IS IMPLEMETATION OF VOICE OVER INTERNET PROTOCOL (VOIP) MORE
ECONOMICAL FOR BUSINESSES WITH LARGE CALL CENTERS?

by

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A Graduate Research Report Submitted for INSS 690
in Partial Fulfillment of the Requirements of the Degree of
Master of Science in Management Information Systems

Bowie State University
Maryland in Europe
May 2005

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Abstract

Is implementation of Voice over Internet Protocol (VoIP) more economical for businesses with large call centers? This paper is written for the Chief Information Officer (CIO) or business owner of an existing business or to anyone who is considering starting a business that will require a call center. VoIP is a new type of phone service that uses the Internet to make telephone calls. VoIP service can save a significant amount of money by reducing infrastructure and monthly maintenance expenses as well as providing telephone service at significantly lower rates. From the data analyzed a company could save 76.2% on their outbound calling expenses by using VoIP technology.

CHAPTER 1
INTRODUCTION

Definition of the Problem

In the current market being competitive is required. Companies need to streamline operations to effectively compete in the global economy. Overhead costs, while necessary, do not contribute to the company's bottom line. Telephone expenses that a call center generates are part of the overhead that a company must have. With new technology there are mores ways to communicate than before. Recent advances in technology has allowed for a new type of phone service to emerge as an alternative to the public switched telephone network (PSTN) or plain old telephone system (POTS). This is Voice over Internet Protocol (VoIP). As with any new technology many may be leery of switching over. The purpose of this project is to show that VoIP phone service is more economical than PSTN.

This proposal is working from the hypothesis that VoIP is more economical. To show this the following questions will be answered to show whether or not the hypothesis is correct. What is VoIP? What are the technology requirements? How is the quality of service (QoS)? What are the costs of setting up and using VoIP versus the PSTN?

Need for the Study

Not all technology is economically feasible. It is for this reason that a cost comparison of monthly expenditures be examined in order to determine if start up or switching costs can be justified through the long term savings a company would receive by adopting a new technology.

Definition of Terms

CALEA: Communications Assistance for Law Enforcement Act
DSL: direct subscriber line
IP: Interent protocol
POTS: plain old telephone system
PSTN: public switched telephone network
QoS: quality of service
RTP: real-time protocol
UDP: unreliable datagram protocol
VoIP: voice over Internet Protocol

CHAPTER II
REVIEW OF THE LITERATURE

Literature Review

What is VoIP?

Voice over Internet Protocol (VoIP) is a new way of communicating. It requires the use of the internet and the technology that allows information to travel between users. Before I delve into how VoIP works it is important to understand how the plain old telephone system (POTS) works.

When you make a telephone call your voice travels in its analog form from your telephone to a telephone company switch. At the switch it is determined if your call is passed to another switch or if it can be routed to its destination. Using the POTS system your phone call travels the same path along physical wires based upon where the phone call will terminate.

VoIP requires an individual to have broadband Internet access. The most common of which is either through the use of a cable modem or DSL (direct subscriber line). Data travels the Internet in packets. In order for your voice to travel the Internet, it must be converted from analog to digital. Once your voice has been converted to digital packets it can be transferred via the Internet. But before your voice can enter the Internet and travel to its destination some information has to be added to it so that it meets IP (Internet Protocol) standards.

It mentioned earlier that data travels in packets, that is your voice is broken up into several different packets that must reach your destination and be reassembled in the right order and converted from its digital form back to an analog form so that the recipient can hear your voice. So each packet of data, which contains a portion of your phone call, has a minimum of 160 bits added to it so it can reach its destination. (White, Curtis, 2002) In addition to the IP protocol it also requires the use of real-time protocol (RTP). "It provides timing information that allows the receiver to reconstruct the original timing of the transmitted material in a way that identifies the content being sent, provides security, and notifies the overriding application of lost data." (Gilmer, 2004) RTP is usually used in conjunction with unreliable datagram protocol (UDP). UDP allows for information such as voice and video to be sent without waiting for acknowledgement of it being received. "It is useful in cases where one sender wants to send the same information to multiple receivers and is not too worried if some pieces get lost along the way." (Gilmer, 2004) VoIP requires the use of these three protocols in order to function. For this reason broadband access is needed. The fastest modem dial up connection using POTS can only achieve 53Kbps (kilobits per second) whereas cable modems and DSL

can achieve speeds of 10 – 100 Mbps (megabits per second). The higher speed is needed in order for an actual conversation to take place over the Internet without significant delay.

