# CECH Infrastructure Update

By:

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A Proposal Submitted to the Faculty
of the School of Information
Technology in Partial Fulfillment of
the Requirements for the Degree of
Bachelor of Science in Information
Technology

University of Cincinnati

College of Education, Criminal
Justice, and Human Services

April 2016

Learner's Signature _____ Date: 4-18-16

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Advisor's signature: _____ Date: 4-18-16

Advisor's printed name: Professor Jim Scott

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# Abstract

The College of Education, Criminal Justice and Human Services (CECH), a public research institution located in Cincinnati, Ohio, presently deploys an outdated and over provisioned storage array. This system is unable to keep up with growth and demand of the college. While weighing datacenter options and cost effective measures, Nick Christen chose a plan of action to provide adequate storage and computing resources for The College of Education, Criminal Justice and Human Services. The object of the research was to find a system that is both economical within the budget of the college but also presents a performance and storage upgrade. The research and planning led to a hardware proposal that the college will review and decide to implement. The hardware was able to provide the college with considerable upgrades as well as a new hardware plan for the future of the college.

# Introduction

The College of Education, Criminal Justice and Human Services currently promotes innovation and growth inside the college. As a whole the college employees 150 full time faculty and staff as well as 5,500 students. With the current infrastructure the amount of growth will reach a plateau and slow the growth process. While continuing to move forward the need for a new infrastructure has been put to the front of the line.

So what will this project accomplish? Well, it will take care of upgrading an outdated system as well as adding performance and storage to the college system. With the storage and performance upgrade The College of Education, Criminal Justice and Human Services will continue to provide innovation and cutting edge technology to The University of Cincinnati as a whole.

# Problem

At The College of Education, Criminal Justice and Human Services, the current infrastructure is outdated, overused and over provisioned. Since The College of Education, Criminal Justice and Human Services is growing every day the need for an upgrade is eminent. The current system is built with HP ProLiant BL460c Gen 8 Blades comprised of anywhere from 8 cores up to 16 cores depending on the application. Due to the high level of usage on the system, The College of Education, Criminal Justice and Human Services wants a storage solution as well as a resource solution.

The College of Education, Criminal Justice and Human Services is in need of this new system because the current hardware is getting older and requires constant maintenance as well as new technologies are causing The College of Education, Criminal Justice and Human Services to run into multiple compatibility issues. During the past couple of years the college has experienced growth outside of their

10 year plan and the storage quotas have fallen behind. With a total of 65 Terabytes of storage and nearing full capacity the need for a storage upgrade is near so faculty and staff can continue to provide quick and ground breaking research for the college. Along with faculty and staff the students at The College of Education, Criminal Justice and Human Services use many resources and for them to continue to learn and grow the technology needs to keep up and be very dynamic to keep up with a changing educational environment. While also looking into a performance upgrade The College of Education, Criminal Justice and Human Services wants to pursue an architecture that includes Fiber cabling over the traditional CAT 5E.

During the initial process choosing a vendor was a major step towards completing the project within the scope. This process included choosing the right vendor based on price, performance and overall fit into the project scheme.

When everything is ready and in place a schedule for data migration could prove difficult due to the total amount of data as well as the amount of accessed data for crucial business and research related tasks. During the development of the migration plan the schedule will include weekend and extra hours outside of normal business operations.

# Solution

Due to the high level of use on the current system at The College of Education, Criminal Justice and Human services the solution will include a reworked virtual environment, new hardware resources and a larger storage capacity and performance upgrade. With the purchase of the new hardware the current infrastructure and data will be moved from the new hardware with the use of a migration plan. The migration plan contains information for strict time and use sensitive data as well as a schedule to provide general guidelines to the migration. This new system leads to greater resources for students,

faculty and staff alike. With an increased infrastructure current time constraints are able to be solved with the performance enhancement.

## Rack vs. Blade Environment

The current environment at CECH includes a blade chassis with 6 HP blades. CECH wanted to explore the possibilities of moving from a blade chassis to a rack solution for the new hardware plan. While researching the differences and best applications, the blade solution stood out the most with the infrastructure CECH is deploying. The blade chassis allows for multiple blades while keeping space consumption at a minimum which applied to CECH because of the move to the new data center. The blade infrastructure itself is also more efficient than rack-mounts. Consolidated power and cooling inside a blade enclosure reduces the number of power supplies and fans required. Rack-mounts, on the other hand, each need several fans and power supplies for just one server. [1] The rack solution was reviewed but eventually disregarded because of the amount of future expansion the blade system allowed. Compared to rack-mount servers spread throughout the data center, blades ease server management by reducing the number of places an administrator must physically visit. [1] Since CECH is such a small datacenter and limited employees the availability to see everything in once place appealed to CECH, while also having worked with the blade environment in the previous hardware solution.

# 3 Par

The 3 Par from Hewlett Packard was an easy choice for the Storage Area Network solution. The 3 Par provides high availability, increased speeds and performance as well as a great architecture for file storage. The 3 Par is a SAN that allows for the computers to see the storage as raw storage being in 1 GB chunklets. These 1 GB chunklets are spread across all of the drives and due to this the environment can function while having a full shelf of drives fail. The 3 Par also uses Adaptive Optimization which includes allowing applications to move across storage tiers as they are used more often or less frequently. The Adaptive Optimization can be set to calculate as much as every 15 seconds and move accordingly. With Adaptive Optimization on the 3 Par, the use of solid state and near line drives become more useful and allows for a hands off approach to get the most performance. The 3 Par also allows for thin form factor drives which allows for great space savings. The 3 Par application used by CECH includes 8 480 GB Solid State Drives, 40 1.2 terabyte 10K drives and 12 2.0 terabyte 7.2K drives. In total each shelf will have 15 drives, 2 Solid Sate Drives, 10 10k drives and 3 7.2k drives.

