#1302

NDSU Technology Action Plan Request

I. Action Plan Introduction and Authorizations

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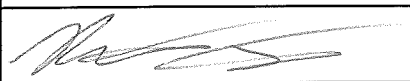
MAR 28 2013
Office of the Vice President for Information Technology

NDSU ORGANIZATION OR UNIT Computer Science and Operations Research		
TITLE OF PROJECT Expansion of Departmental OpenStack Infrastructure		
Project Duration (3 years maximum)	From: June 3, 2013	To: Dec 31, 2013
Type of Project (Check one)	New	
Total Technology Fee Request: At least Two Dell R710 Servers		
Project Director (Must be NDSU faculty or staff) Robert Foertsch	Campus Address: Department of Computer Science NDSU Dept. 2740 P.O. Box 6050 Phone: 701.231.7786 Fax: 701.231.8255 E-mail: robefoer@cs.ndsu.edu	

Name (Type or Print)	Signature	Date
Project Director Robert Foertsch		3/28/2013
Unit Head Kenneth Magel		3/28/13
IT Division Consultant Nathan Olson	Signature Nathan Olson	Date 03-28-2013

Executive Summary (maximum of 175 words)

Infrastructure as a service (IaaS) is a rapidly expanding field in enterprise cloud computing. NDSU's Computer Science department has an interest in enhancing our own knowledge and offering in IaaS by focusing on one project: OpenStack. Beginning as a collaborative project with IBM in the spring of 2012, a student group in CSCI 445 (Software Projects Capstone) created a small OpenStack deployment; first as a proof of concept, and then deployed it within the department's infrastructure on servers purchased by Dr. Do and Dr. Nygard.

This semester, another group in CSCI 445 is continuing the collaboration with IBM. However, limited resources hamper the project. Aside from prototyping, not much testing can occur on surplus hardware; the present OpenStack installation needs to be stable and available for researchers.

OpenStack keeps growing. With two versions released every year, hardware is needed for testing before deploying it fully within the department. Our own experiences with cloud platforms help build institutional knowledge which can be shared between departments, making Computer Science the best champion for such a project.

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II. Project Overview

1. How does this project meet student needs?

Students would have access to a resource that does not yet exist on this campus: OpenStack. OpenStack has the potential to serve students in many roles.

Students in CSCI 277 and MIS 460 would gain system administration skills that cannot be easily taught without individual virtual machines for each student.

Students in other disciplines often need specialized environments to complete course projects and seminar work. Imagine a physics student who is running a complex simulation, or a design student who is working with animation modeling software, or a biology student working with protein folding experiments. These cases often require specialized software; there is no guarantee that the required software is available on present campus resources. These cases also entail experiments that may run for extended periods of time, such things are impossible to run on a personal laptop. Thus the student must forgo such projects, as students do not have the resources to build their own cluster. An OpenStack cluster on campus gives the flexibility of custom environments to meet the needs of these students, while still allowing for central management by a team of administrators.

Students need OpenStack. NDSU needs OpenStack. It offers many possibilities with regards to research and experience in STEM related disciplines. NDSU needs a department to lead the charge with OpenStack, and that's exactly what we propose to do. As a Computer Science department, this is our area of expertise. We want to show the campus how to build a successful OpenStack cluster here at NDSU.

2. What audience does this project directly serve? What audience is indirectly served? How many students are affected?

This project directly serves any student who was unable to pursue an area of research or a class project because it was incompatible with the current offerings by abacus.nodak.edu or CCAST. OpenStack offers flexibility; these students could spawn their own virtual machines and configure them as required by their projects. This empowers the students to complete projects that were untenable before.

The information we gain and the documentation we create would best serve other departments or colleges that have an interest in server infrastructure and cloud platforms. In particular, the College of Engineering and Architecture, Mathematics, and Physics could find our project useful, as these entities do rely on servers for research and class projects. These departments could deploy their own OpenStack environment and make it available to their students and faculty.

Should ECI or CCAST create IaaS programs, they could benefit, also. OpenStack could be used for either internal projects in ECI and CCAST, or IaaS could be offered to students and researchers across campus.

3. For projects that target a subset of NDSU's students, please describe the possibility for broader application in the future.

The broader application of our project revolves around another NDSU entity who provides such services to take what we've learned with regards to OpenStack at NDSU, and building their own OpenStack infrastructure for others to use (whether it is for research or academic work). Our documentation would give them a head start. This service could then be provided through CCAST or ITS.

4. Describe both the immediate and long term impact of this project.

The immediate impact is this: Computer Science would have the hardware required to keep one stable, ready to use OpenStack deployment available for research and academic use internal to our department. We would also have a second set of hardware to be used for experimentation and testing of new OpenStack releases (OpenStack is rapidly evolving, and has about two releases a year) without breaking the stable deployment.