VoIP telephone is relatively new and as such can have some potential drawbacks. First it requires access to the Internet so if the power goes out so does the phone service and therefore contingencies should be made. "sound quality and reliability are still not up to the level of traditional telephone service." (Trope & Royalty, 2004)

What are the technology requirements?

To get started with VoIP service there are a few basic items you need: Broadband Internet access, computer and software if you plan to use the computer as your phone, adapter box if you plan on using your regular house phone. However, for a call center there are more things to consider.

You still need broadband Internet access but supporting hardware becomes more complex. First, a decision is need to determine how much bandwidth is required to support adequate VoIP telephone service. Then you need to determine the amount of bandwidth you have on your Internet access. Then you can determine how many phones can be supported by a single broadband connection. In order to share the broadband connection an intelligent router will be needed to split the connection between all of the phones.

Westminster college in Salt Lake City, Utah changed their phone system over to VoIP. Based upon their article, Implementing campus-wide voice over Internet protocol (VoIP) phone systems at small colleges, they installed servers, switches, routers, phone hardware and power switches. They upgraded to a 1-gigabit backbone for Internet. They set over 1000 phones on this system. (Allred, Greenwood, and Ross, 2002)

Quality of Service

Quality of service (QoS) is something that can be different for each and every individual. For some quality can refer to how well the voice sounds over the phone, for others it may refer to the amount of noise they hear in the background, echoes, reaching an individual are all issues that go into quality of service. Another side of quality can refer to security of a conversation as well reliability. A study in India showed that the majority of people preferred the lower cost of service over responsiveness, value added services, reliability and voice quality. (Jaiswal & Raghav 2004)

Security or privacy of phone calls is another issue for QoS. This becomes exceptionally important for law enforcement officials. There are many differences between security of measures of public switched telephone networks (PSTN) and VoIP. Sicker and Lookabaugh in their paper titled VoIP Security: Not an Afterthought used the following table to show the differences between security measures.

Security Concerns	Wired PSTN Measures	VoIP Measures
Confidentiality	Physical security	Encryption techniques
Integrity	Physical security	Encryption techniques
Availability	Physical access control	Network/Service access control
Authentication	Physical connectivity, voice recognition, caller ID	Login, password
Authorization	Caller ID, access control	Access control role-based authorization
User Expectation	Assumed and static	Variable
Implementation and Design Concerns		
Software design	Large, monolithic, complex	Variable, distributed, complex
Interoperability	Centralized and tested	Distributed and potentially ad hoc
Software implementation	Centralized and tested	Distributed and potentially ad hoc

 (Sicker & Lookabaugh, 2004)

Currently law enforcement officials are looking for ways and authorization to be able to tap VoIP phone services. The challenge is that VoIP encrypts and digitizes the voice. This makes a conversation appear to be nothing more that data being passed around the Internet. The Communications Assistance for Law Enforcement Act (CALEA) does not allow for the interception of data packets such as email. Currently VoIP phone service is treated the same way and so law enforcement officials are petitioning to classify VoIP as a telecom service so that it falls under CALEA. (Sicker & Lookabaugh, 2004)

Comparison of Costs

Which type of phone service is cheaper? PSTN or VoIP. Costs are more involved than a simple phone bill at the end of the month. Costs include hardware requirements, training costs, switch over costs, potential and loss of business in transition. Different companies will have different costs for telephone service based upon whether they are working on the international, national or local level. The company CISCO provides a lot of hardware for VoIP phone service and claims on their web site that companies have saved millions of dollars by using their technology. (Cisco, 2004)

CHAPTER III
METHODOLOGY

Design, Participants, Procedures and Assumptions

In order to determine which type of telephone service is more economical, a more in-depth review of operating expenses will be needed. To acquire this information I contacted and interviewed a local phone companies and VoIP provider on the potential set up costs and maintenance for having 100 phones. Using a sample of 100 phones allows for smaller centers to see how they can benefit and larger call centers can scale the prices based upon the actual number they have. Furthermore, I acquired the average cost to make phone calls and receive calls on a toll free number. I anticipate there will either be volume pricing for a certain amount of minutes or an average of how much a call cost per minute. International expenses will also be considered and used as a factor to differentiate on the viability of each phone service.

