarty. This module allows an administrator to view, create, and modify policies as well as credit types. In addition, a student can view used and available quota. Through the Shopping Cart, the user selects a credit type (quota) and waits for approval from an administrator.

Scheduler: The main interface of the scheduler is a JavaScript calendar, based on FullCalendar jQuery plugin, and with all the desired scheduling functionality added to it. Students can select which resource they want to reserve a time slot and schedule it on the calendar. The calendar will show the users not only their appointments but also the availability of resources to make the scheduling process easier.

Certificate Test: The main interface of the Certificate Test module is also built with jQueryUI. This module is very similar to Virtual Labs with an added quiz tab. Upon completion of said quiz and evaluation, specific certificates may be rewarded.

## 1.2 Purpose of New System

In our proposed system, the aforementioned modules will be made and hosted in eFront, eliminating all Moodle dependencies from the current system. In addition, all applets will be replaced by an HTML5 Remote Desktop Gateway called Guacamole. This will increase response time and overall performance of those tabs. In terms of UI, the proposed system will continue using jQueryUI but the latest and greatest version, updating the look to be clean and modern. Overall, the proposed system is an revamping of the current one, keeping the structure and functionality but giving it a new look and performance upgrade.

In addition to the current services provided by the current system, there will be a new module called vLabsAdmin that allows an administrator to handle the access of vLabs to certain users and to manage the database tables pertaining to the various modules

## 1.3 Guacamole for Virtual Labs

The current version of Virtual Labs uses Java Applets to deliver RDP connections through a web browser. Due to security concerns, all major web browsers have phased out NPAPI plugins, thus Virtual Labs ability to provide RDP connections has been severed.

In order to bring back this functionality, our team agreed to implement a new HTML 5 compliant solution for Remote Desktop called Guacamole. Guacamole is an open source, mature project that has very good documentation and a very complete API. All these qualities are very important for Virtual Labs, as they will empower the project to move forward with a solid remote desktop solution.

# 2 User Stories

The following section contains all user stories created by the product owner to be implemented in Guacamole for Virtual Labs subsystem.

There are two subsections: Implemented User Stories – which covers what user stories have been implemented, tested, and approved, and Pending User Stories – which covers what user stories have not been implemented or completed during the time allotted this semester. Pending user stories, though not completed, will eventually be apart of the next version of the system.

## 2.1 Implemented User Stories

User Story # 124 – Find the best open source Web-based RDP

* As an instructor of the IT Automation course at FIU, I would like to be able to provide my students with the best open source Web-based Widows remote desktop, so that my students can connect to their Windows virtual machines in their virtual lab environment.

User Story # 121 – Learn webRDP

* As a developer, I would need to learn about webRDP, so that I can use both the applet-based and HTML5-based versions when need be.

User Story # 120 – Learn webNetwork

* As a developer, I would need to learn WebNetwork, so that I can integrate it with eFront as an eFront module with single-sign-on support.

User Story # 142 – Device a Performance Test For Guacamole

* As a developer of the vLabs Project I would like to device a test to observe the responsiveness and stability of a single instance of Guacamole under a workload of 100 concurrent connections so that I can establish if additional Guacamole instances and even a load balancer may be required.

User Story # 147 – Create Documentation for the Guacamole Performance Test Script

* As a Guacamole Administrator I would like to use the guacamole\_performance\_test.py to perform performance tests. In order to do that I need to have a well documented manual of use. Also, I would like the script to be well documented in order to be able to fine-tune the code if needed.

User Story # 152 – Accept REST Calls with Parameters to Relay RDP Sessions

* As a developer for eFront vLabs module, I would like to be able to be able to create RDP sessions using simple URLs, so that I can provide the end users with access to their virtual machines.

User Story # 223 – Find out what Guacamole parameters can be passed via URL

* As a vLabs admin I want to be able to define guacamole connection settings by passing those in the URL, setting such as the color depth, screen size and the alike. I want this as to not use unnecessary server resources, as well as to provide a good user experience.

User Story # 235 – Deploy Guacamole to vLabs servers

* Guacamole should be deployed and functioning on vlabs-dev.cis.fiu.edu and vlabs.cis.fiu.edu

User Story # 246 – Create a Guacamole Installer

* As a vLabs administrator I want to be able to deploy Guacamole and the guacamole-auth-url authentication plugin using installer scripts so that the installation is done quickly and minimizing human error.

User Story # 248 – Restrict Machines to Which Guacamole Allows Connections

* As an administrator of vLabs I want to be able to restrict the client computers to which Guacamole allows connections, so that the system cannot be abused by connecting through it to any other computers.

User Story # 239 – Finish testing, commenting, and documenting the Guacamole Plugin Code

* As a vLabs developer, I would like to be able to fully understand the code and its use, so that I can make improvements to the code in the future.2.2 Pending User Stories

User Story # 236 – Investigate security issues with Guacamole

* Look into how we can avoid misuse of the Guacamole server. Investigate things such as timeouts, using id for security, and other options to ensure that our deployed virtual machines are the only ones being serviced by Guacamole

User Story # 151 – Enable and Evaluate HTTPS on Guacamole Servers

* As the admin of vLabs, I am concerned with security issues and would like to know how hard it is to enable HTTPS on Guacamole servers and how much performance hit we would incur. The RDP communications does not need to be secure, but the REST calls that includes the information for an RDP connection should be considered to use HTTPS.

# 3. Project Plan

The following section has two subsections: Hardware and Software Resources – which covers the software and hardware resources used in development, and Sprints Plan – which outlines each sprint. The user stories completed are listed under the appropriate sprint with the associated tasks and acceptance criteria.