The long term impact is an increase in institutional knowledge. Should another department interested in IaaS give me a phone call and ask about our setup, I can point them to the departmental wiki (wiki.cs.ndsu.nodak.edu) or other forms of our internal documentation to show them how OpenStack is implemented on our campus. Without having the requested servers in this project, we would still obviously have some information available to other departments; however, it would be incomplete as we do not have a good, standard platform to test such deployments ourselves.

5. Who will pay for ongoing expenses following the technology fee funded portion of this project (e.g., who will replace hardware or software after it has reached its end of life)?

The Computer Science department (with the possibility of faculty researchers) would help support this platform. These faculty members have provided all of the funding for the current departmental OpenStack deployment, and have promised to continue supporting OpenStack in the future. These requested servers would certainly support our needs well beyond the immediate needs of the project (implementing OpenStack Grizzly). It is difficult to predict the state of cloud infrastructure at NDSU in three years; the platform could be readily adopted such that an additional testing platform isn't needed when the hardware reaches the end of life.

6. Describe how this project will follow NDSU's best practices in information technology. (Please make sure the NDSU IT Division staff you consulted signs in Part I of this form.)

NDSU Computer science already has an OpenStack infrastructure, with no objections from ITS. As with our other virtualization technologies, we have infrastructure built to support user authentication within the whole department. The department also maintains one remote logging server, of which only departmental administrators have access. Available updates (both security and non-security updates) are reported through Nagios.

7. What service on campus is most similar to the one proposed here? How does this project differ?

The services on campus most similar to OpenStack are the hosting services provided by ITS, along with the distributed computing infrastructure provided by CCAST.

ITS presently provides server hosting for various entities across campus. OpenStack has the potential of decreasing administrative costs of these services.

CCAST provides a platform for distributed computing, yet the one drawback is that a researcher's application must be suitable to run on CCAST's platform. This is a severe restriction, as some faculty may require certain applications that conflict with CCAST's offerings, and thus cannot be run on their distributed cluster. OpenStack would give a researcher full administrative access to their virtual machines, which then run on top of the hardware cluster. This would provide faculty with the exact environment required for their research, without conflicting with other users on the OpenStack system.

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III. Project Description (5 pages maximum)

Infrastructure as a service (IaaS) is a rapidly expanding field in enterprise cloud computing [1] [2] [3]. NDSU's Computer Science department has an interest in enhancing our own knowledge in offering IaaS by focusing on one product: OpenStack.

Our request of servers would allow us to maintain a stable, production ready deployment of OpenStack within our department (which we already possess). In addition to the stable environment, we would also have the necessary hardware to test new versions of OpenStack (a new version is released every six months). The requested hardware would allow us to build this testing environment. It would also allow us to conduct experiments on the best way to deploy OpenStack, testing out different networking or storage arrangements on a fully fledged platform. This information can then be used to enhance our stable OpenStack deployment, along with adding to our institutional knowledge and experience with OpenStack.

At the completion of this project, we should have complete documentation on how to build a multi-node OpenStack cluster. This documentation would be available for other departmental uses.

Declaration of Objectives

The objective of this project is really quite simple: we wish to add to the institutional knowledge of OpenStack here at NDSU. An IaaS cloud infrastructure is not the type of thing to be built in a week or a month. Such an environment requires a strong background in systems administration and design, along with other pillars of enterprise computing (best practices in security, storage, network optimization, etc.). Of all the academic departments on campus, Computer Science is the best fit to pursue such projects; to dive into the abyss, head first, heels up as it were. Not only is cloud infrastructure a large interest of both the faculty and students within the department, we also have years of experience with cloud infrastructure topics; this knowledge is still rapidly expanding.

Thus, at the end of the project we hope to have created extensive documentation on how to get a multi-node OpenStack cluster up and operational here at NDSU. It will cover many of the pitfalls and intricacies of NDSU's specific IT infrastructure (for example, networking at NDSU is atypical of most enterprise environments). This documentation will be available to all either on our department Wiki, or in the form of an internal white-paper.

With that being said, Computer Science has no interest in being a service provider on campus. Should a department have a use for our internally hosted cloud infrastructure, such requests may or may not be accepted on a case-by-case basis (and in the past, we have provided virtualization resources to other departments). Yet, it is not our area of expertise, and we do not have the funding or resources to support all of campus's needs in cloud computing. Again, the requested servers would help us to build knowledge on the subject; that knowledge is then available for other departments to use.

OpenStack 101

What is OpenStack? As stated by the OpenStack developers: "OpenStack is a cloud operating system that controls large pools of compute, storage, and networking resources throughout a datacenter, all managed through a dashboard that gives administrators control while empowering their users to provision resources through a web interface" [4].

We wish to emphasize the point "empowering their users." The biggest advantage of OpenStack compared to other cloud or virtualization platforms is that users have more control over their own piece of the infrastructure, in terms of CPU time, storage, memory, and other key attributes.

This differs greatly from the VMware model. In VMware, a central team of administrators manage the virtual machines. We create the images, allocate drive space and memory, and will often install the operating system. After these tasks are done, we alert the users and let them know that his/her virtual machine is available for use. This is problematic; the bottleneck becomes the team of administrators who needs to intercede on the behalf of every single user who wants a virtual machine.

