

VoIP in the Small and Medium Business

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Abstract

This paper looks at the current state of Voice over IP from a technology manager's perspective. Specific attention is paid to the small and medium sized business which have up until recently been under represented in the VoIP market. In this paper both the positive and negative effects of VoIP implementation are considered to help the SMB manager make an educated decision about the appropriateness of VoIP in their own environment.

Introduction

The Small and Medium Business (SMB) sector is often ignored when new technologies are introduced. There are a number of reasons for this including such issues as scaling down products that were designed for larger enterprises and technical know how available to SMBs running with small technology staffs. Voice-over Internet Protocol (VoIP) is no exception to this rule. VoIP has been available to large companies for a number of years and many large companies have taken advantage of VoIP for its cost savings potential when making calls throughout the company and to its partners. This makes perfect sense. Larger companies typically operate their own private branch exchanges (PBX) so it is a logical extension to bring the long hall transport between offices into the company as well. VoIP makes this a cheaper option for these companies since there is no longer a need to dedicated leased lines between offices. This is a similar to the cost savings achieved by using VPN technology to replace leased lines for site to site network connectivity.

At the other end of the spectrum, home and small office/home office (SOHO) users have had VoIP options for a few years. These options started humbly with computer to computer solutions that transferred voice but did not allow for calling a phone on the public switched telephone network (PSTN). Currently there are a number of companies offering services that allow customers to use a regular phone and place calls over the Internet as easily as if they were using a POTS (plain old telephone service) line. Solutions geared to the SOHO market often do not scale up to accommodate all the features needed by a SMB.

SMBs have up until recently been left out of the VoIP revolution. For telecommunications a SMB is typically defined to have less than 250. Any company with less than 50 employees is typically referred to as a very small company (Eberle, 2005). SMBs have typically used either key telephone systems (KTS) or PBX switches for telephone connections. Throughout this paper I will refer to PBX solutions but unless I state otherwise it can be assumed I am referring to both PBX and KTS implementations.

SMBs typically fall into two categories when discussing technologies. Many SMBs are extremely conservative in their technology implementations. At the other extreme many SMBs see their size as an advantage because it allows them to be a flexible early adopter. Regardless of the preferred technology stance many SMBs have not had an option of implementing VoIP even when they were interested in the technology. For companies that have only one or two offices the cost of replacing or upgrading a PBX with a system that is VoIP capable is often not cost effective since even small PBX implementations typically run in the tens of thousands of dollars. Some SMBs that have numerous distributed offices have already found advantage in using VoIP solutions. These SMBs are not the main concert of this paper, but most of the points I will make will be applicable to these companies.

What is VoIP?

At its simplest VoIP is a method of using an IP network as transport for voice telephone calls thus bypassing the public switched telephone network. (Werbach, 2005) There are a number of reasons that VoIP is popular but the major driving force has been cost savings and increased functionality.

VoIP can be implemented in two different ways. The first and more established method involves the implementing company purchasing a VoIP capable PBX and VoIP module. This method has been available for a number of years now. This also has the maximum flexibility since it allows different calls to be handled in different ways. As an example, local calls outside the office can be send to the PSTN while calls to offices and partners that would typically require toll charges can be sent out over a VoIP connection. Typically an arrangement must be made ahead of time that allows VoIP calls between two different PBX systems so this type of solution works best when a company has offices or close partners that they are trying to connect. There are now options available that allow a company to connect to a service provider that will rout their VoIP traffic back to the PSTN allowing VoIP calls to be made to people who are not part of the companies VoIP infrastructure. These plans can be purchased at either a discounted rate lower than regular long distance prices or on a flat rate basis. This is a fairly new service offering in the corporate world.

The second approach, a softswitch, allows a company to take advantage of a VoIP infrastructure implemented by either a telecommunications or a data service provider without having to make in initial investment in a new PBX. A softswitch consists of a very large VoIP switch owned by the service provider that in turn has part of its capacity leased to end customers. This allows the end customer to have the functionality of a new VoIP PBX without the investment in new hardware.

A softswitch will typically integrate with the PSTN so the company purchasing service dose not have to concern themselves with the intriccy of deciding how calls will be handled. This allows the end customer to have VoIP without having the additional

complexity of having different calls handled in different ways. All calls are handled essentially the same until they get to the service providers softswitch at which point it becomes the service provider's responsibility to assure delivery of the call. Obviously, a softswitch does not offer all of the flexibility that is available through the use of a PBX owned and operated by the company.