## 3.1 Hardware and Software Resources

Minimum Hardware Requirements:

Dual core 2.2 GHz

8 GB or memory

20 GB HDD

Minimum Software Requirements:

OS: Ubuntu Server 14.04 (64 Bits)

Apache Tomcat

Java JDK 6 and over

Maven 2

Programming Languages: Python 2.7, Java, PHP, Bash.

Development Tools: Vim, Sublime3.

## 3.2 Sprints Plan

### 3.2.1 Sprint 1

05/18/2015 - 05/29/2015)

User Story # 124 – Find the best open source Web-based RDP

Tasks:

* Web-Based RDP Alternative 3: Tool Installation in vLabs-dev
* Research for Guacamole VM Server specs and settings
* Web-Based RDP Alternative 3: Users and Connections Configuration
* Web-Based RDP Alternative 3: Tool Installation
* Web-Based RDP Alternative 3: Guacamole - Results of Research Part I
* Web-Based RDP Alternative 2
* Web-Based RDP Alternative 1: Ericom - Results of Research

Acceptance Criteria:

* A feasibility study that identifies the most popular open-source Web remote desktop solutions is conducted and documented.
* The feasibility study compares and contrasts the identified alternative solutions to both applet-based and HTML5-based webRDP solutions with respect to the following criteria:
  + The richness of the API and the flexibility in configuring RDP sessions dynamically.
  + The community that maintains/supports the solution.
  + The performance of RDP sessions and how responsive RDP sessions are in similar test environments.
  + The scalability of the solution. Basically, does the solution supports 100 concurrent RDP sessions, assuming other required resources are available.
* One Web-based RDP solution is recommended based on the outcome of the above comparisons.
* The required resources to support 100 simultaneous Web RDP sessions has been identified in details. For example, the specs of the server hosting the solution with the required network bandwidth are calculated based on the documentation provided in the selected solution.

User Story # 121 – Learn webRDP

Acceptance Criteria:

* I can develop a web page that can use applet-based webRDP to remotely login to a Windows machine.
* I can use all the different parameters supported by the applet-based webRDP to dynamically change the RDP session configuration on the web page.
* I can develop a web page that can use the HTML5-based webRDP to remotely login to a Windows machine.
* I can use all the different parameters supported by the HTML5-base webRDP to dynamically change the RDP session configuration on the web page.
* I can set up the webNetwork server side to scale when the HTML5-based webRDP is in use by many end users (target is 100 concurrent users).

User Story # 120 – Learn webNetwork

Acceptance Criteria:

* I can install a WebNetwork instance that is scalable (target is 100 concurrent users).
* I can configure the WebNetwork instance to support eFront themes and have the same look and feel.
* I can adjust the WebNetwork instance so that it allows users to sign in programmatically (as opposed to manually via a login page) using an API (e.g., REST API, Web Services, or simple http get/post).
* I can adjust the WebNetwork instance to support an API, if not existing already, that allows user management (create new user in WebNetwork, delete, modify, add to a group, etc.).

### 3.2.2 Sprint 2

(06/01/2015 - 06/12/2015)

User Story # 142 – Device a Performance Test For Guacamole

Tasks:

* Research for a proper and efficient way to perform the test (which may change all the above and below steps)
* Get 100 server virtual machines to connect to. (From Dr. Sadjadi / FIU)
* If actual pcs are needed for the test, device a way to drive the machines to perform the connections.
* Develop a script to collect the performance logs from Guacamole.
* Run the actual test.
* Analyze the data and make decision as to how to implement Guacamole for vLabs.

Acceptance Criteria:

* The test must open 100 concurrent RDP connections to Guacamole.
* The test must be automated.
* The test must use virtual machines.
* Each client (pc or browser tab) must open a connection to Guacamole, and open 1 (## or more? ##) RDP sessions.
* Logs of CPU and memory usage must be captured for analysis.
* Additional non-automated connections can be made during the test to get a feeling of the responsiveness.

### 3.2.3 Sprint 3

(06/15/2015 - 06/26/2015)

User Story # 147 – Create Documentation for the Guacamole Performance Test Script

Acceptance Criteria:

* A MS. Word compatible document manual with clear instructions of use.
* Good practices documentation inside the guacamole\_performance\_test.py script.

User Story # 152 – Accept REST Calls with Parameters to Relay RDP Sessions

Acceptance Criteria:

* The URL should follow the format in this examples: http://vlabs.cis.fiu.edu:8080/guacamole/#/client/connectionID?id=connectionID&guac.host=vc9.cis.fiu.edu&guac.port=50491&guac.username=icard005test&guac.password=encryptedPassword&guac.domain=ITTC
* If the target virtual machines, in this case vc9.cis.fiu.edu:50491, is running and reachable via the specified port using RDP, the session is created.
* There is no need for any other authentication.

### 3.2.4 Sprint 4

(06/29/2015 - 07/10/2015)

User Story # 236 – Investigate security issues with Guacamole

Acceptance Criteria:

* Possible solutions are found and presented for further steps to be taken

User Story # 246 – Create a Guacamole Installer

Acceptance Criteria:

* A README.txt file explaining how the scripts work.
* A guacamole-installer.sh script that installs a standard guacamole server.
* A guacamole-auth-url-installer.sh script that sets the files needed for a Guacamole + guacamole-auth-url working server.
* All the configurations files required for the Guacamole server to work, this files will be used to overwrite the default configuration files.

User Story # 223 – Find out what Guacamole parameters can be passed via URL

Acceptance Criteria:

* The connection settings should be passed in the URL with the format guac.[setting]=[value]
* Find what settings can be passed via URL and document it.

