Infrastructure-in-a-Box

By

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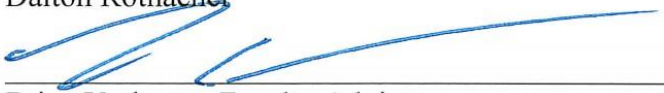
the Degree of Bachelor of Science
in Information Technology

Cody Crockett — Date

Dalton Rothacher — Date



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University of Cincinnati
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Abstract

There are many associative costs to starting a business and an easily overlooked expense is IT infrastructure. Infrastructure-in-a-Box is a solution that can be offered to clients who need extra computational power for projects, or who need to upgrade their current environment without spending a fortune on enterprise-grade equipment. Infrastructure-in-a-Box contains a lot of power in a small and inexpensive package allowing customers' flexibility in use. With the ability to host several servers on one physical machine, Infrastructure-in-a-Box can handle the many needs of a school with a limited budget, small business, and technicians working on one-off projects for clients. As these needs grow, our solution can also be upgraded quickly and efficiently to keep up with modern demands.

Introduction

Infrastructure-in-a-Box is a solution designed to help schools and small business increase infrastructure usability. Aimed at teams of one or, in some circumstances, zero system administrators, Infrastructure-in-a-Box is easy to implement, cost effective, and can be utilized as needed. As demand increases in a growing environment, the budget for expensive equipment may not. Infrastructure-in-a-Box is an all in one solution which can answer the requests of a strained backend infrastructure.

Product Description

Our team is creating an inexpensive, portable, all-in-one solution that can be implemented into an existing network, or deployed for one-off projects. Enterprise level hardware is expensive and bulky; Infrastructure-in-a-Box is able to utilize consumer-grade components, designed in a small form factor, to achieve a product which is both cost effective and able to handle the demand of a small to medium size environment. Infrastructure-in-a-Box is able to lessen the burdens this creates through remote configuration, semi- automated configuration, and easily deployable virtual machines to handle the roles and services that are needed. Through the use of PowerShell, we are able to automate some of the configurations associated with a new service. Our customers will be able to enter their known information into prompts, which will then be used to create the desired service. If the customer requests a one-off project, our equipment can be deployed and execute the desired task with minimal burden on the existing backend.

Problem

In many of Today's technical infrastructures, equipment is reaching End of Life (EOL) and becoming unsupported. For those who are reaching their maximum capacity of usability, this presents a unique problem. IT infrastructure is often times not thought about, which leads to budgets that cannot adequately fund the needed upgrades. Many schools rely on levees to pass, and budgets which limit what can be bought and when. This leaves a need for an inexpensive, readily available product that can support the demands of a growing and underfunded environment.

Solution

Our solution to this problem is something we drastically needed daily. Hours spent in server rooms had us wishing for someone to develop a low cost, high powered, and portable system that could bypass restricting technology. Alas such a solution did not exist, which lead to Infrastructure-In-A-Box. IIAB is a low cost, high powered, and portable server that can be utilized in many different scenarios. IIAB can be carried around with techs and engineers to and from locations, or it can be deployed as a stand-alone server for customers. IIAB was designed with schools and small businesses in mind, with the implementation of IIAB customers will have the performance they need at minimal cost. System admins, engineers, and techs will benefit from the guided setup we have included for Windows Server.

User Profile

Figure 1 describes the types of users who would benefit from implementing our solution.