Since bandwidth can affect quality of service, I researched and took available studies where they have stated their bandwidth and number of phones to determine the amount of bandwidth required so that Internet costs can be taken into account for the financial comparisons. This data could be subjective in that different companies could have a different definition for voice quality that could affect the amount of bandwidth that they use. Therefore an average will be taken and used. I will assume that this average value would be indicative of adequate voice quality to conduct business without incurring a loss of customers.

Another factor that will need to be considered in determining bandwidth is the requirement for simultaneous use of the Internet in addition to the phone service. Since this can vary from company to company it could modify the comparison results since some companies only need phone service and others need phone service and Internet service to function. For the purpose of this paper it will be assumed that Internet access will be required.

The data will be laid out in a table format to view. There will be different tables to show requirements based upon a company's need for phone and Internet service or just phone service.

Since the cost data will be acquired from actual service providers, the data will be reliable. Older studies used for reference of the costs/benefits during the same period of time will need to be converted to current dollars. Only information that will be moved forward to present time will be minutes used or other data that does not deteriorate or lose value with time. This will ensure that any comparisons are reliable and valid.

Scope and Limitations

This scope of this project is based upon a fixed number of telephones being required by a call center or other organization. Expenses vary based upon quantity and it is not linear therefore twice the number of phones required will not be twice the cost. Furthermore, only a limited number of service providers will be contacted. For this reason a better pricing plan may be available from another source. The scope of this project is to show that the implementation of new technology can reduce expenses and does not look at the actual cost an organization may have to pay to change or dismantle their current system.

CHAPTER IV
RESULTS

The first step in evaluating VoIP phone service is to use VoIP yourself. With this in mind I changed my phone service. I got rid of my long distance carrier, changed my land line to dial tone only to support my DSL connection and added call forwarding so all my phone calls would come over my new VoIP service. Since I live in New Jersey and Verizon provides my local service and DSL so I decided to use their Voicewing VoIP service. In the process of getting my VoIP phone service set up I was provided with key requirements for VoIP to work. These requirements apply to single users as well as large call centers. To use VoIP you must have an available download speed of 512Kbps and an upload speed of 96Kbps. These values were according to the Verizon representative I was talking too. On www.vonage.com, Vonage states you only need 90 kbps upload speed. These speeds are required per telephone line being used.

How much VoIP and traditional phone costs compare?

Before costs can be compared an analysis of a companies phone usage must be done. A company needs to determine what percentage of phone calls are outbound and what percentage are inbound. Another factor to be considered is if a toll free number is to be used for inbound phone calls. For the purpose of this research inbound phone calls will be using a toll free number. A comparison will be done using 100 phones for inbound calls and 100 phones for outbound calls. As with many products being sold there are special deals, volume discounts, etc. For our purposes we will be using standard pricing with no special deals or volume discounts.

For the cost of VoIP phone service we will use the information that comes from Vonage's website, www.vonage.com. For traditional service the information is coming from the small business group department of Verizon. Set up fees will not be used as they are one time fees only and the thrust of this paper is to determine which is more economical on a long term basis.

For comparison purposes I will assume each phone line will be used for 6 hours a day or 360 minutes for 20 days a month and calls are only to and from customers in the United States. It is also assumed that broadband Internet service will be needed in order to perform working functions. I was quoted a price for a static IP address from Verizon with 7.1 Mbps download and 768Kbps upload for 234.95/month. Allowing approximately 1Mbps for download and 96Kbps upload for work and ensuring sufficient bandwidth is available to maintain VoIP operations would require a traditional phone center to have 15 IP addresses to provide service to 100 users and in a VoIP center it would require 25 IP addresses. Refer to table 1 for comparison data. There is also the

cost of the equipment needed to split the DSL lines to employees. The type and cost of the equipment will not be used because any savings in monthly phone costs will eventually payoff any hardware investment.