# Proposal

HP C7000 Enclosure with 2 Blades which includes 2 BL460 Gen 9 blades with 512 GB Memory and 2 BL460 Gen 8 blades from the previous infrastructure. The backup system is based on a 48 terabyte Store Once 3540 Backup Target that allows for de-duplication as well as one to many backup to allow for data to be sent to multiple backup systems to help with disaster recovery. The storage area network is made up of a 3 Par 8200 System with 8 480 GB Solid State Drives,

40 1.2 TB 10K drives and 12 2.0 TB 7.2K to get 60 total drives with 60 terabytes of storage available. The proposal also includes a fiber channel switch to connect everything together and provide increased data speeds. The proposal also includes a move to the UC data center from the previous data center that will allow for a fine-tuned environment for the new hardware.

# User Profile

The user profile form shows the different parts of the project from a user standpoint.

| User Profile Form |
| --- |
| Application: CECH is looking for a new System to handle data operations at the college. This will include and upgrade of current system hardware and memory as well as CPU power. |
| Potential Users: Faculty/Staff/Students |
| Software and Interface Experience: The typical user has low to moderate level of experience with the windows operating system and how to get to network drives and other network storage. The typical user also has moderate experience with Linux and Macintosh operating systems. |
| Experience with Similar Applications: Similar applications such as drop box and other hosted cloud services could be compared to this application. |
| Task Experience: Most of the system will be very easy for the user to use, such as network mapped drives, single sign on and ease of movement between services provided on the Windows, Linux and the Macintosh operating systems. |
| Frequency of Use: This system will be heavily used by any faculty, staff and student in the College of Education, Criminal Justice and Human Services. This system will be used every day for basic tasks and helping better improve research and student resources at CECH. |
| Key Interface Design Requirements that the Profile Suggests:<br>1.Simple Interface<br>2.Pre-Mapped Drives<br>3.Seperation of elements (Departmental Separation)<br>4. Simple and usable forms. |

Figure 1, User Profile Form

# Use Case

The use case shows how the users and administrators will use the system and how each will interact with the system.