OpenStack follows the Amazon Web Services model; in particular we can look to Amazon's Elastic Cloud Computing (EC2) and Amazon's Simple Storage Service (S3). With EC2, the user logs into a web interface, and they readily have full control of their virtual machines. They can create, destroy or clone VMs without contacting an administrator. They

can also add more storage to their images, and so on. All of this occurs without contacting an administrator. With S3, users can manage their own levels of persistent storage as needed within the scope of their project.

OpenStack creates all of the flexibility of Amazon's EC2 and S3 offerings, and has all the privacy and security advantages of hosting it within a private cloud infrastructure. User allocations are managed through quotas, to prevent any individual user from 'hogging' all of the resources.

OpenStack also works to maintain compatibility with the Amazon EC2 and S3 API. This means an application can be prototyped within OpenStack, and then later ported to Amazon's infrastructure with minimal effort. Should a large data-mining or simulation project require hundreds of nodes, it could be tested on OpenStack and later deployed to the Amazon EC2 cloud once it grows beyond the abilities of the local infrastructure.

In addition, OpenStack is offered under an Apache 2.0 license [5]. Without going too deep into the particulars of this license, OpenStack is an open source project, free to use (and contribute to) for all environments, whether it's being used for commercial, educational, or academic purposes. This protects entities from the ever-dreaded "vendor lock-in" and helps keep costs low. Free to use also means that departments and other entities can dive into OpenStack to try it out without worrying about sunk costs.

OpenStack has a remarkable amount of industry support. Originally OpenStack was a collaborative project between Rackspace and NASA [6]. OpenStack now has support from IBM, Red Hat, AT&T, and even VMware [7].

OpenStack , NDSU Computer Science, and IBM

NDSU Computer Science's first involvement with OpenStack was in the spring of 2012. CSCI 445 (Software Projects Capstone) will often feature collaborative projects between a group of students and companies from industry. In spring 2012, a group was tasked with an initial deployment of OpenStack within the department. Within the span of a semester, this group of students was able to set up a prototype OpenStack install running as virtual machines in the departmental VMware system, followed by deploying OpenStack on some spare machines, and then finally on hardware Dr. Do and Dr. Nygard (both of Computer Science) purchased for different grants.

Needless to say, IBM was impressed, and three of those four students are now working full time for IBM. IBM has also continued this partnership with CSCI 445, and is sponsoring another team of students to continue work with OpenStack this current semester.

Departmental Issues

The department has faced one issue again and again: we do not have sufficient hardware to test and experiment with a standard OpenStack deployment. This is a common lament by Logan Paschke, a senior in Computer Science who is presently funded by Dr. Do to continue support of the departmental OpenStack infrastructure, and by the present team of Computer Science seniors who are collaborating with IBM in CSCI 445 this semester.

You may be thinking: "The department has an OpenStack infrastructure already! Why can't you use this to test and deploy future versions of OpenStack?" Simple: This resource needs to be available and stable for faculty and graduate students to actually use OpenStack. Using that platform to test new versions of OpenStack along with different configurations for storage and networking increases the risk that the platform is unavailable for these same faculty and graduate students. Unavailable resources results in missed deadlines for papers and grants, which is completely unacceptable.

Yet you may say: "Why can't you test OpenStack in your present VMware system?" Or "Why can't the department use old hardware they have laying around?" Good questions! Testing OpenStack inside VMware creates two problems. First: modern processors offer a specific instruction set to boost virtualization. This instruction set is not available from within a virtual machine, so running virtual machines within other virtual machines greatly hampers performance. This makes many of OpenStack's new features impossible to test in this "nested" virtual machine environment. The other problem is that the networking setup for VMware is configured specifically for VMware. Forcing OpenStack within VMware binds OpenStack to networking requirements that wouldn't be found in a standalone enterprise environment. These two cloud platforms should be built separately. As for old departmental hardware, you simply cannot run many virtual machines on yesterday's hardware. Thus to test aspects of OpenStack, like live virtual machine migration, you need an infrastructure set up to run these experiments on *as if it were a live environment,* with production ready hardware.

If the department possessed the two additional servers requested, we would have that testing environment in which new versions of OpenStack can be installed and tested. We could then look at different configurations and create a set of best practices for OpenStack cloud deployment here at NDSU.

With OpenStack, the most basic multi-node setup requires two servers to act as the virtualization hosts, and one additional server to act as the head node of the cluster (often called the cloud controller). The two servers requested in this proposal would serve the role of the two virtualization hosts. The virtualization hosts are where the virtual machines exist and execute, thus generally need higher performing servers. The cloud controller simply keeps track of the state of the system, along with hosting the dashboard. This does not require much in terms of resources. An older workstation or server in the department can satisfy this role.