### 3.2.5 Sprint 5

(06/13/2015 - 07/24/2015)

User Story # 235 – Deploy Guacamole to vLabs servers

Acceptance Criteria:

* Guacamole has been deployed on aforementioned servers and is functional

User Story # 248 – Restrict Machines to Which Guacamole Allows Connections

Acceptance Criteria:

* A file where we can write the allowed connections in the following format:  
  [\*].domain.name:port-range  
  examples:  
  \*.cis.fiu.edu:45658  
  \*.cis.fiu.edu:40000-60000

User story #239 – Finish testing, commenting, and documenting the Guacamole Plugin Code

Acceptance Criteria:

* The code is fully tested.
* The code is fully commented.
* The project documentation includes all the documents related to this plug-in.
* The code is committed and merged to the development branch and pushed to GitHub.
* The code is pulled and deployed on both vlabs-dev and vlabs and is fully functional.
* The user manual is developed that explains what are the parameters and which ones are optional.
* The installation and maintenance manual is developed that shows how to install this plug-in and there are references on installing Guacamole itself. The configuration file should be also explained on how to add new hosts/ports allowed for RDP.

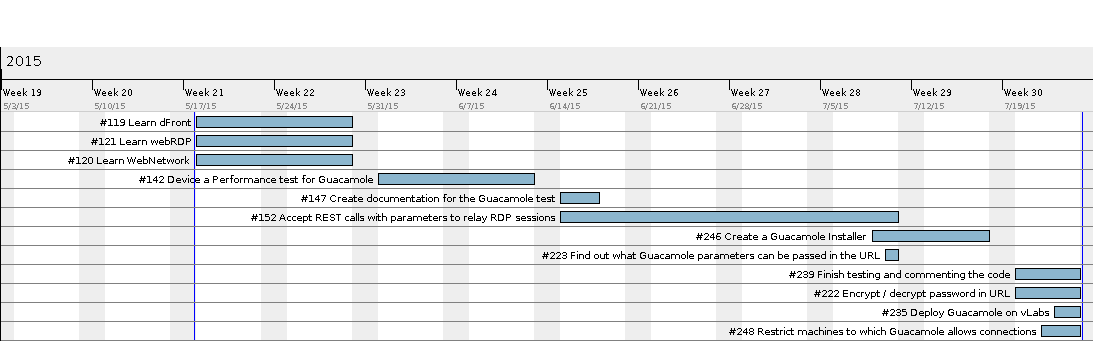
User story #222 – Encrypt/Decrypt password in URL passed to Guacamole

Acceptance Criteria:

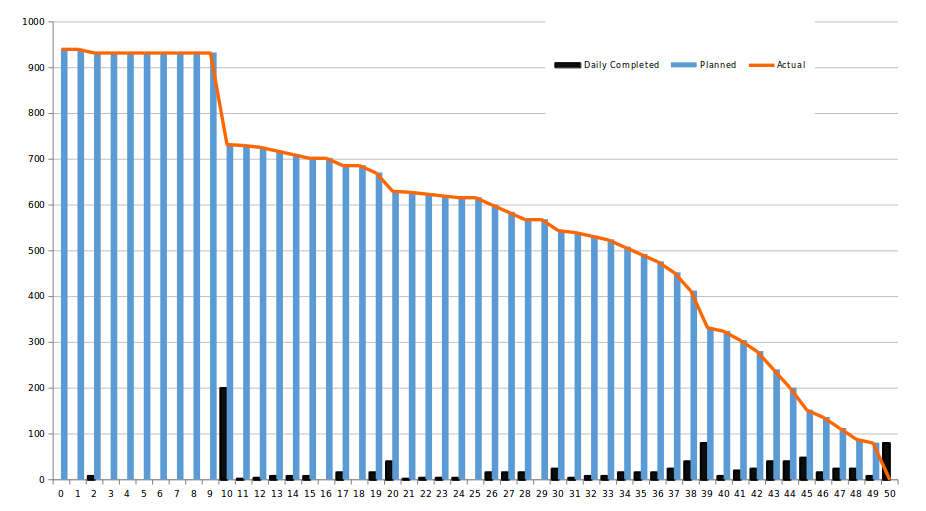
* Guacamole must take the encrypted password and decrypted to set up the connection.

## 3.3 Gantt Chart

Figure 3.3.1 – Gantt Chart for the Guacamole Subsystem



## 3.4 Burn Down Chart for the Whole Team



Sprint 1 had all almost all the points “submitted” at the end because it was a sprint of pure research.

Apart from sprint 1, sprint 4 and 5 where then ones with the most points been completed, as velocity of the whole team increased greatly.

# 4 System Design

This chapter focuses on the design of the Guacamole authorization plugin (guacamole-auth-url), describing the architectural design as well as the system decomposition. The chapter also explains why the implementation is not concerned with security implementation.

## 4.1 Architectural Patterns

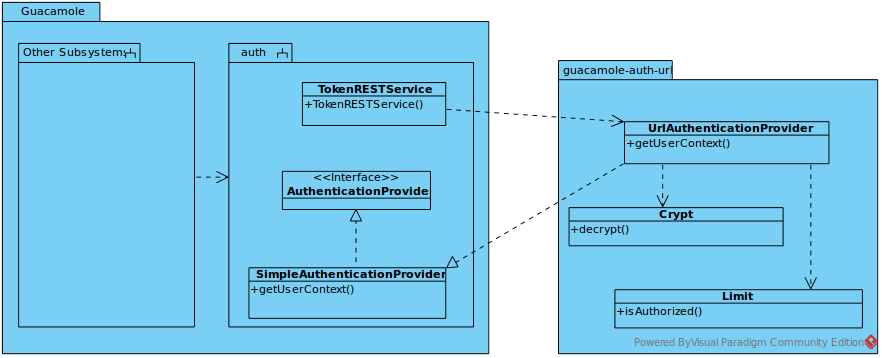
Virtual Labs is implemented with a Three Tier architecture, Guacamole is part of the Presentation tier. Guacamole in time uses the Model View Controller pattern architecture as it is a good fit for web based gateways. The guacamole-auth-url plugin is part of the controller component as it implements some logic to act on the user's provided information.

