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Dakota State University

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*VIRTUALIZED EDUCATIONAL LAB
SETUP
PROJECT PLAN AND SUPPORTING
PROJECT DOCUMENTATION*

A graduate project submitted to Dakota State University in partial fulfillment of the requirements for
the degree of

Master of Science

in

Information Systems

April, 2013

By

Aaron Napierala

Project Committee:

Dr. Stephan Krebsbach

Mr. Kyle Cronin

Mr. Chad Bryan



PROJECT APPROVAL FORM

We certify that we have read this project and that, in our opinion, it is satisfactory in scope and quality as a project for the degree of Master of Science in Information Systems.

Student Name: Aaron J. Napierala

Master's Project Title: Virtualized Educational Lab Setup

Faculty supervisor: _____ Date: _____

Committee member: _____ Date: _____

Committee member: _____ Date: _____



PROJECT APPROVAL FORM

We certify that we have read this project and that, in our opinion, it is satisfactory in scope and quality as a project for the degree of Master of Science in Information Systems.

Student Name: Aaron J. Napierala

Master's Project Title: Virtualized Educational Lab Setup

Faculty supervisor: *Lynne Heber* Date: 4/30/2013

Committee member: *[Signature]* Date: 4/30/2013

Committee member: *[Signature]* Date: 4/30/2013

Acknowledgment

I would like to thank the following people/resources:

- Professor Stephen Krebsbach for his support and guidance throughout my graduate project.
- Professor Kyle Cronin for his insight into how a virtual environment runs and extremely helpful suggestions.
- Mr. Chad Bryan for his help and support with setting up the environment in the 13000 building.
- The administrator of windows-noob.com for the excellent tutorials and walkthroughs on configuring System Center.

Abstract

The current infrastructure being used for IT courses at the University of Northwestern Ohio is not adequate for students. In addition, hands-on components of courses are difficult to test over, faculty administration of class resources was minimal, and students did not have access to enterprise level systems. The solution was to implement a lab environment to accomplish all of these concerns. This project closely mirrors how a real world project would function using the knowledge acquired during coursework completed at DSU. Documentation submitted for coursework at DSU was used as templates during this project. Not only was this project designed to outline how a project would be completed but also includes deliverables of analyzing virtualization solutions for a lab environment, an architectural diagram of the proposed virtualized lab environment, purchasing a solution, and finally implementing the proposed solution.

The project deliverable entitled “Virtualized Educational Lab Setup Top Solutions and Recommendation” includes a comparison of several solutions for the proposed lab. Included in this documentation is the proposed architectural diagram which outlines how the lab should be setup.

The project deliverable entitled “Virtualized Educational Lab Setup Implementation” outlines the systems used within the lab. This includes documentation of both hardware and software being used. Specific identifying information about some systems has been excluded to protect the integrity of the environment; however, revised information will be distributed to internal faculty and staff at UNOH so it can be maintained and managed.

Declaration

I hereby certify that this project constitutes my own product, that where the language of others is set forth, quotation marks so indicate, and that appropriate credit is given where I have used the language, ideas, expressions or writings of another.

I declare that the project describes original work that has not previously been presented for the award of any other degree of any institution.

Signed,

Aaron Napierala
Aaron J. Napierala

VIRTUALIZED EDUCATIONAL LAB SETUP

PROJECT PLAN AND SUPPORTING PROJECT DOCUMENTATION



MSIS PROJECT
Aaron Napierala

Revision History

Release	Date	Changes
1.0	1/14/2012	Plan created
1.1	1/23/2013	Activities and scope defined

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1 INTRODUCTION

The goal of this project is to provide students with an environment in which they will be able to work with Type 1 hypervisors as well as provide a lab environment to hold System Administration and Network Security courses at the University of Northwestern Ohio. The current facilities are not capable of adequately providing resources for students. Students have no way to interface with bare metal Type 1 Hypervisor outside of nesting a Type 1 within a Type 2.

Faculty teaching the courses for the two aforementioned degrees would also like to have a way to test students over hands-on labs completed throughout each course. In the past students would complete labs inside and outside the class, but there was not a method for students to complete hands-on work for a test. The faculty would like to setup a small network with several virtual machines available and have the students' login to these to complete a hands-on test. Access will need to be strictly monitored so they are looking for a solid authentication system to be put into place.

2 PROJECT MANAGEMENT APPROACH

The Project Manager, Aaron Napierala, has overall authority and responsibility for managing and executing this project according to this Project Plan and any Subsidiary Management Plans. The project team will consist of DSU faculty and UNOH faculty and staff.

3 PROJECT SCOPE

The scope of this project is to research commercialized or readily available solutions for providing services to students securely in order to complete coursework and hands-on tests. In addition, solutions to manage the computer systems in the lab will also be researched based on the requirements from the customer and sponsor.

The deliverables of this project will include:

- An analysis of the top solutions considered
- A recommendation for a classroom solution based on the customer requirements
- An architecture diagram of the proposed implementation
- Purchasing a classroom solution
- Implementing system as described in the recommend architecture diagram

Any deviation from this scope statement must go through the proper change control process which will include the project manager and the project sponsor.

4 MILESTONE LIST

The key milestones for this project include:

Milestone	Description	Date
Kickoff Meeting	This is the meeting to form the team and set expectations	1/14/2013
Requirements Approval	Requirements for the system are approved by the sponsor	1/21/2013
Solution research complete	Team completes research of virtualized classroom and management solution	2/4/2013
Presentation of top solution and preliminary recommendation to sponsor and customer	Top solutions are presented to the sponsor and customer	2/8/2013
Architecture diagram complete	Architecture diagram based on the requirements of tool selected is complete	2/12/2013
Final solution selection	Final solution selected	2/15/2013
Purchase equipment/classroom management solution	Purchase equipment for classroom solution	2/21/2013
Implement virtualized classroom management solution	Configure services/equipment needed to provide solution to customer	4/9/2013
Final report complete	Report to sponsor is complete	4/17/2013

5 SCHEDULE BASELINE AND WORK BREAKDOWN STRUCTURE

This section contains the schedule baseline and Work Breakdown Structure (WBS).

5.1 Schedule Baseline – Gantt Chart

Name	Duration	Start_Date	Finish_Date	Predecessors	Resource_Names
Virtualized Educational Lab Setup Project	60.0 4 days	1/14/13 12:00 AM	5/10/13 9:00 AM		Aaron Napierala
Planning	3.67 days	1/14/13 8:00 AM	1/21/13 12:00 AM		Aaron Napierala
1.1.1 Create Preliminary Scope Statement	0.33 days	1/14/13 8:00 AM	1/14/13 5:00 PM		Aaron Napierala
1.1.2 Determine Project Team	0.33 days	1/14/13 8:00 AM	1/14/13 5:00 PM		Aaron Napierala
1.1.3 Project Team Kickoff Meeting	0.33 days	1/15/13 8:00 AM	1/15/13 5:00 PM	4	Aaron Napierala
1.1.3 Develop Project Plan	2 days	1/16/13 8:00 AM	1/20/13 12:00 AM	4	Aaron Napierala
1.1.5 Submit Project Plan	1 hr	1/20/13 12:00 AM	1/20/13 1:00 AM	6	Aaron Napierala
1.1.6 Project Plan Approved	0 days	1/21/13 12:00 AM	1/21/13 12:00 AM	7	Dr. Stephen Krebsbach
Execution	40.7 1 days	1/21/13 8:00 AM	4/9/13 9:00 AM	8	
1.2.1 Project Kickoff Meeting	1 hr	1/21/13 8:00 AM	1/21/13 9:00 AM		Aaron Napierala
1.2.2 Verify & Validate User Reqs	3 days	1/21/13 8:00 AM	1/27/13 8:00 AM		Aaron Napierala, Chad Bryan
1.2.3 Solution Research	4 days	1/27/13 4:00 PM	2/4/13 12:00 AM	11	Aaron Napierala, Chad Bryan
1.2.4 Recommend Solution	0 days	2/8/13 12:00 AM	2/8/13 12:00 AM	12	Aaron Napierala
1.2.5 Create Architecture Diagram	3 days	2/8/13 8:00 AM	2/12/13 5:00 PM	13	Aaron Napierala

1.2.6 Recommendation Accepted	1 hr	2/8/13 8:00 AM	2/8/13 9:00 AM	13	Aaron Napierala
1.2.7 Purchase Solution	7 days	2/8/13 9:00 AM	2/21/13 9:00 AM	15	Aaron Napierala, Chad Bryan
1.2.8 Configure Solution	25 days	2/21/13 9:00 AM	4/9/13 9:00 AM	16	Aaron Napierala, Chad Bryan
Closeout	4 days	4/9/13 9:00 AM	4/17/13 9:00 AM	17	
1.3.1 Document Lessons Learned	3 days	4/9/13 9:00 AM	4/14/13 5:00 PM		Aaron Napierala
1.3.2 Submit Final Report	1 day	4/14/13 5:00 PM	4/17/13 9:00 AM	19	Aaron Napierala, Dr. Stephen Krebsbach

5.2 Work Breakdown Structure (WBS)



5.3 WBS Dictionary

Level	WBS Code	Element Name	Definition
1	1	Virtualized Educational Lab Setup	All work to provide virtualized educational lab to UNOH faculty.
2	1.1	Planning	The work for the planning process for the project.
3	1.1.1	Create Preliminary Scope Statement	Project Manager creates a Preliminary Scope Statement.
3	1.1.2	Determine Project Team	The Project Manager determines the project team and requests the resources.
3	1.1.3	Project Team Kickoff Meeting	The planning process is officially started with a project kickoff meeting which includes the Project Manager, Project Team and Project Sponsor.
3	1.1.4	Develop Project Plan	Under the direction of the Project Manager the team develops the project plan.
3	1.1.5	Submit Project Plan	Project Manager submits the project plan for approval.
3	1.1.6	Project Plan Approval	The project plan is approved and the Project Manager has permission to proceed to execute the project according to the project plan.
2	1.2	Execution	Work involved to execute the project.
3	1.2.1	Project Kickoff Meeting	Project Manager creates a Preliminary Scope Statement.
3	1.2.2	Verify & Validate User Reqs	The original user requirements are reviewed by the project manager and team, and then validated with the users/stakeholders. Additional clarification will be needed.
3	1.2.3	Solution Research	The team will research potential virtualized environments that meet the needs of the customer requirements.
3	1.2.4	Recommend Solution	Based on the research and customer requirements, a virtualized environment is recommended.
3	1.2.5	Create Architecture Diagram	Using the software recommendation and customer requirements, develop an architectural diagram.
3	1.2.6	Recommendation Accepted	The customer accepts the recommendation.

3	1.2.7	Purchase Solution	Purchase request is submitted and IT department orders equipment.
3	1.2.8	Configure Solution	Project Team installs and configures solution.
2	1.3	Closeout	The work to close-out the project.
3	1.3.1	Document Lessons Learned	Project Manager along with the project team performs a lessons learned meeting and documents the lessons learned for the project.
3	1.3.2	Submit Final Report	Report generated that outlines the virtualized educational lab setup.

5.4 Activity List

ID	Activity	Description of Work
1.1.3	Project Kickoff Meeting	Project manager prepares and presents kick off meeting.
1.2.2	Verify & Validate User Reqs	Work with customer and sponsor to derive requirements for the virtualized educational lab setup.
1.2.3	Solution Research	Based on the requirements, perform a search of solutions that meet a majority or all of the requirements from 1.2.2.
1.2.4	Recommend Solution	Recommend a solution based on user requirements and research.
1.2.5	Create Architecture Diagram	Create an architecture diagram for the customer that meets the needs of the virtualized educational lab system.
1.2.6	Recommendation Accepted	Present recommendation to customer and get acceptance.
1.2.7	Purchase Solution	Purchase request is submitted.
1.2.8	Configure Solution	Project Team installs and configures solution.

5.5 Activity Resource Requirements

WBS ID	Type of Resource	Quantity	Comments
1.2.1	Project manager	1	PMP certification not required by customer
1.2.2	Team member	2	Team member to work with customer to derive requirements. Software/hardware skills and communication skills needed.
1.2.3	Team member	1	Team member to research solutions. Software skills and some business skills needed.
1.2.4	Team member	1	Software skills, good understanding of customer requirements.
1.2.5	IT Architect	1	Solid background in software, hardware, and network technologies. Good understanding of customer requirements needed. Must understand virtualized systems.
1.2.6	Team member	1	Good communication skills needed to present solution to customer.

1.2.7	Project manager	1	Completes process to procure hardware/software
1.2.8	Team member	2	Solid background in software, hardware, and network technologies. Good understanding of customer requirements needed. Must understand virtualized systems.

6 PROJECT CHANGE CONTROL PROCESS

Any change to the scope of this project must be approved by the project manager and the project sponsor. This includes increase or decrease in the scope of the project. The approval can take place via email. However, if more information is needed, a teleconference may be required.

7 COMMUNICATIONS MANAGEMENT PLAN

This Communications Management Plan sets the communications framework for this project. It will serve as a guide for communications throughout the life of the project and will be updated as communication needs change.

This plan identifies and defines the roles of persons involved in this project. It also includes a communications matrix which maps the communication requirements of this project. An in-depth guide for conducting meetings details the communications rules and how the meetings will be conducted, ensuring successful meetings. A project team directory is included to provide contact information for all stakeholders directly involved in the project.

7.1 Communications Management Approach

The Project Manager will take a proactive role in ensuring effective communications on this project. The communications requirements are documented in the Communications Matrix presented in this document. The Communications Matrix will be used as the guide for what information to communicate, who is to do the communicating, when to communicate it and to whom to communicate.

7.2 Roles

7.2.1 Project Sponsor and Program Manager

On this project, the project sponsor and program manager is a shared role. First, the project sponsor side of the role owns the champion of the project and has authorized the project. This person is responsible for the funding of the project and is ultimately responsible for its success. Since the Project Sponsor is at the executive level, communications should be presented in summary format unless the Project Sponsor requests more detailed communications.

Second, the Program Manager side of the role oversees the project at the portfolio level and owns most of the resources assigned to the project. The Program Manager is responsible for overall program cost.

7.2.2 Key Stakeholders

Stakeholders include all individuals and organizations that are impacted by the project. For this project we are defining a subset of the stakeholders as Key Stakeholders. These are the stakeholders with whom we need to communicate and are not included in the other roles defined in this section.

7.2.3 Change Control Board

The Change Control consists of the project manager and the project sponsor on this project. Others will be pulled in as needed.