Departmental Commitment

The department has proven their commitment to new cloud infrastructure technologies. With the department's initial commitment to VMware in 2010, we now run over 100 virtual machines on our four VMware compute hosts (three presently owned by the department, and one purchased through a grant by Dr. Denton). The uses of these virtual machines differ greatly; some are used as virtual desktops for students and teaching assistants, others as a build environment for unit testing, some project servers for various Capstone projects, or other infrastructure needs, such as network gateways, database servers, etc. Few of these resources would be available without virtualization technologies.

The department has also shown a strong commitment to the future of OpenStack. Dr. Nygard and Dr. Do have both purchased servers to contribute to the OpenStack cloud through completely different grants. Dr. Do is also presently funding Logan Paschke as an undergraduate student technician to keep OpenStack stable and available for use (Supporting Documentation 3a). Dr. Denton has provided some initial funding in the fall of 2012 for Logan's wages (Supporting Documentation 3b), and has also provided funds for solid state drives to be used for local instance storage Supporting Documentation 4). The departmental course fee committee has also provided funds for three four-terabyte hard disk drives to be used for slow storage (Supporting Documentation 5), along with a small memory upgrade (Supporting Documentation 6) to a compute host used by the Capstone group this semester.

And of course, CSCI 445 (and the department as a whole) is committed to continue building our relationship with the industry giant IBM, too. Such industry/university relations have great benefits for both parties involved.

Yet with these upgrades and commitments from the past year, none of these faculty researchers have the available funds to purchase fully fledged server hardware for OpenStack testing purposes.

Project Objectives in Detail

Should this proposal be accepted, the department will begin building a two-node OpenStack cluster. The two servers requested will be used as the two compute nodes, while an additional machine we have available in the department will serve as the cloud controller.

The department will target the OpenStack release version "Grizzly," which is set to be released sometime in April of 2013 [8]. This will give us the end of the Academic year and the summer months to implement Grizzly in this two-node cluster.

OpenStack is modular, not every component needs to be implemented to have an OpenStack cluster. However, there are a few key components that we wish to have running and tested. The following are the components that we would test, as they seem to be the most appealing to our current lines of work in Computer Science:

- Compute Services (Nova): Nova is the component that takes care of the virtualization itself, thus OpenStack would be nothing without it. In particular, we will target Nova with Kernel-based Virtual Machine (KVM) as the underlining virtualization technology.
- Object Storage (Swift): Swift is modeled very closely to the Amazon S3. It is a service that stores and retrieves data, yet abstracts away the concepts of a file or file system. Swift is advantageous as it can take care of replication and load-balancing of the storage side of OpenStack.
- Block Storage (Cinder): Cinder is modeled after Amazon's Elastic Block Storage (EBS). This allows users to create file systems (stored in volumes) should Swift not satisfy the storage requirements of the particular project.
- Networking (Quantum): Quantum takes care of the allocation and usage of IP addresses. Quantum can be used in such a way as to partition network traffic: one user of OpenStack is unable to see the network traffic of another user in OpenStack, which is good for security reasons. We plan on building OpenStack on a private network (thus it won't conflict with the limited number of IPv4 addresses on the NDSU network). One optional objective is

building our OpenStack cluster using IPv6. We are currently looking into this option, but have not yet determined if this can or cannot be completed.

- Dashboard (Horizon): This is the web interface for OpenStack, similar to the Amazon Web Services console. This allows users to manage their own virtual machines.
- Machine Imaging Service (Glance): Glance allows users to create and clone virtual machine images. If a researcher was building a small MPI (Message Passing Interface) cluster, they could create and configure one node of the cluster, and then clone that virtual machine for as many nodes as they need. The department could also create standard virtual machine images for use by researchers that contained all the remote system logging and authentication configuration files in place. Users could then clone this base machine, thus not requiring an administrator to set up each machine while still meeting the security requirements of the department.
- Identity Service (Keystone): Keystone gives administrators the ability to specify which user has access to certain resources, along with creating user groups and other management tasks.

The following are new features in Grizzly, of which we have no experience with yet. We include them as potential objectives; yet since Grizzly is not released, we cannot comment on how mature they will be at the release date.

- Cloud Orchestration (Heat): The goal of Heat is to provide a way for users to easily manage configuration of their virtual machines. Imagine if I had 20 virtual machines for an experiment. Should I wish to change a configuration on these machines without OpenStack Heat, I'd have to connect to each machine individually and modify some configuration file. Heat's objective is to automate that task.

Once we've had enough time to test this new version of Grizzly, we will begin to formally write the documentation. This will consist of an overview, along with quirks of NDSU's environment, followed by the installation and configuration of each component of OpenStack, starting from page one. More than likely, this documentation will be completed by Logan Paschke, under the supervision of Robert Foertsch.

To test the completeness of the documentation, Robert will try to follow the instructions provided by Logan. Robert is a good test case; though he is familiar with UNIX systems administration as a whole, Logan has taken care of the day to day issues the departmental OpenStack installation faces. Since the documentation is aimed at other departments who already have some experience with systems administration and would like to test out OpenStack, Robert's level of experience should be a perfect test case.