Figure 1: User Profile

User Profile Form
Project: Infrastructure-in-a-Box
Potential Users: ● System/Network Administrators ● Technicians ● Small to medium sized companies ● Schools with smaller IT staff/budgets
Software and Interface Experience: The project will utilize the following: ● vSphere client for administration of virtual machines on ESXi ● Active Directory, DHCP, DNS, SCCM, SQL management consoles ● PowerShell ISE for scripting ● PuTTY for interfacing with the manageable switch Familiarity with the aforementioned is great; however, we will also be setting up remote access for additional configuration and support as needed. This allows for a much smaller, if any, in-house IT staff.
Experience with Similar Applications: Average business owners and non-technical individuals are most likely not going to have experience in the software and management consoles required to configure and stand up additional roles/virtual machines. We will make integration with existing environments as easy as possible with user prompted scripts and automated configuration. Remote configuration will be available for additional features and future support.
Task Experience: ● Users will be able to carry our solution to specific locations for imaging projects ● Users will be able to easily integrate our solution into new or existing infrastructures

- Users will be able to create and destroy virtual machines as needed

Frequency of Use:

This solution will have the flexibility to used once for a project-type scenario, or be stood up as a standalone/additional backend server for the long term. Spatially, the project will only be about the size of a shoebox upon completion and there is no need for the client to need a server room full of racks for equipment.

Key Interface Design Requirements that the Profile Suggests:

System/Network Administrator will use vSphere to administer virtual machines and remote desktop for accessing and configuring the servers. The manageable switch will have telnet configured, so administrators can access the switch through console or telnet.

Objectives/Deliverables

Research Equipment/Parts List for Build

Buy Equipment

Assemble Server

Install/ Configure Software

ESXI

Install/IP Configuration for box and management interface

VSphere administration

AD Server

A few users and security groups

DNS and DHCP Roles

SCCM

Driver repository for generic drivers

Differing task sequences for different image deployments (i.e. Students, Employees, and Administrators)