7.2.4 Customer

The customers for this project are Aaron Napierala and Casey Kahsen. As the customers who will be accepting the final deliverable of this project they will be informed of the project status including potential impacts to the schedule for the final deliverable or the product itself.

7.2.5 Project Manager

The Project Manager has overall responsibility for the execution of the project. The Project Manager manages day to day resources, provides project guidance and monitors and reports on the projects metrics as defined in the Project Management Plan. As the person responsible for the execution of the project, the Project Manager is the primary communicator for the project distributing information according to this Communications Management Plan.

7.2.6 Project Team

The Project Team is comprised of all persons who have a role performing work on the project. The project team needs to have a clear understanding of the work to be completed and the framework in which the project is to be executed. Since the Project Team is responsible for completing the work for the project, they play a key role in creating the Project Plan including defining its schedule and work packages. The Project Team requires a detailed level of communications which is achieved through day to day interactions with the Project Manager and other team members along with bi-weekly email updates.

7.2.7 Steering Committee

The Steering Committee includes management representing the departments which make up the organization. The Steering Committee provides strategic oversight for changes which impact the overall organization. The purpose of the Steering Committee is to ensure that changes within the organization are effected in such a way that it benefits the organization as a whole. The Steering Committee requires communication on matters which will change the scope of the project and its deliverables.

On this project, the steering committee consists of the project sponsor and the customer representatives.

7.2.8 Technical Lead

The Technical Lead is a person on the Project Team who is designated to be responsible for ensuring that all technical aspects of the project are addressed and that the project is implemented in a technically sound manner. The Technical Lead is responsible for all technical designs, overseeing the implementation of the designs and developing as-build documentation. The Technical Lead requires close communications with the Project Manager and the Project Team.

7.3 Project Team Directory

The following table presents contact information for all persons identified in this communications management plan. The email addresses and phone numbers in this table will be used to communicate with these people.

Role	Name	Email
Project Sponsor & Program Manager	Dean Hobler	dahobler@unoh.edu
Project Manager	Aaron Napierala	ajnapierala@dsu.edu
Project Stakeholders	Aaron Napierala Casey Kahsen Chad Bryan Prof. Kyle Cronin	ajnapierala@dsu.edu ckahsen@unoh.edu cbryan@unoh.edu kyle.cronin@dsu.edu

	Dr. Stephen Krebsbach	stephen.krebsbach@dsu.edu
Customer	Aaron Napierala Casey Kahsen	ajnapierala@dsu.edu ckahsen@unoh.edu
Project Team	Chad Bryan Aaron Napierala	cbryan@unoh.edu ajnapierala@dsu.edu
Technical Lead	Chad Bryan Aaron Napierala	ajnapierala@dsu.edu cbryan@unoh.edu

7.4 Communications Matrix

The following table identifies the communications requirements for this project.

Communication Type	Objective of Communication	Medium	Frequency	Audience	Owner	Deliverable
Kickoff Meeting	Presentation to introduce the project team and the project. Review project objectives and management approach.	Formal meeting	Once	Project Sponsor Project Team Stakeholders	Project Manager	Agenda Meeting Minutes
Project Team Meetings	Review status of the project with the team.	Verbal	Weekly	Project Team	Project Manager	Notes
Technical Design Meetings	Discuss and develop technical design solutions for the project.	Verbal	As Needed	Project Technical Staff	Technical Lead	Notes
Project Status Reports	Report the status of the project including activities, progress, costs and issues.	Email	Bi-monthly	Project Sponsor Project Team Stakeholders	Project Manager	Project Status Report

7.5 Guidelines for Meetings

7.5.1 Meeting Agenda

Meeting Agenda should be distributed 2 business days in advance of the meeting. The Agenda should identify the presenter for each topic along with a time limit for that topic. The first item in the agenda should be a review of action items from the previous meeting.

7.5.2 Meeting Minutes

Meeting minutes will be distributed within 2 business days following the meeting. Meeting minutes will include the status of all items from the agenda along with new action items.

7.5.3 Action Items

Action Items are recorded in both the meeting agenda and minutes. Action items will include both the action item along with the owner of the action item. Meetings will start with a review of the status of all action items from previous meetings and end with a review of all new action items resulting from the meeting. The review of the new action items will include identifying the owner for each action item.

8 PROCUREMENT MANAGEMENT PLAN

This Procurement Management Plan sets the procurement framework for this project. It will serve as a guide for managing procurement throughout the life of the project and will be updated as acquisition needs change. This plan identifies and defines the items to be procured, the types of contracts to be used in support of this project, the contract approval process, and decision criteria. The importance of coordinating procurement activities, establishing firm contract deliverables, and metrics in measuring procurement activities is included.

8.1 Procurement Management Approach

The Project Manager will provide oversight and management for all procurement activities under this project. The Project Manager will work with the project team to identify all items to be procured for the successful completion of the project. The Program Manager will then review the procurement list prior to purchasing. If the Program Manager is not available, the customer representative can perform this role in conjunction with agreement of the Project Manager.

8.2 Procurement Definition

The following procurement items and/or services have been determined to be essential for project completion and success. The following list of items/services, justification, and timeline are pending PMO review for submission to the contracts and purchasing department:

Item/Service	Justification	Needed By
MS Project Software	Needed for Project Manager to plan and track project	1/15/2013
MS Visio Software	Needed by entire team to create and review architecture diagrams	1/24/2013
MS Word Software	Needed by entire team to create and review project documents and deliverables	1/15/2013
VMware Software suite	Needed to implement educational lab solution	2/21/13
Microsoft Software Suite	Needed to implement educational lab solution	2/21/13

In addition to the above list of procurement items, the following individuals are authorized to approve purchases for the project team:

<u>Name</u>	<u>Role</u>
Dean Hobler	Program Manager

8.3 Type of Contract to be Used

All items and services to be procured for this project will be solicited under firm-fixed price contracts. The project team will work with the Program Manager to define the item types, quantities, services and required delivery dates. Given the short duration and size of this project, procurement will be performed based on the Project Managers recommendation with the Program Managers approval.

8.4 Contract Approval Process

This is a small, low cost project being managed by Aaron Napierala with oversight from the Program Manager and Team members. The first step in the contract approval process is to determine what items or services will require procurement from outside vendors. This will be determined by conducting a cost analysis on products or services which can be provided internally and compared with purchase prices from vendors. Once cost analyses are complete and the list of items and services to be procured externally is finalized, the Project Manager and Program Manager will work together to send out solicitations to outside vendors. Once solicitations are complete and proposals have been received by all vendors the approval process begins. The first step of this process is to conduct a review of all vendor proposals to determine which meet the criteria established by the project team and the purchasing and contracts department. Purchases greater than \$50 must be approved by the Program Manager.

8.5 Decision Criteria

The criteria for the selection and award of procurement contracts under this project will be based on the following decision criteria:

- Ability of the vendor to provide all items by the required delivery date
- Quality
- Cost
- Past performance

These criteria will be measured by the Project Manager. The ultimate decision will be made based on these criteria as well as available resources.

9 PROJECT SCOPE MANAGEMENT PLAN

The Scope Management Plan provides the scope framework for this project. This plan documents the scope management approach; roles and responsibilities as they pertain to project scope; scope definition; verification and control measures; scope change control; and the project's work breakdown structure. Any project communication which pertains to the project's scope should adhere to the Scope Management Plan.

9.1 Scope Management Approach

For this project, scope management will be the sole responsibility of the Project Manager. The scope for this project is defined by the Scope Statement, Work Breakdown Structure (WBS) and WBS Dictionary. The Project Manager, Sponsor and Stakeholders will establish and approve documentation for measuring project scope which includes deliverable quality checklists and work performance measurements. Proposed scope changes may be initiated by the Project Manager, Stakeholders or any member of the project team. All change requests will be submitted to the Project Manager who will then evaluate the requested scope change. Upon acceptance of the scope change request the Project Manager will submit the scope change request to the Change Control Board and Project Sponsor for acceptance. Upon approval of scope changes by Project Sponsor the Project Manager will update all project documents and communicate the scope change to all stakeholders. Based on feedback and input from the Project Manager and Stakeholders, the Project Sponsor is responsible for the acceptance of the final project deliverables and project scope

9.2 Roles and Responsibilities

The Project Manager, Sponsor and team will all play key roles in managing the scope of this project. As such, the project sponsor, manager, and team members must be aware of their responsibilities in order to ensure that work performed on the project is within the established scope throughout the entire duration of the project. The table below defines the roles and responsibilities for the scope management of this project.

Name	Role	Responsibilities
Dean Hobler	Sponsor	Approve or deny scope change requests as appropriate Evaluate need for scope change requests Accept project deliverables
Aaron Napierala	Project Manager	Measure and verify project scope Facilitate scope change requests Facilitate impact assessments of scope change requests Organize and facilitate scheduled change control meetings Communicate outcomes of scope change requests Update project documents upon approval of all scope changes
Aaron Napierala	Team Lead	Measure and verify project scope

		Validate scope change requests Participate in impact assessments of scope change requests Communicate outcomes of scope change requests to team Facilitate team level change review process
Chad Bryan	Team Member	Participate in defining change resolutions Evaluate the need for scope changes and communicate them to the project manager as necessary

9.3 Scope Definition

The scope for this project was defined through a comprehensive requirements collection process. First, a thorough analysis was performed on the University's current needs based on student and user feedback. From this information, the project team developed the project requirements documentation for what the new solution being recommended must accomplish.

9.4 Project Scope Statement

The project scope statement provides a detailed description of the project, deliverables, constraints, exclusions, assumptions, and acceptance criteria. Additionally, the scope statement includes what work should not be performed in order to eliminate any implied but unnecessary work which falls outside the of the project's scope.

The scope of this project is to research virtualized educational lab environments based on requirements from the customers and sponsor.

The deliverables of this project will include:

- An analysis of the top solutions considered
- A recommendation for a virtualized lab environment based on the customer requirements
- An architecture diagram of the proposed implementation
- Purchasing recommended solution
- Implementing system as described in the recommend architecture diagram

This project does NOT include:

- Optimally configuring system

9.5 Scope Verification

As this project progresses the Project Manager will verify interim project deliverables against the original scope as defined in the scope statement, WBS and WBS Dictionary. Once the Project Manager verifies that the scope meets the requirements defined in the project plan, the Project Manager and Sponsor will meet for formal acceptance of the deliverable. During

this meeting the Project Manager will present the deliverable to the Project Sponsor for formal acceptance. The Project Sponsor will accept the deliverable by signing a project deliverable acceptance document. This will ensure that project work remains within the scope of the project on a consistent basis throughout the life of the project.

9.6 Scope Control

The Project Manager and the project team will work together to control the scope of the project. The project team will leverage the WBS Dictionary by using it as a statement of work for each WBS element. The project team will ensure that they perform only the work described in the WBS dictionary and generate the defined deliverables for each WBS element. The Project Manager will oversee the project team and the progression of the project to ensure that this scope control process is followed.

If a change to the project scope is needed the process for recommending changes to the scope of the project must be carried out. Any project team member or sponsor can request changes to the project scope. All change requests must be submitted to the Project Manager in the form of a project change request document. The Project Manager will then review the suggested change to the scope of the project. The Project Manager will then either deny the change request if it does not apply to the intent of the project or convene a change control meeting between the project team and Sponsor to review the change request further and perform an impact assessment of the change. If the change request receives approval by the Project Manager and Sponsor, the Project Manager will update all project documents and communicate the scope change to all project team members and stakeholders.

10 SCHEDULE MANAGEMENT PLAN

The project schedule is the roadmap for how the project will be executed. Schedules are an important part of any project as they provide the project team, sponsor, and stakeholders a picture of the project's status at any given time. The purpose of the schedule management plan is to define the approach the project team will use in creating the project schedule. This plan also includes how the team will monitor the project schedule and manage changes after the baseline schedule has been approved. This includes identifying, analyzing, documenting, prioritizing, approving or rejecting, and publishing all schedule-related changes.

10.1 Schedule Management Approach

Project schedules will be created using MS Project 2010 starting with the deliverables identified in the project's Work Breakdown Structure (WBS). Activity definition will identify the specific work packages which must be performed to complete each deliverable. Activity sequencing will be used to determine the order of work packages and assign relationships between project activities. Activity duration estimating will be used to calculate the number of work periods required to complete work packages. Resource estimating will be used to assign resources to work packages in order to complete schedule development.

Once a preliminary schedule has been developed, it will be reviewed by the project team and any resources tentatively assigned to project tasks. The project team and resources must agree to the proposed work package assignments, durations, and schedule. Once this is achieved the project sponsor will review and approve the schedule and it will then be baselined.

The following will be designated as milestones for the project schedule:

- Completion of scope statement and WBS/WBS Dictionary
- Baselined project schedule
- Approval of final project budget
- Project kick-off
- Requirements definition approval
- Completion of data mapping/inventory
- Project implementation
- Acceptance of final deliverables

Roles and responsibilities for schedule development are as follows:

The project manager will be responsible for facilitating work package definition, sequencing, and estimating duration and resources with the project team. The project manager will also create the project schedule using MS Project 2010 and validate the schedule with the project team, stakeholders, and the project sponsor. The project manager will obtain schedule approval from the project sponsor and baseline the schedule.

The project team is responsible for participating in work package definition, sequencing, and duration and resource estimating. The project team will also review and validate the proposed schedule and perform assigned activities once the schedule is approved.

The project sponsor will participate in reviews of the proposed schedule and approve the final schedule before it is baselined.

The project stakeholders will participate in reviews of the proposed schedule and assist in its validation.

10.2 Schedule Control

The project schedule will be reviewed and updated as necessary on a bi-monthly basis with actual start, actual finish, and completion percentages which will be provided by task owners.

The project manager is responsible for holding bi-weekly schedule updates/reviews; determining impacts of schedule variances; submitting schedule change requests; and reporting schedule status in accordance with the project's communications plan.

The project team is responsible for participating in bi-weekly schedule updates/reviews; communicating any changes to actual start/finish dates to the project manager; and participating in schedule variance resolution activities as needed.

The project sponsor will maintain awareness of the project schedule status and review/approve any schedule change requests submitted by the project manager.

10.3 Schedule Changes and Thresholds

If any member of the project team determines that a change to the schedule is necessary, the project manager and team will meet to review and evaluate the change. The project manager and project team must determine which tasks will be impacted, variance as a result of the potential change, and any alternatives or variance resolution activities they may employ to see how they would affect the scope, schedule, and resources. If, after this evaluation is complete, the project manager determines that any change will exceed the established boundary conditions, then a schedule change request must be submitted.