As shown in Milestone 4, this documentation will doubtfully be perfect in its first version. Much like a software project, we will iterate through the documentation, providing feedback to Logan as to where defects or omissions may exist, and he will modify the documentation as needed. This cycle continues until the detected list of defects or omissions approaches zero.

At this point, the documentation should be complete and available for other departments to use. In addition to documentation on our Wiki, there may be other ways to educate departments on the virtues of OpenStack (for example, a presentation at an IT-Techs meeting). The department is open to such discussion.

Benefits to students

Students would benefit greatly: Any student project (be it for research, a class project, or for a paper) can benefit from OpenStack, because now they would have the environment they need to succeed.

The possibilities are endless, but NDSU needs to have a cluster first. As mentioned earlier, any student with a project that requires specialized software that isn't presently available at CCAST or other NDSU resources greatly benefits. These students would have access to an environment that they can configure to meet their own needs; what is impossible with NDSU resources now, yet would easily become possible should we continue to pursue cloud technologies like OpenStack.

In addition to students having the resources they need, departments and other entities can adopt OpenStack to fit their infrastructure needs, too. In collaborating with this semester's Capstone group, the College of Engineering has found some potential uses for OpenStack. Instead of replacing workstations within their clusters, Engineering could try implementing virtual desktops within OpenStack, and using their existing workstations as thin-clients and thus connect to the desktops via remote desktop. This would also allow students to connect to their virtual desktops from off campus, too, freeing up valuable lab space for students who need to come to the cluster to work. These are potential benefits to students in the College of Engineering. Yet, barriers to entry exist if the College of Engineering needs to completely build OpenStack from scratch. Starting from our documentation would decrease deployment time.

There are classes that would directly benefit students, too. CSCI 277 Introduction to UNIX is a classic example. Students need full administrative access to a system as part of the course. Yet sharing a server with the rest of the class is problematic, as any student could put the server in an unusable state. OpenStack would allow students to quickly launch their own servers from the browser based dashboard, connect to them, and complete the assignments of the course. If a student breaks their individual server, they can reset it or spawn a new instance, all without ever contacting an administrator. MIS 460 Enterprise Infrastructure I is another similar course, and could be taught by allocating users their own virtual server.

Being an open source project, OpenStack has the potential to reduce server administration costs in departments who adopt it in place of a licensed project, like VMware or Microsoft's Hyper-V technology. Thus the benefit to the students would be measured in terms of cost-savings to the department.

Conclusion

Students need access to their own computer environments. OpenStack can solve this problem here at NDSU. These new technologies have many possibilities in regards to research and academic use, along with providing more resources as a piece of the NDSU infrastructure. Yet, to realize their full potential, NDSU needs to take the first step in supporting and promoting such technologies.

The Computer Science department is a perfect champion for such technologies. We have already proven our commitment to cloud technologies through our implementation of our VMware cloud in 2010, along with continued industry collaboration through our involvement with IBM and OpenStack. These years of experience have shown us the potential cloud infrastructure technologies have at an academic institution. Should NDSU desire to continue pursuing such technologies, we need to support the Computer Science department. We can continue to prototype and test these new architectures with the commitment of TFAC through this proposal.

Bibliography

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[3] Synergy Research Group, "IaaS and PaaS revenues growing at 65% per year," 11 December 2012. [Online]. Available: http://www.srgresearch.com/articles/iaas-and-paas-revenues-growing-65-year. [Accessed 27 March 2013].

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[6] RackspaceHosting, "Rackspace Cloud Builders - Origin," 13 December 2011. [Online]. Available: http://www.youtube.com/watch?v=bxotAMyofB4. [Accessed 27 March 2013].

[7] OpenStack, "Companies," [Online]. Available: http://www.openstack.org/foundation/companies/. [Accessed 27 March 2013].

[8] OpenStack, "OpenStack Roadmap," [Online]. Available: http://www.openstack.org/software/roadmap/. [Accessed 27 March 2013].

IV. Milestones

List the date for each project milestone. These milestones should represent the ***significant*** accomplishments that will be associated with the action plan. For each milestone, please indicate its expected outcome and the means for assessing that outcome. (The table may be extended as needed.)

	Date	Milestone	Expected Outcomes	Means of Assessment
1.	July 1, 2013	Grizzly Installed	OpenStack Grizzly will be implemented, along with the five components listed in "Project Objectives in Detail."	1: User is able to create, spawn, and delete virtual machines. 2: User can read and write data from Swift storage service. 3: User can create, attach, detach, and delete block storage devices from virtual machines. 4: Users can manage their own provisioned spaces within the OpenStack private network. 5: Users can connect to the Horizon dashboard and manage the virtual machines.
2.	August 1, 2013	First draft of documentation completed	An initial draft of Grizzly documentation is online and available for use.	Documentation is available for each component of OpenStack, along with an OpenStack overview and solutions to NDSU's quirky infrastructure.
3.	September 1, 2013	Documentation is ready for review	From the perspective of Logan Paschke, the documentation is free from error and omissions.	Assessment is Milestone 4.
4.	October 1, 2013	Documentation is tested (through iterations, making improvements as needed)	Robert Foertsch can implement OpenStack on the two-node cluster following the documentation completed in Milestone 3.	Should the documentation be correct, Robert should have no problems installing and configuring OpenStack. Should the documentation be incorrect (or incomplete), Robert will have a difficult time implementing OpenStack.

