Cyber Network Capture Generator

Project Plan

Sd-May19 Team 5

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List of Definitions

ETG : Electronical Technology Group
GPL : General Public License
RSPAN : Remote Switched Port Analyzer
SPAN : Switched Port Analyzer
CAPEC : Common Attack Pattern Enumeration and Classification

1 Introductory Material

1.1 Acknowledgement

We would like to acknowledge our client, Benjamin Blakely, and our faculty advisor, Thomas Daniels, for their contributions to our project. Benjamin has dedicated significant time to meet with us every week as we continue to work out the details of the project. Dr. Daniels has contributed his time and technical advice to our team, as well as assisted in steering us in the right direction on multiple occasions.

1.2 Problem Statement

The needs to analyze traffic for hosts, applications, or services is essential in the world of computer security. Traffic is a way of describing how a computer sends information to the internet, and how the computer receives that information back. Traffic analysis is used to detect any malicious or harmful programs that can enter and harms one's computer, like a virus. Thus, preventing any undesired outcomes.

The solution of the problem is to create a program that automatically analyzes traffic data of many types, helping researchers create more innovative ways to combat malwares, and other un-safe softwares. This proposed program will not only serve as a catalyst for researchers to come up with potential solutions, but also provide a simple understanding of Traffic and its effect in computers.

There is also need for the development of a software that analyzes computer traffic for the following reasons:

1. Computer traffic is essential in gaining information that directly affects the inner-structure of a malware.

2. Computer traffic help in creating tests that detect the presence of malware.

3. Computer traffic maintain a safe software in which the hardware runs on.

Thus, our project creates a software that benefit the community in many ways, and not just 1 or 2 ways. We aim for our project to be controlled by Argonne National Laboratory, and they reserve the right to use it either privately or publicly.

1.3 Operating Environment

- For this project, the operating environment will be a web application.

- A web application is convenient because it provides the user with an interface that is admirable and easy to use

- The web application will also be designed to withhold a large number of requests without crashing while the user is typing commands.

1.4 Intended Users and Intended Uses

- Intended Users: our tool will be used by cyber researchers to analyze captures of traffic from a particular combination of host, application, and service. They will be able to use a web application that can automate the traffic generation and analyze it for the scenario they specify.

- Intended Uses: our product will allow a user to select OS, service, and traffic types for a set of servers and clients, and then generate that traffic and analyze it in an entirely automated manner. The above scenario might be for the purposes of traffic engineering, generating training datasets for machine learning, or general host/protocol analysis.

1.5 Assumptions and Limitations

Assumptions:

- The tool will use a predefined list for traffic types
- The generated traffic file won’t be stored locally
- Chef and Xen can be used together to create a properly configured VMs
- Free version of Chef is enough for our purposes

Limitations:

- The project is cost free
- PCAP files are very large that we might run out of space

1.6 Expected End Product and Other Deliverables

- Web application:

  Our end product will be an extensible web application tool that will allow a user to select the type of OS, Service, and traffic types (from a predefined list) for a set of servers and clients, and then, in an automated manner, create and configure the necessary virtual machines, initiate a packet capture (saved to PCAP files) and the specified traffic type, and save the capture for later analysis. The source code will be delivered as a Git repository.

- PCAP files:

  Packet capture files of the generated traffic, for some different combinations of OS, service, traffic type, saved for later analysis.

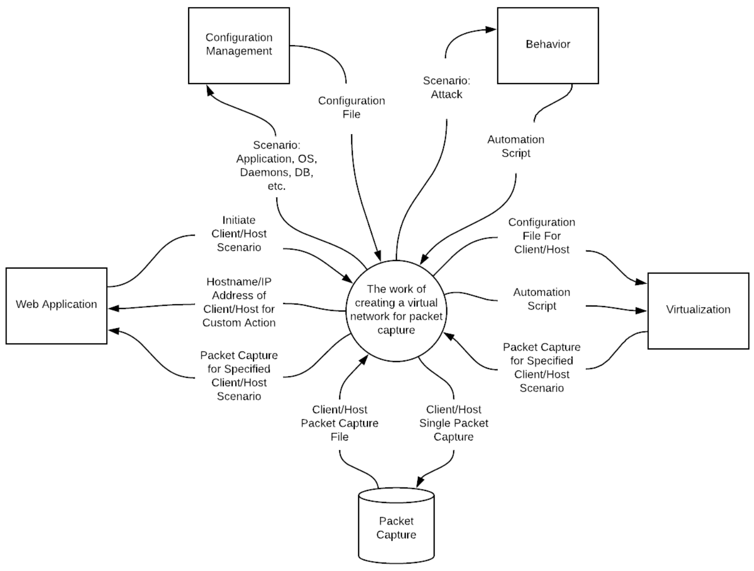
- Written report:

A report describing the architecture,   testing methodology, and expected performance characteristics of the code.

2 Proposed Approach and Statement of Work

2.1 Objective of the Task

The goal of this project is to create a tool that will help in cyber-related research when there is a need to analyze captures of traffic from a particular combination of host, application, and service. As described in the end product section above, the tool will make it easier and less time-consuming for the researchers to analyze the traffic of interest.



Configuration Management
Behavior
Scenario: Attack
Configuration File
Scenario: Application, OS, Daemons, DB, etc.
Automation Script
Initiate Client/Host Scenario
Configuration File For Client/Host
Web Application
Hostname/IP Address of Client/Host for Custom Action
The work of creating a virtual network for packet capture
Automation Script
Virtualization
Packet Capture for Specified Client/Host Scenario
Packet Capture for Specified Client/Host Scenario
Client/Host Packet Capture File
Client/Host Single Packet Capture
Packet Capture