Software catalog

SQL Server

Dedicated database for SCCM

Remote access

Possible VPN/RDP Server

Automation

Possible automation of configuring server roles

Possible automated integration into current infrastructure

Begin Testing

Successfully Deploy Image

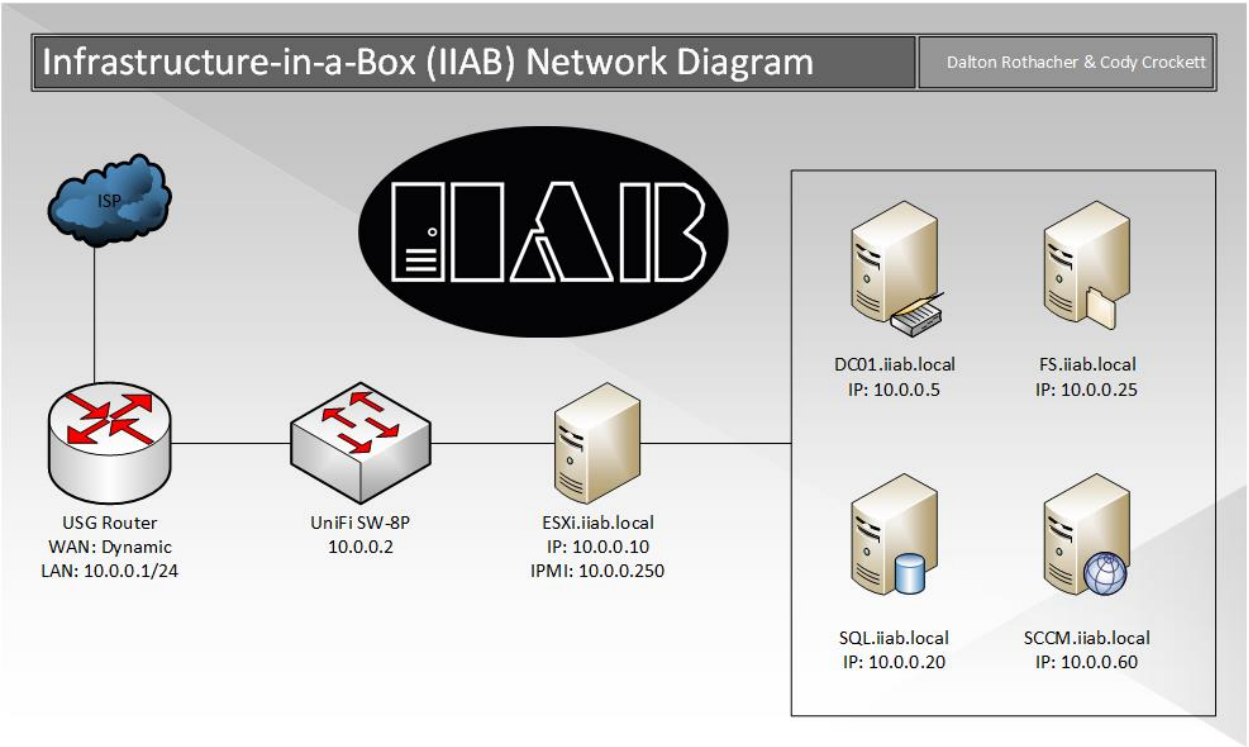
Successfully Remote into Box

Testing

Using VMware Workstation 12, a virtual Windows 2012R2 server was created to test the PowerShell scripts and other options responsible for the configuration of our services. Thus far, we have successfully automated Active Directory, DNS, and DHCP role installation. PowerShell scripts were also created to configure an Active Directory forest and promote the machine to a domain controller. Through the manipulation of CSV files and PowerShell, we've automated the configuration and importation of our DHCP scopes and some Active Directory users as well. To date, we have been able to successfully test some of our services individually, however, due to delays in receiving hardware, we are unable to test all the services or implement VLANs and

other inter-networking between the services. Figure 2 shows how these servers and services are interconnected.

Figure 2: Network Diagram



Overview

This section will explain the testing methodology for Infrastructure-In-A-Box and should be used as a guide. The following individuals should use this section:

- Administrators
- Field Techs
- Project Managers

Scope

The scope of this test is to ensure the functionality of Infrastructure-in-a-Box in a practical environment. The test will be organized based on the typical demands from small to medium-sized business customers, and educational institutes of similar size.

Objective

The objective of testing is to verify the box is performing all required services for a successful deployment of an image across the network to various different devices. These tests are designed to test the speed of deployment and the reliability of a consistent outcome.

Entry and Exit Criteria

Entry Criteria:

- Server is built
- Necessary services are installed
- Images and Task Sequences are created
- Backups are setup
- Environment is stable

Exit Criteria:

- Image was successfully deployed
- Backups successfully tested
- Issues incurred were documented and resolved
- Server resources are divided appropriately and server is running stable

Logging Test and Reporting

If an error occurs, it will be documented and rectified. Administrators will meet after testing to determine best course of action based on the test results.

System Testing

Infrastructure-In-A-Box will be tested by utilizing individual services first, then tested as a complete solution. Testing each service first will help eliminate potential problems when the complete solution is tested. Once solution is verified as functioning properly, stress tests will be conducted.

Testing Procedures

Testing will consist of the following:

- Create physical/ virtual environment
- Necessary documents detailing process and findings
- Error report specifying issue and resolution

The Following tests will be performed:

- Service Stability- Tests that individual services are stable on their own
- Solution Stability- Tests the stability of entire solution
- Image Deployment- Tests that an image can be successfully deployed across network
- Service Creation- Tests the speed in which a requested service can be created and deployed
- Backup/Disaster Recovery – Test the validity of the backups and how fast systems can be recovered

- Maximum Stress- Tests the maximum number of requests the server can handle with reasonable response time.

Pass/ Fail Conditions

IIAB is expected to pass every test with reasonable results to be successful. If a test fails, the issues will be documented and team members will address the issues accordingly.

Schedule of Team Member Testing

Figure 3 below is the expected testing schedule of team members.

Figure 3: Team Member Testing

Team Member	Timeline to be Completed	Frequency
Dalton Rothacher	3/2/2017 to 4/10/2017	Weekly
Cody Crockett	3/2/2017 to 4/10/2017	Weekly

Testing Results

Figure 4 shows the results of the tests that were ran to verify the stability of IIAB.