Comparison Data

Number of minutes used per day per phone	360
Number of days used per phone	20
Total number of minutes per month per phone	7200
Bandwidth requirement for work	1 Mbps download, 96 Kbps upload
Bandwidth requirement for VoIP	512 Kbps download, 96 Kbps upload
Bandwidth per IP address	7.1 Mbps download, 768 Kbps upload
Number of IP address needed for a business not using VoIP for 100 workstations	15
Number of IP addressed needed for a business using VoIP for 100 workstations and phones	25

Table 1

Inbound Phone Costs

   Verizon.

      According to the small business group sales representative that I spoke too, the following is a break down of monthly recurring costs. Cost of each line is $26.00. Toll free number is $5.00. Cost per minute of phone calls received on a toll free number is $.052/minute.

   Vonage.

      According to www.vonage.com for small businesses the following is a break down of monthly recurring costs. First line is $49.99. Each additional line is $44.99. Toll free number is $5.00. Cost per minute of phone calls received on a toll free number is $.049.

Outbound Phone Costs

   Verizon.

      The following is a break down of monthly recurring costs. Cost of each line is $26.00. Cost per minute of outbound phone calls is $.052/minute

Vonage.

The following is a break down of monthly recurring costs. First line is $49.99.
Each additional line is $44.99. The cost of outbound phone calls made is included in the
monthly line fees, therefore the cost to call out is $0.00.

See the following tables for the full cost breakdown. There is a table for inbound
and outbound phones calls and a final table taking the values of the other tables to
simulate the costs of a 200 phone call center with exactly 100 phones being used for
outbound and 100 phones being used for inbound phone calls.

Inbound Phone Call Center Expenses

	Verizon	Vonage
Monthly Line Charge	$2600.00	$4504.00
Toll Free Number	$5.00	$5.00
Cost of Inbound Calls	$37440.00	$35280.00
Internet Service	$3524.25	$5873.75
Total Monthly Costs	$43569.25	$45662.75

Table 2

Outbound Phone Call Center Expenses

	Verizon	Vonage
Monthly Line Charge	$2600.00	$4504.00
Cost of Outbound Calls	$37440.00	$0.00
Internet Service	$3524.25	$5873.75
Total Monthly Costs	$43564.25	$10377.75

Table 3

Combined Inbound and Outbound Call Center Expenses

	Verizon	Vonage
Monthly Line Charge	$5200.00	$9008.00
Toll Free Number	$5.00	$5.00
Cost of Inbound Calls	$37440.00	$35280.00
Cost of Outbound Calls	$37440.00	$0.00
Internet Service	$7048.50	$11747.50
Total Monthly Costs	$87133.50	$56040.50

Table 4

Another factor in determining which type of phone service is more the cost to
contact customers and suppliers that are overseas. For international rates I picked a
former long distance company I used to use called ACN. From there website,
www.acninc.com, they have a complete listing of rates. For VoIP rates I chose to use

Vonage and their rates can be seen on their website at www.vonage.com. The following table lists a few countries picked at random and how much it costs to call per minute.

International Phone Rates

Country	ACN Plus Rate	Vonage
China	$.049	$.06
France	$.115	$.03
Germany	$.115	$.04
Japan	$.079	$.05
Mexico	$.08	$.08
Switzerland	$.115	$.06
Taiwan	$.059	$.06
United Kingdom	$.085	$.03
Venezuela	$.25	$.07

Table 5

In regards to quality of service, I have changed my phone service over to VoIP to experience it. I have a standard residential DSL that connects to a router that has three computers networked and the VoIP phone connected. I have had two of the computers using the Internet for either browsing or online gaming which is constantly sending and receiving data and have been able to use the phone with very little difference it what I use to have. I have noticed that when I call my VoIP phone using my cell phone I tend to hear an echo in my cell phone but I have never heard an echo yet on my VoIP phone. Some voices have sounded a bit different but never enough for me not to know who was on the line by the sound of their voice. While this information applies to a single phone line it can be scaled up to a call center.