Figure 1: Context Diagram (1st Iteration) for Application

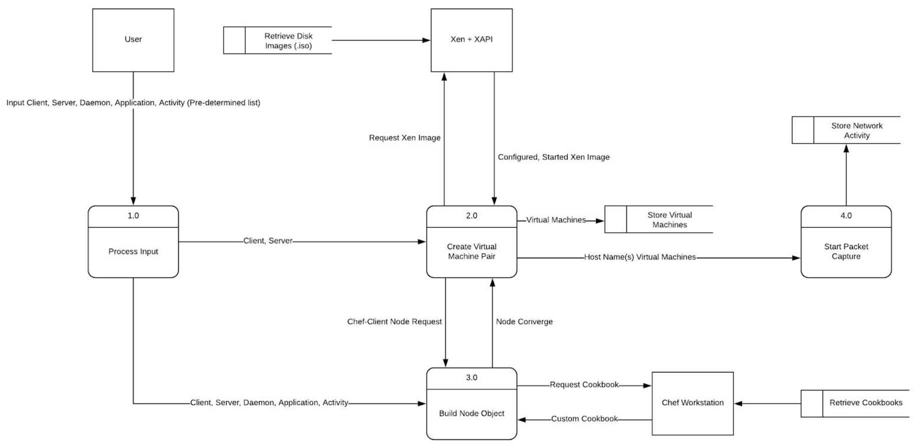


Figure 2: Data Flow Diagram Level 2 for Application

2.2 Functional Requirements

1. **Ubiquitous Requirements**
   1.1. The hypervisor software shall be remotely accessible through a web application (Figure 1: (IN) “Web Application,” adjacent system)
   1.2. The web application shall provide secure user authentication prior to access (Figure 1: “Web Application,” adjacent system)
   1.3. The web application shall allow the user to create network capture from pre-determined combination of client, server, daemon(s), application, and activity (Figure 2: Process 1 Input)
   1.4. The generated network flow shall be stored in a database for later access (Figure 2: Process 4 Output)
2. **Event-driven Requirements**
   2.1. When the user selects client/server combination the hypervisor shall allocate and create two separate virtual machines (Figure 2: Process 2 Abstraction)
   2.2. When the hypervisor has created a virtual machine the configuration management shall establish a connection and load configuration file to virtual machine (Figure 2: Process 2 Incoming Arrows)
   2.3. When configuration management has initialized a virtual machine the application shall load/execute behavioral scripts on the virtual machine (Figure 1: (IN) “behavior” adjacent system and (OUT) “Virtualization,” adjacent system)
3. **State-driven Requirements**
   3.1. While the virtual machines are active the server shall store network traffic to database (Figure 1: (OUT) “capture,” adjacent system)
4. **Unwanted Behaviour Requirements**
   4.1. If hypervisor detects insufficient resources then the web application shall restrict virtual machine creation and display “insufficient resources” warning

4.2. If server detects insufficient storage then the web application shall display "insufficient storage" warning

5. **Complex Requirements**

5.1. When the network traffic is being stored, if the server detects insufficient storage, then the web application shall display "insufficient storage warning"

2.3 Constraints Considerations

Non-functional requirements

- Performance
  - Demonstration of a working system.
- Scalability
  - Prototype will handle at least 5 virtual machines on a network.
  - Store scenario data for at least 10 one day long worth of traffic flow of the virtualization network.
- Availability
  - Available only to our team of developers and permissioned users during our prototype development.
- Reliability
  - Always properly store compressed PCAP in a reliable manner.
  - Spun up virtual machine scenarios should have a 99% success rate.
- Recoverability
  - No backup data will be required for the prototype development.
- Maintainability
  - Be able to continue development of features and bug fixes of the project through the Spring 2019 semester 492 class at Iowa State University.
- Regulatory
  - The majority of software should be written in Python 3.
  - All software incorporated in our project has been selected because of their licensing and open source status. The GNU General Public License (GNU GPL or GPL) is a widely used free software license, which guarantees end users the freedom to run, study, share and modify the software.The Apache License is a permissive open source software license — so users can release modified versions of the Apache licensed product under any license of their choice. Users can freely use, modify, distribute and sell a software licensed under the Apache License without worrying about the use of software: personal, internal or commercial.
    - Xen
      - GNU General Public License, version 2
    - Selenium
      - Apache 2.0 License
    - Chef
      - Apache 2.0 License

        - https://www.chef.io/terms-of-service/

- Usability
    - All use case functionality will be accessible through a web application.
- Interoperability
    - Accessible through the Iowa State network for the development team.
    - Virtual networks between the virtual machines should be manageable.
- Cost
    - No costs associated with software as everything is open source.
    - Hardware initial cost and maintainability for hosting VMs, data, server, client information.
- Platform compatibility
    - Web application compatible with any machine capable of hosting any popular web browser.
- Security
    - Any password information will be salted and hashed passwords stored separately from the Server.
    - Any execution of potentially malicious software should be isolated to the virtual network, this will be done with a gateway/proxy to ensure network connectivity to ensure traffic will not leave the environment. In additional any rules for Xen itself may restrict access to the outside network.
- Safety
    - All hardware should be stored and operated in a safe and responsible manner
- Standard Protocol.
    - PEP8-compliant source code as a Git repository.
    - CAPEC for maintaining the catalog of common attack patterns and vectors
- Ethicality
    - All work should be original for our development team with credit given to proper sources.
    - No unauthorized copying of software.

2.4 Previous Work And Literature

Relevant Team Experience:

- Development experience with programming languages: Python 2.7, 3.7, JavaScript.
- Experience with building and maintaining database systems.
- Experience with lightweight framework and server deployment.
- Experience with web development creating and updating custom webpages.
- Experience with Selenium:
    - Fully functioning web scraper for custom web pages capable of executing javascript programmatically.
    - Web crawler with specific setable parameters to control pace, randomization, and execution time.

    - URL redirects/Web testing using selenium to ensure links properly work and javascript executes correctly under varying controlled circumstances.
- VMware/VirtualBox virtual machine experience for testing with different operating systems as well as examining and testing malware in a controlled environment.

Existing market products
- VMware Workstation
    - Vmnet-sniffer: captures all virtual machine traffic to the virtual machines at once to be sorted out later.
        - Isolate HTTP traffic sent through host level load balancer to a random virtual machine.
        - Determine where specific DNS queries are getting picked up.
        - Low level network management packet realizations seperate from main network.
    - Works well with Vagrant and CloudShark API requests to automate functions.

Relevant market products
- Wireshark and PerformanceVision Virtual Capture
    - Run concurrently in promiscuous mode.
    - Visualize traffic within virtual server.
    - Virtual switch acts like hub for VMs.
- Phantom TAP and GigaVue
    - Intrusive kernel level sends data to an off site analysis device.
    - Sends copies of data from source seperate from the network.
    - Is a paid service.
    - May require license upgrade costs.
- Vswitch for VMWare and Openvswitch for Virtualbox/Xen
    - Clean and easy install process.
    - Flexible for multiple purposes.
    - Is a paid service.
    - Requires a ESX license.
    - Has a physical switch for RSPAN and ERSPAN capabilities.