Submittal of a schedule change request to the project sponsor for approval is required if either of the two following conditions is true:

- The proposed change is estimated to reduce the duration of an individual work package by 10% or more, or increase the duration of an individual work package by 10% or more.
- The change is estimated to reduce the duration of the overall baseline schedule by 10% or more, or increase the duration of the overall baseline schedule by 10% or more.

Any change requests that do not meet these thresholds may be submitted to the project manager for approval.

Once the change request has been reviewed and approved the project manager is responsible for adjusting the schedule and communicating all changes and impacts to the project team, project sponsor, and stakeholders. The project manager must also ensure that all change requests are archived in the project records repository.

10.4 Scope Change

Any changes in the project scope, which have been approved by the project sponsor, will require the project team to evaluate the effect of the scope change on the current schedule. If the project manager determines that the scope change will significantly affect the current project schedule, he/she may request that the schedule be re-baselined in consideration of any changes which need to be made as part of the new project scope. The project sponsor must review and approve this request before the schedule can be re-baselined.

11 QUALITY MANAGEMENT PLAN

As projects progress, ensuring the deliverables have high quality is an important part of the project.

11.1 Quality Measurements

During bi-monthly status meetings, the customer will be invited to review the progress of the team as well as the documentation produced since the last status meeting. If the customer feels the project component under development meets the needs of lab, the piece of work will be marked as “meets quality expectation.” If at any time in the project a deliverable does not meet the quality expectation of the customer, the project manager will work with the team member, customer, and sponsor to improve the quality in order to achieve the expected quality level.

12 RISK MANAGEMENT PLAN

As organizations begin new projects they begin operating in an area of uncertainty that comes along with developing new and unique products or services. By doing so, these organizations take chances which results in risk playing a significant part in any project. The purpose of the risk management plan is to establish the framework in which the project team will identify risks and develop strategies to mitigate or avoid those risks. However, before risks can be identified and managed, there are preliminary project elements which must be completed. These elements are outlined in the risk management approach.

This project is considered a medium risk project as it has an overall risk score of 24 on a scale from 0 to 100. The project risk score is the average of the risk scores of the most significant risks to this project. A risk score below 16 is low risk project, a score between 16 and 45 is a medium risk project and a score above 45 is a high risk project.

Before risk management begins it is imperative that a foundation is established for providing structured project information, thus, the following project elements were completed and defined prior to developing this Risk Management Plan:

- Define work scope, schedule, resources, and cost elements
 - Develop project WBS/WBS dictionary
 - Develop master schedule and detailed schedules
 - Estimate project cost and finalize budget
 - Identify required and available resources
 - Establish performance measurement metrics

- Define minimum and maximum baseline thresholds
 - Schedule
 - Resources
 - Cost

- Baseline reporting requirements
 - Format
 - Frequency of distribution
 - Distribution list

- Define Risk Management Roles and Responsibilities
 - Project Manager chairs the risk assessment meetings
 - Project team participates in risk assessment meetings and members serve as meeting recorder and timekeeper
 - Key stakeholders participate in risk assessment meetings
 - Project Sponsor may participate in risk assessment meetings

12.1 Top Two Risks

The top high impact risks to this project are:

R1. Virtualized educational lab solution meeting UNOH's requirements cannot be found

The project's deliverable is a recommendation for a virtualized educational system that meets the needs of UNOH. It is feasible that no solutions meet the needs of the customer.

R2. Virtualized lab configured incorrectly

Configuration is mainly being performed by the Project Manager/Team Lead/Customer. Hence, the deliverable may not meet the needs of the customer due to misconfiguration.

12.2 Risk Management Approach

The approach we have taken to manage risks for this project included a methodical process by which the project team identified, scored, and ranked the various risks. The most likely and highest impact risks were added to the project schedule to ensure that the assigned risk managers take the necessary steps to implement the mitigation response at the appropriate time during the schedule. Risk managers will provide status updates on their assigned risks in the bi-weekly project team meetings, but only when the meetings include their risk's planned timeframe. Upon the completion of the project, during the closing process, the project manager will analyze each risk as well as the risk management process. Based on this analysis, the project manager will identify any improvements that can be made to the risk management process for future projects. These improvements will be captured as part of the lessons learned knowledge base.

12.3 Risk Identification

For this project, risk identification was conducted in the initial project risk assessment meeting. The project team reviewed the history of similar projects in order to determine the most common risks and the strategies used to mitigate those risks.

12.4 Risk Qualification and Prioritization

In order to determine the severity of the risks identified by the team, a probability and impact factor was assigned to each risk. This process allowed the project manager to prioritize risks based upon the effect they may have on the project.

12.5 Risk Monitoring

The most likely and greatest impact risks have been added to the project plan to ensure that they are monitored during the time the project is exposed to each risk. Risk monitoring will be a continuous process throughout the life of this project. As risks approach on the project schedule the project manager will ensure that the appropriate risk manager provides the necessary status updates which include the risk status, identification of trigger conditions, and the documentation of the results of the risk response.

12.6 Risk Mitigation and Avoidance

The project manager has led the project team in developing responses to each identified risk. As more risks are identified, they will be qualified and the team will develop avoidance and mitigation strategies. These risks will also be added to the Risk Register and the project plan to ensure they are monitored at the appropriate times and are responded to accordingly.

The risks for this project will be managed and controlled within the constraints of time, scope, and cost. All identified risks will be evaluated in order to determine how they affect this triple constraint. The project manager, with the assistance of the project team, will determine the best way to respond to each risk to ensure compliance with these constraints.

In extreme cases it may be necessary to allow flexibility to one of the project's constraints. Only one of the constraints for this project allows for flexibility as a last resort. If necessary, funding may be added to the project to allow for more resources in order to meet the time (schedule) and scope constraints. Time and scope are firm constraints and allow for no flexibility. Again, the cost constraint is flexible only in extreme cases where no other risk avoidance or mitigation strategy will work.

12.7 Risk Register

The Risk Register for this project is a log of all identified risks, their probability and impact to the project, the category they belong to, mitigation strategy, and when the risk will occur. The register was created through the initial project risk management meeting led by the project manager. During this meeting, the project team identified and categorized each risk. Additionally, the team assigned each risk a score based on the probability of it occurring and the impact it could potentially have. The Risk Register also contains the mitigation strategy for each risk as well as when the risk is likely to occur.

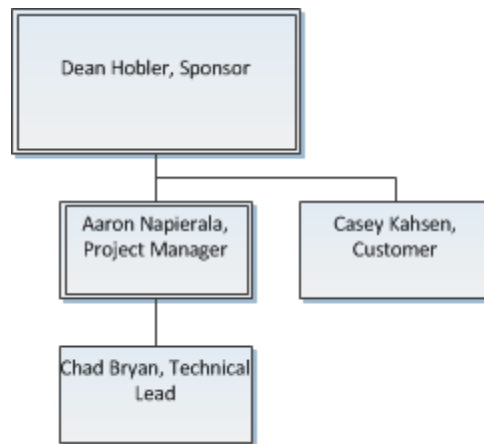
13 RISK REGISTER

The Risk Register for this project is provided in Appendix G, Risk Register.

14 STAFFING MANAGEMENT PLAN

The staffing management plan explains how the project will be staffed. It examines which resources will be needed and how resources will be procured and managed. In addition, it includes the key resources that are needed for the project.

Virtualized Educational Lab Org Chart



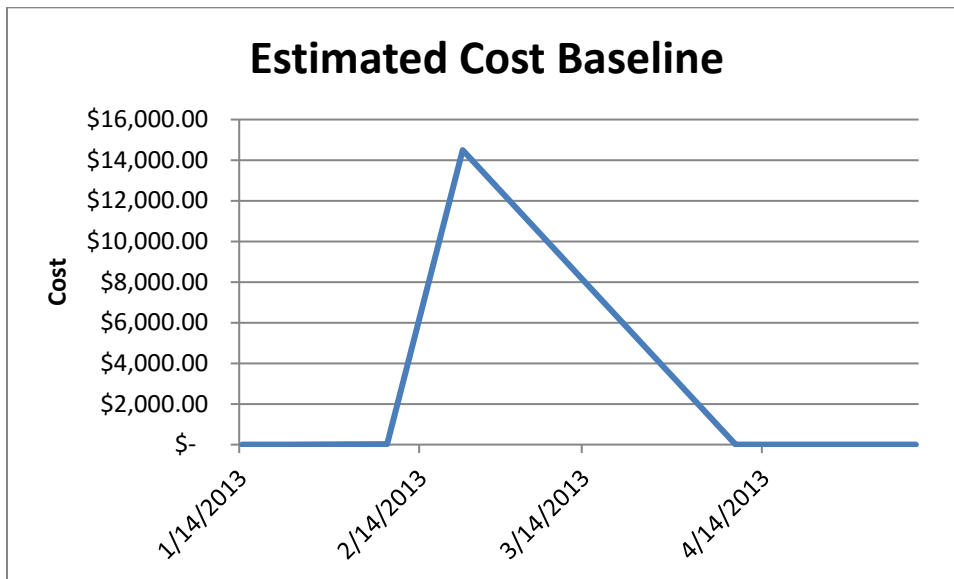
15 RESOURCE CALENDAR

This section defines the calendar that the resources for this project will be needed.

Project Member	Start	End
Dean Hobler	1/14/13	4/9/13
Aaron Napierala	1/14/13	4/17/13
Chad Bryan	1/14/13	4/9/13
Casey Kashen	1/14/13	4/9/13

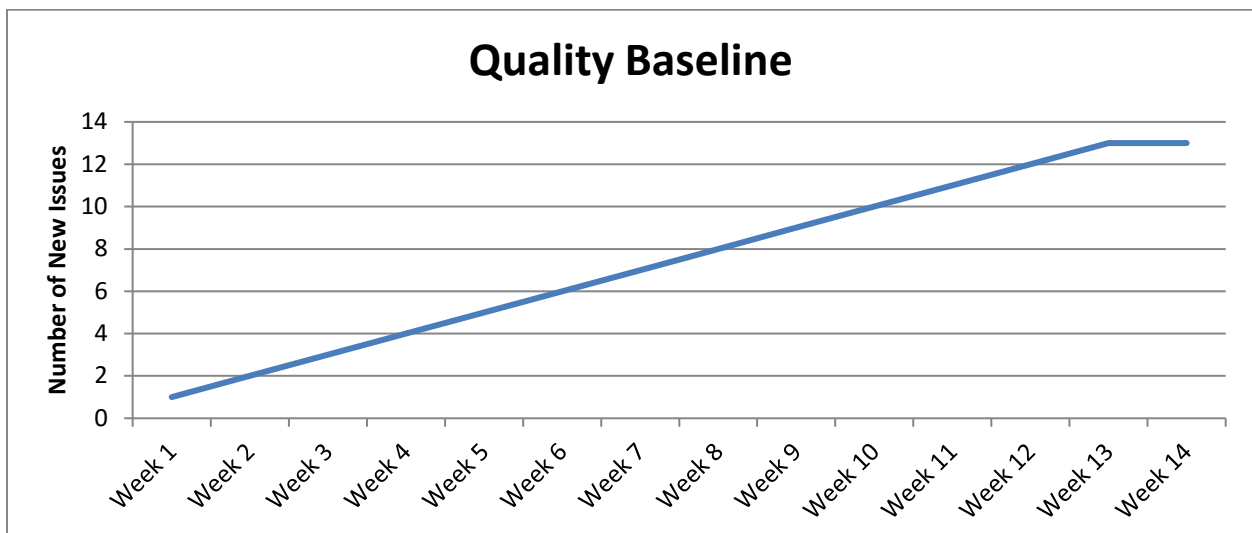
16 COST BASELINE

This section contains the cost baseline for the project. Cost management will be based on this baseline. This estimate was prepared using the work from the Gantt chart and Work Break down Structure.



17 QUALITY BASELINE

Compared to similar projects, we are assuming that there will be approximated one issue per week until the final week of the project. Then, there will be no new issues and outstanding issues will be resolved.



Appendix A: Project Charter

Project Title: Virtualized Educational Lab Setup

Project Sponsor: Dean Hobler Date Prepared: 1/14/2013

Project Manager: Aaron Napierala Project Customer: Casey Kahsen

Project Purpose or Justification:

Faculty teaching computer related courses at University of Northwestern Ohio (UNOH) would like to have a way to tests students over hands-on labs completed throughout each course. In the past students would complete labs inside and outside the class, but there was not a method for students to complete hands-on work for a test. The faculty would like to setup a small network with several virtual machines available and have the students' login to these to complete a hands-on test. Access will need to be strictly monitored so they are looking for a solid authentication system to be put into place.

Computer systems that could be centrally managed through Active Directory is a key component. Imaging of the systems, group policy, among other administrative tasks would be managed by both Casey and Aaron. These systems would need to be isolated from other UNOH systems within their own network, but still be able to access UNOH services such as the UNOH Learning Management System (LMS). The servers needed to provide services, such as AD DS, DNS, DHCP, File services, image management/deployment, in addition to servers dedicated to the UNOH Cyber Defense (CD) Club should all be consolidated on two servers running a Type-1 Hypervisor.

Project Description:

The goal of this project is to provide students with an environment in which they will be able to work with Type 1 hypervisors as well as provide a lab environment to hold System Administration and Network Security courses in for the University of Northwestern Ohio. The current facilities are not capable of adequately providing resources for students. This project will look at methods that provide the required facilities and services instructors need in their lab.

Project and Product Requirements:

The deliverables of this project will include:

- An analysis of the top solutions considered
- A recommendation for a classroom solution based on the customer requirements
- An architecture diagram of the proposed implementation
- Purchasing a classroom solution
- Implementing system as described in the recommend architecture diagram

This project does NOT include:

- Optimally configuring systems

Acceptance Criteria:

To accept the results of this project:

- A report with the implementation of the virtualized lab outlined that meets all of the high priority requirements must be presented to Dean Hobler
- An architecture diagram that supports the recommendation must be presented to Dean Hobler
- Dean Hobler must agree that the recommendation meets the high priority requirements

Initial Risks:

Initial Risks:

Virtualized educational lab solution meeting UNOH's requirements cannot be found
 The project's deliverable is a recommendation for a virtualized educational system that meets the needs of UNOH. It is feasible that no solutions meet the needs of the customer.

