University of Utah MSIS Project

VoIP System Course Report

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Voice over Internet Protocol has a rich history reaching back several decades. Telephone Infrastructure providers, such as large phone companies, were interested in encapsulating voice and data for many years. These companies, which strove to use resources more efficiently, put information into packets traveling across their infrastructure long before the Internet was invented. Though the methods used were different than what is now known as VoIP, the progression of innovation and technology would lay the groundwork for the full realization of this technology. What they didn't realize was that the Internet would put this development of packetized data and voice into overdrive.

Largely driven by the possibility of bypassing toll charges, VoIP excited many inventors and computer scientists. These innovators quickly looked for ways to packetize voice and deliver it across the Internet. Though different stakeholders developing these technologies had various motives, all parties desired to change the playing field for the existing telecommunications market. Telephone Infrastructure providers would soon see people using soft switches (software based switches), thereby bypassing legacy switching platforms.

While VoIP was used for bypassing toll charges, others saw it as an opportunity to create business phone systems. Public Branch Exchange (PBX) works both on a Local Area Network as well as the Internet, therefore it was a suitable replacement for traditional phone systems used by businesses. Legacy hardware providers were no longer protected by the high costs of entry into the market and soon found themselves struggling to keep up with the changing world of VoIP. Traditional phone system companies, such as Lucent (Avaya), Nortel, and Toshiba, soon had new competitors they would have never expected such as Cisco, Shortel, and even Asterisk. The world of communication was quickly changing from the traditional digital and analog world into a VoIP-centered existence.

VoIP has now matured to the point that it has largely replaced traditional PBX style phone systems. No longer just a method to carry voice, it now carries other forms of media

such as video. VoIP is used to bridge communication gaps at prices that were once unthought of. Companies can connect to locations in ways that in the past were either impossible or cost prohibitive. A person can call into one location and ring all locations over VoIP, save virtually an unlimited number of voicemails, and integrate these into their email and instant messenging systems. Many systems can even keep track of a user's "presence". This means other users on the system can see if another user is on the phone, busy, out of the office, etc.

Due to the popularity of VoIP, there are many manufacturers creating products in support of the technology. As new hardware and software is released, manufacturers generally contribute to only their own proprietary technologies. This becomes a problem when systems must interact with various kinds of platforms and protocols. Asterisk is is an open source VoIP product that is written and maintained by the Digium Corporation. Asterisk works on many platforms, allowing for a solid user experience regardless of operating system.

Asterisk has become a very powerful product due to the contributions of the open source community. Due to its open source nature, Asterisk includes many of the features that the closed source products have and much more. Another advantage of the product is an increased control over functionality. If a user isn't satisfied with the way a feature works, Asterisk can be customized to meet specific demands of individuals and organizations.

The creators of Asterisk decided early on to make the system modular, which means it is entirely composed of independent modules. The modular design allows for system scalability and innovation; the scope and creativity of features are not limited by rigid and static boundaries. This makes it extremely easy to use and popular among users. Users can customize Asterisk in ways that the source developers never could have anticipated. This architecture has made Asterisk capable of integrating with many different systems. Different users have tested the system on other systems with great success. Many modules are available that allow for connections with several different VoIP protocols. Modules make Asterisk a very flexible product and platform to develop on.

Motivation

As Masters Students at the University of Utah, we naturally have the desire to examine technologies with the intent of understanding and experimentation. VoIP has changed telephony communication, influenced the creation of new technologies and provided many people a means to communicate that they wouldn't have had otherwise.

Most companies have telephony systems of some kind, whether it's a digital phone system or a VoIP system. As older systems are replaced, more systems will eventually move to VoIP. Though the line between data and voice traffic is beginning to blur, professionals are needed who comprehend the underlying technologies. More people will be needed who are proficient in VoIP technologies to create and maintain telephone systems and their integration into he other existing networks. These reasons provided a compelling case to develop a Masters project around VoIP technologies.