Difference from market products
- Our solution is completely free.
- Our solution is based entirely on open source material
- Our solution also comes with an application that will combine resources to automate traffic capture
- Our solution will generate virtual traffic automatically with prewritten automation scripts
- Out solution is completely controlled under our own domain without relying on a third party service for data capture or analysis.

2.5 Proposed Design

Programs:
Xen for running Virtual Machines.
Chef for configuring Virtual Machines.
PCAP, Netflow for recording traffic from Virtual Machines.

Front-end:

For the front-end development, we are using Django framework to construct the web application that holds our program together.

Front-end will include the following features:

- Login Page

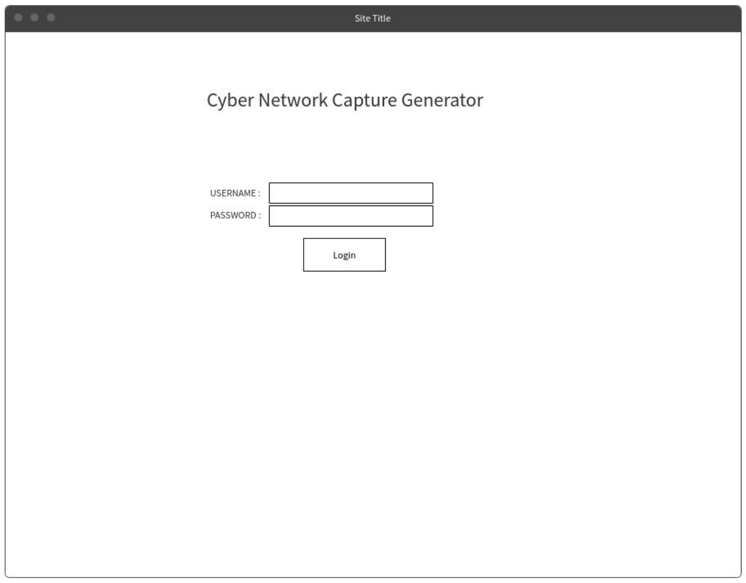


Figure 3 : Wireframe for Login Page

In this template, the user is able to login to the application with his username and password as authenticated.

- Action Choice

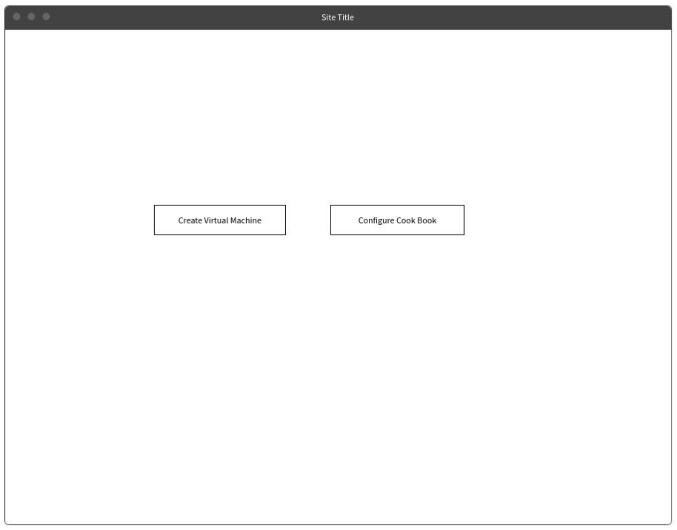


Figure 4: Wireframe for 2nd Page

In this template, the user is able to choose to create a new Cook book/ Scenario or Create a Virtual Machine with a specified list of scenarios.

- Creating a Virtual Machine

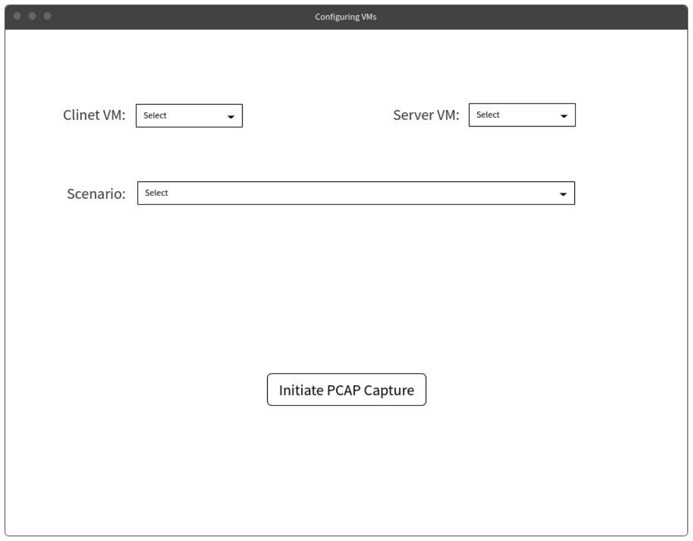


Figure 5 : Wireframe for Creating a Virtual Machine

In this template, the user will be able to choose the desired combination of client, server, and scenario from a predefined list. Then, the user can click on Initiate PCAP Capture button to start the process of creating the VMs and running the chosen scenario.

- Capture Process

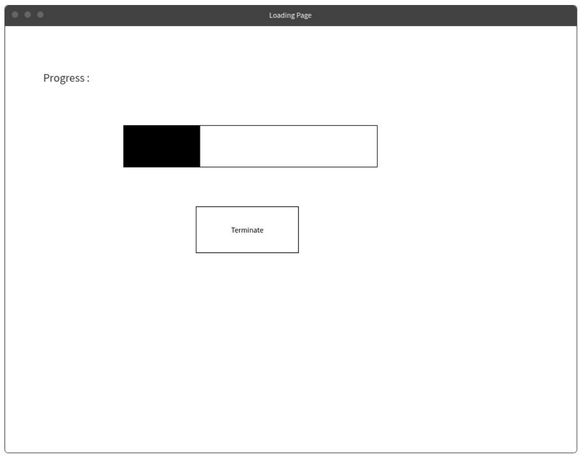


Figure 6 : Wireframe for Capture Process

In this template, the user will be able to monitor the progress of the capture. The user is also able to terminate the capture if needed to.

- Configuring a Chef Cookbook
<u>Will be further discussed</u>

- Displaying Results

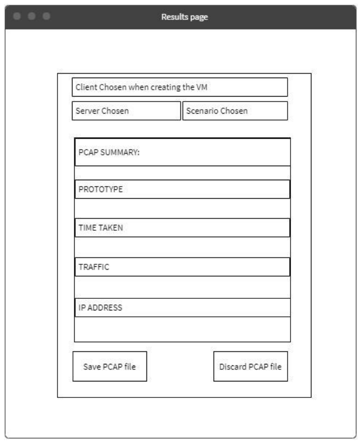


Figure 7: Wireframe for Displaying Results

In this template, the user (Client) will be able to view the results from running a specific scenario on a virtual machine of his choosing. He/She will have the option to save a snip of the file in a .**PCAP extension,** or discard the results, if they didn't receive what was originally planned.