## 4.2 System and Subsystem Decomposition

Guacamole is a working gateway developed and maintained outside of the scope of Virtual Labs. The guacamole-auth-url plugin was developed by our team to implement some features Guacamole did not offer.

In order for us to develop the plugin, there was no need to understand all the subsystems of Guacamole, only the subsystem that needed to be extended to hook up our plugin to Guacamole, such subsystem shows in the following package diagram.

**Figure 4.2.1 - Package Diagram**



Guacamole is composed by many subsystems. To successfully implement the features required from Guacamole, we needed not know all of Guacamole's subsystems.

The design and development of the guacamole-auth-url plugin was completed treating the Guacamole application as a black box, only dealing with the class that needed to be extended (the authentication provider).

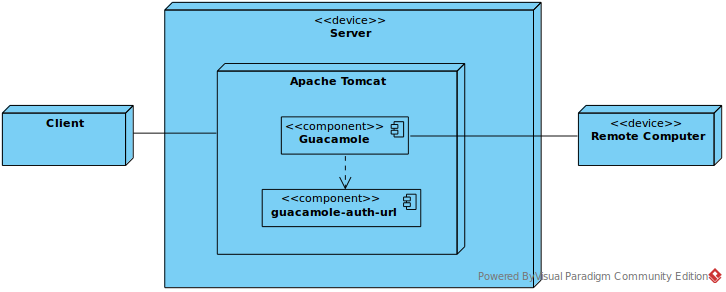
The functionality implemented by the guacamole-auth-url is the ability to create a user context by getting a hold of the URL. This user context is basically composed of a username, password and virtual computer host information.

The other subsystems then are in charge of taking this user context and creating the tunnel that connects to the target remote machine. As long as the credentials provided to Guacamole are correct, Guacamole should be able to open a new RDP connection.

## 4.3 Deployment Diagram

Guacamole is contained in Tomcat, which is called by a client (a web browser or another subsystem like Moodle) to serve the RDP connections. In our Virtual Labs environment, Guacamole needs guacamole-auth-url to create the user context that is used to open the RDP connection to the remote computer.

**Figure 4.3.1 - Guacamole for Virtual Labs Deployment Diagram**



## 4.4 Design Patterns

The main design pattern used in this subsystem is Adapter. Virtual Labs needs to provide Guacamole with the parameters via a REST call, but the default Guacamole installation cannot make use of the parameters passed in the URL. The guacamole-auth-url is basically an adapter that allows both Guacamole and the web browser to interact without having to modify their respective interfaces.

# 5 System Validation

## 5.1 Guacamole Performance Test

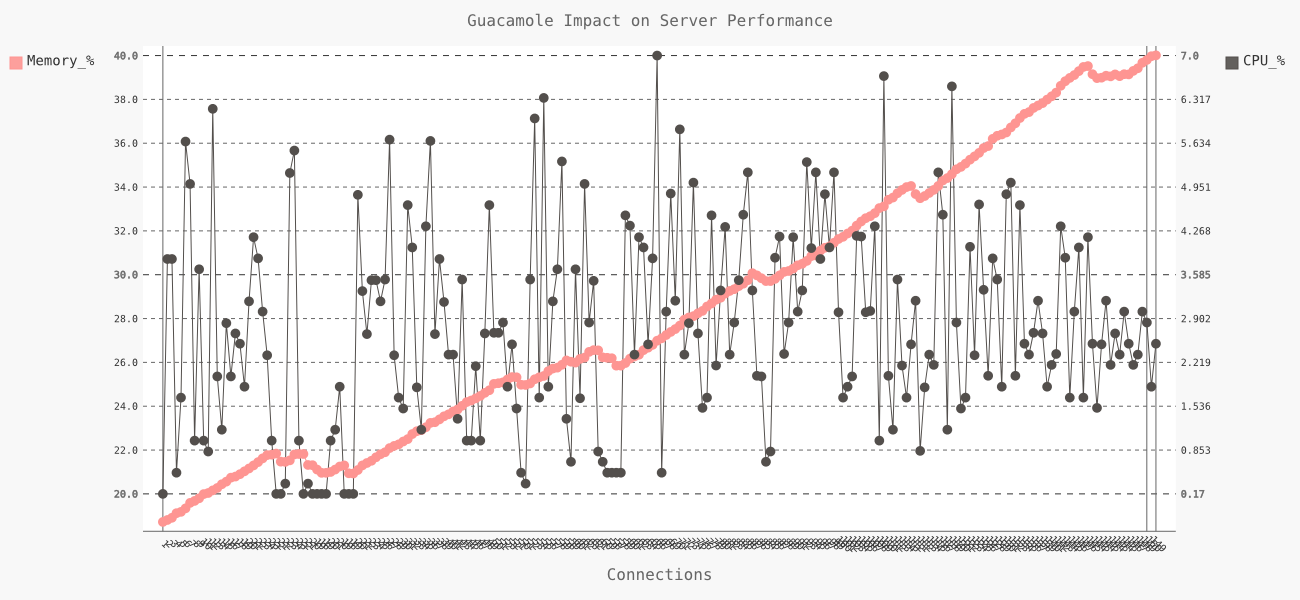
Guacamole was selected from a pool of commercial and open source products from which we were looking for features like been an HTML5 implementation, extensive documentation and rich API.