Virtualized lab configured incorrectly
 Configuration is mainly being performed by the Project Manager/Team Lead/Customer. Hence, the deliverable may not meet the needs of the customer due to misconfiguration.

Project Objectives	Success Criteria	Person Approving
--------------------	------------------	------------------

Scope:

<p>The deliverables of this project will include: An analysis of the top solutions considered A recommendation for a classroom solution based on the customer requirements An architecture diagram of the proposed implementation Purchasing a classroom solution Implementing system as described in the recommend architecture diagram This project does NOT include: Optimally configuring systems</p>	<p>Recommendation and implementation delivered and accepted by sponsor.</p>	<p>Dean Hobler</p>
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Time:

<p>The project shall be completed no later than 4/17/2013</p>	<p>Official acceptance of project deliverable by 4/17/2013.</p>	<p>Dean Hobler</p>
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Cost:

<p>The project shall not overrun costs by more than 10 percent.</p>	<p>Final costs shall not exceed initial budget by more than 10 percent.</p>	<p>Dean Hobler</p>
---	---	--------------------

Quality:

<p>The implementation of a virtualized educational lab will meet the needs of UNOH. End users of the proposed system will be involved with the requirements and investigation process to ensure that the quality of the recommendation is satisfactory.</p>	<p>Requirements will be ranked as high priority, medium priority, and low priority. All of the high priority requirements must be met.</p>	<p>Dean Hobler and Casey Kahsen</p>
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Other:

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Estimated Budget:

This project will not include labor costs. A virtually free software solution will be implemented by leveraging software available from Microsoft IT Academy and VMware IT Academy. The majority of the cost will be invested into hardware. These estimates will be refined in the project plan.

The estimated budget is

Hardware ... \$14,800

Software ... \$200.00

Total budget: \$15,000

Project Manager Authority Level

Staffing Decisions:

The team will be staffed with UNOH employees that will be involved as needed to complete the recommendation and implementation.

Technical Decisions:

Final technical decisions will be made by Chad Bryan, the Network Administrator at UNOH.

Conflict Resolution:

Conflict resolution is the responsibility of Aaron Napierala, the project manager.

Escalation Path for Authority Limitations:

Team members can escalate issues by first going to Aaron Napierala. If Aaron Napierala cannot resolve the issue, he will take the issue to the sponsor, Dean Hobler.

Appendix B: Stakeholder Register

Name	Position / Role	Contact Information	Requirements / Expectations
Aaron Napierala	Project Manager/ Customer/Technical Lead	ajnapierala@dsu.edu	Project Management, Assist project team, develop architecture
Dean Hobler	Sponsor/Manager	dahobler@unoh.edu	Sponsor project, assist project team
Casey Kahsen	Customer	ckahsen@unoh.edu	Assist project team
Aaron Napierala	Customer	ajnapierala@dsu.edu	Assist project team
Dr. Stephen Krebsbach	Project Team	stephen.krebsbach@dsu.edu	Assist project team
Prof. Kyle Cronin	Project Team	kyle.cronin@dsu.edu	Assist project team
Chad Bryan	Technical Lead	cbryan@unoh.edu	Oversee technical aspects of project

Appendix C: Stakeholder Management Strategy

Name	Influence	Impact Assessment	Strategies
Aaron Napierala	Project Management	High	Have open and productive communication with team Work closely with sponsor and customer representative to ensure project quality and to set expectations
Dean Hobler	Sponsor	High	Have open communication with sponsor Provide regular status
Casey Kahsen	Customer	Medium	Work closely to derive requirements Manage conflict and bring in sponsor as needed
Dr. Stephen Krebsbach	Team member	Medium	Monitor progress
Prof. Kyle Cronin	Team member	Medium	Monitor progress
Chad Bryan	Technical Lead	High	Have regular status meetings Set expectations early in the project Monitor progress

Appendix D: Risk Register

Risk ID	Risk Statement	Probability	Impact				Score	Response
			Scope	Quality	Schedule	Cost		
R1	Off the shelf software does not meet needs	Medium	High	High	High	High	10	Research software early, inform sponsor
R2	Virtualized lab configured incorrectly	Low	High	High	High	High	5	Involve customers throughout project

Revised Probability	Revised Impact				Revised Score	Responsible Party	Actions	Status	Comments
	Scope	Quality	Schedule	Cost					
Low	M	M	M	M	8	PM	Meet with sponsor	Open	
Low	M	M	M	M	2	Team	Meet with customer	Open	
Low	L	L	L	L	2	PM	Meet with team	Closed	
Low	L	M	L	L	2	PM	Meet with customer	Closed	

Appendix E: Weekly Team Status Template

Date:

Accomplishments since last status:

<list accomplishments>

Work to complete before next status:

<list work>

Outstanding issues:

<list issues>

Action items:

<list action items>

Appendix F: Change Request Form

Date:

Change Request ID:

Description of Change:

Impact to Project:

Accepted or Rejected?

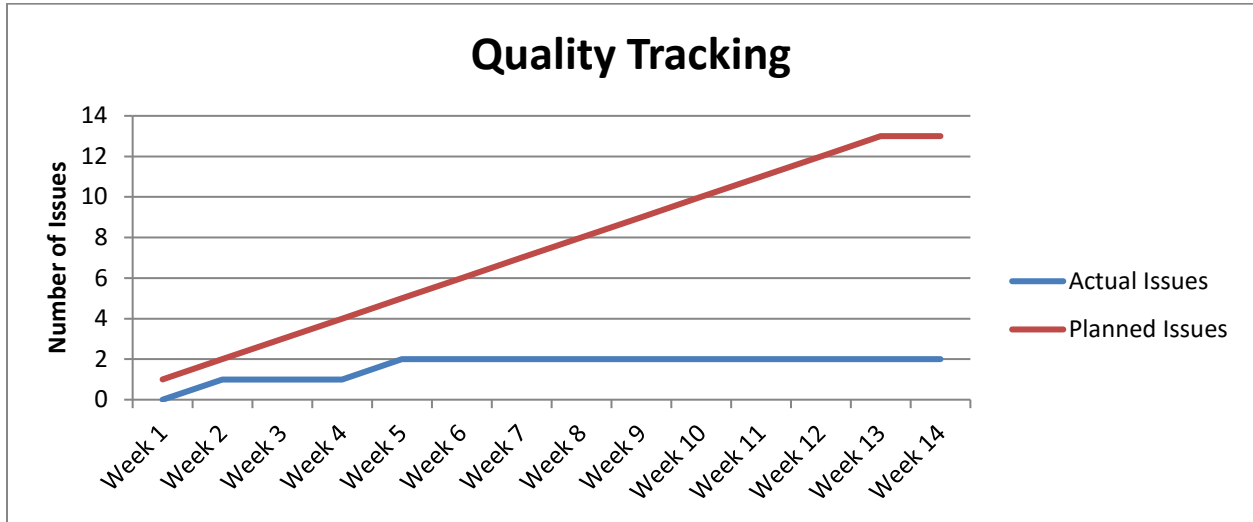
Approved by (if applicable):

Approval Date (if applicable):

Appendix G: Change Log

Change ID	Description of Change	Submitted by	Submission Date	Status	Disposition
C1	Sponsor requested virtualized educational lab to be implemented	Dean Hobler	1/14/2013	Closed	Accepted

Appendix H: Quality Tracking and Audit



Issue ID	Description	Status	Date
I1	Initial tool research progress not adequately meeting needs	Closed	1/28/2013
I2	Customer confusion on architecture diagram	Closed	3/24/2013

Appendix I: Risk Audit

Risk	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12	Week 13	Week 14
R1	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact
R2	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact

Appendix J: Project Performance Summary

Note: The project performance was tracked within MS Project 2010. This section provides a summary of performance.

Task Name	Duration	Start	Finish	Notes
Virtualized Educational Lab Setup Project	60.04 days	1/14/13 12:00 AM	5/10/13 9:00 AM	
Planning	3.67 days	1/14/13 8:00 AM	1/21/13 12:00 AM	
1.1.1 Create Preliminary Scope Statement	0.33 days	1/14/13 8:00 AM	1/14/13 5:00 PM	Completed on time
1.1.2 Determine Project Team	0.33 days	1/14/13 8:00 AM	1/14/13 5:00 PM	Completed on time
1.1.3 Project Team Kickoff Meeting	0.33 days	1/15/13 8:00 AM	1/15/13 5:00 PM	Completed on time
1.1.3 Develop Project Plan	2 days	1/16/13 8:00 AM	1/20/13 12:00 AM	Completed on time; some challenges initially, but was able to make up time in the three week period
1.1.5 Submit Project Plan	1 hr	1/20/13 12:00 AM	1/20/13 1:00 AM	Completed on time
1.1.6 Project Plan Approved	0 days	1/21/13 12:00 AM	1/21/13 12:00 AM	Met
Execution	40.71 days	1/21/13 8:00 AM	4/9/13 9:00 AM	
1.2.1 Project Kickoff Meeting	1 hr	1/21/13 8:00 AM	1/21/13 9:00 AM	Completed on time
1.2.2 Verify & Validate User Reqs	3 days	1/21/13 8:00 AM	1/27/13 8:00 AM	Some challenges with customer communication; able to contain; completed within time allotted
1.2.3 Solution Research	4 days	1/27/13 4:00 PM	2/4/13 12:00 AM	Met
1.2.4 Recommend Solution	0 days	2/8/13 12:00 AM	2/8/13 12:00 AM	Completed on time
1.2.5 Create Architecture Diagram	3 days	2/8/13 8:00 AM	2/12/13 5:00 PM	Some challenges aligning architecture diagram with recommended solution; managed; completed on time
1.2.6 Recommendation Accepted	1 hr	2/8/13 8:00 AM	2/8/13 9:00 AM	Met
1.2.7 Purchase Solution	7 days	2/8/13 9:00 AM	2/21/13 9:00 AM	Met
1.2.8 Configure Solution	25 days	2/21/13 9:00 AM	4/9/13 9:00 AM	Met
Closeout	4 days	4/9/13 9:00 AM	4/17/13 9:00 AM	Completed on time
1.3.1 Document Lessons Learned	3 days	4/9/13 9:00 AM	4/14/13 5:00 PM	Completed on time
1.3.2 Submit Final Report	1 day	4/14/13 5:00 PM	4/17/13 9:00 AM	Completed on time

Appendix K: Project Acceptance Form

ID	Requirement	Verification Method	Validation Method	Acceptance Criteria	Status	Sign-off
RQ1	Analysis of solutions	A document providing a tool analysis is presented to customer	Customer representative and sponsor agree the document meets needs	List of solutions analyzed is present.	Accepted	DH
RQ2	Virtualized Educational Lab Solution recommendation	A document providing a recommendation is presented to customer	Customer representative and sponsor agree the document meets needs	A recommendation for a virtualized educational lab system is present.	Accepted	DH
RQ3	Architecture Diagram	A document providing an architecture diagram is presented to customer	Customer representative and sponsor agree the document meets needs	An architecture diagram and can be used with the virtualized educational lab system is present.	Accepted.	DH
RQ4	Purchase a classroom solution	A purchase requisition submitted and signed	Customer representative and sponsor agree the requisition meets need	Receipt for purchase is presented to sponsor.	Accepted.	DH
RQ5	Implement a classroom solution	Documentation listing the lab environment	Customer representative and sponsor agree the lab environment meets need	An implementation for a virtualized educational lab system is present.	Accepted.	DH

Appendix L: Requirements Documentation

Stakeholder	Requirement	Category	Priority	Acceptance Criteria
Dean Hobler	RQ1. Analysis of solutions	Doc	Low	List of solutions analyzed is present.
Dean Hobler	RQ2. Virtualized Educational Lab Solution recommendation	Doc	High	A recommendation for Virtualized Educational Lab Solution is present.
Dean Hobler	RQ3. Architecture Diagram	Deliverable	High	An architecture diagram and can be used with the Virtualized Educational Lab is present.
Dean Hobler	RQ4. Purchase a classroom solution	Doc	High	Receipt for purchase is presented to sponsor.
Dean Hobler	RQ5. Implement a classroom solution	Deliverable	High	An implementation for a virtualized educational lab system is present.

Appendix M: Requirements Traceability Matrix

ID	Requirement	Priority	Category	Manifests in WBS Deliverable
RQ1	Analysis of solutions	Low	Doc	1.2.2, 1.2.3
RQ2	Virtualized Educational Lab recommendation	High	Doc	1.2.4
RQ3	Architecture Diagram	High	Deliverable	1.2.5
RQ4	Purchase a classroom solution	High	Doc	1.2.7
RQ5	Implement a classroom solution	High	Deliverable	1.2.8

Appendix N: Procurement Audit

Procurement Item	Process Followed?	What worked Well?	What can be improved?
MS Project Software	Yes	Software available on time	No suggestions
MS Visio Software	Yes	Software available on time	No suggestions
MS Word Software	Yes	Software available on time	No suggestions
VMware Software suite	Yes	Software available on time	Continue VMware IT Academy purchasing plan for trial software yearly.
Microsoft Software suite	Yes	Software available on time	Continue Microsoft IT Academy purchasing plan for software.

Appendix O: Project Close-Out

Project Objectives	Success Criteria	How Met	Variance
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Scope:

<i>The team must deliver a summary of virtualized lab solutions, a recommended solution, an architectural diagram, purchase and then implement a solution.</i>	<i>All components delivered.</i>	<i>The team produced documentation and deliverables meeting each objective.</i>	<i>None.</i>
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Time:

<i>The project was to complete by 4/14/2013.</i>	<i>The project completed before 4/14/2013.</i>	<i>Final product was delivered 4/9/2013.</i>	<i>None.</i>
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Cost:

<i>The project was not to exceed budget.</i>	<i>The project was not to exceed \$15,000</i>	<i>Project delivered according to budget.</i>	<i>None.</i>
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Quality:

<i>Project defects/problems were tracked.</i>	<i>No more than three problems were to be discovered.</i>	<i>Only two issues were discovered during the project and were resolved.</i>	<i>None.</i>
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Other:

<i>NA</i>	<i>NA</i>	<i>NA</i>	<i>NA</i>
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Contract Information:

<i>Aaron Napierala met its obligations to UNOH.</i>

Appendix P: Lessons Learned

	What Worked Well	What Can Be Improved
Schedule development and control	The schedule included the necessary tasks and resources.	The timeline should have been revisited to ensure sufficient time to complete the tasks. Some of the project tasks were rushed to complete them on time. The PERT analysis may have been useful.
Communication management	Regular contact with the project team via email to keep everyone informed of major milestones and activities.	More frequent synchronous meetings to enable more productivity and ensure everyone understands their tasks.
Solution implementation	Giving almost two months to implement a solution was enough time to complete the project.	Outside consultants should have been utilized to decrease misconfigurations.