Back-end:

The backend of the project will make use of three open source projects, namely: Xen Hypervisor, Chef, and Vagrant. Xen hypervisor is what will initialize each of our virtual machines. It also will allow us to define the domain where we will be sniffing the traffic generated by the virtual machines. In order to automate the process to initialize these virtual machines we will utilize chef to dynamically create different configuration files (OS, Application(s), Daemons, Databases, etc.) for each of the requested virtual machines. However, Chef does not work directly with Xen. Initially, to connect manually we would have to create custom scripts which may not be very maintainable in the future. A better solution is to implement the project using Vagrant as an intermediary to connect the two technologies. This will work by utilizing the linux generic library, “libvirt”, and Xen’s driver, “libxl”.

2.6 Technology Consideration

Our project will require building a virtual network based on user input. Therefore, we will be utilizing a lot of scripts. Our team considered two options for our scripting language, Python and Ruby.

The project involves a web application. Our team has a lot of web development experience. We originally wanted to use an MVC framework with CSS, JS, and HTML. However, after looking at the functionality for this web application, as well as the time we have to build the application, we decided a proven web development framework would help with time and the complexibility. The team quickly decided to go with the Django web framework for the development of the web application. There is also the free tools that our project will be utilizing. The team researched multiple options for these tools.

When considering the scripting languages to use, Dr. Blakely, had seemed enthusiastic about using Ruby for all of our scripting. Blakely also did not mind Python in Ruby’s place. Therefore, the team started off in the direction of Ruby; however, only one member of our team had ever worked with Ruby. Whereas a majority of the team had a lot of experience in Python. This brought us to our conclusion. In order to save time by not researching into Ruby, we decided to use Python as our main scripting language for all of our backend functionality.

The project also requires the help of a few tools for the virtualization aspect of the system. Our team researched multiple different Hypervisors to use for our project. The team knew a lot about VMWare and VirtualBox. However, there were a lot of bug issues with VirtualBox that we did not think was worth the risk. VMWare was not an option as a license was required. Therefore, our team studied multiple new hypervisors to use. The two that stood out the most were, KVM and Xen. The research our team did showed that Xen had a lot of flexibility with its multiple hooks. KVM seemed to not be as flexible as Xen, but was still a viable option. The scope of our project brought the team to a conclusion that more flexibility of our hypervisor may be useful down the road. Therefore, we will be using Xen as our hypervisor for this project. Dr. Blakely had also stated that he had experience with Xen.

Our project also requires the configuration of multiple virtual machines based on user specification. Therefore, we needed to find a configuration management tool to make this process as efficient as possible. Our team had the value of Dr. Blakely, giving us insight on three major configuration management tools. These tools, Chef, Ansible, and Puppet, are all very popular configuration management tools around the world. However, only two of them are free, Chef and Ansible. Our team made a quick decision on these two possibilities, as Chef used daemons and had a massive library for learning the software.

Another technology that we had difficulties with is Vagrant. We wanted to use Vagrant to spin up the virtual machines on our network. However, the connection between Vagrant and Xen is not as easy as we expected. This required the inclusion of the Libvirt library. A library that integrates Vagrant with Xen. Once we found this library we have had much more success with communicating to Xen via Vagrant.

2.7 Safety Considerations

The overwhelming majority of development work here is software development that has no safety considerations. The only safety concerns exist around the transportation, storage, and maintenance of hardware.

2.8 Task Approach

1. Configure and launch standalone virtual machine using Xen.
2. Configure Chef to be able to ensure compatibility with the project.
3. Capture PCAP traffic in the virtual machine.
4. Configure and launch specific virtual network with 2 virtual machines.
5. Capture PCAP traffic in the virtual network.
6. Develop a server to handle basic requests and integration with a database.
7. Establish database/preliminary storage.
8. Establish front end web application.
9. Store preliminary PCAP data in database/preliminary storage through server.
10. Develop Vagrant to handle required requests according to Figure 1.
11. Develop Chef to handle config requests according to Figure 4.
12. Develop Database (or preliminary storage):
    a. Establish tables
    b. Establish dependencies
    c. Establish meaningful requests within the scope of our project

13. Develop Server:
    a. Create and Handle Xen VMs
    b. Create and Handle Chef
    c. Handle data to and from database
    d. Accept and respond to requests from the front end web application
    e. Safe and secure
    f. Handle compressed PCAP files
14. Develop Web Application:
    a. Establish interactivity that suits all use cases as described in figure 5
    b. Make user friendly and appealing
15. Develop Automation Scripts:
    a. Selenium to generate proper traffic
16. Develop Analysis tools for PCAP data.
17. Work on stretch goals:
    a. Multiple operating systems
    b. Develop users functionality
    c. Cloud interactivity