The selected solution also needed a very important characteristic, it should be able to handle at least 100 concurrent RDP connections.

To verify this capability, a stress test was performed where 45 bare metal computers established 145 RDP sessions to VMs while a Python script monitored and logged to file the host server's memory and CPU usage.

The host specs were a VM with a 2GHz dual core processor and 8GB of memory. The results were very satisfactory:CPU usage barely reached 7% and memory got just close to the 40% mark.

**Figure 5.1.1: Results of the Guacamole Performance Test**



## 5.2 guacamole-auth-url Testing

The testing of the plugin involved the standard ***unit testing*** with jUnit, plus an approach very close to ***black box testing***, as the inner working of Guacamole were unknown to the student involved in this subsystem, and for the most part still are.

Guacamole has enough documentation to guide programmers to implement an authentication plugin, but this was not enough for us, since we needed to be able not only to load a set of credentials to attach them to the HttpRequest, we needed to actually extract the credentials from the HttpRequest (which destroys it), and recreate a new HttpRequest.

There is no guide to do this, there is no documentation to do this, so we had to probe the Guacamole code until we figured out enough to figure out how to accomplish the task.

From that point on, frequent i***ntegration testing*** was done, to make sure the subsystem as a whole worked as expected.

# 6 Glossary

***eFront*** – a modern learning and training platform or virtual learning environment

***Gateway*** – A gateway is a network point that acts as an entrance to another network.

***Guacamole*** – is a HTML5 **client-less remote desktop gateway**

***KVM*** – Kernel-based Virtual Machines is a virtualization infrastructure for the Linux kernel that converts it into a hypervisor.

***URI*** – Uniform Resource Identifiers, a string of characters used to identify a name of a resource. Libvirt uses the URI qemu:///system to connect to KVM

***Virtualization*** – the act of making a virtual version of an operating system, computer network, or other hardware or storage devices.

***Virtual Labs*** – Different virtual environment configurations designed for students to perform their lab assignments. It is composed of a collection of virtual appliances (also called virtual machines), which are connected by some virtual network components and are deployed on one or more physical machines (also called hosts).

# 7 Appendix

## 7.1 Appendix A - UML Diagrams

### 7.1.1 Static UML Diagrams

Figure 7.1.1.1 – Virtual Labs – Partial Component Diagram

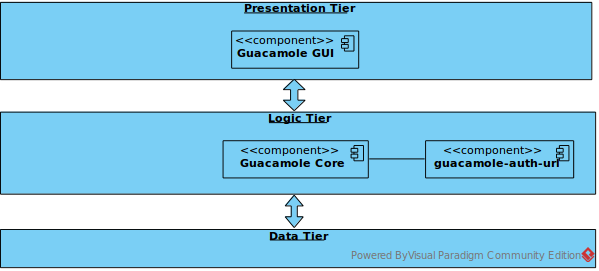


Figure 7.1.1.3 – Guacamole – Minimal Class Diagram

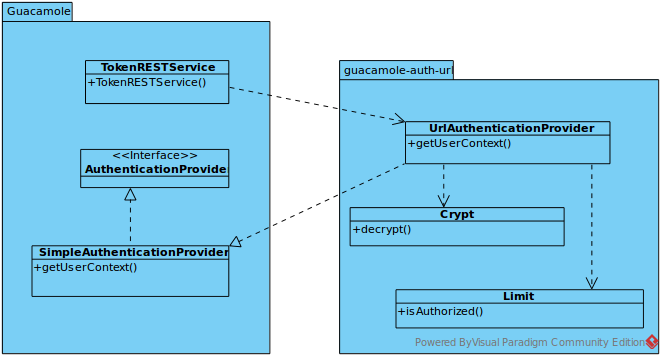
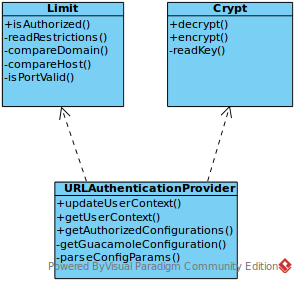
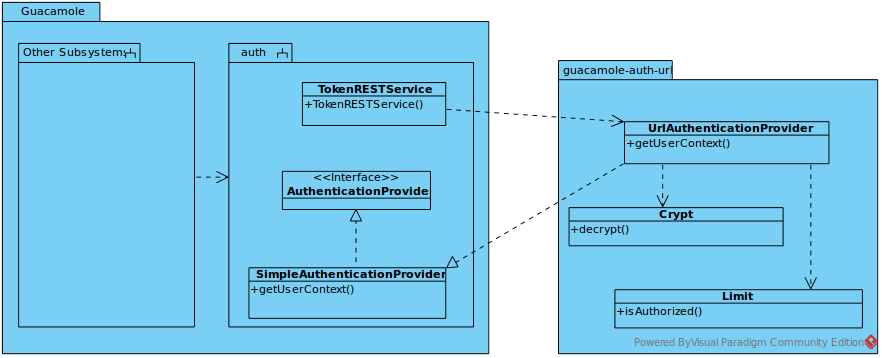