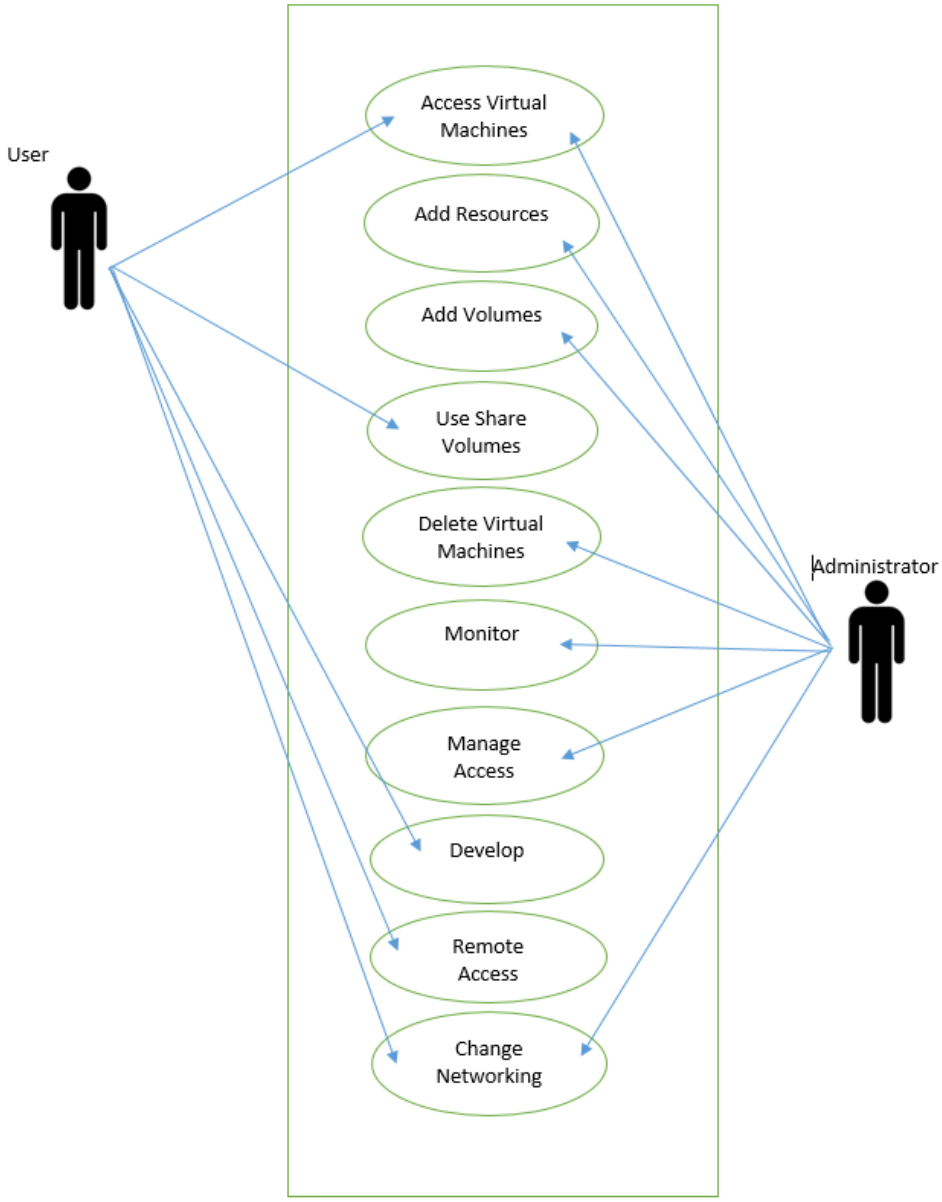
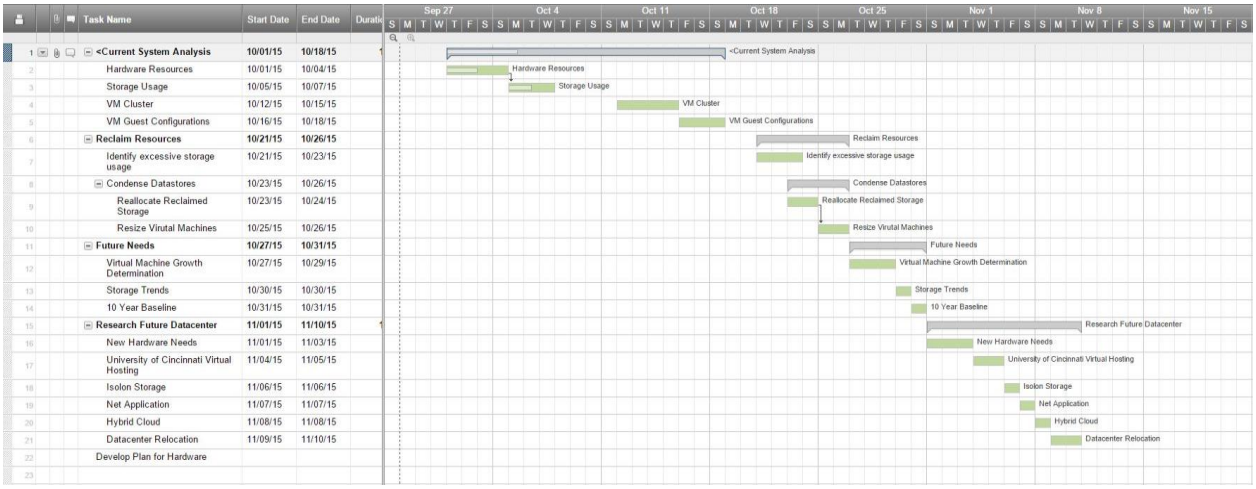



Figure 2, Use Case

# Timeline

The timelines from the first and second semester show the life cycle of the project and each goal reached.

# First Semester




# Second Semester

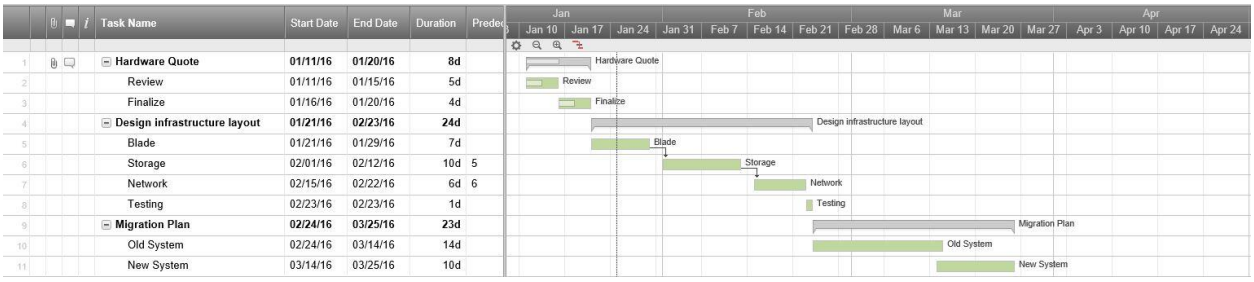



Figure 3, Time Line

# Budget

| Budget | |
|---|---|
| System | Cost |
| Blade Enviroment | $ 95,000.00 |
| Backup Enviorment | $ 35,000.00 |
| SAN Enviroment | $125,000.00 |
| Total | $255,000.00 |

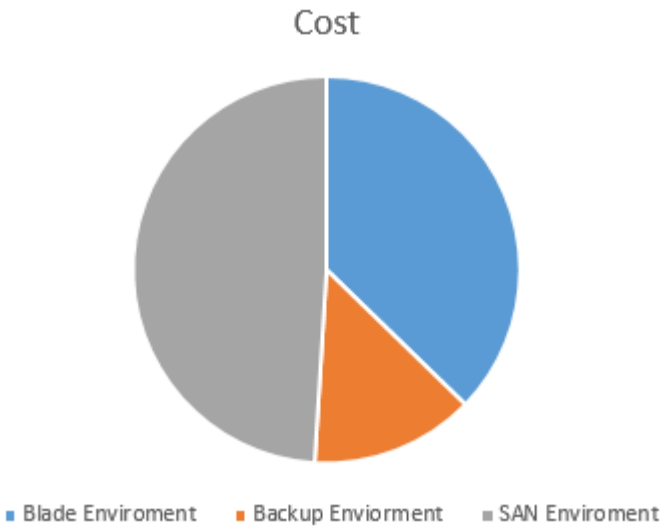



Figure 4, Budget

Included are the budget proposals issued by CECH. The most monetary resources were spent on the Storage Area Network which includes SAN controllers and all the hard drives included. With almost half being spent in this area the SAN is viewed as the most important piece of the new hardware. The backup and blade environment each have a lot of software licenses which take up the majority of the budget while also making sure each environment can interconnect.