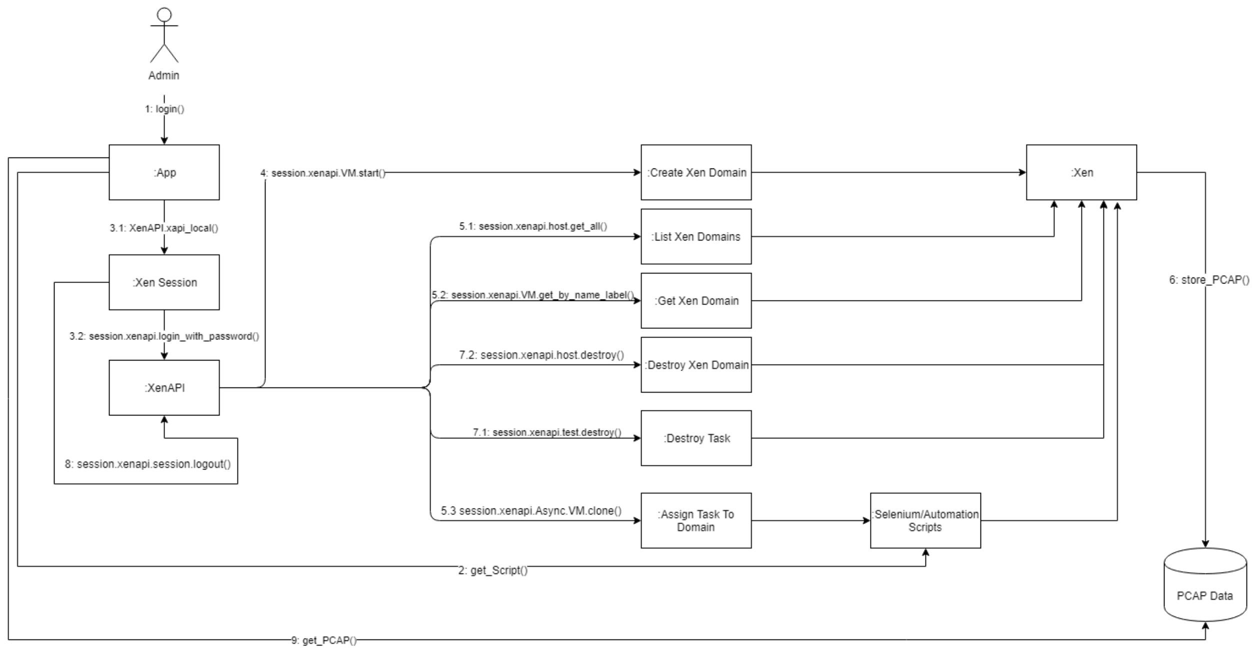

Admin
1: login()
:App
3.1: XenAPI.xapi_local()
:Xen Session
3.2: session.xenapi.login_with_password()
:XenAPI
8: session.xenapi.session.logout()
4: session.xenapi.VM.start()
:Create Xen Domain
5.1: session.xenapi.host.get_all()
:List Xen Domains
5.2: session.xenapi.VM.get_by_name_label()
:Get Xen Domain
7.2: session.xenapi.host.destroy()
:Destroy Xen Domain
7.1: session.xenapi.test.destroy()
:Destroy Task
5.3 session.xenapi.Async.VM.clone()
:Assign Task To Domain
:Selenium/Automation Scripts
:Xen
6: store_PCAP()
PCAP Data
2: get_Script()
9: get_PCAP()

Figure 8: Communication Diagram (Iteration 1) for Xen

This figure describes how Xen and the Xen API will be interacting with the front end web application and database through specific calls.

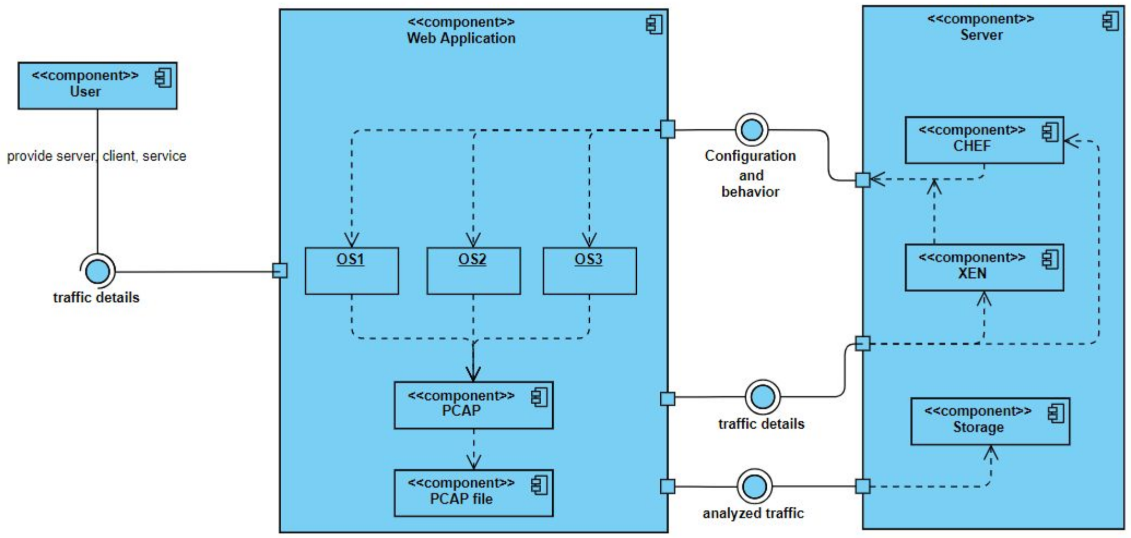


Figure 9: Component Diagram (Iteration 1) for Application

This figure shows how all components of our system fit together and where they will reside.

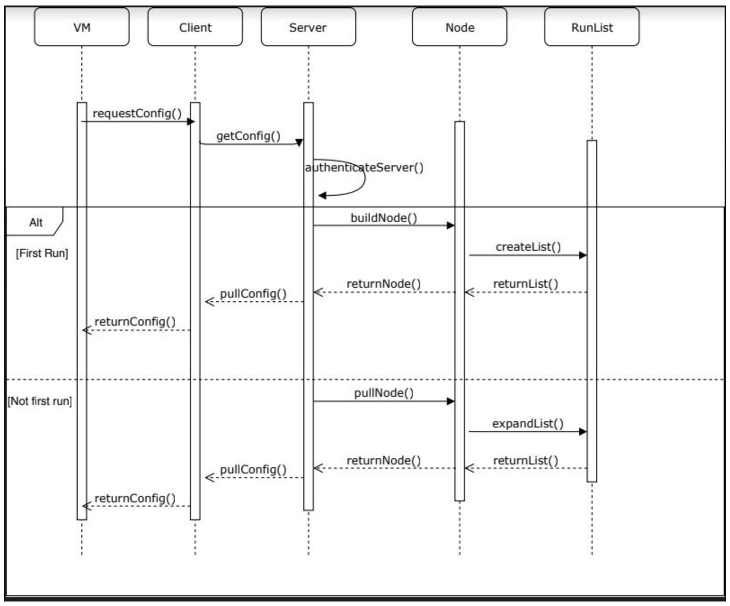


Figure 10: Sequence Diagram (Iteration 1) for Application

This figure shows the sequence of events between our components for chef's functionality.

