IP Telephony from A to Z
Chapters One to Six

ebook

The Complete IP Telephony eBook

ShoreTel™

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This chapter highlights the benefits of IP telephony and discusses the costs in detail so that you can make decisions about your deployment.

The Benefits of IP Telephony

Chapter 1

One of the key drivers of converging voice and data networks is cost savings. Money can be saved, with the right IP telephony solution, in almost all areas—from deployment and management time and costs to ongoing toll and lease charges. IP telephony can also help your organization gain a competitive advantage, boost employee productivity, and enhance customer service. However, there are important considerations to analyze when deciding on a solution, including: equipment costs, which include the cost of the infrastructure equipment (voice switches) and handsets (analog or IP telephones or a mix of both); operational startup costs, including the time and resources it takes to plan, install and trouble-shoot the solution once it is deployed; and finally, maintenance costs, which includes the cost of labor to maintain the equipment plus whatever costs must be paid to the solution vendor for maintenance and upgrades. This chapter will highlight the benefits of IP telephony and go over the costs in details so that you can make decisions about your deployment.

The Savings

When you consider what most businesses pay for long-distance, you wouldn't see a huge need to move to IP telephony, necessarily. Large corporations can be paying pennies per minute for long-distance within the U.S. So while companies beyond North America may realize significant savings on toll charges, these savings are not usually enough to convince a North American company to switch to IP telephony.

Savings for most enterprise networks come from consolidating the voice and data network and using fewer circuits from the public switched telephone network (PSTN). In addition to circuit cost savings, as mentioned earlier, an IP infrastructure requires less time for moves, adds and changes (MACs) and often eliminates the need to hire an outside vendor or service provider to handle them. Moving an IP telephone station temporarily or permanently or adding a new user usually simply entails carrying out a quick and simple GUI-based command. With traditional PBX systems, moving an employee can cost hundreds of dollars in labor. In other words, with IP telephony, each user has their own IP phone profile and the network doesn't care where anybody is located at any particular time, so MACs are simply a matter of conducting a few commands and can often be easily handled by the user.

With IP telephony, management savings are usually immediate since the information technology team can support the voice network as well as the data network because they're now one in the same. There is no longer a need to have two teams of technical professionals to handle each entity, which adds up to tremendous savings. Further savings are seen right away when an enterprise needs to make a change, such as re-locating an office temporarily in the case of construction. The IT staff simply makes the changes from anywhere on the network (or remotely if need be) and a new temporary office is up and running without outside callers ever being the wiser.

Finally, infrastructure tools like physical ports are no longer needed for IP telephony because physical circuit-switched ports aren't necessary. An IP connected voice mail server is all that's needed.

All of these cost savings are tremendously appealing characteristics of IP telephony. When you add to them the features that are available for employees, call centers and receptionists, it quickly becomes obvious that IP telephony is going to continue winning converts.

The Added Capabilities

Call centers in many enterprises today are extremely expensive because dedicated buildings are often

built to accommodate the many staff members. When a company needs to add additional call center staffers, traditional PBX-based phone systems must also grow in blocks because ports are bought in groups, rather than scaling seamlessly with each new hire. These factors make call centers very expensive to maintain and scale. However, with an IP telephony solution, call centers can grow one phone at a time and call centers can span several buildings across many states. There is no longer a need for one huge building to house all of the call center agents. In addition, enterprises are able to leverage expertise across entire organizations, rather than hoping to find a highly skilled team in one location to answer incoming inquiries. With an IP telephony solution, a user can sign in from wherever they are (even at home) and is instantly online and available as part of the call center team.

Another customer service feature available in IP telephony solutions is the hunt group. This feature makes certain that all calls are answered by a live person rather than voice mail, which can be frustrating for callers. With various hunt groups enabled, a call into an organization rings extensions in a specified sequence or rings multiple extensions at once (depending on the company's preference), ensuring callers reach the person they need without navigating through menus or being forced to wait in a queue.