5.	December 1, 2013	Iterate through documentation	After implementing OpenStack through Logan's documentation and providing feedback, the documentation will improve.	The number of errors in the documentation after each iteration should decrease.
6.	December 30, 2013	Documentation is published.	The documentation is complete, and ready for use by other departments on campus.	The assessment is done in milestone five, when no more errors are found in the documentation.

NDSU Technology Action Plan Request

V. Supporting Documentation

The following support documentation can be found below:

1. A letter of support from Dr. Kenneth Magel, Professor and Associate Department Head, Computer Science
2. A letter of support from Dr. Anne Denton, Associate Professor, Computer Science
3. Invoices showing funding for Logan Paschke's continued work with OpenStack
    a. Fund 18751: REU supplement
    b. Fund 17967: Data Driven Agriculture
4. An invoice for Dr. Denton's purchase of two SSDs for the departmental infrastructure
5. An invoice for Course Fee's purchase of three 4TB hard disk drives for OpenStack storage
6. An invoice for Course Fee's purchase of 16GB of memory to support the servers presently used for CSCI 445's OpenStack Capstone Project
7. A letter of support from Dr. Dean Knudson, Associate Professor and Industry/University Consortium Director, Computer Science

NDSU NORTH DAKOTA STATE UNIVERSITY

March 29, 2013

Letter of Support for Technology Fee Action Plan Request entitled "Expansion of Departmental OpenStack Infrastructure" from the Department of Computer Science and Operations Research

The Department enthusiastically supports this proposal. The requested equipment would greatly enhance the research efforts of nearly half the Department's faculty and more than half its graduate students. Students in undergraduate and graduate classes in networking, data mining, bioinformatics, software engineering, and artificial intelligence would gain significant experience with an increasingly important technology.

The Department has built a modest OpenStack infrastructure during the last two years using funds provided by six faculty from research grants and the Department from grant overhead funds. This infrastructure is heavily used for courses and for research projects. If we were to acquire the proposed equipment, we would be able to set up a second OpenStack configuration which would support experimentation and enhancement of the OpenStack open source architecture. The present OpenStack cannot be used for experiments that could use a significant portion of the infrastructure nor for activities that might bring the network down because the single, existing infrastructure is a vital component of too many courses and research efforts.

The Department is eager to commit substantial time of our systems administration staff and significant grant overhead funds to support this second OpenStack, should the grant be awarded.

Sincerely,

Ken Magel

Professor and

Associate Department Head

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NDSU is an EO/AA university.

Gmail by Google

Robert Foertsch <rjfoertsch@gmail.com>

Support for Experimental OpenStack Platform

Denton, Anne <Anne.Denton@ndsu.edu> Wed, Mar 27, 2013 at 8:53 PM
To: "Robert J. Foertsch" <rjfoertsch@gmail.com>
Cc: "Denton, Anne" <Anne.Denton@ndsu.edu>

Robert,

Excellent news that you are requesting resources for an experimental OpenStack platform in our department! We badly need that.

As you know, I have made an effort to integrate the development of OpenStack expertise and resources into my funded projects where possible, even when that was difficult. I strongly believe that we will not be able to keep up with our responsibilities of providing up-to-date teaching platforms as well as teaching up-to-date technology, unless we put substantial effort into the OpenStack platform.

To the extent I could justify a relationship to my research, I have, in the past, provided funds for supporting a student tech to get the OpenStack platform established. I have also contributed funds to hardware where I could make the argument for it.

If you get the servers to establish an experimental platform, I commit to providing student tech and hardware contributions to that platform at the same level as what I did for the production platform that our department operates. An experimental platform is at least as important for developing our resources, and I will support it accordingly.

Thank you for your efforts!