Objective

One of the best ways to learn a subject is to teach it. This requires a level of comprehension to the extent at which an individual can explain topics in a meaningful way, so that others can obtain a consistent understanding. Since our group decided to develop a college level course about VoIP technology, this demanded a greater understanding about the subject matter than if we had solely implemented a VoIP system. Both we as a Masters group and the students we taught would benefit from our development of a course. Ultimately, our group wanted to create and teach this course for a specific class, but also make our materials in a manner that other schools and programs could adopt it as well.

The course curriculum needed material that would interest the students and give them applicable hands on experience they could use. Our group wanted to create many opportunities to implement VoIP subject matter, as opposed to merely seeing examples or hearing lectures. One main purpose of this course was to introduce students to VoIP in a way that will provide

them with both knowledge and application of the subject matter. The combination of these will prepare students to interact with VoIP systems competently and hopefully provide an increased interest in the technology.

Project Process and Results

Our group intended to prepare a full semester college VoIP course and then teach the material in a classroom setting. This proposal was presented to the Information Systems Department Head at LDS Business College, Dr. Kevin McReynolds. Dr McReynolds was interested in the project and LDS Business College approved the course on an initial trial basis.

The LDS Business College is an accredited facility providing educational opportunities for 123 years. It is part of The Church of Jesus Christ of Latter Day Saint's Educational System. As such, it has access to some resources at other of the Church's other educational facilities like Brigham Young University, but yet maintains most academic programs separately.

The school prides itself on teaching students valuable skills leading to promising careers. The Information Systems program has a variety of courses including introductory IS, Cisco, Linux, and Microsoft Windows Administration. Other course offerings prepare students for major industry certifications. The college also prefers to facilitate student opportunities to work in classes with hands-on opportunities. The VoIP course was a perfect fit for the goals and ideals of the LDS Business College.
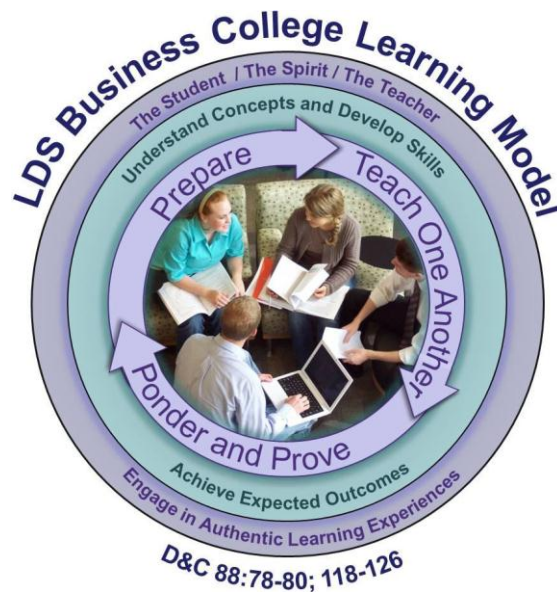
After gaining approval for our course from the LDS Business College, we had to attend several brief instructional meetings to learn about their policies, and procedures. We were introduced to the LDS Business College Learning Model, which is shown below:

The LDS Business College Learning Model fit nicely into the way had envisioned our class. We expected the students to "Prepare" with course text readings, then provide quizzes with questions based on the reading materials. Class discussions led by the instructor consist of a lecture format where material from the text is presented and examined. This followed the "Teach One Another" objective of the Learning Model. The "Hands on Experiences" consists of in-class labs that allow students to try and explore what they had learned about VoIP. These Hands on Experiences fit the learning model in both the "Teach One Another" and the "Ponder and Prove" objectives. Two tests are administered during the semester to complete the "Ponder and Prove" learning model objectives. These tests are designed in a format similar to what could be expected in an industry certification exam. This course is intended to prepare students with practical knowledge and ability in understanding VoIP.