Remote sites are also easy to bring online. With traditional PBX systems, adding a remote site often requires adding a PBX extender, which can cost almost $1,000 per user for the equipment alone. With IP telephony, again, a user can log in from anywhere and have all the same capabilities as if they were working at headquarters or within the call center building. With IP telephony, to the outside world, it can seem as though you have call center locations scattered around the globe to be available 24/7, when really you are simply utilizing IP telephony features such as time-of-day routing and call forwarding to make sure calls are answered quickly by a live human being; these people can be working out of geographically-dispersed branch offices, at remote locations, or even at home. Callers always reach a qualified customer service representative, regardless of what time it is. You are also able to manage peak calling times by having the ability to add other employees, regardless of their location, to the call center to help meet the overflow demand.

With IP telephony, users can also easily re-route their calls so that they are reached wherever they will be working—they can make these changes themselves, without asking for IT assistance. This "find me" feature also enhances customer service as well as productivity by ensuring a caller reaches the right person, regardless of where he or she might be working. An employee can even program his or her extension to ring based on status—ring through when he or she is in the office, forward to a cell phone when there is no answer, or forward to a colleague when the line is busy.

The Customer Service Advantage

IP telephony offers organizations tremendous customer service value-add. First of all, IP telephony systems

provide thorough information right at the time a call comes in by popping data onto an agent's screen. This information can include the most basic of information, such as caller ID information. By integrating specific business applications with the IP telephony system, more in-depth information can populate the screen, including the caller's buying patterns, address, current account status, and more. Many IP telephony systems also provide for operators significant background information on the current caller's experience, such as where the call originated, how many times he or she has been transferred, and whether or not the right person is available to take the call. When the person is again transferred, IP telephony systems eliminate the chance of a caller being asked the same question twice (which is frustrating for callers, and frankly, poor customer service) because the most current information, including notes taken during the present call, populates the next person's screen.

IP telephony systems also allow organizations to implement skills-based routing, whereby calls are routed via an automatic attendant (attendant prompts the caller to choose from a selection) to the most appropriate agent based on criteria like language, experience, technical expertise, and other details. Advanced features that most service providers charge for are also available "free" with IP telephony, including three-way calling and a built-in conference call bridge. This can further aid in customer service when more resources are required to fulfill a customer request or inquiry, and it also allows conference call access by international parties, a feature most expensive conference call services do not provide.

Finally, IP telephony enables self-service options. For instance, when a caller simply wants to find out information about their own account, interactive voice response (IVR) within IP telephony systems enable callers to securely access that information by providing specific information. This eliminates the need for a call center agent to take time to answer a call, and it also eliminates the frustration that can occur if a caller is put in queue on hold for the next available agent to find out information that is readily available.

The Productivity Boosts

IP telephony productivity programs can often transform a company's desktop application, such as Microsoft Outlook, into a multi-media communications center for integrated messaging, providing such features as directory dialing, contact screen pop, caller ID, call waiting, and calendar integration. Employees have more control over both voice and e-mail messages, in one centralized system, and can forward voice mails to colleagues for improved collaboration and customer issue resolution. IP telephony system reports also keep a history of calls made and received, which is helpful in meeting various compliance regulations. Sophisticated features include on-the-fly document sharing and dial-by-name capabilities. Workers are dialing one another, conferencing, transferring calls between locations, and changing their voice mail preferences all with the click of a mouse. There is no longer a need to call the help desk to make such changes. The bottom line is that employees spend less time navigating complex telephone systems and more time performing critical, revenue-producing tasks.

Soft phones further free people from their desks, delivering telephony capabilities to any PC. With calls directed to a laptop and a headset plugged into the USB port, employees can work from anywhere using their computer and its built-in microphone. Employees who travel a lot appreciate the power and simplicity of a soft phone and customers appreciate not having to dial different numbers to reach someone who is traveling.

