

Undergraduates Exploring Enterprise Systems at Illinois State University

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(Mentored By: Dr. Chu Jong)

Abstract - Enterprise Systems are the back bone of almost all Fortune 500 companies, and large organizations. It has become increasingly important for companies and large organizations to have IT professionals with the knowledge to develop and manage these systems. This is the main reason why the enterprise computing systems research project was started at Illinois State University. The main goal of undergraduate students participating in this research effort is to gain knowledge on how to setup and maintain enterprise computing systems and help develop resources for students to learn about enterprise computing. As undergraduate students we will be working with graduate students setting up and running various projects on the z890 mainframe. The projects will be developed from scratch providing a comprehensive understanding of what is going on behind the scenes to support these large-scale systems.

Keywords: Mainframe, Enterprise, Systems, Computing, Undergraduate, Research

1 Introduction

In today's digital era, the ability to process and store large amounts of data has become an essential part of business. Enterprise Computing Systems (ECS) are the systems that execute this functionality and have become the heart of medium to large corporations. The demand for professionals who are capable of managing these systems has skyrocketed [1,2]. The ECS curriculum at Illinois State University (ISU) was developed to address this need. One of the main objectives of the curriculum development is to highlight the development of resources and course to produce graduates with skills and knowledge enterprise computing.

Enterprise computing offers promising jobs to graduate's with skills in this field. Many of the jobs available are in high demand even in the current unstable economy. The areas in enterprise computing that involve such things as programming, operation, networking, maintenance and setup are some of the highest in demand. The majority of employees in enterprise systems are in their mid 50s and already planning for their retirement further contributing to the need for new enterprise computing professionals [1].

There are a number of routes when choosing a career in enterprise computing. A student could specialize in maintaining mainframe servers in data centers; using tools, such as JCL, to communicate with the server; or focus on networking with various machines. With this knowledge in enterprise computing IT professionals manage and maintain these critical systems.

At our school students will work under the mentorship of Dr. Jong and Dr. Suh. Undergraduate and graduate students will work hands on with a z890 mainframe learning how to setup the system from scratch. Threw out the enterprise systems research project, we will setup and help manage the system that will provide the foundation for future courses. Several courses like ITK330, ITK331, and ITK334 are currently using the system and other courses will be using the system in the near future.

2 Background

The ECS curriculum development was originated when several companies approached Illinois State University requesting graduates with skills in the mainframe area. The purpose of the program is to prepare students for the various jobs in the mainframe based computing that companies are requesting. The core of this curriculum development is the two new sequences in ECS. When the program was started, IBM loaned us a z890 mainframe to help with the "hands on" course material to better educate students. As undergrad students, we will be contributing to various projects that will help in the development of the enterprise computing research project.

3 Research Sub-projects Descriptions

Under Dr. Jong's and Dr. Suh's mentorship undergraduate and graduate students will work on projects that will asset the ECS research. The knowledge and experience gained from these sub-projects will be used to help develop educational resources for students studying ECS. We have completed some of our sub-projects and others we are currently working on. The sub-projects include:

3.1 z890 Configuration

When the z890 is in full use it will have two LPARs, one for testing and one for education/production. It is important to have a testing LPAR because there is a chance in running and testing research something could go wrong and by having a testing environment we insure nothing bad will happen to the education or production side.

3.2 Installing System Software on the z890

On the education or production LPAR we will be using z/VM to run multiple virtual machines. The virtual machines will consist of SuSE Linux and z/OS. By using z/VM to run multiple virtual machines we will be able to set up operating system environments geared toward different needs. The test LPAR will not have a specified operating system, what is running on it will depend on the testing and research we are conducting.

3.3 File Server and Research Lab

An ECS lab has been setup to conduct this research. In this lab, workstations will allow us to connect to the z890 mainframe computer. From here, we can conduct most of our research but some things like reallocating memory require trips to the machine room.

A file server has been setup up in the ECS lab to ensure a safe central repository for research work to be stored. This will reduce the risk of losing data versus the data being stored on individual Workstations. The file server uses a mirrored raid configuration.

3.4 Open Source Porting of Quali

Quali is an open source financial program we are working on porting to SuSE Linux on the z890. We are currently working on doing test with Quali on the x86 platform once we have enough information we will begin working on porting it to the z890. Once ported to the z890 we hope to be able to have it hosted on Websphere and work with a DB2 database.