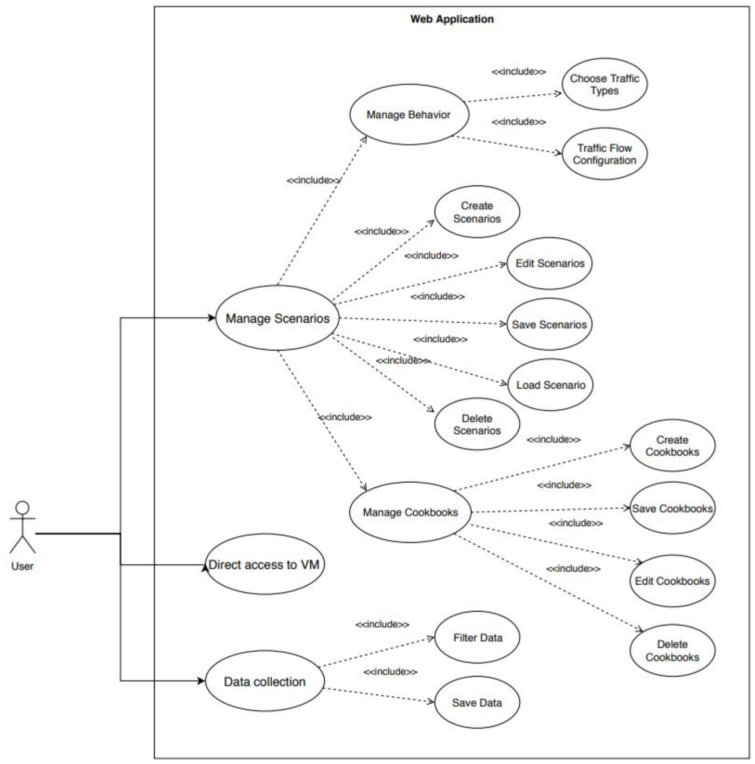


Figure 11: Use Case Diagram (Iteration 1) for Application

This figure shows all front end enabled use cases for the entirety of the project.

2.9 Possible Risks And Risk Management

Possible risks

- Incompatibility of software involved:
  - Xen needs to handle applications and scripts launching automatically, failure to do so would be a complete failure of the system.
  - Chef needs to work with Xen to automate configuration, without this step manual scripts or another application will need to be responsible for automating configuration of the virtual network.
  - Front end application will need to handle all use cases and properly communicate with virtual network, server, and server to database. An improper implementation of that interface will make the application useless
- Hardware limitations:
  - Supplied hardware may not be able to hold as many scenario data as we would like. This factor will be unknown until testing stages of the system.
  - The application may not be able to launch complex virtual networks.

- Time constraints may limit functionality of the system.
- Lack of expertise in virtualization of a network may lead to delays in the development process.

Risk Management Strategies:

- Communication in development:
    - Slack as main conduit of centralized and recorded communication for the development team.
    - Properly documenting and commenting on developed code.
    - Proper use of GitHub for efficient and and progressive development.
- Sharing expertise and knowledge:
    - Code reviews will be conducted weekly during development sprints.
- Shrinking prototype executables to fit hardware limitations - or obtain more or better hardware to meet our goals.
- Project planning and progress reports ensuring minimization of dead time:
    - Use of Trello for task completion and visualization of progress.

2.10 Project Proposed Milestones and Evaluation Criteria

- **Milestone 1**: Install and remotely configure XEN, hypervisor, running on server
    - **Test 1**: Ensure hypervisor properly allocates resources
    - **Test 2**: Ensure hypervisor and server are configured to the network and accessible from other machine.
- **Milestone 2**: Utilize Chef, configuration management tool, to standardize generation of predetermined list of daemon and application
    - **Test 1**: Ensure Chef is configured properly on server to access nodes (created virtual machine)
    - **Test 2**: Ensure Chef Cookbooks (config files) are properly accessible by correct nodes
- **Milestone 3**: Generate and configure virtual machines running multiple operating systems, initial setup scripts, and initialize as node on chef network
    - **Test 1**: Ensure initial daemon with chef-client is accessible from chef workstation (located on server.)
    - **Test 2**: Ensure chef node properly pulls updates from server
- **Milestone 4**: Generate behavior of created virtual machine builds, filter to specific traffic, and store to in PCAP and Netflow.
    - **Test 1**: Ensure PCAP is properly stored to database
    - **Test 2**: Ensure PCAP collects correct data
    - **Test 3**: Perform load testing on database when multiple virtual machines are running and storing data to database.

2.11 Project Tracking Procedures

- Team Work Allocation:
  - https://trello.com/b/elddC5KG
  - Pool tasks (To Do) and delegate to proper team members in team meeting
- Weekly Status Reports and Project Documentation:
  - https://sdmay19-05.sd.ece.iastate.edu/
  - Testing documentation, Github activity, Team member information, and Posted Status Reports
- Github
  - Documented wiki on design choices and project features
  - Guided walkthroughs on development environment and necessary box setup
  - Progress in code development
  - https://git.ece.iastate.edu/sd/sdmay19-05

2.12 Expected Results and Validation

Our end goal will be a fully functional testing web application. The web application will allow the user to create different testing scenarios for a virtual network. The user will then be able to test different malware and applications on their created virtual machines on the virtual network. Our team plans to have extensive unit testing on these front-end functionalities. Our team has prioritized the usability of the application. There will be testing on all functionalities of the front-end after any change. These tests will be run through Hazem.

The application will be able to create up to 5 VM's on one network. The user is able to manipulate these machines on the web app through the configuration pages. The user will also be able to configure how the machines talk to each other. This includes the traffic protocols sent (HTTP, IMCP, HTTPS, SMTP, etc.), the amount of traffic sent, and the direction of the traffic throughout the network. The team has scalability as one of our top priorities. The team will run stress tests on the system throughout the designing process, in order to, get to the desired usage goals.

The user will also be able to get the traffic data from their loaded scenario. The web application will allow for filtering and downloading of the desired traffic on the virtual network. The system will save all of this data into PCAP files. The capturing of the traffic is the main purpose for this project. Our team will be testing this traffic filter and capture on multiple different browsers.

We plan to validate the project by going through our final test plan of the application. This should give good insight to how the web application accomplishes all of our use cases as well as showing that functions work as expected. Our group will also run through multiple test iterations with the client to see if there are any minor functional changes the client would like.

2.13 Test Plan

This project has multiple components to it. Therefore, the team has planned for thorough testing of the system. Most of the tests will be integration tests as we are using multiple tools to come to our one solution. We will also have front-end testing on the web application that will be primarily based on the usability and user experience.

Throughout the design and development of the system, our team will have a test plan that we will be adding to as problems arise. This test plan will be used when unexpected problems or unexpected values occur. The team will update the test plan to account for these problems in the future testing of the component. The team plans to run through this updated test plan as our final run through of the entire application and system.