The Growth Factor

IP telephony systems allow for quick and easy scalability to accommodate new locations or growth within existing locations, as well as the ability to add people one at a time as needed, rather than investing in equipment that will handle more than an organization needs at the time. Scalability benefits also work downward: when an organization reduces its staff count, it is simply a matter of removing those users' profiles from the IP telephony solution. Companies are no longer tied to long leases for equipment that remains underutilized.

The Management Ease

The best IP telephony systems have intuitive browser-based management interfaces, allowing companies to manage the entire system—from switches to voice mail, automated attendant, and desktop applications—from anywhere on the network. The best management interfaces make adding a new user a snap and automatically update every switch and directory feature, including the dial-by-name and number attendant and online directory. System updates are also quick and easy, taking an hour or two at the most when vendors release new code.

In addition to managing the system itself, managing users and MACs is simplified tremendously. Employees can make most of the changes to their profiles without bothering the information technology professionals, and for changes that do require further expertise, IP telephony systems make it simple. There is no longer a need to spend time and money on having a service provider come in. These costs alone can save an organization thousands of dollars a month.

Nemertes Research, which is one of the few research firms that focuses specifically on IP telephony, suggests that you start the process by carefully assessing the size of your rollout. This consideration is not dependent on company revenue but how many stations you need the solution to support. You will analyze solutions for the time it takes to install these stations, and estimate your growth and how your particular solution's scalability will affect the deployment.

The Costs

Nemertes Research interviewed IT professionals from a wide variety of companies and analyzed four leading vendors in specific areas, including total hardware costs, network upgrades, IP handsets, management tools, and conferencing/collaborative applications. From these in-depth interview came a comprehensive report entitled, "Convergence & Next-Generation WAN Technologies" (February 2006). This section will look at some of the costs involved in an IP telephony solution deployment, as well as provide high-level results of the interviews conducted.

Some Features Available in IP Telephony Solutions (not comprehensive)

- Business application integration (for instance, tying IP telephony to CRM database)
- Calendar integration
- Call waiting
- Caller ID
- Click-of-a-mouse simplicity—employees make or transfer calls right on their computer
- Conference call capabilities with on-screen document sharing
- Contact screen pop and comprehensive information about each caller
- Desktop application (i.e., Microsoft Outlook) integration
- Dial-by-name capability
- Features easy to navigate for users
- Four or five-digit dialing to anyone, regardless of location
- Mobility—users can work from anywhere
- Three-way calling

Capital costs are obviously the first line of investment for an IP telephony implementation. This is determined based on how many locations and users you have and a knowledgeable and experienced integrator can help you with this. How many switches and telephones will you need? If you need to, make sure you can phase the solution in over time and use your existing analog lines for some amount of time before switching to IP handsets. Nemertes Research calculated the cost of capital per user, by vendor solution (see Figure 1.1 below).
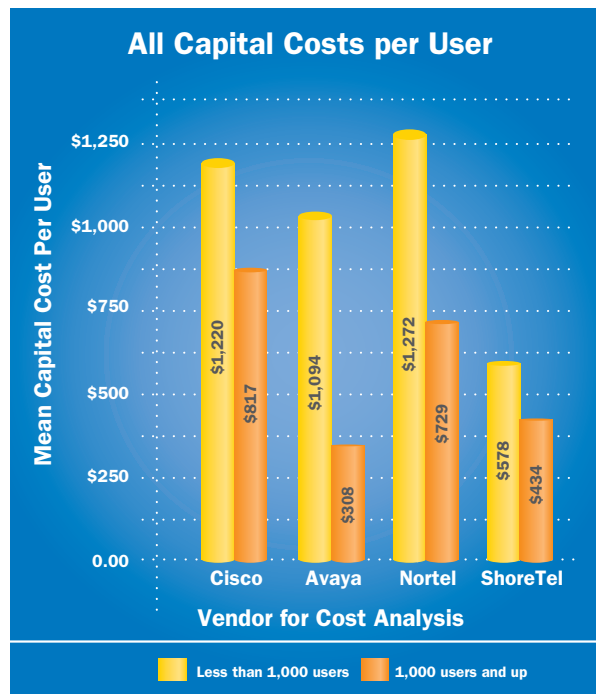