Figure 4: Testing Results

Testing Results		
Team Member	**Test**	**Pass/Fail**
Dalton Rothacher	Image Deployment	Pass
Cody Crockett	Network Throughput speeds	Pass
Cody Crockett	Datastore upload/download	Pass
Dalton Rothacher	Backups	Pass
Dalton Rothacher	Services (SCCM/AD/Policies/etc.)	Pass

Risks

The Following will impact the test cycle:

- Number of devices available
- Delay in error rectification
- New feature configuration

Budget

Figure 3 shows the project budget. The hardware for the project totals $1,773.89. Labor costs are not included in the below figure because this was done as our senior design project for the quest of knowledge. Our labor costs totaled zero dollars; however, we estimate it would take a team of two engineers about 60 hours to complete the same amount of work. At a rate of $75 per hour, this would total roughly $9,000 in labor costs on top of hardware costs.

Figure 5: Budget

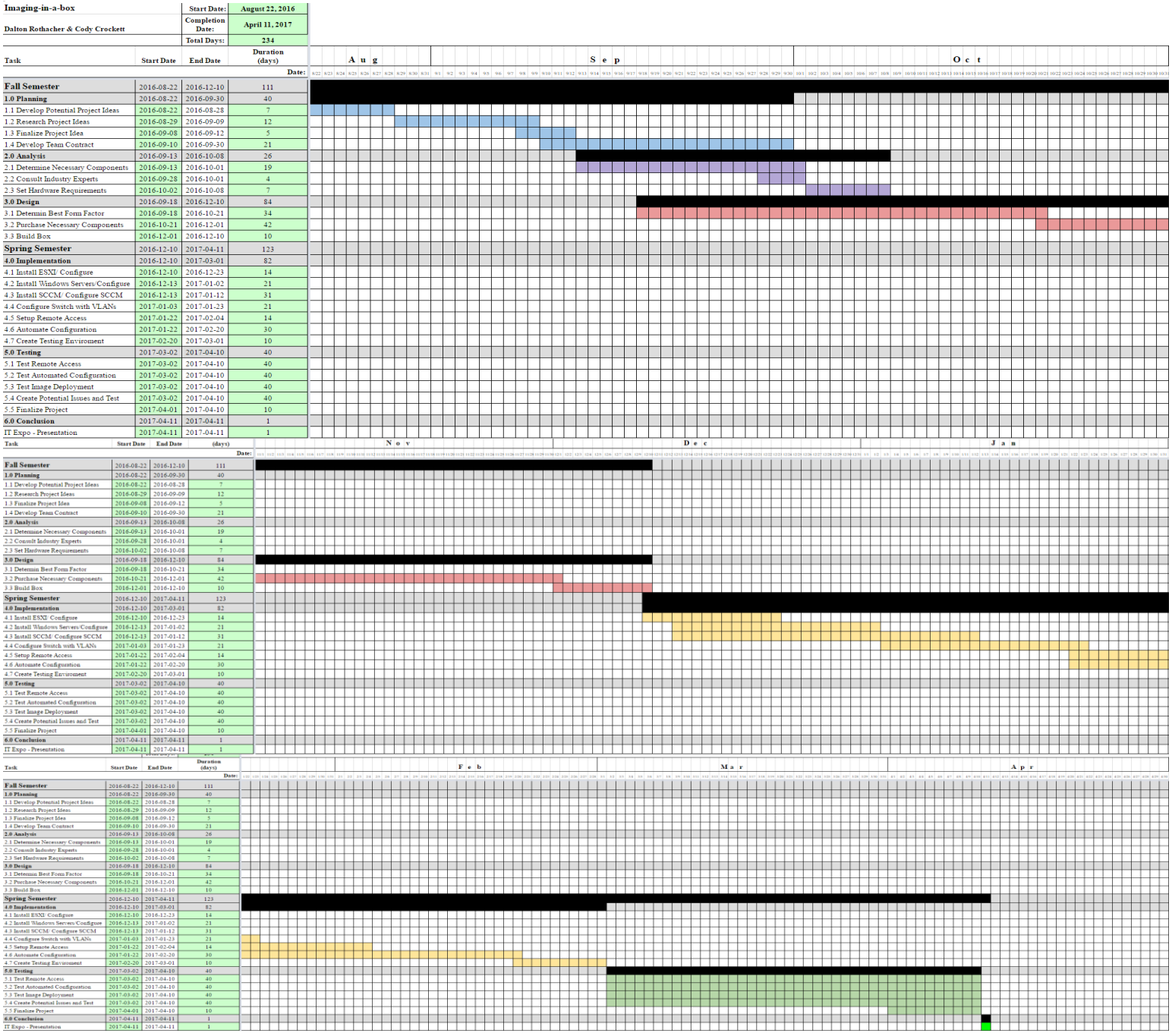
Server			
Parts	**Qty**	**Unit Price**	**Total Price**
Processor	1	$307.99	$307.99
Motherboard	1	$269.99	$269.99
Memory	4	$93.99	$375.99
Storage	4	$79.99	$319.96
Power Supply	1	$89.99	$89.99
Case	1	$69.99	$69.99
RAID Card	1	$59.99	$59.99