3.5 Benchmarking and testing

Not all system configurations can be solved by logic. We plan to use testing software to determine the correct options for installation. Some of the testing suites we will be using come preinstalled with the operating systems and underlying virtualization components. Others will be developed by students at ISU. Initially we plan to start small with deciding on standardized measurements meet our needs for the performance benchmarking, then we will work to develop simple tools to do simple benchmarks and expand from there.

Testing and benchmarking will help us complete our goal which is to port open source applications and using them with

proprietary software on the z system environment. By allowing us to see what the most effective approach is we can make better decisions in our software and system configuration choices. The challenge will lie in how to make the applications work harmoniously without performance and dependency issues. This will help us create a powerful and dynamic environment to run applications.

4 ECS Courses

In the fall semester of 2008, ISU's School of Information Technology (ITK) introduced the Integration of Enterprise Systems and the Enterprise Computing Engineering sequences. Integration of Enterprise Systems is based on the Information Systems major and deals with higher level operations of enterprise software applications. Enterprise Computing Engineering is a branch of Computer Science that deals with low level operations of enterprise system software and hardware. Both of these sequences share three building block courses: ITK 330 Introduction to Enterprise Computing Systems, ITK 331 Operating, Data Communication, Networking, and Security of Enterprise Computing Systems, and ITK 332 Advance Enterprise Computing Systems. These classes ensure that students have a solid background in enterprise computing when they graduate [5].

ITK330 and ITK331 have been offered over the past year with ITK332 still under development. ITK330 is the introductory course to get students feet wet with enterprise systems and the z890. ITK330 covers fundamental such as mainframe architecture, operating systems on enterprise system architecture, system operation, basic enterprise computing networking, and enterprise system user application development. This course is a broad introduction to the main area in enterprise computing [3].

ITK 331 provides students with the opportunity to learn about the network infrastructure of an enterprise computing system. This includes old and new IBM technologies. SNA has largely been replaced by TCP/IP protocol. However, many large organizations still have applications that depend upon SNA. In this course students are exposed to the basics of SNA, TCP/IP and how SNA can travel over TCP/IP via data-link switching. There are numerous other topics covered as well such as security, inter-machine commutations (such as sysplex) and even information about 3270 terminals [4].

ITK332 is still under development but, it will offer students advanced experience into the materials covered by ITK330 and ITK331. The majority of the ITK332 course material will be developed by the research done by the ITK Enterprise Computing Systems team. This course will be offered sometime around the Fall 2010 and Spring 2011 semesters [5].

Once students in both ECS sequences finish ITK330, ITK331, ITK332, they will have a concluding capstone course. For students in the Integration of Enterprise Systems sequence

there capstone course will be ITK 392 Enterprise Systems integration and application development. This course will reinforce a student's knowledge and skills in business applications, systems integration, enterprise business decisions, systems administration, and the systems deployment life cycle. For students in the Enterprise Computing Engineering sequences they will finish with the capstone course ITK394 Enterprise Systems Architecture, Performance Analysis, and Server Structures. This course will reinforce the student's knowledge and skills in enterprise system architectures, hardware/software design, performance analysis/evaluation and improvements, and server construction. [5, 6] These courses will draw on the knowledge and experience that the student has accumulated from other courses and require them to apply it, this will bring a solid reinforcement to the student's capabilities and insure graduates with a solid background in ECS.

5 z890 System Setup and Environment

An important step in developing productive research and educational environments is to keep them separate. The z architecture allows us to do this with separate LPARs. The use of system software like z/VM will allow us to further separate risks and create a reliable work environment. We will elaborate on these below.

5.1 z/VM and LPAR configuration

It is important to set up an environment where research and academic work can be done without disrupting each other. This is done with z/VM and the use of separate LPARs. By using separate LPARs, experiments and tests can be completed while not disturbing the production side of the system. We will use two separate LPARs, one called PIKEY will be the test side of the system and another called ZEWOX will be the production/education side of the system. PIKEY's configuration will vary based on the research and testing that is being done, while ZEWOX will have z/VM installed with Linux and z/OS images running on it.

z/VM will serve an important role in developing a robust ECS environment. z/VM is a hypervisor which permits us to run virtual machines on the z/architecture. It allows us to run multiple instances of z/OS and Linux on a single LPAR. This will let us test various configurations of these OS's simultaneously. Coincidentally, if one of the virtual machines goes down, none of the other virtual machines are affected by it. In principle all we will have to do to bring that virtual machine back up is reload an image of it. This should allow us to have minimal downtime if this kind of situation occurs.