All Capital Costs per User

Figure 1.1 | All Capital Costs per User, by Vendor
Source: Nemertes Research

The planning and design phase of any rollout is one of the most important. Consider your team and think of how you will divide up responsibilities. Also, consider whether you will need to add to or reduce your team size. For the implementation, decide on a few team leaders who will commit to making themselves available in the off-hours when necessary until the deployment is complete. The best solutions are easy to implement rather quickly and seamlessly, but you will still want some key people available throughout the deployment.

Installation is the time it takes to physically deploy and configure the solution—it does not include training. Again, consider carefully who is available to help with the installation, taking all things into consideration such as work schedule flexibility, knowledge and expertise, and the ability to work under pressure. Consider your business and determine the best time to deploy the solution and when it will be easiest to switch over to the IP telephony solution.

Next up is troubleshooting—the time it takes to make changes immediately after the deployment until it works properly. Who is going to be available throughout the deployment right up until the minute you determine that everything is working perfectly? Consider the first few days and how you'll staff the help desk around the clock with people who are substantially knowledgeable about the infrastructure, the configuration, and the features of the handsets.

Next up are the costs for staffing to support the new implementation on a regular basis. How easy is it for your current staff to support the new IP telephony system? Generally, it is very easy for existing network staff to support IP telephony solutions because they work on the data infrastructure, which is what they already know well.

Management is the next cost consideration. What are your staff members doing each day to support the solution? Can things be handled in-house, without wasting time and money on an outside vendor or service provider to handle personnel MACs? According to Nemertes Research, MACs become very easy with IP telephony: Research participants estimate the time involved for an IP MAC at a mere 10 minutes or less, compared to the 30 to 90 minutes required for a TDM MAC. This means that total cost savings, depending on the average number of MACs at a given organization, can be significant.

Nemertes Research ultimately calculated the total cost of ownership (TCO) for IP telephony solutions from leading vendors (see Figure 1.2 below). These numbers were calculated considering all of the costs listed above. This gives you an overview of costs for each vendor's solution based on the implementation size.
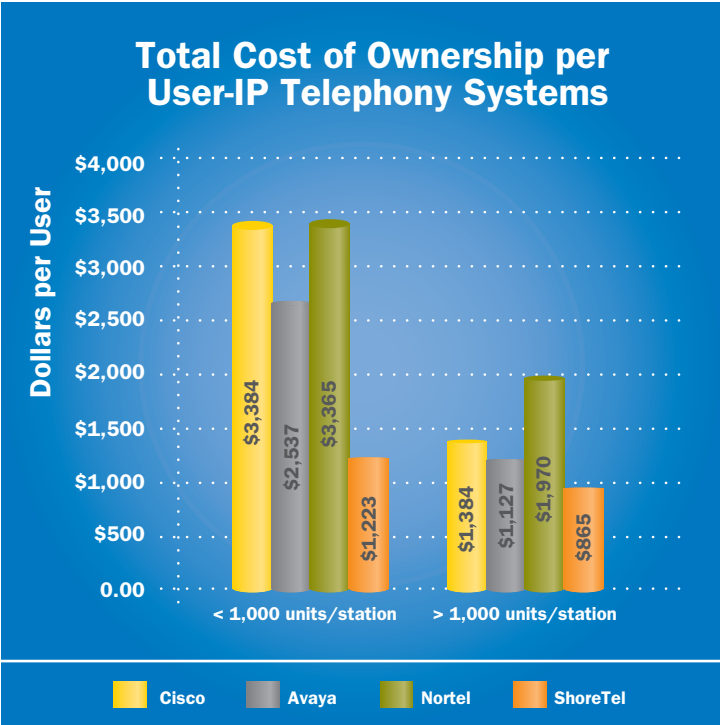
Figure 1.2 | TCO per User
Source: Nemertes Research

Ready to Make the Switch?