The Current Status of VoIP

Voice over IP is gaining popularity with companies of all sizes. Much of this popularity is due to the cost saving available through the use of VoIP, but that is not the whole story. There is also a great deal of functionality that can be gained through the use of VoIP.

VoIP is continuing to improve at a rapid pace, but it is at a point that is stable and usable in a mainstream corporate environment. Much early VoIP implementation has been happening in the home market. Vonage, the largest VoIP company in the United States, has over 1 million users and is growing rapidly. (Vonage, 2005) In Japan over 10% of all homes currently use VoIP as a replacement for traditional landline home phones. British Telecom is planning to convert its entire infrastructure to VoIP by 2009. (Werbach, 2005) Looking at these numbers it is obvious that a large number of consumers are using VoIP as a replacement for traditional PSTN connections.

VoIP is not only being used in home and SOHO implementations. A large number of large corporations have been using VoIP for a number of years. The level at which corporations are using VoIP is increasing but it is still a minority of telephone usage.

As mentioned previously, easy availability of VoIP in the SMB market is a bit less established than VoIP in the enterprise and home markets. This is primarily due to

cost considerations. Due to the cost of replacing PBX systems SMBs have found it difficult to justify the cost of replacing existing systems even when they may have been able to save on long distance charges between offices. For the SMB that has one or two offices there has been even less incentive for VoIP upgrades. Companies offering softswitch service and less expensive plans that take VoIP traffic and route it back to the PSTN have grown out of the home VoIP market and made VoIP available to the SMB that is too large to use a product aimed at the SOHO market but too small to be able to afford enterprise solutions.

What can VoIP do for the SMB?

There are two major areas that VoIP shines. The first is cost savings and the second is the additional functionality available in VoIP solutions. Most of the statements I will make throughout this section will be equally true for companies investing in a VoIP enabled PBX or companies using a softswitch provided by their VoIP vendor.

Cost savings can be achieved by using VoIP because the PSTN is bypassed completely for many calls and at least partially for other calls. As an example, a call between two offices in Nashville, TN and Los Angeles, CA would typically be handled by the calling party seizing a line for dedicate usage on the PSTN. The local phone company would see that the calls is leaving the Local Access and Transport Area (LATA) so the telephone company would hand the call off to the customer's preferred long hall carrier (long distance company) who would in turn hand the call off to a local carrier in the called city. Each of these connections carries a cost since it makes exclusive use of the line used for that connection. The same call using VoIP will never touch the PSTN. The switch will see that the call is not leaving the VoIP network so it will simply

start sending network packets between the originating switch and the destination switch over the Internet. (Werbach, 2005) Internet connections are typically much cheaper than telephone circuits and are purchased on an unlimited usage basis that encourages maximizing the usage of the available bandwidth. In the PSTN each call gets a dedicated connection regardless of whether any data is being passed or not. In a VoIP call dead air does not get transmitted so pauses in the conversation do not continue to eat up valuable network resources. This further lowers the cost of VoIP service. This lack of transmission of dead air was a problem in many early implementations because people are not accustomed to a complete silence on the line when there is no conversation going on. Modern VoIP implementations create fake noise on the line based on previously observed background noise or generated line noise. This fake noise does not take up network resources since it is created by the receiving end node but helps to reassure the person on the line that they have not lost their connection. (Tett, 2004)

The second major selling point for VoIP implementations is the new feature set available with VoIP (Connolly, 2004). For a company using a PBX that is several years old some of the additional functionality may simply come from evolving feature sets but there are a number of features only available with VoIP solutions and new programs are being written every day.

It can be safely stated that nearly any feature currently available on a home phone line is available in a VoIP solution. That does not mean that every conceivable VoIP option is offered by every VoIP vendor or every VoIP implementation so any important features should be investigated on a vendor by vendor basis. Many features not available on home phone systems are available in some VoIP solutions. These features include

items such as unlimited flat rate long distance, one phone number ringing multiple phone, call auditing, hunt groups, and video conferencing among a number of other options.

A major advantage for VoIP implementations is the ease of configuration. Typically programming is done either from the phone or via a web interface eliminating the need for special programs and training. Another area that VoIP can improve efficiency as well as save money is in the ease of moving people in an office. With a traditional PBX if a person moves their phone extension must be physically moved and punched down in the phone room to allow their phone number to move with them. In a VoIP implementation the programming follows the handset. This being the case moving a phone from one office to another is as simple as unplugging the phone and plugging it back in in the new office. With many implementations the phone can even be taken with an employee when they travel. Traveling employees can also use a soft phone. A soft phone is software that is loaded on a computer and allows phone calls to be made as if the person had their regular desk phone with them. This allows the traveling employee to never need to be away from their phone as long as they can get access to the Internet.