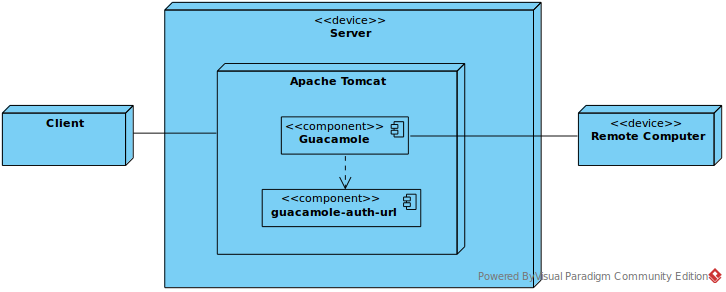
Figure 7.1.1.4 – guacamole-auth-url Plugin – Minimal Class Diagram



7.1.1.5 – Guacamole – Package Diagram



7.1.1.6 – Guacamole – Deployment Diagram



### 7.1.2 Dynamic UML Diagrams

Figure 7.1.2.1 – Guacamole – Use Case Diagram

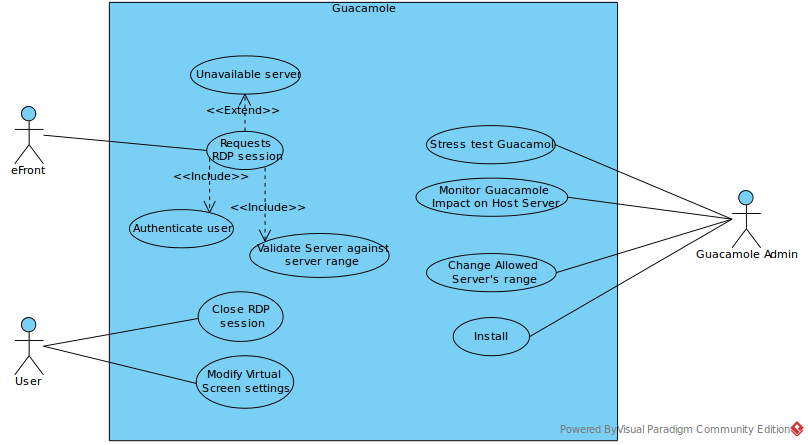


Figure 7.1.2.2 – Establish RDP Connection – Sequence Diagram

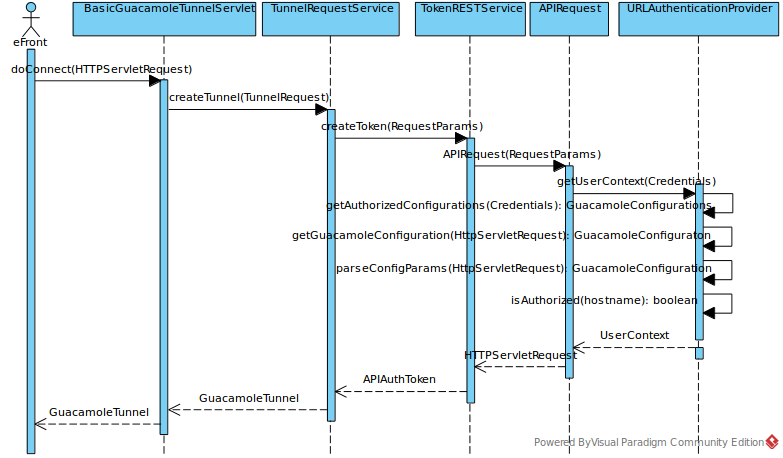
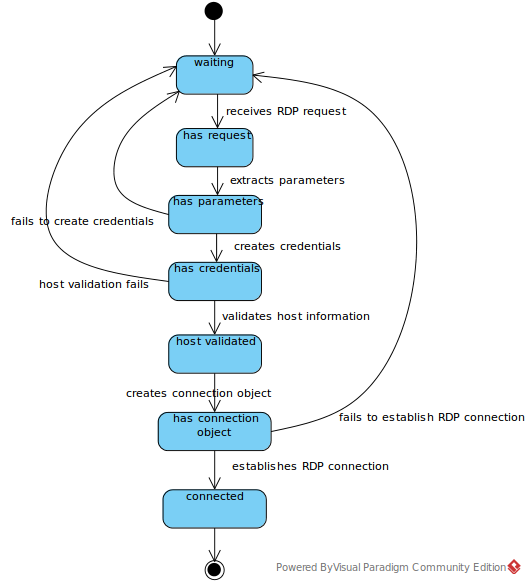