IP telephony is the way of the future, according to Nemertes Research, for a number of reasons. First, vendors are no longer investing research and development dollars into legacy TDM equipment. Second, IP telephony has simplified communications for numerous organizations and their positive results have been shouted from rooftops (or at least highlighted in well-respected trade journals). With TDM, there's no interoperability, transferring between offices is not an option, and employees are often on different voice

mail systems so forwarding messages is not possible. With IP telephony, companies instantly improve productivity with robust feature sets such as built-in conference call capabilities, four-digit dialing across locations, call center capabilities, and integration with desktop applications. Because of robust features like the ability for an employee to log in from any phone, employees are not tied to a desk.

A Network World special report suggests that organizations should consider transitioning to IP telephony when:

- They are using IP Centrex lines that will support phone and Internet service on the same network. Moving to IP telephony will immediately reduce costs because these lines are so expensive.
- The organization is moving to a new building. Since the wiring does not yet exist, it's simple to create a consolidated data and voice network.
- They are coming to the end of a PBX lease agreement or the current phone system is outdated, obsolete or unsupported by a vendor or service provider.
- The company has offices in different area codes and employees dial a lot of long-distance numbers. The reduction in toll charges will be immediate and significant.

You will also want to consider IP telephony for your organization if:

- Your locations shift in size often
- Locations are added regularly
- You have a relatively small technology staff
- You use a great deal of outsourced telephony services that are beginning to add up
- Many of your employees frequently work remotely

Once you've evaluated your organization carefully, analyzing the costs of your current telephony solution along with your employee productivity and customer service needs, and decided that indeed, IP telephony is the way to go, the next chapter will help you with the vendor evaluation and selection process.

The Decision: Vendor Evaluation and Selection

ShoreTel

This chapter provides you with resources to help you evaluate and select IP telephony vendors.

The Decision: Vendor Evaluation and Selection

Chapter 2

You've made the decision to go with IP telephony after careful consideration, but if convergence is new to you personally and to your organization overall, the decision is likely accompanied by worry and concern about making the right choices. Your choice of technology vendor for this transition, as in any decision, is one of the most important. InfoTech, a recognized leader in project consulting and global research in over 90 countries worldwide, thoroughly researched how enterprise decision makers choose their vendor and reported on its findings in a report entitled, "Strategies for IP Telephony Evaluation and Migration" (April 2005). This information will be of great benefit to you since those interviewed by InfoTech have successfully deployed various new technologies, including IP telephony.

Expectations

InfoTech reports that enterprise decision makers generally have three main areas of expectation that help them choose the right vendor. These are areas you'll want to consider as you embark upon the vendor evaluation phase.

1. Convergence experience, expertise and vision
2. Expert, responsive support
3. Customer-focused approach to business

Convergence experience, expertise and vision

Look closely at vendors to determine whether or not they are committed to IP telephony. Have they built their solution as a true IP telephony system, or are they jury-rigging an old PBX-based solution to "look like" an IP telephony solution? Are their solutions built with flexibility, scalability, and longevity in mind? Will you have to completely rip out your old phone system and move to IP telephony in one fell swoop, or has the vendor built its solution with a phased approach in mind for those organizations that need to replace their phone system over time?

Expert, responsive support

When you're working with a vendor during the early stages of consideration, try reaching their technical support team during off-hours. Do you have easy access to technical support representatives and a full range of maintenance and support services? Have they committed to working closely with you during initial deployment as well as future and ongoing projects? While you'll almost certainly have quick and easy access to a sales representative and possibly a pre-sales engineer during the evaluation phase, you need to find out how you'll be treated once you've already deployed your system. Is vendor responsive-ness just as good for customers as it is for prospects?