The roaming abilities of VoIP have been used by some companies to improve their disaster recovery options. In the event that an office cannot be used employees can be moved to an alternate location with Internet access. Using either new handsets or soft phones the employees will be able to continue phone operations normally. This assumes that the switch is still in place. This is an advantage of the softswitch approach. Most telecom providers have much more resilient infrastructures than SMB offices so the likelihood of the service provider's facility being made uninhabitable is much lower than the same happening to their customers. Further, if a company's telecommunications

provider loses their facilities the resulting loss of service is the same regardless of where the switch is held or the technology used. This is one reason that careful evaluation of telecommunications providers is imperative. The exception to this is if company has their own PBX they do have the option of spreading their service across multiple vendors. The reality is this is rarely the case for phone service with even the largest companies much less SMBs. As a general rule softswitches improve disaster recovery options.

Issues inherent to VoIP

E911 service

Enhanced 911 service has been an issue for VoIP. There are a couple of reasons for this issue. The first is financial. Companies that offer VoIP in the home and SOHO markets have advertised almost entirely on a cost basis. E911 service is not cheap to configure especially when companies may not have a substantial amount of equipment in every city that they offer service in.

This has led to a number of horror stories in which people receive 911 operators in cities states away from their location. Due to the danger posed by this type of behavior the FCC has mandated that all VoIP vendors will implement E911 service and notify their customers of the limitations of the service offered no later than November 28, 2005. (Mark 2005). Even with E911 service being made available there are still issues that must be considered. If a traveling user dials 911 using a VoIP phone from somewhere other than the home location that the phone is registered to they will still not receive a local 911 operator for the location they are traveling to. They will receive an operator in their home location who will see information about their home location. For example if a traveling executive from Los Angeles is in New York City and dials 911 from a VoIP

phone the executive will receive a 911 operator from Los Angeles. This can be a problem if the caller does not know how to deal with this limitation. Generally speaking a warning of these limitations is enough since 911 calls can be placed from an alternate phone.

Quality of Service

Quality of service (QoS) can be a huge issue for VoIP if the network is not optimized for VoIP at all levels including the Internet connection. This has been a issued in the SOHO market where the Internet service provider (ISP) and the VoIP company are often not the same entity so the ISP does not have an incentive to treat VoIP traffic with a higher priority than other network traffic. This is not as much of a problem in SMB where it is more common to use the same company for Internet and VoIP services. The Internet connection must still be considered when traveling. When using a VoIP solution from home or in a hotel room there is no control over the prioritization of Internet traffic so there may be quality issues. Equally important is the LAN. Ideally switches and routers should be able to handle QoS queuing and prioritize VoIP traffic above other less time sensitive traffic.

In the absence of a proper QoS implementation there are a number of issues that can degrade the call quality. If the VoIP traffic is not prioritized the phone call may sound good but there is a chance that traffic will start to be delayed or dropped. This is a normal behavior in IP networks and not a problem when transferring time insensitive data since lost data packets will simple be resent and reassembled in the proper order. With VoIP it is important that traffic arrive in the correct order and without the need for retransmission. Any issue on the line can lead to unacceptable sound quality on the line.

(Tett, 2004)

Electrical Power

The handset in a VoIP solution requires a certain amount of power. This is not unique to VoIP but phones typically can pull their power needs from the phone line they are connected to. The Ethernet connection that a VoIP phone is plugged into does not typically carry voltage sufficient to power the phone. There are two options available to eliminate this issue. The first option is to simply use a power converted and plug the phone into an AC outlet for power. This is the easiest and cheapest solution but a bit strange to many people since we are accustomed to simple plugging a phone in and it working. The other option is using an Ethernet switch that handles power over Ethernet (PoE). PoE is not a common feature in switches but as VoIP and other solutions that make use of PoE become more popular switches with PoE capabilities are dropping in price. For a company looking to replace switches to gain QoS or other necessary functionality adding PoE may be an easy decision. For companies with an existing network infrastructure that is VoIP ready in other respects it may be difficult to justify the cost of replacing switches to gain PoE.

Security

Security is possibly the biggest stumbling block for VoIP. There have been security issues inherent in the use of PBXes but these issues have been specialized and well documented. Unlike PC networks where new vulnerabilities are made public on a daily basis phone systems have been fairly low interest targets over the last several years. A combination of the PC oriented nature and newness of VoIP has gained it a great deal of interest from the security community.

There are a number of practical and potential vulnerabilities that must be considered when looking at VoIP. Some of the issues are unique to VoIP and others are an extension of the data vulnerabilities that we have been dealing with for years.