# Project Road Map

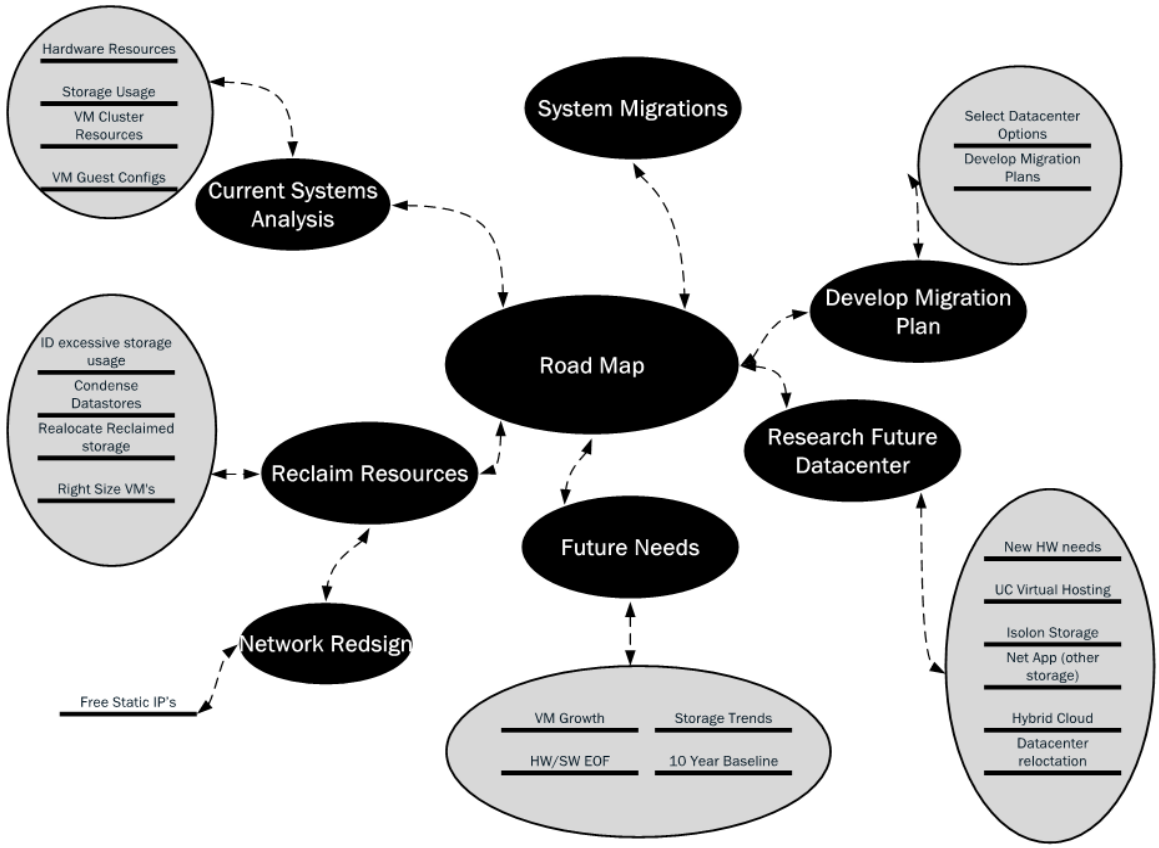
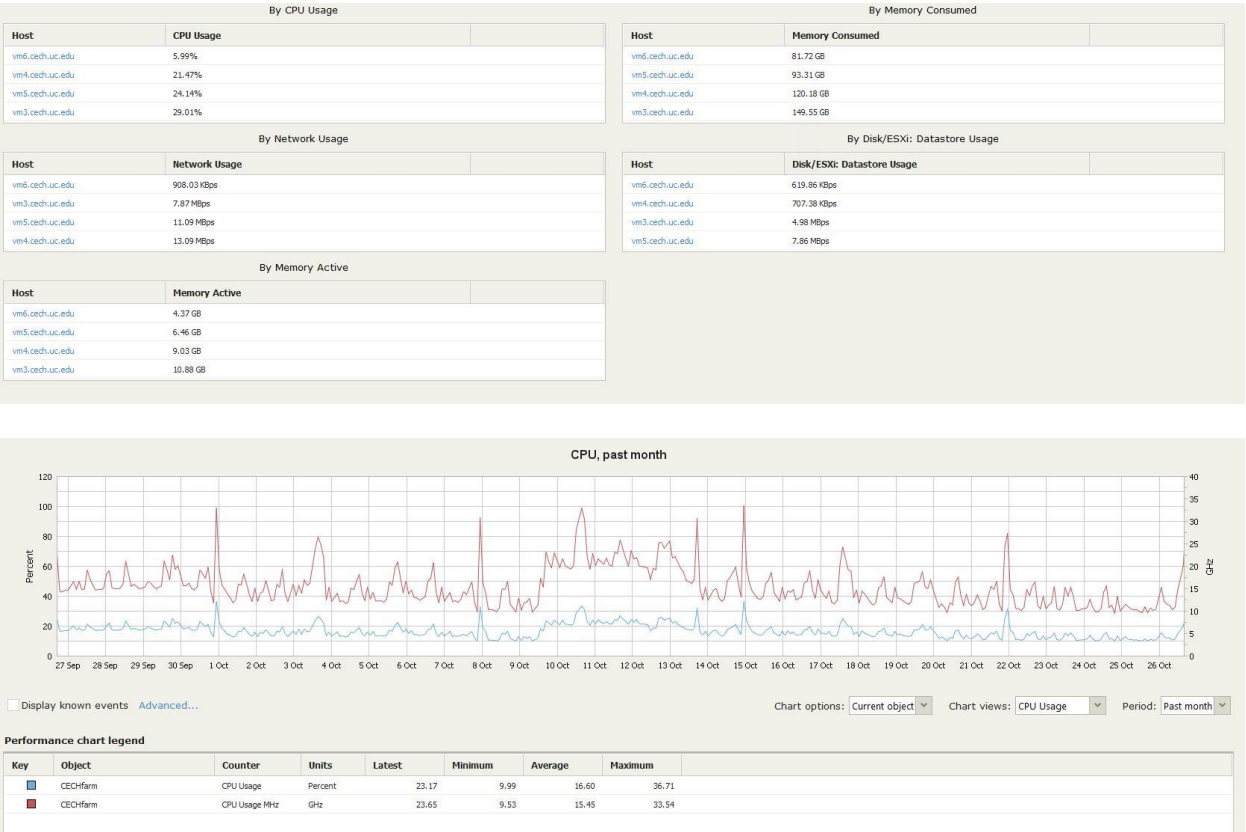