Switch			
Item	**Qty**	**Unit Price**	**Total Price**
Layer 2 Managable Switch	1	$279.99	$279.99
		Total	$1,773.89

Gantt Chart

Figure 4 outlines the schedule we have set for our deliverables and goals. Following this schedule means we will have out project built just after December and have most of the spring semester to test and configure our solution as we see fit.

Figure 6: Gantt Chart



Imaging-in-a-box		Start Date:	August 22, 2016
Dalton Rothacher & Cody Crockett		Completion Date:	April 11, 2017
		Total Days:	234

Task	Start Date	End Date	Duration (days)
Fall Semester	2016-08-22	2016-12-10	111
1.0 Planning	2016-08-22	2016-09-30	40
1.1 Develop Potential Project Ideas	2016-08-22	2016-08-28	7
1.2 Research Project Ideas	2016-08-29	2016-09-09	12
1.3 Finalize Project Idea	2016-09-08	2016-09-12	5
1.4 Develop Team Contract	2016-09-10	2016-09-30	21
2.0 Analysis	2016-09-13	2016-10-08	26
2.1 Determine Necessary Components	2016-09-13	2016-10-01	19
2.2 Consult Industry Experts	2016-09-28	2016-10-01	4
2.3 Set Hardware Requirements	2016-10-02	2016-10-08	7
3.0 Design	2016-09-18	2016-12-10	84
3.1 Determin Best Form Factor	2016-09-18	2016-10-21	34
3.2 Purchase Necessary Components	2016-10-21	2016-12-01	42
3.3 Build Box	2016-12-01	2016-12-10	10
Spring Semester	2016-12-10	2017-04-11	123
4.0 Implementation	2016-12-10	2017-03-01	82
4.1 Install ESXI/ Configure	2016-12-10	2016-12-23	14
4.2 Install Windows Servers/Configure	2016-12-13	2017-01-02	21
4.3 Install SCCM/ Configure SCCM	2016-12-13	2017-01-12	31
4.4 Configure Switch with VLANs	2017-01-03	2017-01-23	21
4.5 Setup Remote Access	2017-01-22	2017-02-04	14
4.6 Automate Configuration	2017-01-22	2017-02-20	30
4.7 Create Testing Enviroment	2017-02-20	2017-03-01	10
5.0 Testing	2017-03-02	2017-04-10	40
5.1 Test Remote Access	2017-03-02	2017-04-10	40
5.2 Test Automated Configuration	2017-03-02	2017-04-10	40
5.3 Test Image Deployment	2017-03-02	2017-04-10	40
5.4 Create Potential Issues and Test	2017-03-02	2017-04-10	40
5.5 Finalize Project	2017-04-01	2017-04-10	10
6.0 Conclusion	2017-04-11	2017-04-11	1
IT Expo - Presentation	2017-04-11	2017-04-11	1

Problems Encountered

During this Process we ran into several issues. First, some of our hardware was on backorder, which in turn put us behind schedule initially. Once we had all of the necessary components we then discovered several items came DOA, again pushing us further behind. However over winter break all of our parts came in which gave us unscheduled time to finish our build and begin testing on schedule.