Customer-focused approach to business

This area focuses on the vendor's commitment to your success. Don't let vendors come into the proposal using a hard sell approach. If they do, they aren't demonstrating a commitment to your success but rather a commitment to their own success (meeting their quota). For real proof points, ask to see a list of the company's latest customer installations and ask if you can speak with those customers. If things have gone smoothly, they won't hesitate to let you talk to a customer in the early phase of their deployment. Don't settle for just a list of customers that have been using the vendor's system for years. Call early phase customers and ask them if the vendor is still in close contact with them, calls to proactively find out about the installation, and provides onsite support at a moment's notice during the deployment.

InfoTech found that while many companies vary in why they choose IP telephony, most enterprises have found the most common anticipated benefits as:

1. Lowering total operating costs
2. Enhancing end-user productivity
3. Improving IT organization efficiency
4. Reinforcing market differentiation and brand image

Choices, Choices

In their 2006 report, "Convergence & Next-Generation WAN Technologies," Nemertes Research provides a comprehensive and unbiased look at what organizations are doing specifically in terms of which vendors they choose. It is an independent and impartial report that translates mountains of data into succinct information organizations can use for convergence planning. The firm collected information by conducting in-depth interviews with IT professionals from a wide variety of companies of various sizes spanning many industries. While the industries varied greatly, all of the respondents had a similar interest in IP telephony and were committed to making technology investments that enhance productivity and the bottom line and prepare their organizations for the future. Nemertes Research presents an overview of how the respondents have assessed IP telephony solutions and how they eventually selected a system vendor. Included in the report are recommendations about which vendors to consider, including a complete IP telephony system vendor analysis, how to thoroughly evaluate all of the solutions available, how to plan for convergence, and how to actually conduct the rollout.

Vendors Analyzed

Organizations in the past have had few vendors to choose from. According to Nemertes Research, today there are more than 25 vendors and carriers out there to meet IP telephony needs. The increase in competition means more innovation and better products from a wider selection of companies. Nemertes Research analysts established that the most frequently evaluated IP telephony system vendors today are: Avaya, Cisco, Nortel and ShoreTel. The following section will highlight each of those vendors, but keep in mind that there are at least a dozen more to evaluate, depending on the size and particular needs of your organization.

Avaya

Avaya offers IP telephony solutions with its IP Office and MultiVantage solutions, which include IP telephones, as well as voice switches, media gateways, communication servers, wireless telephones, communication applications, and more. According to Nemertes Research, Avaya's key strengths are its product features, technology, and overall performance, while weaknesses, according to respondents, fall in the areas of customer service, ease of use (installation and troubleshooting), management tools, and VAR expertise.

Cisco

Cisco is a recognized network infrastructure equipment leader and offers IP telephony solutions under its Unified Communications family. Products include switches, telephones, communication applications, and more. Nemertes Research notes that Cisco's overall performance and technology areas have been rising steadily, according to respondents, while product features have left much to be desired. However, many networks are built on Cisco networking equipment and it would be hasty to overlook the company during an IP telephony vendor review.

Nortel

Nortel offers more than IP telephony solutions and has been around since its 1895 founding as Northern Electric and Manufacturing, supplying telecommunications equipment for Canada's telephone system. Nortel was the first networking vendor to provide an end-to-end IP telephony solution certified by the U.S. Defense Department Joint Interoperability Test Command (JITC) in 2004. For 2005, Nortel's top areas, as noted by Nemertes Research, were performance, product features, value, and customer service. Its weaknesses, according to respondents, were in the areas of ease of installation, VAR expertise and management tools.

ShoreTel

ShoreTel offers end-to-end IP telephony solutions including its ShoreGear voice switches and ShorePhone IP telephones, as well as communication applications, call center functionality, and more. ShoreTel scored highest in all categories studied by Nemertes Research. Four specific areas in which the company excels are value, technology, ease of installation and troubleshooting, and performance. The company's areas for improvement included management tools, solution experience and VAR expertise.