Figure 5, Road Map

This road map includes each major step of the project and then what was done during the major steps.

# Current System Analysis



By CPU Usage

| Host | CPU Usage |
|---|---|
| vm6.cech.uc.edu | 5.99% |
| vm4.cech.uc.edu | 21.47% |
| vm5.cech.uc.edu | 24.14% |
| vm3.cech.uc.edu | 29.01% |

By Memory Consumed

| Host | Memory Consumed |
|---|---|
| vm6.cech.uc.edu | 81.72 GB |
| vm5.cech.uc.edu | 93.31 GB |
| vm4.cech.uc.edu | 120.18 GB |
| vm3.cech.uc.edu | 149.55 GB |

By Network Usage

| Host | Network Usage |
|---|---|
| vm6.cech.uc.edu | 908.03 KBps |
| vm3.cech.uc.edu | 7.87 MBps |
| vm5.cech.uc.edu | 11.09 MBps |
| vm4.cech.uc.edu | 13.09 MBps |

By Disk/ESXi: Datastore Usage

| Host | Disk/ESXi: Datastore Usage |
|---|---|
| vm6.cech.uc.edu | 619.86 KBps |
| vm4.cech.uc.edu | 707.38 KBps |
| vm3.cech.uc.edu | 4.98 MBps |
| vm5.cech.uc.edu | 7.86 MBps |

By Memory Active

| Host | Memory Active |
|---|---|
| vm6.cech.uc.edu | 4.37 GB |
| vm5.cech.uc.edu | 6.46 GB |
| vm4.cech.uc.edu | 9.03 GB |
| vm3.cech.uc.edu | 10.88 GB |




| Key | Object | Counter | Units | Latest | Minimum | Average | Maximum |
|---|---|---|---|---|---|---|---|
| | CECHfarm | CPU Usage | Percent | 23.17 | 9.99 | 16.60 | 36.71 |
| | CECHfarm | CPU Usage MHz | GHz | 23.65 | 9.53 | 15.45 | 33.54 |

Figure 6, Current System Analysis

# Reclaim Resources

**Available Resources**

| Name | Physical CPU (GHz) | Total Cores | Physical Memory (GB) | Allocated Memory (GB) | Local Storage (GB) | Shared Storage (GB) | Number of VMs |
|---|---|---|---|---|---|---|---|
| vm4.cech.uc.edu | 29.99 | 12 | 255.97 | 232.00 | 131.75 | 17,308.25 | 49 |
| vm3.cech.uc.edu | 29.99 | 12 | 255.97 | 197.00 | 131.75 | 17,308.25 | 35 |
| vm6.cech.uc.edu | 17.06 | 8 | 191.99 | 161.00 | 88.25 | 17,308.25 | 39 |
| vm5.cech.uc.edu | 17.06 | 8 | 287.99 | 140.00 | 88.25 | 17,308.25 | 27 |

Figure 7, Reclaim Resources

This shows the different resources available on the original hardware in the virtual environment.

# Future Need

Date-Age Report

College of Education, Criminal Justice, & Human Services, UC

## Report Data

| Date | Total File Size | File Count |
|---|---|---|
| 2013 | 197.34 GB | 55,944 |
| 2014 | 851.74 GB | 231,826 |
| 2015 | 3.09 TB | 954,941 |

Figure 8, Future Need

This chart shows the total file size increasing over the last three years. These numbers were a crucial detail in figuring the expansion of the system through the life of the new hardware.