**VIRTUALIZED EDUCATIONAL LAB SETUP
TOP SOLUTIONS ANALYSIS AND RECOMMENDATION
PROJECT DELIVERABLE**



MSIS PROJECT
Aaron Napierala

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Overview

The goal of this project is to provide students with an environment in which they will be able to work with Type 1 hypervisors as well as provide a lab environment to hold System Administration and Network Security courses in for the University of Northwestern Ohio. The solution provided is based upon requirements gathered from UNOH stakeholders. From this assessment, three solutions were selected. A final analysis resulted in the recommendation of VMware. This report summarizes the systems compared and provides the reasoning for the recommendation.

Narrowing the field

After analyzing many different types of lab configuration software, we narrowed the field to three types of software with the sought after features and the best reputation. In order of the best reputation, the companies are VMware (www.vmware.com), Microsoft (www.microsoft.com), and Citrix (www.citrix.com). We will do a comparison of the three. All three of these implementations can be hosted using UNOH equipment. According to user input, having direct access of the infrastructure is paramount so, analysis of Cloud Services was not done.

Comparison of the Hypervisor software

The following compares these software solutions according to (1) user experience (2) management features (3) guest operating system support (4) price

User Experience: Implementing a software solution that UNOH faculty/staff are familiar with is important. Here is a listing of each of the solutions compared with usage/knowledge:

- VMware vSphere is already in use both within the current lab and on the campus production network. Faculty/staff familiarity with the software is a major benefit. UNOH staff have received training on this solution as well.
- Microsoft Hyper-V is taught in a few of the courses, but outside of these courses it is not used.
- Citrix Xen is not used by faculty or staff in the classroom or in a production environment.

Based upon the current resources documented in the Jan. 21st meeting minutes, VMware ESXi 4.0 is currently being used in a lab. This would make faculty training for a VMware vSphere solution nominal. Additionally, IT staff use VMware in the campus production network. The other two solutions would require IT staff training with only one faculty member having knowledge of Microsoft Hyper-V.

Management Features: The management features that each support are as follows:

- VMware supports management of ESXi hosts via vCenter Server.
- Microsoft supports management of ESXi, Hyper-V, and Xen hosts via System Center 2012 – Virtual Machine Manager (VMM).
- Citrix supports management of XenServer through its own centralized management tool.

Each host management solution is provided by each vendor. Centralized management and authentication of multiple hosts can be attained from any of these solutions. Microsoft does support managing each of the three hypervisors, but there are limitations. Because of these limitations, mainly integration with vCloud and storage provisioning for individual hosts, management using VMM is a moot solution (see Appendix A).

Guest operating system support:

All three support working with the required operating systems outlined by the users of this solution.

Prices: Each of the three software solutions fell within budget as follows:

- VMware vSphere is free to use academically as a yearly trial of the software under the current subscription of VMware IT Academy.
- Microsoft Hyper-V is free to use academically under the current subscription of Microsoft IT Academy.
- Citrix XenServer itself is free, but to utilize it in the capacity needed in a lab environment, there would be a cost associated with it.

Since all the products fell within the target range of the budget, this point of the comparison will have little effect on the final recommendation; however, support cost is not factored in which will play a role in the final recommendation. A summary of the previously outlined items is found in Appendix B.

Hardware Requirements

Aside from software, the hardware is the next most expensive component of this setup. Since the software cost is nominal or already purchased; all the budgetary costs are allocated to the hardware. The university is already affiliated with Dell and has Silver Support. So for this reason, UNOH representatives setup a voice conference with Dell reps to get a quote.

The storage proposed is a Dell PowerVault MD3200i. This will provide an iSCSI SAN solution for access to data. The proposed server is a Dell PowerEdge R620. Included in Appendix C is the quote for hardware to support the proposed lab setup.

Conclusions

The information listed below is a summary of the conclusions reached from the comparison section.

1. All products are within the target range of the budget.
2. All products will be able to support the VMs needed to provide all the services required by the users.
3. All products support some form of Management feature except a cost may be incurred using a Citrix product.
4. User's experience only goes to the extent of VMware, so training would need to be provided for the other solutions, incurring a cost.
5. All funds will be allocated to the purchase of hardware since implementing the software will not cost anything for this project.

Recommendation

From the conclusions reached in this comparison, the VMware vSphere solution is proposed to implement for this project. Hardware should be purchased from Dell as the university currently purchases all their hardware from there and has Silver Support.

- All the users using the in-class solution already have experience with VMware. This includes the IT support staff on campus as well.
- The hardware purchased supports a bare metal installation of VMware ESXi and the storage is compatible with VMware. See appendix B for system requirements. See appendix C for hardware requirements.
- This solution will support the Active Directory infrastructure required. See appendix D and E.
- Additional components necessary to support the projects goals are listed in Appendix F.

Appendix A: VMM Limitations

VMware vSphere

- VMM does not support VMware VMs with disks on IDE bus. V2V of these machines fails.
- Storage must be added to ESX hosts outside of VMM and cannot be provisioned using SMI-S storage automation functionality.
- VMM does not automatically create port groups on ESX hosts. Port groups and VLANs must be configured outside of VMM.
- VMM does not integrate with VMware vCloud.
- You cannot use VMM to deploy vApps
- Update management/cluster remediation is not supported for ESX hosts.
- Bare-metal deployment is not supported for ESX hosts.
- Dynamic memory is supported only on ESX hosts that are running an OS that supports dynamic memory

Citrix XenServer

- Dynamic memory is not supported.
- Virtual floppy drive and COM ports are not available as VM devices.
- SMI-S for discovering and configuring storage on XenServer hosts is not supported.
- XenServer templates are not supported.
- Bare-Metal deployment of XenServer hosts is not supported.

(Finn, Vredevoort, Lownds, & Flynn, 2012)

Appendix B: System Requirements

	VMware	Microsoft	Citrix
Product Name	vSphere	Hyper-V	XenServer
Edition	Enterprise	Standard	Free Edition
Price	Free	Free	Free
Hypervisor Type	Bare Metal	Bare Metal	Bare Metal
Architecture	X86, x64	x64	X86, x64
Supported Storage	DAS, FC, iSCSI, SAS, SATA, SSD for Swap	DAS, FC, iSCSI, SAS	DAS, FC, iSCSI, NAS, SAS, SATA, USB
Host System Requirements	<ul style="list-style-type: none"> -x86 or x64 processor -RAM 128MB min. -Disk Space 1GB min 	<ul style="list-style-type: none"> -x64 1.4GHz compatible processor with Intel VT or AMD-V technology enabled -RAM 1GB min. -Disk Space 8GB min. 	<ul style="list-style-type: none"> - One or more 64-bit x86 CPU(s), 1.5 GHz minimum, 2 GHz or faster multicore CPU recommended -RAM 1GB min. -Disk Space 16BG min.

Appendix C: Hardware

PowerVault MD3200i: (www.dell.com)

GROU P: 1	QUANTIT Y: 1	SYSTEM PRICE: \$8,914.83	GROUP TOTAL: \$8,914.83
Base Unit:		PV MD3200i,RKMNT,iSCSI, 12 Bay, Dual Controller (224-8206)	
Hard Drive:		HD Multi-Select (341-4158)	
Mouse:		No Additional Software (410-1074)	
Mouse:		Hard Drive Filler, Single Blank (342-0121) - Quantity 9	
Mouse:		500GB 7.2K RPM Near-Line SAS 6Gbps 3.5in Hotplug Hard Drive (342-0118) - Quantity 3	
Mouse:		600GB 15K RPM SA SCSI 6Gbps 3.5in Hotplug Hard Drive,CusKit (342-0454- Quantity 4	
Sound Card:		Bezel Option, MD3200i (313-9401)	
Feature		RackRails, RapidRails for Dell Rack (330-6048)	
Service:		Dell Hardware Limited Warranty Plus On Site Service Initial Year (922-5697)	
Service:		Pro Support : Next Business Day Onsite Service After Problem Diagnosis, 2Year Extended (927-0042)	
Service:		ProSupport : 7x24 HW / SW Tech Support and Assistance , 3 Year (927-0082)	
Service:		Dell Hardware Limited Warranty Plus On Site Service Extended Year (929-6318)	
Service:		Pro Support : Next Business Day Onsite Service After Problem Diagnosis, Initial Year (931-2920)	
Service:		Dell ProSupport. For tech support, visit http://support.dell.com/ProSupport or call 1-800-845-3355 (989-3439)	
Installation:		On-Site Installation Declined (900-9997)	
Support:		Proactive Maintenance Service Declined (926-2979)	
Misc:		Power Cord, NEMA 5-15P to C13, 15 amp, wall plug, 6 feet / 2 meter (310-9965)	

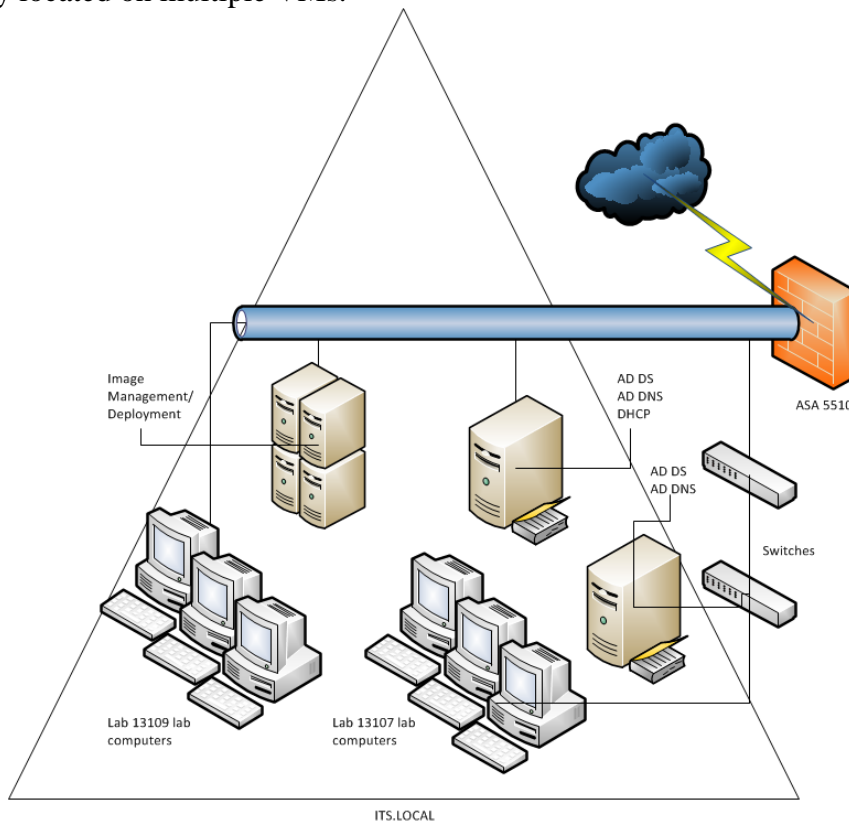
PowerEdge R620: (www.dell.com)

GROU P: 1	QUANTIT Y: 1	SYSTEM PRICE: \$5,581.77	GROUP TOTAL: \$5,581.77
Base Unit:		PowerEdge R620 (225-2108)	
TBU:		PowerEdge R620 Shipping - 4/8 Drive Chassis (331-4761)	
TBU:		iDRAC7 Enterprise (421-5339)	
TBU:		Intel Ethernet I350 QP 1Gb Network Daughter Card (430-4447)	
TBU:		Cable for Mini PERC Cards for Chassis with up to 8 Hard Drives (331-4823)	
TBU:		Chassis with up to 8 Hard Drives and 3 PCIe Slots (342-3666)	
TBU:		RAID 1 for H710P/H710/H310 (2 HDDs) (331-4224)	
TBU:		PERC H710 Integrated RAID Controller, 512MB NV Cache (342-3529)	
TBU:		Intel Xeon E5-2640 2.50GHz, 15M Cache, 7.2GT/s QPI, Turbo, 6C, 95W, Max Mem 1333MHz (317-9595)	
TBU:		Heat Sink for PowerEdge R620 (331-4762)	
TBU:		DIMM Blanks for Systems with 2 Processors (317-8688)	
TBU:		Intel Xeon E5-2640 2.50GHz, 15M Cache, 7.2GT/s QPI, Turbo, 6C, 95W (317-9609)	
TBU:		Heat Sink for PowerEdge R620 (331-4762)	
TBU:		8GB RDIMM, 1333 MHz, Low Volt, Dual Rank, x4 (317-9644) - Quantity 8	
TBU:		1333 MHz RDIMMs (331-4422)	
TBU:		146GB 15K RPM Serial-Attach SCSI 6Gbps 2.5in Hotplug Hard Drive (342-0427) - Quantity 2	
TBU:		Electronic System Documentation and OpenManage DVD Kit (331-4513)	
CD-ROM or DVD-ROM Drive:		DVD+/-RW, SATA, Internal (318-1391)	
CD-ROM or DVD-ROM Drive:		ReadyRails Sliding Rails With Cable Management Arm (331-4765)	
CD-ROM or DVD-ROM Drive:		Dual, Hot-plug, Redundant Power Supply (1+1), 750W (331-4605)	
CD-ROM or DVD-ROM Drive:		Power Cord, NEMA 5-15P to C13, 15 amp, wall plug, 10 feet / 3 meter (310-8509) - Quantity 2	
CD-ROM or DVD-ROM Drive:		No Operating System (420-6320)	
Service:		Dell Hardware Limited Warranty Plus On Site Service Initial Year (936-1787)	
Service:		ProSupport: Next Business Day Onsite Service After Problem Diagnosis, 2 Year Extended (936-9493)	
Service:		ProSupport: 7x24 HW / SW Tech Support and Assistance, 3 Year (936-9503)	
Service:		Dell Hardware Limited Warranty Plus On Site Service Extended Year (939-4668)	
Service:		Dell ProSupport. For tech support, visit http://support.dell.com/ProSupport or call 1-800-845-	

	3355 (989-3439)
Service:	ProSupport: Next Business Day Onsite Service After Problem Diagnosis, Initial Year (989-5221)
Installation:	On-Site Installation Declined (900-9997)
Support:	Proactive Maintenance Service Declined (926-2979)

Appendix D: Architecture

Infrastructure required supporting the user requirements for the lab configuration which is listed in the following illustration. This is a logical depiction of the proposed infrastructure as it will be physically located on multiple VMs.