Future Recommendations

If we did this project in the future, we would not change much. Our product was designed to be versatile, and by its nature we can adjust what we need to on the fly. Knowing what the customer wants will change more of the design and approach than the issues we have faced. If we had an unlimited amount of time, it would be nice to design a 3D printed case which contains the server hardware as well as the switch. We would also like to see hot swappable drives implemented to reduce downtime.

Conclusion

Not having the correct equipment in place on any network can be infuriating. Many schools and small businesses do not have the budget to purchase expensive equipment frequently. Infrastructure-in-a-Box was designed to be versatile and approachable.

Through this process, we are learning more about planning and budgeting than we originally thought. Trying to create a product that is competitive in performance while staying budget friendly was a challenge. We also ran into product failures along the way. This ended up costing us more than we budgeted for, but was thought to be a one off incident which should not affect budgeting in the future. Overcoming these obstacles helped us build our troubleshooting skills which is a must in the IT world, in addition, we were able to polish our system administration skills and networking skills. The tools we used in this project are utilized in many different environments and being able to understand their functionality in such depth will help us succeed. Overall, we are confident that our project will represent the knowledge we have gained during our time in the program and provide a viable solution we can implement into a real world scenario. It was important to create a final product we will be able to use in the future, and Infrastructure-in-a-Box is just that.

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Appendix

Figure A1: Network Diagram 1

University of CINCINNATI

IIAB

Cody Crockett & Dalton Rothacher

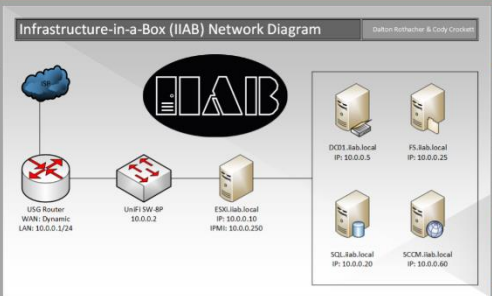
College of Education, Criminal Justice, & Human Services – School of Information Technology Technical Advisor – Brian Verkamp

Abstract

There are many associative costs to starting a business and one that is easily overlooked is IT infrastructure. Infrastructure-in-a-Box (IIAB) is a solution that can be offered to clients who need extra computational power for projects, who need to upgrade their current environment without spending a fortune on enterprise-grade equipment, or who need a stand-alone base to start their environment. IIAB contains a large amount of power in a small form factor, can scale with the company, and be upgraded quickly.

Problem / Solution

- **Problem:** Many networks are becoming outdated and upgrades can be costly/difficult.
- **Solution:** Provide an inexpensive and easy solution that is able to stand up to modern demand.



Implementation

IIAB incorporates the ability to have multiple services that allow us to provide flexible configuration for user needs.

- **ESXI**- Hypervisor which allows us to host our virtual servers
- **Windows Server-** Platform for services: Active Directory, DNS, DHCP, SQL, WSUS, SCCM, File Shares, and a UniFi Controller
- **Gigabit Switch**- A UniFi switch provides 1Gb/s throughput for optimum data transfer
- **Assisted Configuration-** PowerShell scripts provide an assisted standup for users

Technical Elements

vmware, Windows, intel inside Xeon, Microsoft System Center 2012, UBIQUITI NETWORKS, Microsoft SQL Server

Conclusion

Technology grows at an incredible rate. Current solutions are costly to implement for growing business and schools. Due to the unique configuration of IIAB, we are able to provide a cost effective solution to modern demands.

Acknowledgements

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- Brian Verkamp
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