# Datacenter

While pursuing the idea of a new hardware system, CECH, wanted to explore the possibility of relocating the data center environment. The current datacenter located on the University of Cincinnati west campus has 3 racks of equipment as well as dedicated HVAC, security by alarm and a full temperature alarm system to notify the staff if the room is over 70 degrees. The current datacenter also has a fire suppression system fueled by Inergen which is a heavy gas that will remove oxygen from the air and extinguish the fire without water which could damage the hardware. The next data center and eventual home to the new hardware is the University of Cincinnati Data Center located on the Medical Campus. This data center was selected due to the dedicated power and Ethernet drop as well as security. With the dedicated power CECH is able to use a better blade chassis and provide better growth while staying within a set budget. The dedicated Ethernet allows for a performance upgrade that CECH will welcome over the 1GB

shared network in the previous location. The new data center also has a higher level of security as someone is always there to check in and out visitors while being behind a locked door.

## Benchmark Test

| New System | Capacity Raid 10 in GB | Capcity Raid 6 in GB | Capacity Raid 5 in GB | IOPS Raid 10 | IOPS Raid 6 | IOPS Raid 5 |
|---|---|---|---|---|---|---|
| SSD 480GB 8 Drives (New System) | 1,740 | 2,609 | 3,044 | 53,000 | 22,535 | 31,621 |
| 10K 1.2 TB 40 Drives (New System) | 22,000 | 39,600 | 39,600 | 3,333 | 1,400 | 2,000 |
| 7.2 2.0 TB 12 Drives (New System) | 10,770 | 17,950 | 17,950 | 640 | 274 | 384 |
| | 34,510 | 60,159 | 60,594 | | | |
| Old System | | | | | | |
| 15k 600 GB 34 Drives (Old System) | 9,230 | 16,280 | 16,280 | 4,420 | 1,894 | 2652 |
| 10K 1TB 35 Drives (Old System) | 15,300 | 27,900 | 27,900 | 2,917 | 1,250 | 1,750 |
| | 24,530 | 44,180 | 44,180 | | | |

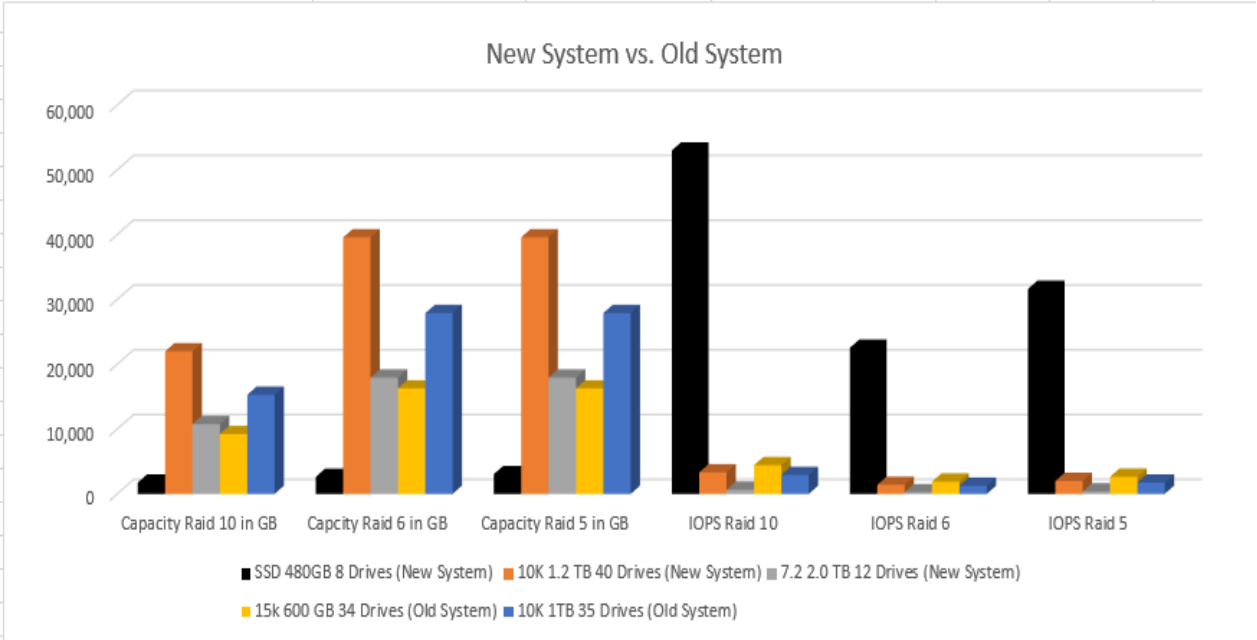



Figure 9, Benchmark Test

This chart is the performance and storage side by side of the new hardware and old hardware. The new system will gain almost 16 terabytes of storage in RAID 5 and RAID 6 configurations form 44 to 60 terabytes. The performance boost will include 1,894 Input/output per second to almost 23,000 Input/output per second on the first tier of storage. This performance boost allows CECH to have multiple boosts in file retrieving and file uploading.