ASA 5510- This hardware will be provided by the UNOH IT department and managed and maintained by them.

AD DS, AD DNS, DHCP server- Configure Windows 2008 R2 Datacenter OS with 2GB of RAM and 2 virtual sockets @ 2.50GHz. Install AD DS, AD DNS, and DHCP roles on server. VM will be hosted on R620 PowerEdge.

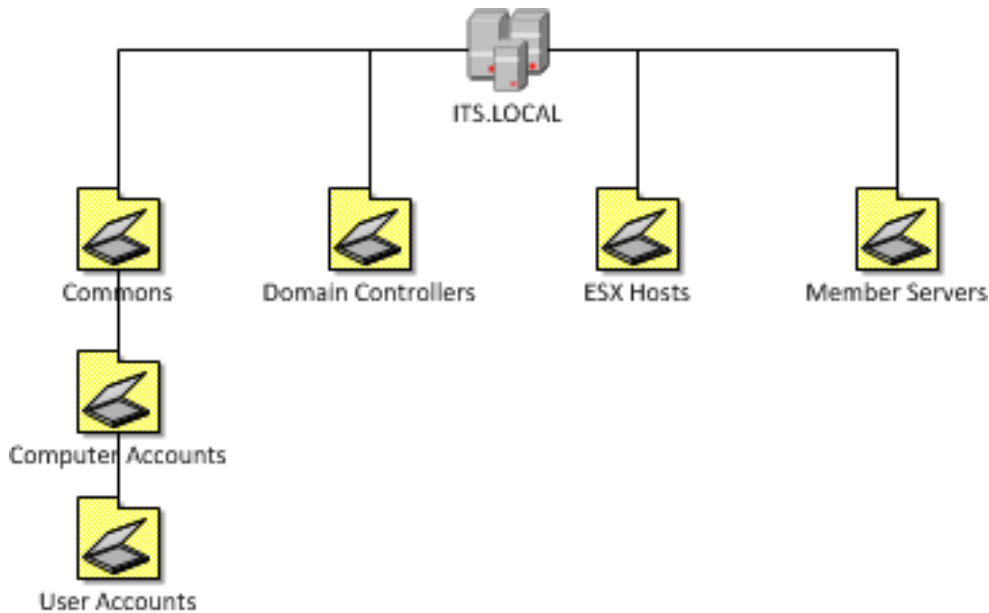
AD DS, AD DNS server- Configure Windows 2008 Datacenter OS with 2GB of RAM and 2 virtual sockets @ 2.70GHz. Install AD DS and AD DNS roles on server. VM will be hosted on R200 PowerEdge.

Image Management/Deployment server- Configure Windows 2008 R2 Datacenter OS with 4GB of RAM and 2 virtual sockets @ 2.50GHz. Install AD LDS, File Services, and WDS roles on server. SCCM 2012 will be installed to manage and deploy images to client computers. VM will be hosted on R620 PowerEdge.

Lab 13109 computers- Windows 7 Professional will be deployed to each of these systems using Zero Touch Installation.

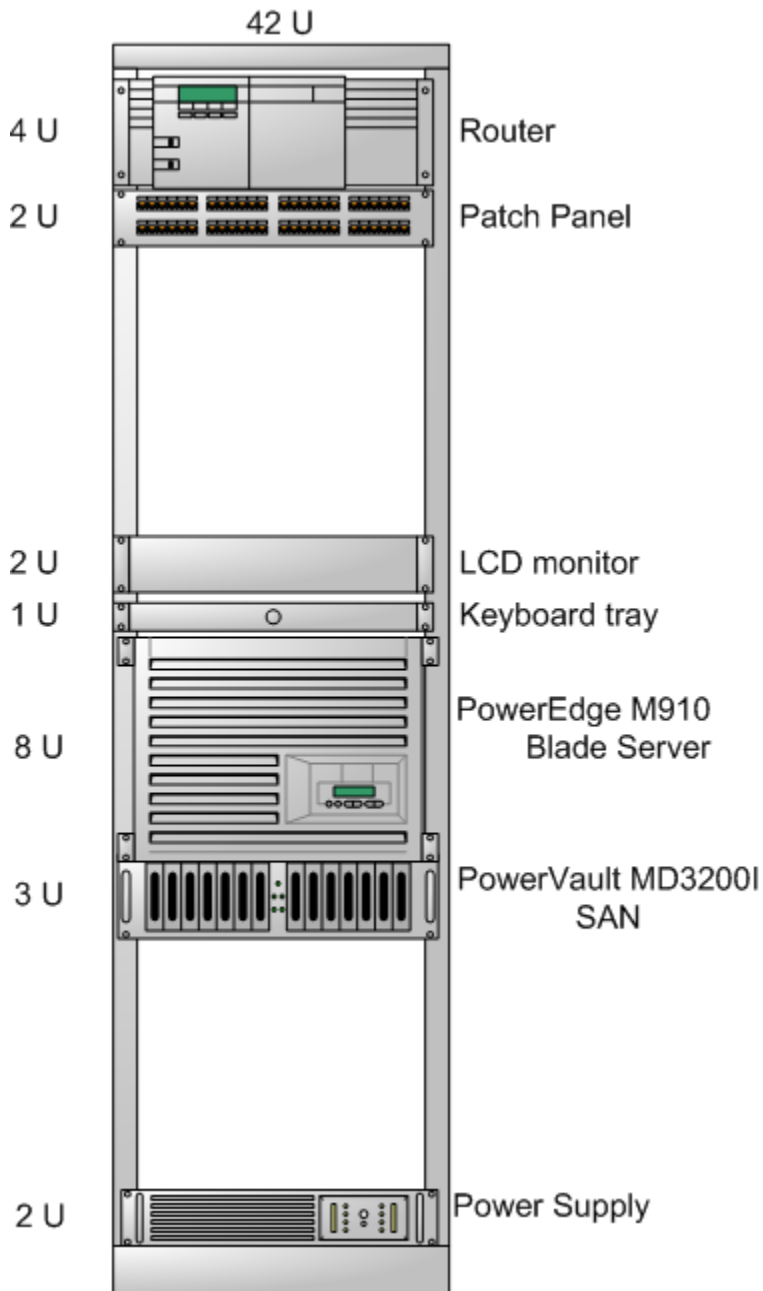
Lab 13107 computers- Windows 7 Professional will be deployed to each of these systems using Zero Touch Installation.

Appendix E: Active Directory Setup



Create several child organizational unit (OU) within existing domain to allow for data autonomy, not isolation from the domain. Place Image Management/Deployment server within Member Servers OU. Two Domain Controllers, one from each PowerEdge server within the Domain Controllers OU. The two ESXi Hosts installed on each PowerEdge will be located inside the ESX Hosts OU. All lab computer account will be located inside the Computer Accounts OU. All user accounts will be placed inside the User Accounts OU.

Appendix F: Server Information



PowerEdge M910 Blade Server- Hosts all virtual machines for the network. Technical specifications listed below.

PV MD3200i,RKMNT,iSCSI, 12 Bay, Dual Controller- Datastore for the virtual machines on the PowerEdge. Technical specifications listed below.

Router- Connects internal network to Internet.

Patch Panel- Connects client computers within the network with each other and hosted servers on PowerEdge.

Power Supply- Needed to supply power to server rack components.

LCD monitor- Need to see display on PowerEdge.

Keyboard- Needed for input on the PowerEdge.

Glossary of Terms

AD DS. Active Directory Domain Services role installed on Windows 2008 server to promote to a Domain Controller.

AD DNS. Active Directory Domain Name Services role installed on Windows 2008 server to provide Active Directory integrated DNS services.

AD LDS. Active Directory Lightweight Directory Services role installed on Windows 2008 server to provide WDS.

host. Type 1 hypervisor referring to vSphere ESXi, Microsoft Hyper-V, or Citrix XenServer.

iSCSI. Internet Small Computer System Interface which is an IP-based storage for connecting to data storage.

SAN. Storage Area Network is a dedicated network that provides access to storage.

SCCM. System Center Configuration Manager which is used to manage image deployment.

VM (virtual machine). Software representation of a computer that performs like a physical machine.

V2V. Term used to refer to the migration of one virtual machine to another virtual machine.

WDS. Windows Deployment Services role needed to provide SCCM services.

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**VIRTUALIZED EDUCATIONAL LAB SETUP
IMPLEMENTATION
PROJECT DELIVERABLE**



MSIS PROJECT
Aaron Napierala

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Overview

The goal of this project is to provide students with an environment in which they will be able to work with Type 1 hypervisors as well as provide a lab environment to hold System Administration and Network Security courses in for the University of Northwestern Ohio. The implementation completed is based upon requirements gathered from UNOH stakeholders. A description of both the newly purchased R620 PowerEdge along with the redesigned R200 is presented along with the PowerVault MD3200i. Each VM running on these systems are presented in Appendix B. Two main components of this project, SCCM 2012 and VMware vCenter Server, are also presented in a general overview. Finally, remote management of the lab is discussed. A description of each of the racks and their contents are presented in Appendices F and G. This report summarizes the implementation of the above listed items.

PowerEdge R620 and supporting VMs

The following information lists the hosts running on the PowerEdge along with virtual machines. The version of VMware running on this system is: VMware vSphere 5 Enterprise Licensed for two physical CPUs (unlimited cores per CPU). This license expires on 8/30/2013. The supported features included for this license such as vMotion and vSphere FT cannot be utilized due to the hardware limitations of the PowerEdge R200.

ESXi hosts:

- esx-620.its.local
- CD-ESX-host.1
- CD-ESX-host.2
- CD-ESX-host.3
- Course-ESX

Virtual Machines:

- CD-pfSense.1
- IT-DC1
- pfSense-RC-2.0.1
- SCCM
- Temp-win7-2
- Win7-temp

Resource Pool

- CD && COURSE
 - CD-ESX-host.1
 - CD-ESX-host.2
 - CD-ESX-host.3
 - CD-pfSense.2

- Course-ESX
- Windows Server 2012

The resource pool listed above is a work in progress until a solution such as vCloud Director can be implemented. Each of the above listed resources is each broken down in Appendix B.

System Summary: See Appendix A

PowerEdge R200 and supporting VMs

The following information lists the host running on the PowerEdge along with virtual machines. The version of VMware running on this system is: VMware vSphere 5 Enterprise Licensed for one physical CPUs (unlimited cores per CPU). This license expires on 8/30/2013. The supported features included for this license such as vMotion and vSphere FT cannot be utilized due to the hardware limitations of the PowerEdge R200.

ESXi hosts:

- esx-R200.its.local

Virtual Machines:

- 2008 Server
- IT-DC2

Each of the above listed resources is each broken down in Appendix B.

System Summary: See Appendix C

PowerVault MD3200i

The PowerVault MD3200i Whitepaper best practices, Dell PowerVault MD32xxi Deployment Guide, and iSCSI SAN Configuration Guide (www.dell.com) were used in deploying the SAN. The original configuration of the SAN did not allot for anything but a RAID 0, so after installing the SAN another purchase was made to create an array of RAID 5. Several attempts at using a storage array management system were used, but after confirming with Dell support that the Dell MD Storage Array vCenter plug-in would not work “well”, that out-of-the-box PowerVault Modular Disk Storage Manager was used. It is managed out-of-band currently, but when CHAP authentication is enabled, it can be managed remotely.

VMware vCenter Server

VMware vCenter Server is installed on the VM sccm.its.local. Two datacenters were created, one for the CD team and the other for faculty use. This is the location where domain permission should be set for users in the domain its.local. The default port number was changed from 443 to 444, so when it is managed through vSphere Client, sccm:444 should be used. It can also be managed by its IP address. The version of vCenter Server used is 5.0.0 Build 623373.

Recourse Pools are being developed, but they are still in the early stages. This must be completed before vCloud Director can be implemented.

System Center Configuration Manager

One of the customer requirements was to develop an imaging management system. SCCM 2012 was chosen because the software was available free of charge through the Microsoft IT Academy subscription already accounted for through the university. Many hours were logged into developing the SCCM VM, so a brief overview will be provided here. In-depth questions should be directed to Aaron Napierala. Most all of the configuration was made by referring to resources located here: <http://www.windows-noob.com/forums/index.php?/topic/4045-system-center-2012-configuration-manager-guides/> (noob)

One primary site was created called TES – Student Commons IT Lab. A CAS was not used because the number of clients in the lab does not exceed 50,000. A primary site supports up to this number, so this is why the decision for only one primary site was made. Operating system images were created to allow for image capturing to occur. Operating system installers were then created based on these captured images to deploy to systems to be imaged. Driver packages also needed to be created for newer systems that could not be imaged because network drivers were not included on the original operating system image. Finally, applications were created to deploy to client systems after they were imaged such as Adobe Flash and Microsoft Office.

Some concerns or optimizations that should be considered are software licensing for imaged systems, Windows Updates, as well as cleaning up the database of old “test” images.

Remote Mangement of Resources

A VPN connection can be established to the Cisco ASA device from outside UNOH network. This configuration will allow for a connection to the vCenter Server, but a host name error is received due to DNS not being configured properly when a VM connection is attempted. Additionally, a remote desktop connection cannot be established to a system within the isolated network to connect to the vCenter Server to avoid the DNS error. These issues have been submitted as work orders to the UNOH IT department. The current workaround is to connect to each ESX host directly from their respective IP addresses.