Anne

Fund:	FAR0020086
Category:	Salary and Fringes
Beginning Balance:	$16,000.00
Accumulated:	$1,944.00
Balance Remaining:	$14,056.00

Fund 46000 - FAR0020086

Date	Vendor	Explanation	TCC	Amount	x
11/15/13	Paschke, Logan	November Salary	512000	$216.00	x
	Paschke, Logan	November fringes	516000	$0.00	x
11/30/13	Paschke, Logan	November Salary	512000	$216.00	x
	Paschke, Logan	November fringes	516000	$0.00	x
12/31/12	Paschke, Logan	December salary	512000	$528.00	x
	Paschke, Logan	December fringes	516000	$0.00	x
1/31/13	Paschke, Logan	January Salary	512000	$456.00	x
	Paschke, Logan	January Fringes	516000	$0.00	x
2/15/13	Paschke, Logan	February Salary	512000	$528.00	x
	Paschke, Logan	February Fringes	516000	$0.00	x
Total				$1,944.00	

Fund:	17967
Category:	Supplies
Beginning Balance:	$16,500.00
Accumulated:	$971.37
Balance Remaining:	$15,528.63

Data Driven

Fund 17967 - Undergraduate Salary

Ref #

Date	Vendor	Explanation	TCC	Amount	x
09/30/12	Logan Paschke	September Salary	512000	$240.00	x
	Logan Paschke	September Fringes	516000	$2.86	x
10/15/12	Logan Paschke	October Salary	512000	$240.00	x
	Logan Paschke	October Fringes	516000	$2.80	x
10/31/12	Logan Paschke	October Salary	512000	$480.00	x
	Logan Paschke	October Fringes	516000	$5.71	x
Total				$971.37	

CDW

800.808.4239

THANK YOU FOR YOUR ORDER

ORIGINAL INVOICE

Order Number: 1B9BJWL

CDW Government
75 Remittance Drive
Suite 1515
Chicago, IL 60675

INVOICE DATE	INVOICE NUMBER	INVOICE TERMS	DUE DATE
10/16/2012	R994251	MasterCard	11/15/2012

Purchase Reference

Customer Notes

Beginning of customer text: Denton Drives for OpenStack End of customer text.

OUR PART NO.	DESCRIPTION	QTY ORD	QTY SHIP	QTY B/O	UNIT PRICE	TOTAL
2816303	OCZ Vertex 4 Series solid state drive - 512 GB - SATA-600 Mfg Part # : VTX4-25SAT3-512G.M	2	2	0	$492.76	$985.52

ORDER DATE	SHIP VIA	PO NUMBER	CUSTOMER NO.
10/15/2012	Drop Ship Ground	DENTON	11517520

BILL TO:
BETTY OPHEIM
BETTY OPHEIM
ATTN: NORTH DAKOTA ST
1320 ALBRECHT BLVD N
258 IACC BLDG
FARGO , ND 58105-5769
P (701) 231-9460

SHIP TO:
C/O LOGAN PASCHKE
ATTN:BETTY OPHEIM
258 IACC BLDG
1320 ALBRECHT BLVD
FARGO , ND 58102

PRODUCT SUBTOTAL	$985.52
SHIPPING & HANDLING	$12.99
US Tax	$0.00
INVOICE AMOUNT	$998.51
AMOUNT DUE	PAID

ACCOUNT MANAGER
Brett Johnson
(312) 705-6256
brejohn@cdw.com

CDW
An Illinois Corporation FEIN 36-4230110

HAVE QUESTIONS ABOUT YOUR ACCOUNT? PLEASE E-MAIL US AT CREDIT@CDW.COM.

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CDW

800.808.4239

THANK YOU FOR YOUR ORDER

ORIGINAL INVOICE

Order Number: 1BB7R1H

CDW Government
75 Remittance Drive
Suite 1515
Chicago, IL 60675

INVOICE DATE	INVOICE NUMBER	INVOICE TERMS	DUE DATE
2/7/2013	X464481	MasterCard	3/9/2013

Purchase Reference

Customer Notes

Beginning of customer text: 3 x 4TB Drives for Dr. Denton Smartfarm. End of customer text.

OUR PART NO.	DESCRIPTION	QTY ORD	QTY SHIP	QTY B/O	UNIT PRICE	TOTAL
2886701	WD Black WD4001FAEX - hard drive - 4 TB - SATA-600 Mfg Part # : WD4001FAEX Serial # : WCC130183930 Serial # : WCC130184274 Serial # : WCC130200084	3	3	0	$326.07	$978.21

Contract : NJPA

ORDER DATE	SHIP VIA	PO NUMBER	CUSTOMER NO.
2/7/2013	UPS Ground	1BB7R1H	11517520

BILL TO:
BETTY OPHEIM
BETTY OPHEIM
ATTN: NORTH DAKOTA ST
1320 ALBRECHT BLVD N
258 IACC BLDG
FARGO , ND 58105-5769
P (701) 231-9460

SHIP TO:
C/O ROBERT FOERTSCH
ATTN:BETTY OPHEIM
258 IACC BLDG
1320 ALBRECHT BLVD
FARGO , ND 58102

PRODUCT SUBTOTAL	$978.21
SHIPPING & HANDLING	$0.00
US Tax	$0.00
INVOICE AMOUNT	$978.21
AMOUNT DUE	PAID

ACCOUNT MANAGER
Brett Johnson
(312) 705-6256
brejohn@cdw.com

CDW
An Illinois Corporation FEIN 36-4230110

HAVE QUESTIONS ABOUT YOUR ACCOUNT? PLEASE E-MAIL US AT CREDIT@CDW.COM.