# Conclusion

In conclusion, CECH, decided to pursue a new datacenter hardware plan that allows for expansion as well as a hardware refresh. This plan has allowed CECH to provide users with an up-to-date and more reliable infrastructure system. While the previous system couldn't provide the storage space required for the college the new hardware has provided a substantial increase in space and performance. CECH was able to complete all goals that were set during project planning which included a performance upgrade, storage upgrade and a new up-to-date hardware system.

# References

1 "Blades vs. Rack Servers for Virtualization." SearchServerVirtualization. Accessed October 07, 2015. http://searchservervirtualization.techtarget.com/feature/Blades-vs-rack-servers-for-virtualization.

2 "HPE 3PAR StoreServ Storage Best Practices Guide." Hewlet Packard Enterprise. Accessed November 15, 15. http://www8.hp.com/h20195/v2/GetPDF.aspx/4AA4-4524ENW.pdf.

# CECH Migration Plan

Migration plan for the College of Education, Criminal Justice, & Human Services to perform an Active Directory Migration.

This document will serve has the migration reference for the College of Education, Criminal Justice and Human Services Active Directory Migration.

# Contact List

The Contact list below will be the contact for communication points during the life cycle of the migration.

| | |
|---|---|
| Brian Verkamp | 999-999-9999 |
| Jason Gerst | 999-999-9999 |
| Ryan Moore | 999-999-9999 |
| Ben Overberg | 999-999-9999 |
| Nick Christen | 999-999-9999 |

# Major Tasks

During the life of the data migration CECH will be responsible for these major tasks.

1) Account Migration
2) Access Permissions
    a. Files
    b. Shares
3) Determine Forests and Organizations
4) Switching to the new domain
    a. Disabling source accounts
    b. Logging into new domain
5) Post Migration
    a. Source Account Review

# Possible Challenges

- Size and Complexity- the Size and Complexity can be a challenging because of the amount of data and different forms of data that can corrupt during the migration. The time spent will also be complicated and could cause problems.
- Impact on users- The users of the migration might be impacted due to interruption of productivity.
- Security Concerns- The user data might still be concealed on the old system causing for security concerns.

# Schedule of Migrations

The Schedule of Migrations will be the resource for CECH to determine productivity as well as a gauge for upcoming milestones.

| Migration | Date |
|---|---|
| | |
| | |
| | |
| | |

# Guidelines for Migration

During the migration every set of data or virtual machine will be given a severity level. This severity level will include the level at which if upon failure would impact business functions.

Severity 1: This would include anything where a failure would cause business operations to fail.

Severity 2: This would include anything where a failure would greatly affect business operations but would not stop business operations.

Severity 3: This would include anything where a failure would not affect business operations.

## Planning

This documentation will serve as the planning process for the data migration and guidelines for determining the status of current data.

Pre Migration-

- ☐ Check Current Network Status
- ☐ Check Current Application Status
- ☐ Check Current Network Services

Virtual Machines-

- ☐ Determine unused Virtual Machines
- ☐ Determine Duplicate Virtual Machines
- ☐ Determine Virtual Machines that can be consolidated
- ☐ Determine underused Virtual Machines

Data-

- ☐ Determine total file migrations
- ☐ Determine File location ( Storage Tier)
- ☐ Determine backup cycle

- ☐ Determine Cycle for Data (Retention)
- ☐ Determine Duplicated Files/Folders

# Preparing for Migration

This section will be used to prepare for migration.

## *Preparation Steps*

- ☐ Do not Migrate
- ☐ Rebuild on New System
- ☐ Expand other applications
- ☐ Use other resources

## *Create Goals for Migration*

This is a good opportunity to develop goals that are in scope and goals to determine benchmarks for success.

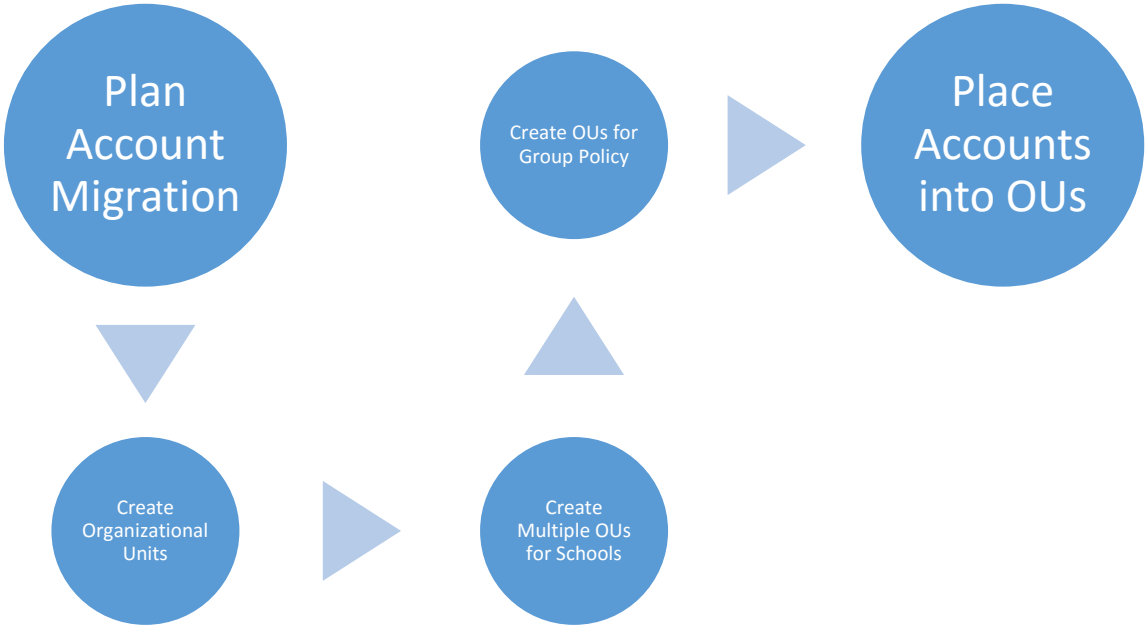
| Goal | Completion Date |
|---|---|
| | |
| | |
| | |
| | |
| | |
| | |
| | |