Appendix A: R620 System Summary

BIOS Manufacturer: Dell Inc., BIOS version:1.2.6
 Model: PowerEdge R620, Serial Number 3J3QQV1, Tag 23.0

GROU P: 1	QUANTIT Y: 1	SYSTEM PRICE: \$5,581.77	GROUP TOTAL: \$5,581.77
Base Unit:		PowerEdge R620 (225-2108)	
TBU:		PowerEdge R620 Shipping - 4/8 Drive Chassis (331-4761)	
TBU:		iDRAC7 Enterprise (421-5339)	
TBU:		Intel Ethernet I350 QP 1Gb Network Daughter Card (430-4447)	
TBU:		Cable for Mini PERC Cards for Chassis with up to 8 Hard Drives (331-4823)	
TBU:		Chassis with up to 8 Hard Drives and 3 PCIe Slots (342-3666)	
TBU:		RAID 1 for H710P/H710/H310 (2 HDDs) (331-4224)	
TBU:		PERC H710 Integrated RAID Controller, 512MB NV Cache (342-3529)	
TBU:		Intel Xeon E5-2640 2.50GHz, 15M Cache, 7.2GT/s QPI, Turbo, 6C, 95W, Max Mem 1333MHz (317-9595)	
TBU:		Heat Sink for PowerEdge R620 (331-4762)	
TBU:		DIMM Blanks for Systems with 2 Processors (317-8688)	
TBU:		Intel Xeon E5-2640 2.50GHz, 15M Cache, 7.2GT/s QPI, Turbo, 6C, 95W (317-9609)	
TBU:		Heat Sink for PowerEdge R620 (331-4762)	
TBU:		8GB RDIMM, 1333 MHz, Low Volt, Dual Rank, x4 (317-9644) - Quantity 8	
TBU:		1333 MHz RDIMMs (331-4422)	
TBU:		146GB 15K RPM Serial-Attach SCSI 6Gbps 2.5in Hotplug Hard Drive (342-0427) - Quantity 2	
TBU:		Electronic System Documentation and OpenManage DVD Kit (331-4513)	
CD-ROM or DVD-ROM Drive:		DVD+/-RW, SATA, Internal (318-1391)	
CD-ROM or DVD-ROM Drive:		ReadyRails Sliding Rails With Cable Management Arm (331-4765)	
CD-ROM or DVD-ROM Drive:		Dual, Hot-plug, Redundant Power Supply (1+1), 750W (331-4605)	
CD-ROM or DVD-ROM Drive:		Power Cord, NEMA 5-15P to C13, 15 amp, wall plug, 10 feet / 3 meter (310-8509) - Quantity 2	
CD-ROM or DVD-ROM Drive:		No Operating System (420-6320)	
Service:		Dell Hardware Limited Warranty Plus On Site Service Initial Year (936-1787)	
Service:		ProSupport: Next Business Day Onsite Service After Problem Diagnosis, 2 Year Extended (936-9493)	
Service:		ProSupport: 7x24 HW / SW Tech Support and Assistance, 3 Year (936-9503)	
Service:		Dell Hardware Limited Warranty Plus On Site Service Extended Year (939-4668)	
Service:		Dell ProSupport. For tech support, visit http://support.dell.com/ProSupport or call 1-800-845-3355 (989-3439)	
Service:		ProSupport: Next Business Day Onsite Service After Problem Diagnosis, Initial Year (989-5221)	
Installation:		On-Site Installation Declined (900-9997)	
Support:		Proactive Maintenance Service Declined (926-2979)	

Appendix B: Virtual machine/Host supporting information

esx-620.its.local

Host specific:

- ESXi host managed by IT faculty members
- VMware ESXi 5.0.0 (VMKernel Release Build 623860)
- Bare metal host installed on PowerEdge R620
- DNS host record created in AD DNS
- Authentication provided through Active Directory for domain its.local
- Virtual Machine Startup and Shutdown is configured to Startup IT-DC1 and SCCM virtual machines in the event of power being lost
- VMware vSphere 5 Enterprise Licensed for two physical CPUs (unlimited cores per CPU)
- License expires on 8/30/2013

Network specific:

- vSwitch0 contains port groups for CD network systems (CD-Intranet and CD-DMZ). The physical adapter for these port groups is vmnic0
- vSwitch1 contains ports (iSCSI1 and iSCSI2) for connection to the PowerVault MD3200i. Two physical adapters are used: vmnic1 and vmnic2.
- vSwitch2 contains the port group (lab_network) for the lab network that all the clients systems have access to

Storage specific:

- NFS_storage
 - Device: 172.20.1.2:/nfs_share
 - Capacity: 500GB
 - File System NFS
 - Slow connection for archival purposes
 - Exists as local disk storage on R200
- PowerEdge_RAID_0
 - Device: DELL iSCSI Disk (naa.6d4ae520009f67de000003d550211c8c):1
 - Capacity: 1.36TB
 - File System VMFS5
 - RAID level 0
- PowerEdge_RAID_5
 - Device: DELL iSCSI Disk (naa.6d4ae520009f67610000049b50ff98b8):1
 - Capacity: 1.64TB
 - File System VMFS5
 - RAID level 5
- R620_local_storage

- Device: Local DELL Disk (naa.6d4ae520a7cd2200178fa02211cf6161):3
- Capacity: 131GB
- File System VMFS5
- RAID level 1

CD-ESX-host.1

Host specific:

- ESXi host managed by CD Team members
- VMware ESXi 5.0.0 (VMKernel Release Build 623860)
- Nested host installed on PowerEdge R620
- DNS host record not created in AD DNS
- Authentication provided through local database; Active Directory authentication available on vCenter Server
- Processor: 4 vCPU
- Memory: 10240MB
- VMware vSphere 5 Enterprise Licensed for one physical CPUs (unlimited cores per CPU)
- License expires on 12/30/2013

Network specific:

- Network Adapter 1 connected to lab_network
- Network Adapter 2 connected to CD-Intranet
- Network Adapter 3 connected to CD-DMZ

Storage specific:

- Hard Disk 1
 - Device: [PowerEdge_RAID_5] Team-2-ESX.1/Team-2-ESX.1-000002.vmdk
 - Capacity: 100GB
 - Thick Provisioned Lazy Zero
- Hard Disk 2
 - [PowerEdge_RAID_5] Team-2-ESX.1/CD-ESX-host.1-000001.vmdk
 - Capacity: 50GB
 - Thin Provisioned
- Hard Disk 3
 - [PowerEdge_RAID_5] Team-2-ESX.1/CD-ESX-host.1_1.vmdk
 - Capacity: 150GB
 - Thin Provisioned

CD-ESX-host.2

Host specific:

- ESXi host managed by CD Team members
- VMware ESXi 5.0.0 (VMKernel Release Build 623860)
- Nested host installed on PowerEdge R620
- DNS host record not created in AD DNS

- Authentication provided through local database 2; Active Directory authentication available on vCenter Server
- Processor: 2 vCPU
- Memory: 4096MB
- VMware vSphere 5 Enterprise
- License expires on 12/30/2013

Network specific:

- Network Adapter 1 connected to lab_network
- Network Adapter 2 connected to CD-Intranet
- Network Adapter 3 connected to CD-DMZ

Storage specific:

- Hard Disk 1
 - Device: [PowerEdge_RAID_5] CCDC-ESX-servers.1/Team-2-ESX.2-000001.vmdk
 - Capacity: 100GB
 - Thick Provisioned Lazy Zero

CD-ESX-host.3

Host specific:

- ESXi host managed by CD Team members
- VMware ESXi 5.0.0 (VMKernel Release Build 623860)
- Nested host installed on PowerEdge R620
- DNS host record not created in AD DNS
- Authentication provided through local; Active Directory authentication available on vCenter Server
- Processor: 4 vCPU
- Memory: 16384MB
- VMware vSphere 5 Enterprise Licensed for two physical CPUs (unlimited cores per CPU)
- License expires on 2/28/2014

Network specific:

- Network Adapter 1 connected to lab_network
- Network Adapter 2 connected to CD-Intranet
- Network Adapter 3 connected to CD-DMZ

Storage specific:

- Hard Disk 1
 - Device: [PowerEdge_RAID_5] CCDC-ESX-clients/Team-1-Hyper-V.3-000001.vmdk
 - Capacity: 100GB
 - Thick Provisioned Lazy Zero
- Hard Disk 2
 - [PowerEdge_RAID_5] CCDC-ESX-clients/CCDC-ESX-clients.vmdk

- Capacity: 200GB
- Thick Provisioned Lazy Zero

Course-ESX

Host specific:

- ESXi host managed by IT faculty members
- VMware ESXi 5.0.0 (VMKernel Release Build 623860)
- Nested host installed on PowerEdge R620
- DNS host record created in AD DNS; course-esx.its.local
- Authentication provided through local database and Active Directory for domain its.local
- Processor: 4 vCPU
- Memory: 16384MB
- VMware vSphere 5 Enterprise Licensed for one physical CPUs (unlimited cores per CPU)
- License expires on 12/30/2013

Network specific:

- Network Adapter 1 connected to lab_network
- Network Adapter 2 connected to CD-Intranet
- Network Adapter 3 connected to CD-DMZ

Storage specific:

- Hard Disk 1
 - Device: [PowerEdge_RAID_5] ESX-courses/ESX-courses-000001.vmdk
 - Capacity: 100GB
 - Thick Provisioned Lazy Zero

CD-pfSense.2

Virtual Machine specific:

- pfSense 2.0.2 FreeBSD managed by CD Team members
- Testing system
- 32-bit
- Processor: 1 CPU
- Memory: 1024MB

Network specific:

- Network Adapter 1 connected to CD-DMZ
- Network Adapter 2 connected to CD-Intranet
- Network Adapter 3 connected to lab_network

Storage specific:

- Hard Disk 1
 - Device: [PowerEdge_RAID_0] CD-pfSense.2/CD-pfSense.vmdk
 - Capacity: 5GB
 - Thin Provisioned

Windows Server 2012

Virtual Machine specific:

- Windows Server 2012 Datacenter VM managed by IT faculty members
- Testing system
- Roles installed: AD DS, DHCP, DNS, File and Storage Services, IIS, NAP, Print Services, Remote Access, WDS, and WSUS
- 64-bit
- Processor: 2 CPUs
- Memory: 4096MB
- Activated through Microsoft

Network specific:

- Network Adapter 1 connected to lab_network

Storage specific:

- Hard Disk 1
 - Device: [PowerEdge_RAID_0] Windows Server 2012/Windows Server 2012.vmdk
 - Capacity: 60GB
 - Thick Provisioned Lazy Zero

IT-DC1

Virtual Machine specific:

- Windows Server 2008 R2 Datacenter SP1 VM managed by IT faculty members
- Name: IT-DC1
- Domain Controller for its.local
- Roles installed: AD DS, DHCP, DNS
- 64-bit
- Processor: 2 CPUs
- Memory: 2048MB
- Activated through Microsoft

Network specific:

- Network Adapter 1 connected to lab_network

Storage specific:

- Hard Disk 1
 - Device: [R620_local_storage] IT-DC1/IT-DC1.vmdk
 - Capacity: 35GB
 - Thick Provisioned Lazy Zero

CD-pfSense.1

Virtual Machine specific:

- pfSense 2.0.2 FreeBSD managed by CD Team members
- Testing system

- 32-bit
- Processor: 1 CPU
- Memory: 512MB

Network specific:

- Network Adapter 1 connected to lab_network
- Network Adapter 2 connected to CD-Intranet
- Network Adapter 3 connected to CD-DMZ

Storage specific:

- Hard Disk 1
 - Device: [PowerEdge_RAID_5] pfSense-Team-2/pfSense-Team-2-000001.vmdk
 - Capacity: 2GB
 - Thick Provisioned Eager Zero

pfSense-RC-2.0.1

Virtual Machine specific:

- pfSense 2.0.2 FreeBSD managed by CD Team members
- System reserved for backup and testing purposes
- 32-bit
- Processor: 1 CPU
- Memory: 512MB

Network specific:

- Network Adapter 1 connected to lab_network
- Network Adapter 2 connected to CD-Intranet
- Network Adapter 3 connected to CD-DMZ

Storage specific:

- Hard Disk 1
 - Device: [PowerEdge_RAID_0] pfSense/pfSense-000001.vmdk
 - Capacity: 2GB

Thick Provisioned Eager Zero

SCCM

Virtual Machine specific:

- Windows Server 2008 R2 Datacenter SP1 VM managed by IT faculty members
- Name: SCCM
- Member Server for its.local
- Roles installed: AD LDS, File Services, IIS, WDS, WSUS
- System Center Configuration Manager 2012, Microsoft SQL 2008 R2, Microsoft Windows AIK installed
- 64-bit
- Processor: 4 CPUs

- Memory: 4096MB
- Activated through Microsoft

Network specific:

- Network Adapter 1 connected to lab_network

Storage specific:

- Hard Disk 1
 - Device: [PowerEdge_RAID_5] SCCM/SCCM-000002.vmdk
 - Capacity: 75GB
 - Thick Provisioned Lazy Zero
- Hard Disk 2
 - Device: [PowerEdge_RAID_5] SCCM/SCCM_1-000002.vmdk
 - Capacity: 250GB
 - Thick Provisioned Lazy Zero

win7-temp

Virtual Machine specific:

- Windows 7 client VM managed by IT faculty members
- Name: TEMP-DELETE
- System used to create images for SCCM 2012
- IP address: assigned through DHCP
- 64-bit
- Processor: 4 CPUs
- Memory: 2048MB
- Activated through Microsoft

Network specific:

- Network Adapter 1 connected to lab_network

Storage specific:

- Hard Disk 1
 - Device: [PowerEdge_RAID_0] win7-temp/win7-temp-000004.vmdk
 - Capacity: 32GB
 - Thick Provisioned Lazy Zero

esx-r200.its.local

Host specific:

- ESXi host managed by IT faculty members
- VMware ESXi 5.0.0 (VMKernel Release Build 623860)
- Bare metal host installed on PowerEdge R200
- DNS host record created in AD DNS
- Authentication provided through Active Directory for domain its.local
- Virtual Machine Startup and Shutdown is configured to Startup IT-DC2 in the event of power being lost

- VMware vSphere 5 Enterprise Licensed for one physical CPUs (unlimited cores per CPU)
- License expires on 8/30/2013

Network specific:

- vSwitch0 contains the port group (lab_network) for the lab network that all the clients systems have access to lab

Storage specific:

- R200_local_storage
 - Device: Local Dell Disk (naa.600508e0000000000188b5190d878602):3
 - Capacity: 693GB
 - File System VMFS5
 - RAID level 1

IT-DC2

Virtual Machine specific:

- Windows Server 2008 Datacenter SP1 VM managed by IT faculty members
- Name: IT-DC2
- Domain Controller for its.local
- Roles installed: AD DS, DNS
- 64-bit
- Processor: 2 CPUs
- Memory: 2048MB
- Activated through Microsoft

Network specific:

- Network Adapter 1 connected to lab_network

Storage specific:

- Hard Disk 1
 - Device: [R200_local_storage] IT-DC2/IT-DC2.vmdk
 - Capacity: 80GB
 - Thick Provisioned Lazy Zero
- Hard Disk 2
 - Device: [R200_local_storage] IT-DC2/IT-DC2_1.vmdk
 - Capacity: 500GB
 - Thick Provisioned Lazy Zero