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amazon.com

Final Details for Order #106-4032858-8910615

Print this page for your records.

Order Placed: March 7, 2013
Amazon.com order number: 106-4032858-8910615
Order Total: $87.98

Shipped on March 8, 2013

Items Ordered	Price
2 of: *Kingston Technology HyperX Red 8GB Kit (2x4GB) 1333MHz 9-9-9 1.5V DDR3 PC3-10666 Non-Ecc DIMM Motherboard Memory KHX13C9B1RK2/8* Condition: New Sold by: Amazon.com LLC	$43.99

Shipping Address:
Computer Science Dept c/o Robert Foertsch
NDSU 258 IACC Bldg
1320 Albrecht Blvd
Fargo, ND 58102
United States

Shipping Speed:
FREE Super Saver Shipping

Item(s) Subtotal:	$87.98
Shipping & Handling:	$13.19
Super Saver Discount:	-$13.19
Total before tax:	$87.98
Sales Tax:	$0.00
Total for This Shipment:	**$87.98**

Payment information

Payment Method:
MasterCard | Last digits: 4045

Billing address
Carole Huber
Computer Science 2740
PO Box 6050
Fargo, ND 58108-6050
United States

Item(s) Subtotal:	$87.98
Shipping & Handling:	$13.19
Super Saver Discount:	-$13.19
Total before tax:	$87.98
Estimated tax to be collected:	$0.00
Grand Total:	**$87.98**

To view the status of your order, return to Order Summary.

Please note: This is not a VAT invoice.

Conditions of Use | Privacy Notice © 1996-2013, Amazon.com, Inc. or its affiliates

Gmail by Google

Robert Foertsch <rjfoertsch@gmail.com>

OpenStack support

Knudson, Dean <Dean.Knudson@ndsu.edu> Wed, Mar 27, 2013 at 2:32 PM
To: "robefoer@web.cs.ndsu.NoDak.edu" <robefoer@web.cs.ndsu.nodak.edu>

Robert,

I just wanted to add my comments regarding IBM's OpenStack and the need to have solid support within the CS department.

For the past nine years IBM has been a great supporter of our computer science capstone program. During that time we have worked with them on a number of areas. However, over the past two years they have shown a very strong interest in working with the student teams on projects related to OpenStack. This has been a real opportunity for our students and as a matter of fact three of the four people on last year's team accepted job offers from IBM as a direct result of their involvement with their capstone work.

In addition to the student involvement, we have also had faculty working with the students to explain their research needs and how they could be met with OpenStack. This work crosses over into the work being done through our industry/university consortium as well as major grant work such as the Smart Farm program. IBM is very interested in these kinds of applications and has been directing the student teams to come up with use cases from the professors that can be dealt with through OpenStack.

While all this is very positive both from the student perspective and the faculty point of view there have been some issues. These primarily relate to the lack of hardware to support both a solid production environment for the faculty as well as a test environment for the student teams. One thing that would greatly help with this would be to have additional hardware so that we could support both environments.

Dean Knudson
Capstone Coordinator
Industry/University Consortium Director
701-231-5612

NDSU Technology Fee Action Plan Request
VI. Budget

(double-click on the form to begin entering data)

1.	NDSU ORGANIZATION OR UNIT	
	Computer Science and Operations Research	
2.	PROJECT DIRECTOR(S)	
	(Must be NDSU faculty or staff)	
	Robert Foertsch	

3.	SALARIES AND WAGES			
	Personnel description	Number employed	Number of months	Funds Requested
	A. Staff	0	0	$0.00
	B. Graduate students	0	0	$0.00
	C. Undergraduate students	0	0	$0.00
4.	TOTAL SALARIES AND WAGES			$0.00
5.	FRINGE BENEFITS			$0.00
6.	TOTAL SALARY, WAGES AND BENEFITS			$0.00

7.	EQUIPMENT	
	A. Tw o Dell R710 Servers	0.00
8.	TOTAL EQUIPMENT	$0.00

9.	MATERIALS AND SUPPLIES	
10.	TOTAL MATERIALS AND SUPPLIES	$0.00

11.	TOTAL TECHNOLOGY FEE REQUEST	$0.00
12.	MATCH (Describe in Match Section)	
13.	TOTAL PROJECT EXPENDITURE	$0.00

NDSU Technology Action Plan Request

VII. Budget Justification

No funds are being requested, so there is no budget to justify.

NDSU Technology Action Plan Request

VIII. Budget Match

While NDSU's Computer Science has not proposed exact funding values to support this project, the attached letters should clearly show the department's continued support for OpenStack, both with regards to student employment and required hardware.

The department has server rack space available for the servers, along with the required networking infrastructure. More than likely, the department will need to purchase the proper server mounting hardware, which should be the main expense. Other expenses could include a memory upgrade for the servers, along with small amounts of storage. These costs will be well within the abilities of the department and the faculty.

Dr. Denton has also pledged funding support for Logan Paschke to continue working on the project (Supporting Documentation 2).