In order to create a course that would be of value, we needed to find material that covered general VoIP concepts and the Asterisk software. After researching several books, we decided on "Asterisk the Definitive Guide" by O'Reilly Publishing. This is an excellent book that Digium (the creators of Asterisk) bases their Asterisk Certification on. Since this isn't a textbook, the book didn't include prepared materials like PowerPoint slides, quizzes or tests. Our group has created all the course materials (slides, quizzes and tests) based on concepts from the book.

Next, we determined the course schedule for the class. Our course is a Summer term class taught weekly on Thursday nights from 5:00pm to 8:30 pm for twelve weeks total. With this information we could then decide which chapters we would like to cover for each scheduled class period. The course syllabus was constructed as a group and lecture assignments were made accordingly to include all mandatory topics.

As determined earlier, each scheduled class period would include a lecture discussion, a reading quiz, and a "Hands-on Experience". The course tests consists of a mid-term exam halfway through the semester and a final exam the last day of the course. The schedule is divided evenly so each group member prepares and teaches four individual class times. Each group member prepares a batch of questions based on the chapters covered for the week. Some of the questions then are used on the weekly quizzes while the remainder of them are used for the tests.

As each team member completes the materials for assigned class periods, these items are shared with the group prior to the scheduled class. This allows all team members to review the slides and test the "Hands-on Experiences". Using a group testing format for materials aids in the identification and correction of previously unnoticed mistakes.

Project Results

Since this course is scheduled to be completed on August 18, our entire project will continue after the submission of this report and the project presentation. Thus far, the course curriculum has proceeded on schedule as outlined during the planning phase of this project. A few minor syllabus changes were made to better facilitate a timeline to cover core topics and activities.

Through the course of the class, our group has met and maintained project objectives. All team members attends the class each Thursday night to assist with the labs, lecture and offer assistance to students and group members as well. As planned, each member has been in charge of the course materials for the week they are scheduled to teach. July 6 was the halfway point of the course, which included a midterm exam. We feel that the course have gone extremely well and we are pleased with the progress we are making. The students especially enjoy the hands on projects. Several have even indicated that they have taken the material

home and are repeating the work outside of class to allow for more practice and mastery of the subject.

The students come prepared every week, interacting with us during lectures and we feel like they are enjoying the classes and learning the material. Each one is performing very well in the course and attending class consistently. Every student is on track to pass the course and has completed all of the their labs (hands-on experiences) and assignments up to this point. Although some students have struggled through a few of the weekly quizzes, every student scored higher than 80% on the midterm exam we gave them on July 6. These students are attending class each week with an eagerness to learn and apply concepts within Asterisk.

The "Hands-on Experiences" provided to the students each week are a crucial portion of learning concepts presented in class. The classroom lab contains computers and IP phones for each student to personally use for each lab. Up to this point through the labs, each student has installed CentOS on his machine, installed and configured Asterisk, and then connected and configured a VoIP phone to that machine. They have been taught how to create a dialplan in Asterisk and setup a dialplan on the Asterisk system. The students have also configured music on hold, connected to each other's systems using SIP trunks, and successfully placed calls to each other. They have also learned to set up and use voicemail functionality for Asterisk. All of this has been done from the ground up with the students having to install Asterisk from the source code. The above activities were performed from the Linux command line in order for the students to learn the basics of what is going on behind the scenes. The bare-bones installation and configuration of Linux and Asterisk provides students a greater perspective on how the different parts of Asterisk work together. This lower-level understanding provides the students with an advantage they would not receive using many of the other proprietary VoIP technologies.

The syllabus schedule still has much more planned for their hands-on experiences, including diving deeper into the Asterisk dialplan, coding and more automated services. By the

time the students have completed this course, each will have had many excellent applied experiences. Some of these additional activities will include working at the command line configuring Asterisk and its many capabilities, such as auto-attendant and Interactive Voice Response (IVR). The students will also be introduced to some of the many GUI's available to Asterisk. One of the main ones we will use is FreePBX, which several of the free and commercially-based Asterisk products use for the main configuration and control interfaces.