The integration testing will begin at the start of development. Our group will begin the development of the client and server. The first few integration tests between the connection of our client and server will begin.

From here we begin the integration of our hypervisor and our configuration management tool, Chef. The connection between Chef and our hypervisor will be crucial for our project to succeed. All of the integration testing for this connection will be run from the individual boxes themselves, as well as from the Chef Workstation. These tests will be looking for edge cases from possible inputs into the configuration management tool.

The integration of the traffic data from the system to the database and then to the web application will account for a lot of the testing time. This data must be able to be captured, saved, and filtered. This is the most important aspect of the system. Our team will be testing every available protocol, as well as filtering through all possible combinations. The team will also be pushing the system to its data capturing limits through stress tests.

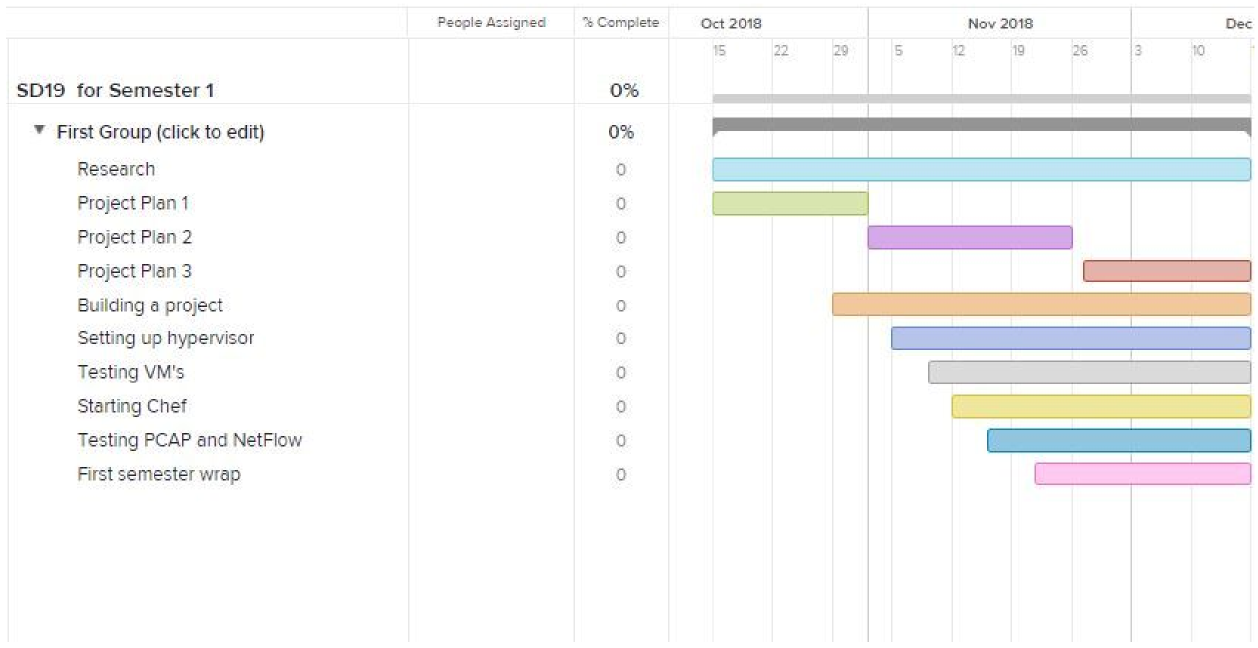
The front-end of this project must be user friendly as well as very hands on with the scenarios. Our team will be creating multiple scenarios in order to find any headaches or problems with the front-end functionality. We will be going over the visual appeal of the front-end as well.

The final testing will be done by the entire team over the whole system. This testing will be through the team-contributed test plan that we made throughout the development process. This will include all problems that we ran into, as well as small unit tests.

3 Project Timeline, Estimated Resources, and Challenges

3.1 Project Timeline

Semester 1 → Gantt Chart



	People Assigned	% Complete
SD19 for Semester 1		0%
▼ First Group (click to edit)		0%
Research		0
Project Plan 1		0
Project Plan 2		0
Project Plan 3		0
Building a project		0
Setting up hypervisor		0
Testing VM's		0
Starting Chef		0
Testing PCAP and NetFlow		0
First semester wrap		0

Figure 12 : Gantt Chart for first semester

- The Research above means to keep learning as we go through projects, and not learn a specific task and then try to brute force the project at one.
- The **3** tabs describing the project plan are important because they provide us with a series of steps to help implement our project on time.
- Building a project is building an interface that holds all pieces of our project. For example, a website that holds all aspects of the project together
- Setting up hypervisor is one of the crucial steps in this project. A hypervisor acts as the brain of our program, which tells every component how to do the job.
- Testing VM's is starting a couple of virtual machines and testing them before applying them to our project.
- Starting Chef is analyzing and configuring our Chef script that will eventually be responsible for creating our virtual machines.
- Testing PCAP and Netflow is working with these types of traffic recorders before including them in our project.

- First semester Wrap is when we review everything and make sure every component is working well separately, before merging all of them together in the second semester.