The first of these issues, denial of service (DOS), is a simple extension of an existing data network issue. Possibly the easiest of all attacks against a network is the DOS or distributed denial of service (DDOS) attack. These attacks rely on resource depletion to cause the attacked system to quit handling legitimate traffic. (Vagle, 2005) This can be as simple as overwhelming the network with more traffic than it is capable of handling as is usually the case with a DDOS attack or attacking vulnerabilities in the protocols or software used. The DDOS attack is probably the most difficult to defend since it does not rely on the attacked party not defending against attack so much as being able to generate more traffic than the available bandwidth or processing power can cope with. This is doubly dangerous in an integrated network where the same connection that handles Internet traffic also handles telephone traffic. If an attacker decides to attack a web or mail server the phone system may be taken down as collateral damage thus essentially ending all outside communication for the company. On the other hand to launch an DOS attacks against a traditional phone system the attacker would have to either find a vulnerability in the PBX system or have enough phone lines at her disposal to continually call all of the lines and keep the lines tied up. When considering DOS attacks against VOIP it is also important to remember that attackers do not need to completely bring the network to a stop. They need only increase the latency to a point that conversations are no longer possible.

Spam over Internet telephone (SPIT) is still thankfully in the theoretical stages, but as more systems allow VoIP switches to connect to each other autonomously without the need to a PSTN layer this becomes a concern. The idea is that SPIT will combine the annoyance of telephone solicitation with the low cost and volume of spam to fill up voice mailboxes with unwanted offers. This is still a theoretical danger at the moment but as more VoIP implementations become available the reward for the spammer who finds a practical way to implement SIPT will increase. At the same time VoIP companies have a vested interest in keeping SPIT from becoming a reality so SPIT may never materialize are a real threat (Vagle, 2005).

Confidentiality is a concern with any traffic on the Internet. Since traffic crossing the Internet does not take a predefined route a rogue operator may be able to intercept voice communications and eavesdrop or even inject data into the conversation. Software for capturing and replaying VoIP traffic already exists. Some companies offering VoIP will guarantee that VoIP traffic will never leave their network. This is primarily a method of assuring QoS but it can also assure that calls are as private as a call made using the same companies regular phones lines. VoIP traffic can be encrypted but strong encryption that does not introduce noticeable latency is at best a resource intensive proposition. (Vagle, 2005)

There are a number of steps that can be taken to improve the security of VoIP implementations. VoIP and regular data traffic should be at a minimum logically separated to minimize any intermingling of data and voice traffic. Some experts suggest that the VoIP and data networks be operated separately. This has the disadvantage of losing much of the cost savings inherent in operating one network for both voice and

data. This separation will also be lost any time someone travels with her phone or uses a softphone on a network that is not controlled by the company. (Vagle, 2005)

Firewall rules must be carefully configured to allow VoIP traffic through but block unwanted connections. Stateful packet filters can help in assuring that unwanted packets are kept out of conversations. (Vagle, 2005)

As mentioned earlier, VoIP can be encrypted but care must be taken not to overtax the finite resources of network or CPU. An administrator turning on encryption can easily degrade call quality or even cause the system to become unusable. (Vagle, 2005)

Conclusion

VoIP has a great deal to offer to companies in both cost saving as well as introduction of new features and in all likely hood will continue to grow in popularity as more legacy systems are replaced. Some people have even stated that it is not a matter of if but when a company will transition to VoIP. (Tett, 2004)

A company must ask several questions when considering VoIP. Is the service offered in my area an acceptable replacement for PSTN? What do I stand to gain by moving to VoIP? Is there only a cost savings or will the company gain needed functionality not available in the current phone system? Is the current data network capable of handling the additional requirements as well as the additional data throughput of a VoIP implementation? How old is the existing phone equipment? A company with a relatively new PBX with several years of life left in it will find it more difficult to make a change than a company that is looking at having to upgrade to a new PBX. Is it possible to upgrade my current system to allow integration of VoIP alongside PSTN service? If

this is an option a hybrid approach may be desirable. Finally, can the company accept the additional risk inherent in an integrated voice and data network?

Any company regardless of size must consider these questions before making a move to VoIP. If existing PBX equipment will accommodate a hybrid system, it may be desirable to try using VoIP for either some workers or for certain classes of calls such as calls between locations within the company.

VoIP is a revolutionary new approach to telephone service and it is gaining new customers every day. VoIP should be a consideration as part of the periodic telecommunications review undertaken by any company, but VoIP is certainly not the right choice for every company.

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