Figure 7.1.2.3 – Establish RDP Connection – State Machine Diagram



## 7.2 Appendix B - User Interface Design

Figure 7.2.1 – New Virtual Labs Interface with Guacamole

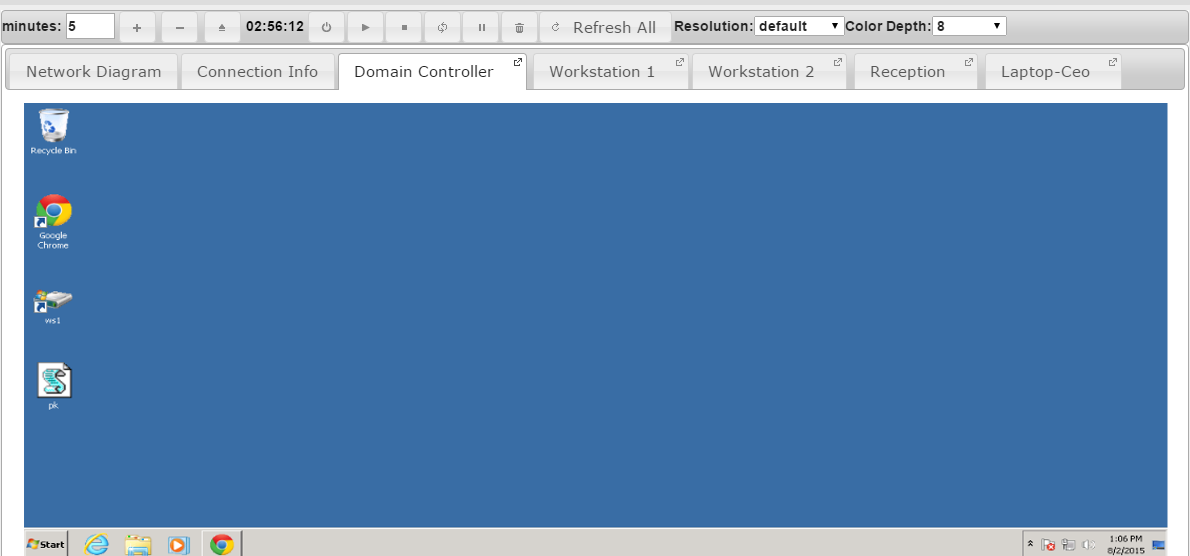
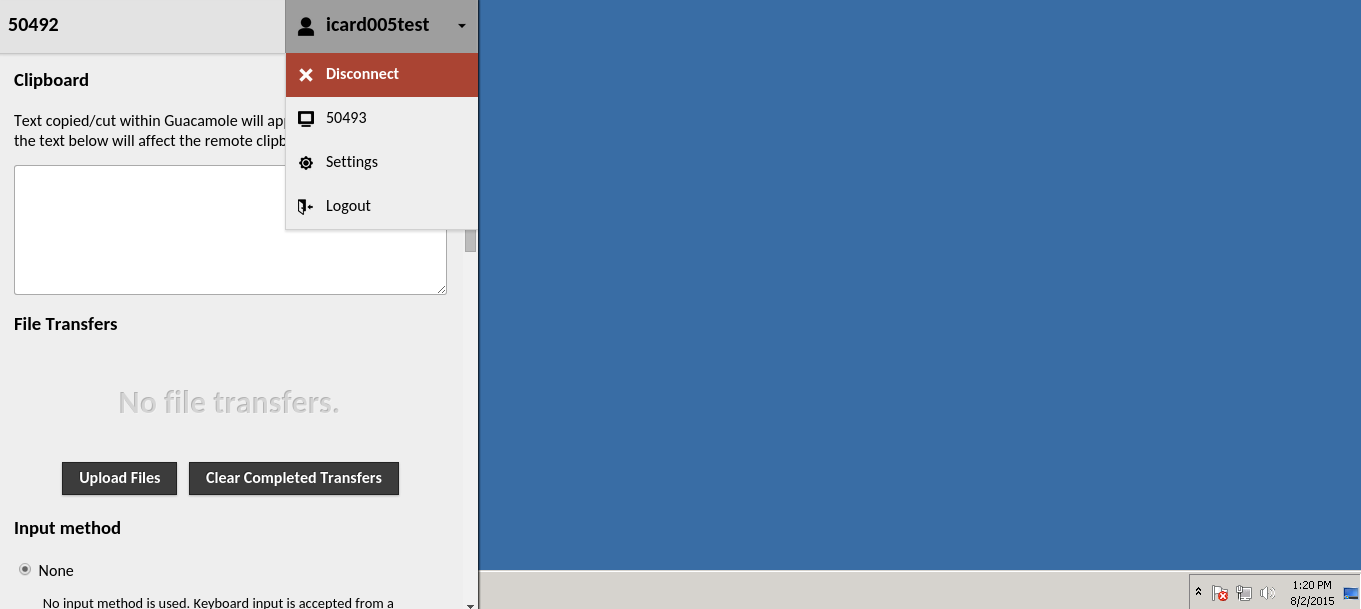


Figure 7.2.2 – Guacamole Menu – (Ctrl-Alt-Shift Menu)



## 7.3 Appendix C - Sprint Review Reports

### 7.3.1 Sprint Review 1

Date: 5/28/2015

Attendees: All

Start time: 8:30

End time: 9:00

Minute Taker: All

First student: Crystal Rivera

* What was done since the last scrum meeting?
  + created module that utilizes tabs instead of drop downs
* What is planned to be done until the next scrum meeting?
  + fix color theme in module
* What are the hurdles?

Second student: Daniel Gonzalez

* What was done since the last scrum meeting?
  + Studied up more on KVM
  + explored libvert which is a virtualization module
* What is planned to be done until the next scrum meeting?
* What are the hurdles?

Third student: Johann Henao

* What was done since the last scrum meeting?
  + About to install KVM in his machine
  + He learned there may be a Java interface for libvirt
* What is planned to be done until the next scrum meeting?
  + Install KVM
  + Experiment with different means compatible with Java to control the creation, start, stop of VMs.  Explore the libvirt Java binding apis command line, python.  Demonstrate the different methods and come up with pros/cons of each to determine which is best for the vlabs project.
  + Find what are the different ways to manage KVM from PHP.
  + Create VMs the same way as in vlabs.
  + Investigate if images from VMWare can be used in KVM.
* What are the hurdles?

Fourth student: Juan

* What was done since the last scrum meeting?
  + Looked into the scalability of Guacamole
    - there really is no limit on the software side but on server capacity
* What is planned to be done until the next scrum meeting?
  + take a look into some wedRDP server specs
  + set up guacamole on vlabs-dev
* What are the hurdles?

Fifth student: Trung Ngo

* What was done since the last scrum meeting?
  + began experimenting with jQueryUI
* What is planned to be done until the next scrum meeting?
* What are the hurdles?