Semester 2 → Gantt Chart

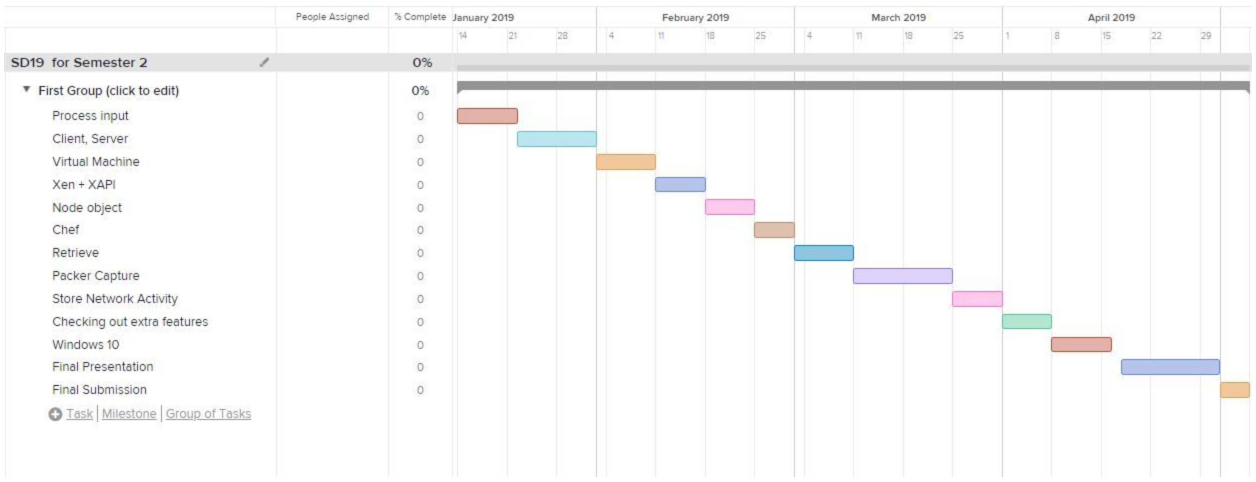


Figure 13 : Gantt Chart for second semester

- Configuring a user input such that, when the user commands something, the program retrieves that command and does some work in the back end.
- Connect the client and server to the hypervisor before adding any other parts to the project..
- Adding the Xen software to the hypervisor to enable direct commands between the two of them.
- Adding Cookbooks and Allowing Chef to sends commands to the virtualization software, and creating virtual machines with certain requirements via Xen.
- Configuring Packet Capture (PCAP) and Netflow to record traffic arriving and leaving from one certain virtual machine.
- If time allows, add extra features that the clients would like to be added in the program, such as virtualization for Windows 10.
- Prepare for final presentation and final submission in the last 2-3 weeks of the semester.

3.2 Feasibility Assessment

The project is to create a tool that will enable cyber researchers to generate a specific type of traffic, capture and store the generated traffic, and analyze it in entirely automated manner. We will follow the timeline mentioned in section 3.1 above, as we believe that this timeline will meet the requirements for implementing the web application tool.

3.3 Personnel Effort Requirements

Major Requirements:

Task	**Description**	***Estimated Time Required***
Research Xen	Research on how Xen suits our requirements and how to use it for our project	10 hours
Research Chef	Research on the Chef suits our requirements and how to use it for our project	10 hours
Research pairing Xen and Chef	Research on how the pair of Xen and Chef work side by side each other to achieve our requirements	10 hours
Research Django Framework	Research on how to use the Django Framework to develop our front end	10 hours
Testing Virtual Machines	Come up with several test cases or scenarios that we can run on the virtual machine according to our needs	50 hours
Testing PCAP and NetFlow	Come up with several test cases or captures that can used as examples of outputs we would want according to our needs	30 hours
Setting up Hardware	This task requires setting up hardware in the department lab to be used as a “server” to run our Virtual Machines	10 hours
Design Project Layout	Developers are required to come up with a design of the interface of the project	20 hours
Setup Xen	Setting up Xen to work in ways that fits our needs and requirements	30 hours
Setup Chef	Setting up Chef to work in ways that fits our needs and requirements	30 hours
Develop Frontend	Developing the frontend of the project, such as the layouts and the webpage using various libraries .	60 hours

Develop Backend	Developing the backend of the project, such as integrating the automation of the virtual machines that will be used in our project.	90 hours
Testing Full Project	This will require the develops to run multiple test cases to test the major functions of our project and testing the final project to work according to our requirements	50 hours
Beautifying layout of Project	This will be a optional task that requires the developers to further beautify the layout of the project and make it more user-friendly	20 hours
Documenting Software	Members are required to use proper documentation of all code, design pattern and architectures used throughout the project	100 hours

Table 1 : Major Requirements

3.4 Other Resource Requirements

To conduct the project, there are a few other resources that are required on both the software and hardware sides. On the software side, the team will be using GitHub for code control as well Google Drive to maintain the documentation required for the project. The Google Drive storage will be provided by Iowa State University while GitHub will be provided by the Electrical and Computer Engineering Department's Electronics and Technology group. To draw our diagrams, we will be using both MockFlow and DrawIO. We also will be using NotePad++ as our preferred IDE. NotePad++ is provided as a free and code produced on it can be used/redistributed under the terms of the GNU General Public License. As for the development of the frontend, we will be making use of the Django Framework, which is a free and open source web framework that is written in Python. On the hardware side, the team will be using 2 desktops provided by the Electrical and Computer Engineering Department's Electronics and Technology group to be used in the department's lab as our "server" that will be running the virtual machines as well as databases.

3.5 Financial Requirements

The project is proposed to be developed cost free. The hypervisor used for the project, Xen, is a free and open-source software that is only subjected to the requirements of the GNU General Public License. For the configuration management of the virtual machines, the team will be using Chef. Chef has a paid as well as a cost-free version. The cost-free version of Chef will most probably be enough to support the requirements needed for the project.

4 Closure Materials

4.1 Conclusion

Cyber attacks are becoming an increasingly bigger problem for the world every day. The problem with trying to prevent any attack on a system is that we can only stop what we know of. Therefore, the best mitigation for stopping any cyber attack on a system is to test the actual attack on your system. You can then identify the symptoms of those attacks on your system when they are attempted.

The only way to safely test a malware on your own system is through a sandbox of your system. This would be a virtual environment where you can record and control the activity of your system and the malware. There have been tools and software made just for these tests; however, these tools and softwares are not cheap and can sometimes be very strict on their configuration.

Therefore, our solution is to create a free, fully configurable testing software. Our team will build a web interface that will control a virtual environment. This will allow users control over the systems added to the environment as well as control over all the data sent over the virtual network. This solution will help push the research for cyber-security forward.

4.2 References

Websites used for Research of Tools:

1. https://www.xenproject.org/
2. https://wiki.xenproject.org/wiki/Xen_Project_Beginners_Guide
3. http://www-archive.xenproject.org/products/xenhyp.html
4. https://www.xenproject.org/developers/teams/xapi.html
5. https://docs.chef.io/chef_overview.html
6. https://www.seleniumhq.org/
7. http://www.tcpdump.org/manpages/pcap.3pcap.html
8. https://www.solarwinds.com/what-is-netflow
9. http://xapi-project.github.io/xen-api/usage.html
10. https://wiki.xenproject.org/wiki/Xen_Project_4.9_Man_Pages
11. https://wiki.xenproject.org/wiki/Xen_Networking
12. https://help.ubuntu.com/community/Xen
13. https://discourse.chef.io/t/resolved-advise-on-first-chef-invocation-on-a-vm/2847/3
14. http://www.tomsitpro.com/articles/configuration-management-tools,2-920.html

15. http://www.admin-magazine.com/Articles/Automating-with-Expect-Scripts
16. https://learn.chef.io/#/

4.3 Appendices

All diagrams were used in explaining the parts