Issuing the RFP

If you work with a network integration partner or consultancy, you may want to call on them to help you with the Request for Proposal (RFP). You may also request a sample RFP from any of the vendors you'll be evaluating, but be careful to go through and make sure the one you use is comprehensive and not skewed toward any one vendor. If you decide to write the RFP yourself, here is an outline on how to go about it.

RFP: From Concept to Paper

Assemble your RFP team. Be sure and include an IT representative, a budget specialist, and any senior executives in charge of departments that will use the technology extensively (sales, telemarketing, etc.). This team should be briefed on the IP telephony project and should understand what new capabilities such a solution will offer so that they are informed enough to give you an extensive "wish list" for features that will make them more productive.

1. Select a project leader. This person should be experienced in networking and IP telephony, if possible, and should be able to answer basic technical questions related to the technology, if not the specific vendor solutions.

2. Assess what you need from the IP telephony solution.
   - Evaluate the current situation, including costs, etc.
   - Identify key goals.
   - Review most common product capabilities and decide on the importance of them.
   - Determine if there will be training required.
   - Estimate the cost of the project.

3. Record your requirements, goals, and recommendations in a tentative plan.

4. Present your plan to the appropriate organizational leaders (executive management, financial department, etc.). Get their input before writing the proposal.

5. Write the proposal. A typical proposal contains:

- A summary of the proposal.

- A statement of what you need – the reason you're looking for a new solution. Include every capability the RFP team has mentioned—be sure and get input from executives, managers, and staff level employees so that every need is met. Do not overlook the obvious and assume that every vendor provides one specific capability (you know the saying, "do not assume anything"). Conversely, what is missing from the current telephony solution should also be noted.

- A weighted ranking of all of the capabilities and features should be included (see figure 2.1 for a sample weighted ranking worksheet). Be specific in the features/capabilities list and avoid "buzz" words that each vendor could define differently. If necessary, describe any word that could be misconstrued, such as "availability," which vendors often define differently. Again, don't assume. Include every single capability that you need. The list should be exhaustive. In other words, don't omit "voice mail boxes for every employee" from the list because you assume all vendors provide them.

- A description of how the project will be implemented and evaluated.

- Provide information about your organization and its technology goals.

- Include a project schedule. Indicate when you want the new IP telephony solution in place. Provide details on how you want to implement: in phases, within three months from the date of selection, etc. Be sure to include how you want each phase to be implemented so that you get as much out of your old equipment as possible and extend the life of existing equipment and handsets.

- Provide an approximate budget.

- Conclude the RFP with specific open-ended questions for vendors, such as:

  » What is your approach to training? Where is training held and how long does it take? Will the price of the solution cover travel time and expenses for your staff to attend if it is offsite?

  » Is there a guaranteed response time for support calls? How will your system be updated? Is telephone support all that's covered in maintenance fees or are other things covered? Is there an option for hourly support? How many support staffers are on call 24 hours a day? Does the solution contract come with a support guarantee?

  » What is your history? How long has your company been in business? How many customers do you have? How many new customers have you signed on in the past year? The past six months? Are there any current merger discussions?

  » What about customer references—to whom can we speak? Beyond happy customers, ask to speak with the most recent customers. A reputable company should be able to give you references from the most recent three-month period.

  » How are upgrades handled and what are the typical costs involved? Also, ask what the process is for a customer to make suggestions and specifically ask if they can name some features that were a result of suggestions from users.

  » What kind of "bake-offs" and industry reports mention your company? Ask for references in the form of reputably published reports and articles.

6. Submit the proposal to the vendors you've selected in your long list. Your integration partner or consultant, if you have one, can help you with this process, or simply e-mail or fax it to your vendor list.

Seeing is Believing

The next step, after issuing the RFP, is to closely review the proposals from each vendor. It will be helpful to use a weighted ranking system to score each vendor based on your long list of requirements. First, rank each requirement based on the vendor's answer to your checklist items. See Figure 2.1 for a sample worksheet.