## *Naming conventions*

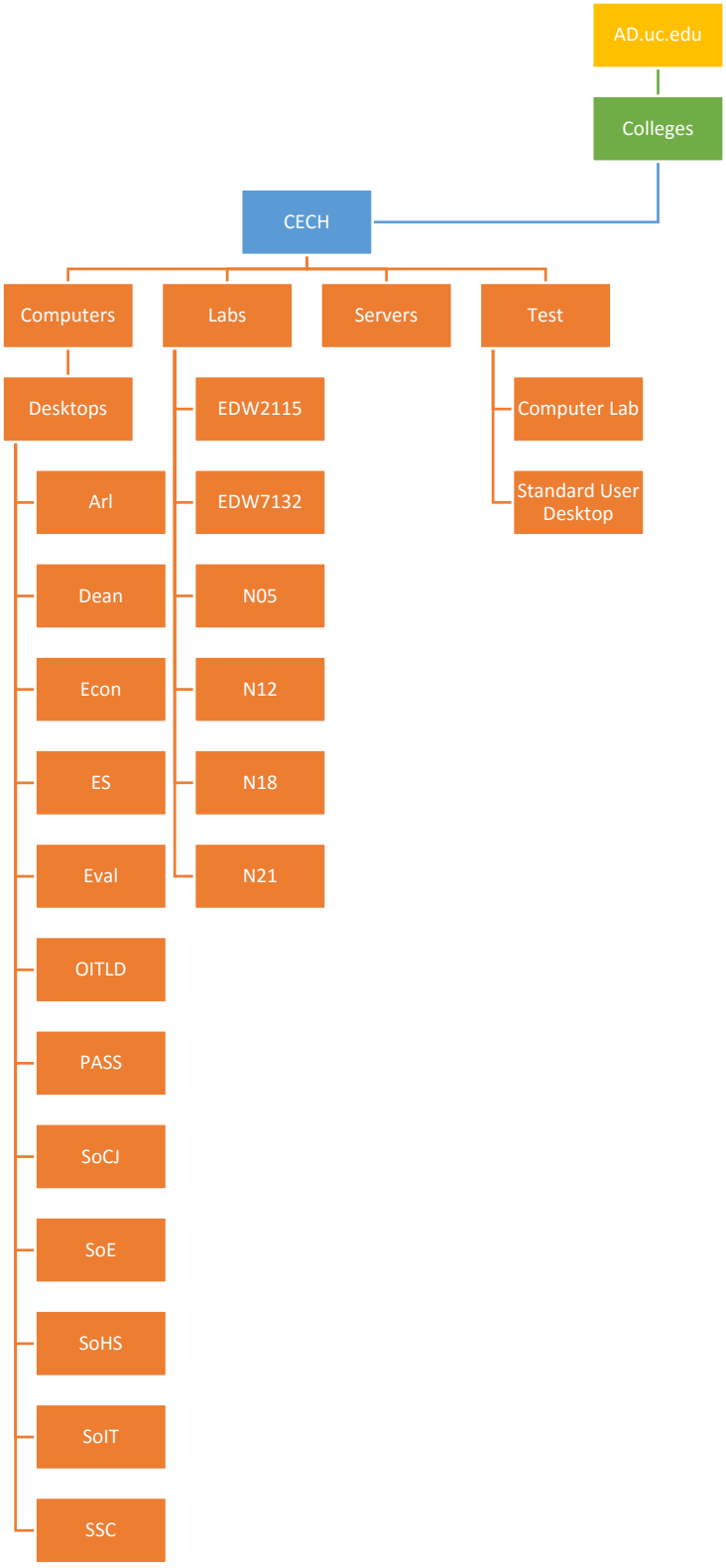
This is the section to determine the naming convention for data and virtual machines that will reside on the new system.

- Capitalize first letter of each word within an element.
- Abbreviate when possible
- Avoid complex structures with multiple levels and repeated levels.
- Avoid spaces and characters (!,@,#,$,%,^,&,*,~,=,+,;)
- Names should be last name followed by first initial

# Migration Process


Plan Account Migration
Create Organizational Units
Create Multiple OUs for Schools
Create OUs for Group Policy
Place Accounts into OUs

# Active Directory Structure



## Server Migration Checklist

| Server Name | OS | Severity Level | Current Directory | Migration Destination | Completed Y/N |
|---|---|---|---|---|---|
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## Best Practices for Account Migration

These are the best practices for Group and User Account Migrations

- Perform regular backups.
- Do migration in sample sizes up to 100 users at a time. This allows for easy management over the migration process.

## Host Name Change during migration