Currently there is only z/VM running with image of SuSE Linux on the z890. We are working on learning the installation procedures so we can more effectively understand how to setup the system. There are many options and configurations that can be done to install z/VM and SuSE Linux. It is important that we understand these various options and configuration choices.

5.2 Dynamic Rescore Utilization

It is important to establish and develop procedures and methods for benchmarking and monitoring the system. Once we know the current state of the system and how the resources are used, we can make educated suggestions about system administration. If one of our future applications is running near maximum capacity, more memory and higher CPU priority can be redistributed from other applications that are not utilizing all of their resources. This is critical in a large company running many processes at once on the same system. If one process is taking too long, it can be granted more resources. If resources were not redistributed, processing would slow down and time would be lost and costs would increase. We are currently looking into using the z systems built in Work Load Manager (WLM) for this purpose.

5.3 Application and development tools

When setting up and configuring Linux and z/OS on the z890 there are number of development tools that we will need to install. An example would be GNU's gcc which is a C compiler for Linux. We will also need to setup proprietary software like DB2 on SuSE Linux. It will be important to document what we install and what it does for reference, so if a problem arises it will be easier to figure were it may have come from.

5.4 Documentation

A critical thing that needs to be done is the creation of documentation that outlines the steps and procedures to setting up our configuration. This will make easier to reconfigure the system when needed and allow for better problem solving. Documentation will also be critical because it will allow future people working on system to quickly learn how it is configured. Documentation that we create could potentially be used as educational martial as well. Documentation will also asset us in our own learning in helping us understand the process that are evolved in setting up and configuring the system.

6 Current Research Plans

Through the research and experiments, we will collect and analyze the data to help us better understand how to implement the various applications on the z890 system. This collection of information will be used to develop resources for classes to teach and give students "hands on experience" with an enterprise computing system. Some projects we are currently working on involve z/VM, Linux, z/OS, and having applications such as Quali work in the Linux environment on the z890.

One of our goals is to port open source applications and have them work with the proprietary applications in the mainframe environment. Porting is moving an application to another environment or architecture, for example for going from x86

to Power PC. This will allow a more flexible environment for the system to react to the user's needs. An operating system does not serve much purpose without user programs. Some of the applications we plan to install on SuSE Linux on the z890 include Java Virtual Machine, Tomcat /Apache, gcc, Ant, Kual, and Sakai. On the proprietary side we will be working with z/OS, as well as implementing Websphere and DB2. The intermixing of proprietary and open source software will make our system more flexible to continuously demanding changes.

One open source application that we plan to port is Sakai; we hope to have it run on the SuSE Linux environment on the z890. Sakai is a software package that has many coursework and learning packages similar to Blackboard. Another open source application that we plan to port is Kual. Kual is a financial software suite based off of Indiana University's financial management system. One key advantages of porting Sakai and Kual to the mainframe is the flexibility in being able to expand the resources available to them as needed. These programs can easily expand in a mainframe environment compared to having to add a new x86 server every time an expansion is needed.

The current goal is to get Kual running on SuSE Linux on the z890. Once we get Kual running in this environment we plan to use a DB2 database instead of a MySQL database. This will allow us to demonstrate the flexibility of running Open source application and proprietary applications together in the Linux environment on the mainframe. We also hope to use Websphere to host Kual as an alternative Apache Tomcat.

7 Summary

As undergraduate students participating in the ECS research project we have some unique opportunities to gain hands on experience and knowledge on enterprise computing systems. We also have opportunity to make suggestions and influence the development of the class and sequences within the ECS curriculum. This will allow courses to be potentially more appealing and better geared toward undergraduates.

We have many concurrent paths to explore in our learning about and research into enterprise computing. Since we have both undergraduate and graduate students, we plan to work on these projects simultaneously. There are many new exciting areas of research that we are currently considering. These have the potential to expand the resources here at ISU for teaching enterprise computing and preparing students for the demanding world of IT.

8 References

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