Another factor in deciding which type of call center is more economical is infrastructure. With a tradition phone center housed in a building you are confined to the size of the building and if a company wishes to move all of its hardware and wiring must move with it. If it grows beyond its capacity additional buildings will be needed. By using VoIP technology call centers can be virtual. A virtual call center is where the employees are in diverse locations. Some may be in the company building but others could be at home or other offices. A company called Call Centers 24X7 went with a virtual call center for its business and reported that it had saved around $200,000 in up-front costs and $10,000 a month in maintenance. (Bailor, 2005)

CHAPTER V
ANALYSIS AND DISCUSSION

From the data it is obvious that the type of phone calls being made play a key factor in which type of phone service is more economical. VoIP phone service is clearly more advantageous for outbound calling with a savings of 76.2%. However, if a toll free number is used a more traditional land-line phone center is more economical by 4.6%. If a company had their call volume exactly split between outbound and inbound calls, VoIP would be more economical with a savings of 35.6%.

In the battle for individual long distance business many providers of long distance service are offering unlimited state to state calls at a fixed price. Should the phone companies make this a standard rather than offering per call rates the need for a company to maintain a toll free number will no longer be necessary. If a company does not use toll free number then VoIP phone service is clearly more economical.

Depending upon the amount of international business a company has and in what country the type of telephone technology used can reduce expenses.   According to the information provided for a small sample of countries it is clear to see that VoIP rates are about as good or if not better than regular international phone rates.

The key factor in maintaining adequate quality of service is to ensure that the minimum download and upload requirements are met. For a company this requires careful and thorough management of its Internet resources. The company would need to make a thorough look at how many phones will be in use at one time? How many users will be using the Internet at the same time? The company would also need to look at how many resources are left for additional users or additional areas of potential growth. Once this has been determined a company could make the switch to VoIP and ensure that quality of service is maintained.

A number of potential costs have not been covered. Some of these include infrastructure, to include building and hardware costs, the cost of changing from one type of phone service to another, and the cost of expanding beyond a company's current infrastructure. Keeping these factors in mind it is very probable that the initial savings in using VoIP technology will be enjoyed by those making an entrance into their business market as it will allow them to operate at a lower cost while they establish themselves. Established companies can begin to take advantage of these lower costs simply by using VoIP as their infrastructure expands which will allow them to continue to operate efficiently and lower their operating expenses.

The last issue that needs to be discussed is the weaknesses of VoIP. The biggest weakness of VoIP is its dependence upon local power. If the power goes out in a building, VoIP phone service will cease. This can be over come through the use of battery back up devices for short term outages but would require back up generators if power outages last longer than the capacity of the battery back up devices. One key factor to remember about a power failure is that with a company's dependence upon information systems to conduct business any power failure would most likely bring a company to a halt.

The other key factor of VoIP is the Internet service provider. If the provider cannot provide consistent bandwidth or service the quality of service or even use of the phone may be impaired. For this reason it is important to have a reliable provider for your Internet service.

If a company diversifies its call center and other information systems through the creation of a virtual call center it can minimize the effects of a local power outage or Internet outage as other locations could easily pick up the load till power or Internet service is restored.

Telephone security is always a big concern as important information is being passed around. As mentioned earlier security is done through encryption and as industry requirements grow to safeguard information, VoIP telephone security will also improve.

As with any technology a company should research the pros and cons before embracing it as part of the company strategy.

CHAPTER VI
CONCLUSIONS AND RECOMMENDATIONS

In summary, adopting VoIP technology for a call center can reduce monthly expenses by up to 76.2% based upon the type of telephone usage. For new companies that start up with VoIP it can save on infrastructure costs and allow for easier growth of its call center. VoIP is definitely a low cost alternative for a company's telephone needs. In the beginning it was asked if the implementation of VoIP more economical for businesses with large call centers? Based upon the information, it would appear that VoIP is more economical. While there are many expenses involved, companies who have switched or implemented VoIP from the beginning are reaping the benefits of this newer technology.

Since competition is tight in the business market, companies with a large demand for telephone service should seriously consider utilizing VoIP telephone service to reduce telephone expenses.

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