2008 Server

Virtual Machine specific:

- Windows Server 2008 Datacenter SP1 VM managed by IT faculty members
- Name: Server
- Test system for its.local
- Roles installed: None
- 32-bit

- Processor: 2 CPUs
- Memory: 2048MB
- Activated through Microsoft

Network specific:

- Network Adapter 1 connected to lab_network

Storage specific:

- Hard Disk 1
 - Device: [R200_local_storage] vCenter Server/vCenter Server.vmdk
 - Capacity: 50GB
 - Thick Provisioned Lazy Zero

Appendix C: R200 System Summary

BIOS Manufacturer: Dell Inc., BIOS version:1.4.3
 Model: PowerEdge R200, Serial Number F71VVH1, Tag 23.0

GROU P: 1	QUANTIT Y: 1	SYSTEM PRICE: Included	GROUP TOTAL: Included
Base Unit:		Dual Core Intel Pentium E5400 2.7GHz, 3MB Cache,1066MHz Front Side Bus for PowerEdge R200 (224-5951)	
Memory:		8GB DDR2, 800MHZ, 4X2G, Dual Ranked DIMMs (311-7923)	
Video Memory:		Riser with 2 Slots: 1 PCI Exprx8 slot and 1 PCI Express x4 slot (320-4959)	
Hard Drive:		750GB 7.2K RPM Near-Line SAS 3Gbps 3.5-in Cabled Hard Drive (341-7432)	
Operating System:		No Operating System (420-6320)	
NIC:		On-Board Dual Gigabit Network Adapter (430-2008)	
CD-ROM or DVD-ROM Drive:		NO CD-ROM OPTION (320-2961)	
Sound Card:		Bezel (313-5844)	
Documentation Diskette:		No Hard Copy Documentation E-Docs Only and OpenManage CD Kit (310-9876)	
Additional Storage Products:		750GB 7.2K RPM Near-Line SAS 3Gbps 3.5-in Cabled Hard Drive (341-7432)	
Feature		Add-in SAS6iR RAID Controller (SATA/SAS Controller) which supports 2 Hard Drives -RAID 1 (310-9873)	
Feature		Rack Chassis w/Rapid Rails forDell, HPQ or other Square HoleRacks, PE1750 (310-3955)	
Service:		Dell Hardware Warranty Plus On Site Service Initial Year (988-1397)	
Service:		Dell Hardware Warranty, Extended Year(s) (988-1398)	
Service:		Mission Critical Package: 4-Hour 7x24 On-Site Service with Emergency Dispatch, 2 Year Extended (988-1902)	
Service:		ProSupport for IT: 7x24 HW / SW Tech Support and Assistance for Certified IT Staff, 3 Year (988-2092)	
Service:		Mission Critical Package: 4-Hour 7x24 On-Site Service with Emergency Dispatch, Initial Year (988-5870)	
Service:		Thank you choosing Dell ProSupport. For tech support, visit http://support.dell.com/ProSupport or call 1-800-945-33 (989-3439)	
Service:		MISSION CRITICAL PACKAGE: Enhanced Services, 3 Year (990-7298)	
Installation:		On-Site Installation Declined (900-9997)	
Misc:		Power Cord, NEMA 5-15P to C13 wall plug, 10 feet (2 meter) (310-4450)	
Base Unit:		Dual Core Intel Pentium E5400 2.7GHz, 3MB Cache,1066MHz Front Side Bus for PowerEdge R200 (224-5951)	
Memory:		8GB DDR2, 800MHZ, 4X2G, Dual Ranked DIMMs (311-7923)	
Video Memory:		Riser with 2 Slots: 1 PCI Exprx8 slot and 1 PCI Express x4 slot (320-4959)	
Hard Drive:		750GB 7.2K RPM Near-Line SAS 3Gbps 3.5-in Cabled Hard Drive (341-7432)	
Operating System:		No Operating System (420-6320)	
NIC:		On-Board Dual Gigabit Network Adapter (430-2008)	
CD-ROM or DVD-ROM Drive:		NO CD-ROM OPTION (320-2961)	
Sound Card:		Bezel (313-5844)	
Documentation Diskette:		No Hard Copy Documentation E-Docs Only and OpenManage CD Kit (310-9876)	

Appendix D: PowerVault MD3200i IP address assignment

Storage array name: PowerVault01

CHAP: Disabled

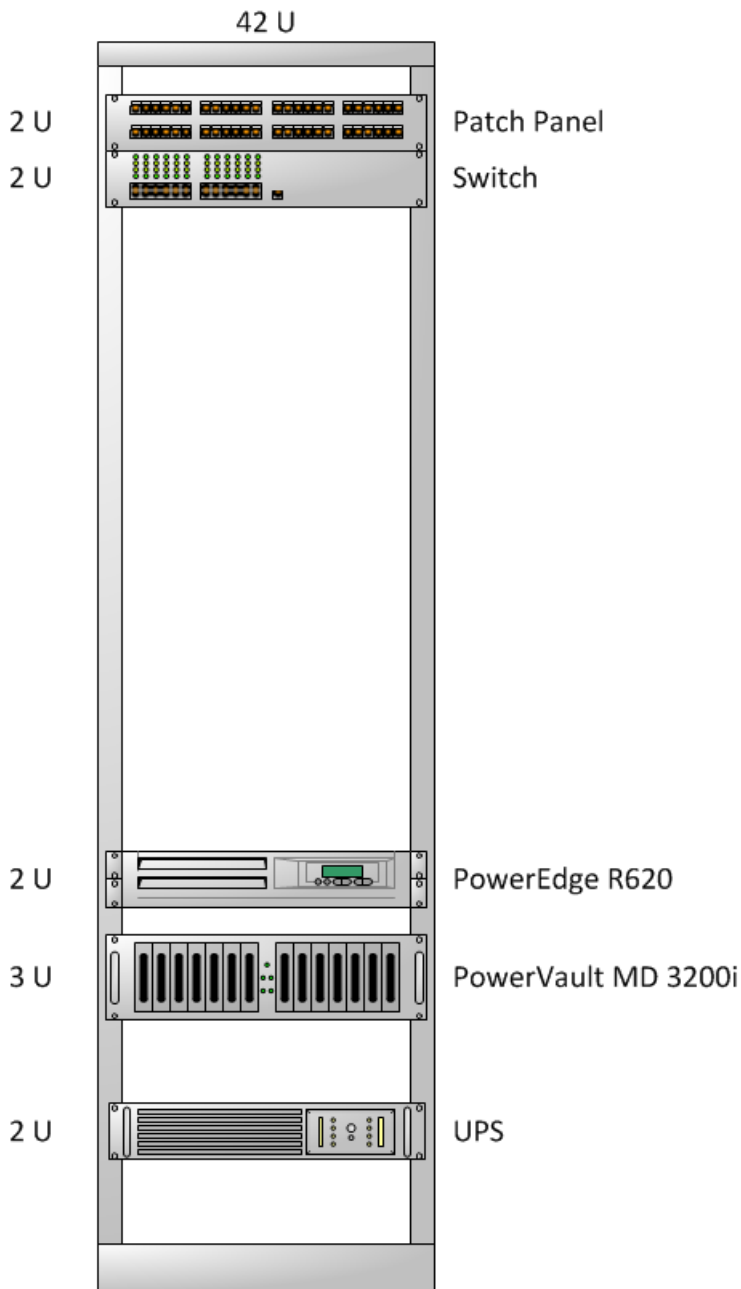
Controller 0:

Controller 1:

Appendix E: PowerVault MD3200i System Summary

GROU P: 1	QUANTIT Y: 1	SYSTEM PRICE: \$8,914.83	GROUP TOTAL: \$8,914.83
Base Unit:		PV MD3200i,RKMNT,iSCSI, 12 Bay, Dual Controller (224-8206)	
Hard Drive:		HD Multi-Select (341-4158)	
Mouse:		No Additional Software (410-1074)	
Mouse:		Hard Drive Filler, Single Blank (342-0121) - Quantity 9	
Mouse:		500GB 7.2K RPM Near-Line SAS 6Gbps 3.5in Hotplug Hard Drive (342-0118) - Quantity 3	
Mouse:		600GB 15K RPM SA SCSI 6Gbps 3.5in Hotplug Hard Drive,CusKit (342-0454- Quantity 4	
Sound Card:		Bezel Option, MD3200i (313-9401)	
Feature		RackRails, RapidRails for Dell Rack (330-6048)	
Service:		Dell Hardware Limited Warranty Plus On Site Service Initial Year (922-5697)	
Service:		Pro Support : Next Business Day Onsite Service After Problem Diagnosis, 2Year Extended (927-0042)	
Service:		ProSupport : 7x24 HW / SW Tech Support and Assistance , 3 Year (927-0082)	
Service:		Dell Hardware Limited Warranty Plus On Site Service Extended Year (929-6318)	
Service:		Pro Support : Next Business Day Onsite Service After Problem Diagnosis, Initial Year (931-2920)	
Service:		Dell ProSupport. For tech support, visit http://support.dell.com/ProSupport or call 1-800-845-3355 (989-3439)	
Installation:		On-Site Installation Declined (900-9997)	
Support:		Proactive Maintenance Service Declined (926-2979)	
Misc:		Power Cord, NEMA 5-15P to C13, 15 amp, wall plug, 6 feet / 2 meter (310-9965)	
Misc:		Power Cord, NEMA 5-15P to C13, 15 amp, wall plug, 6 feet / 2 meter (310-9965)	

Appendix F: 13109 Server Information



PowerEdge R620 Server- Hosts all virtual machines for the network.

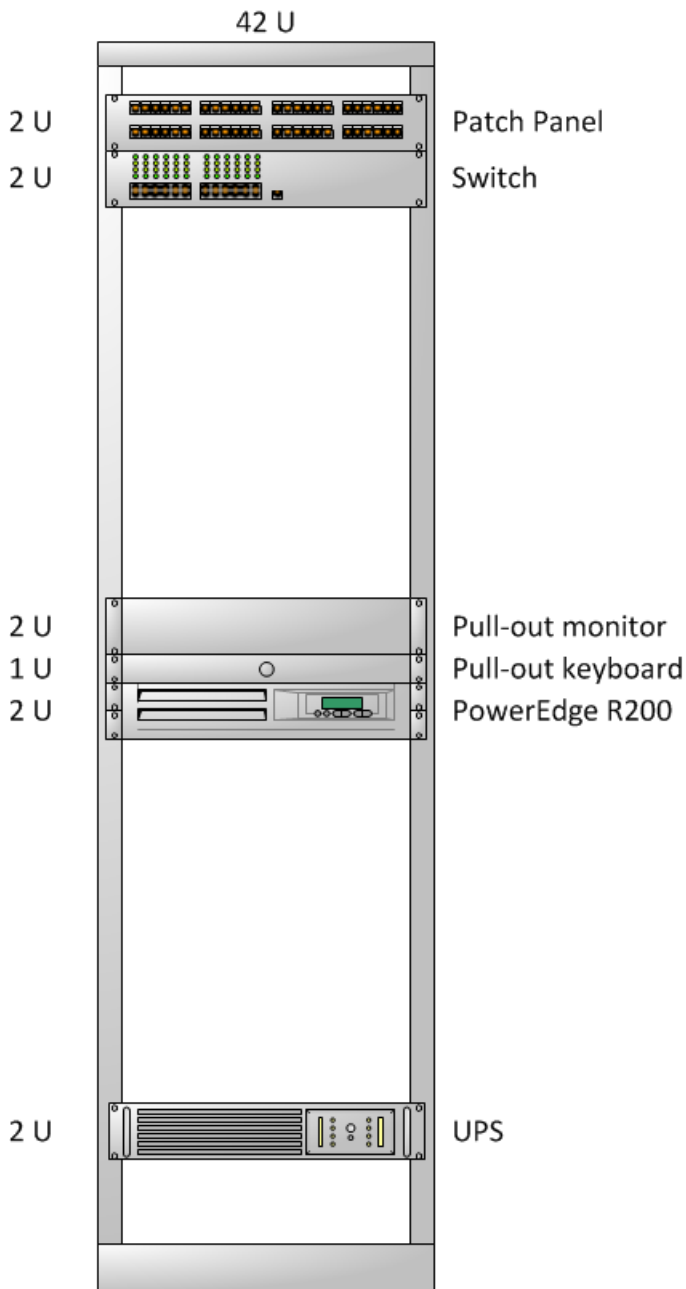
PV MD3200i,RKMNT,iSCSI, 12 Bay, Dual Controller- Datastore for the virtual machines on the PowerEdge. Technical specifications listed below.

Switch- Connects internal network to Cisco ASA.

Patch Panel- Connects client computers within the network with each other and hosted servers on PowerEdge.

Power Supply- Supplies power to server rack components.

Appendix G: 13108 Server Information



PowerEdge R200 Server- Hosts all virtual machines for the network.

PV MD3200i,RKMNT,iSCSI, 12 Bay, Dual Controller- Datastore for the virtual machines on the PowerEdge. Technical specifications listed below.

Switch- Connects internal network to Cisco ASA.

Patch Panel- Connects client computers within the network with each other and hosted servers on PowerEdge.

Power Supply- Supplies power to server rack components.

LCD monitor- Need to see display on PowerEdge R200.

Keyboard- Need for input on the PowerEdge R200.

Glossary of Terms

AD DS. Active Directory Domain Services role installed on Windows 2008 server to promote to a Domain Controller.

AD DNS. Active Directory Domain Name Services role installed on Windows 2008 server to provide Active Directory integrated DNS services.

AD LDS. Active Directory Lightweight Directory Services role installed on Windows 2008 server to provide WDS.

CAS. The Central Administration Site coordinates intersite data replication across the site hierarchy.

CD. Cyber Defense Team abbreviation.

host. Type 1 hypervisor referring to vSphere ESXi, Microsoft Hyper-V, or Citrix XenServer.

iSCSI. Internet Small Computer System Interface which is an IP-based storage for connecting to data storage.

SAN. Storage Area Network is a dedicated network that provides access to storage.

SCCM. System Center Configuration Manager which is used to manage image deployment.

VM (virtual machine). Software representation of a computer that performs like a physical machine.

Works Cited

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<http://www.windows-noob.com/forums/index.php?app=portal>

www.dell.com. (n.d.). Retrieved 3 28, 2013, from <http://www.dell.com/>: <http://www.dell.com/>