Overall, the project has been proceeding smoothly and as a group we are satisfied with the progress of this project. We are constantly learning more about VoIP, as well as how to effectively teach the subject matter. The current class size consists of five students, which is fortunate because the smaller number of students has allowed us to fine-tune our approach and come up with ideas that would help us teach this course on a larger scale in the future. The remainder of the semester contains more exciting topics; we anticipate a successful completion of the course according to the planned schedule and learning objectives.

Lessons Learned And Future Direction

Throughout the project, we have learned important lessons and have had some unique experiences. These experiences helped us not only learn more about VoIP and Asterisk systems for ourselves, but also about how to plan and teach it to others. We learned the process of effectively building an entire college course on a particular subject and then how to teach it to others through application and experience. Some of the lessons we learned included how to effectively plan, how to study and learn concepts, how to teach and explain concepts, and how to develop learning experiences for others. Although this specific course will end shortly, we hope that the LDS Business College will be impressed enough to add the course in their future course offerings.

Planning an entire course requires large amounts of dedicated effort, focus, planning and flexibility. Before our group started the creating the course material, we planned out and

scheduled how the course would be set up and designed. The class was scheduled to be held weekly for 12 weeks straight, so we assigned each team member specific responsibilities and put each member in charge of one of the classes each week. We learned that by specifically planning out roles and responsibilities, project risks and potential issues could better identified and mitigated. No major surprises or unexpected situations have occurred yet due to careful planning, assigning responsibilities to group members and effective collaboration.

Each class consisted of a lecture, a quiz, and a lab lasting three and one-half hours and were held on a weekly basis. We had to develop lecture material such as slides, quiz questions, and a lab or "Hands-on Experience." In order to prepare and have this material ready for the students, we had to be certain we understood the material well. We learned how to read and understand from the textbook and use outside sources to understand the concepts well enough to actually teach it to others. There were several instances while working on "Hands-on Experiences" that examples in the book were not accurate. We had to research the problems we encountered and find the answers to why we were having problems and how to resolve them. The students frequently ask well thought out questions on the lecture topics, so it is important for our group to come prepared with explanations and insight. The ability to teach is completely different from merely learning and becoming an expert on a subject.

Although the course consisted of standard lectures just like any college course, we were able to interact with the students more than the average college course. For most weeks of the curriculum, all three team members have attended the class and worked with the students. This was especially useful during the labs. As instructors, we have learned how to work with the class and individuals to explain difficult concepts. Some of the students struggled with different concepts within the labs; we learned how to work with the students until they were able to understand the difficult concept.

We also learned a substantial amount about troubleshooting and problem-solving. Some of the labs did not work as intended, so we as a group had to identify the issue or issues and

make the proper correction. Many times it was something very simple, like a coding error. However, the experiences helped us to better understand how to detect errors, use resources for research assistance and then applying the best correction. We then updated our material with corrections to help avoid the problems we had so that as we taught the course in the future these problems could be avoided.

This masters project experience has allowed our group to gain valuable insight, knowledge and experience that we otherwise may not have obtained. We learned skills that will benefit each of us throughout our careers and lives, regardless of what unique career paths we pursue. Our group has realized the strength and value of team collaboration, proper planning, identifying and solving problems, conveying ideas and complex subjects, and much more. We anticipate that the course will become part of the course offerings at LDS Business College, so it can continue to introduce many students to learn about VoIP and Asterisk phone systems.

Recommendations For Other MSIS Students

We learned some valuable lessons throughout the duration of our project that could be beneficial to other students. Through developing and teaching a course for the LDS Business College IS department, we were able to develop a relationship between the business college and the MSIS program at the University of Utah. The foundation has been laid for other students to pursue the same direction if they desire. The business college is looking at continuing on with this course and may have interest in additional courses if a good idea was presented to them. If students were interested in doing the same type of project, the opportunity may be available to them here at the business college. Another important recommendation we can offer is to get to know someone within the organization or company you want to work with. Having a contact at the LDS Business College really helped us get the project. Finally, starting early on and working hard throughout the project helped make the project a success.