### 7.3.2 Sprint Review 2

Date: 6/11/2015

Attendees: All

Start time: 8:30

End time: 9:00

Minute Taker: All

First student: Crystal Rivera

* What was done since the last scrum meeting?
  + Trying to make theme changes
* What is planned to be done until the next scrum meeting?
  + Continue working on theme changes
* What are the hurdles?

Second student: Daniel Gonzalez

* What done since the last scrum meeting?
  + worked on the start\_ve.py
    - provisioner2.py
    - start\_ve2.py
* What is planned to be done until the next scrum meeting?
  + work on stop\_ve.py
* What are the hurdles?

Third student: Johann Henao

* What was done since the last scrum meeting?
  + Scripted the functions to import the data
* What is planned to be done until the next scrum meeting?
  + working on the functionality
* What are the hurdles?

Fourth student: Juan

* What was done since the last scrum meeting?
  + worked with the professor on the guacamole app
* What is planned to be done until the next scrum meeting?
  + continue doing so
* What are the hurdles?
  + not sure where to start

Fifth student: Trung Ngo

* What was done since the last scrum meeting?
  + Implemented modify and delete policy
* What is planned to be done until the next scrum meeting?
  + complete the addpolicy with the correct id
* What are the hurdles?

### 7.3.3 Sprint Review 3

Date: 6/26/2015

Attendees: All

Start time: 8:30

End time: 9:00

Minute Taker: All

First student: Crystal Rivera

* What to be done for next sprint:
  + create the user story for migrating the moodle vLabs module into eFront
  + Goal for this sprint: to get the current version of vLabs running correctly in eFront and begin applying the fixes and changes discovered through development of the other module
  + For the jQuery resources: Keep a copy of the specific version under Code/frameworks

Second student: Daniel Gonzalez

* What to be done for next sprint:
  + create the user story for finishing everything in VC12
  + create a user story for the specific conversion schedule
  + make sure all the scripts have comments
  + possibly write a script to convert all the images in vc0-vc11
  + Goal for this sprint: convert vc0-vc11 to KVM
  + Work on documenting all my notes

Third student: Johann Henao

* What to be done for next sprint:
  + Create a user story to automate the process of dumping and importing the content of the db for his module
    - when uninstall, all the data is dumped into a dump file before the tables are dropped - this dump file should be kept in the module or a specific location on the target machine
    - for install, all the data is imported after the tables are recreated
    - Share results of this with Trung and Crystal
  + Create a user story to fix db XML references
  + Create a defect story to fix the theme issue

Fourth student: Juan

* What to be done for next sprint:
  + Focus on REST and Guacamole

Fifth student: Trung Ngo

* What to be done for next sprint:
  + Create defect story for misalignment issue using efront themes.
  + Fully finish quota system and test all functionality of module.  Improve on reports user interface and fix bugs.

### 7.3.4 Sprint Review 4

Date: 7/10/2015

Attendees: All

Start time: 8:30

End time: 9:00

Minute Taker: All

First student: Crystal Rivera

* What to be done for next sprint
  + Finalize vLabs Module
    - vm buttons, display parameters in URL, other defects
  + Begin working on the CertTest module - should be similar to vLabs

Second student: Daniel Gonzalez

* What to be done for next sprint
  + Work on refresh script
  + Goal is to finish any remaining scripts like is\_rdp\_ready, run\_vm\_cmd, refresh\_vm

Third student: Johann Henao

* What to be done for next sprint
  + Make sure that the quota store is fully finished and tested
  + The db management tab in vLabsAdmin
    - incorporates the quota store data and the other modules as well

Fourth student: Juan

* What to be done for next sprint
  + fully document and finish the implementation of the guacamole plug in
  + fully deploy the implementation to vlabs-dev and vlabs servers
  + Investigate how we can avoid misuse of guacamole server - security
    - short sessions, timeouts, and a way of using the id so that only our own vms can be serviced by guacamole

Fifth student: Trung Ngo

* What to be done for next sprint
  + Work with Johann and Professor Sadjadi on vLabs admin tabs
  + Finish scheduler
  + Finish testing quota system
  + moving extra tabs to vlabs admin

### 7.3.5 Sprint Review 5

Date: 7/24/2015

Attendees: All

Start time: 8:30

End time: 9:00

Minute Taker: All

First student: Crystal Rivera

* Topics Discussed:
  + things to fix:
    - add refresh popup for confirmation
    - add a condition for modern\_uk theme
    - remove Ajax upon color depth select
    - Adjust button placement and fonts on toolbar
    - check the id in guac URL

Second student: Daniel Gonzalez

* Topics Discussed:
  + Make sure that errors that have been resolved in the past and tiny details are noted in the documentation
  + Add a table of contents and titles for the sections
  + Document making a kvmserver ready in vLabs

Third student: Johann Henao

* Topics Discussed:
  + The export should download a file
  + Finalize testing by 1:00

Fourth student: Juan

* Topics Discussed:
  + Go through Documentation to finalize little things

Fifth student: Trung Ngo

* Topics Discussed:
  + Figure out the install issue pronto

# 8 References

* Installing Guacamole natively. (2015). [Website Manual]. Retrieved from   
  <http://guac-dev.org/doc/gug/installing-guacamole.html>
* Disabling Authentication. (2015). [Website Manual]. Retrieved from  
  <http://guac-dev.org/doc/gug/noauth.html>
* Custom Authentication (2015). [Website Manual]. Retrieved from

<http://guac-dev.org/doc/gug/custom-authentication.html>