	Step 1	In Theory	

Ranking
  0=unsatisfactory
  10=excellent
	This section is where you will simply note whether the vendor offers specific capabilities		

Criteria	**Answer**	**Score**	**Weight**	**Extended**
Cost of solution includes hardware, software and installation	No	0	10	0
Years in business	7	8	10	80
Number of customers	200	9	10	90
Solution can be implemented in phases	Yes	10	8	80
Support 24/7	No	0	9	0
Guarantees 4-hour replacement	Yes	10	8	80
Offers wireless solution	Yes	10	7	70
Features				
Voice mail for unlimited extensions	No	0	10	0
Centralized management of e-mail and voice mail	Yes	10	8	80
Intuitive GUI that simplifies MACs	Yes	10	10	100
Call forwarding	No	0	10	0
Caller ID	Yes	10	10	100
4 or 5-digit dialing across locations	No	0	10	0
Workgroup capabilities	Yes	10	9	90
Hunt capabilities	No	0	9	0
Call center capabilities	Yes	10	10	100
In-depth information about caller "pops" onto screen	Yes	10	8	80
Ability to integrate an IP telephony system with other business apps	No	0	10	0
Least-cost routing functionality	No	0	10	0
Score				950

Figure 2.1 Sample weighted worksheet for vendor evaluation—not an exhaustive list.

Next, ask to see a demo and request a sample set-up to test the solution in your office so you can revise the score based on actual experience. Once you have seen a demo or tested the solution, revise your weighted worksheet to reflect your actual experience. See Figure 2.2 for the revised worksheet and score.

Ranking 0=unsatisfactory 10=excellent	Step 1	In Theory This section is where you will simply note whether the vendor offers specific capabilities			Step 2	In Reality This section is where you will score each vendor's capabilities after testing		
Criteria	**Answer**	**Score**	**Weight**	**Extended**		**Score**	**Weight**	**Extended**
Cost of solution includes hardware, software and installation	No	0	10	0		0	10	0
Years in business	7	8	10	80		8	10	80
Number of customers	200	9	10	90		9	10	90
Solution can be implemented in phases	Yes	10	8	80		10	8	80
Support 24/7	No	0	9	0		0	9	0
Guarantees 4-hour replacement	Yes	10	8	80		10	8	80
Offers wireless solution	Yes	10	7	70		10	7	70
Features								
Voice mail for unlimited extensions	No	0	10	0		0	10	0
Centralized management of e-mail and voice mail	Yes	10	8	80		3	8	24
Intuitive GUI that simplifies MACs	Yes	10	10	100		4	10	40
Call forwarding	No	0	10	0		0	10	0
Caller ID	Yes	10	10	100		8	10	80
4 or 5-digit dialing across locations	No	0	10	0		0	10	0
Workgroup capabilities	Yes	10	9	90		8	9	72
Hunt capabilities	No	0	9	0		0	9	0
Call center capabilities	Yes	10	10	100		7	10	70
In-depth information about caller "pops" onto screen	Yes	10	8	80		4	8	32
Ability to integrate an IP telephony system with other business apps	No	0	10	0		0	10	0
Least-cost routing functionality	No	0	10	0		0	10	0
Score				950	Revised Score			718

These scores remain the same.

Figure 2.2 Revised sample weighted worksheet for vendor evaluation, with experiential scores—not an exhaustive list.

Decision Factors

Once you've collected all of the information and carefully evaluated your chosen vendors, including the four leaders, think carefully about your organization's priorities in general, and carefully consider the following qualities so you can clearly articulate your requirements in these areas as you approach your final decision. These are areas which InfoTech has determined enterprises consistently rank as top priorities.

High system reliability/availability

Do the vendor's products include redundant components in the case of a failure? Are there ways to re-route calls around a failed switch, for instance? Is there a threshold past which the system's performance will degrade? Ask for specific examples of each vendor's system maintaining availability under the harshest circumstances. Ask customer references specifically about how reliable the system is.

Equivalent voice quality to TDM

You don't want your own customers to call your organization and know right away that you're using something of lesser quality than a TDM system. Ask the vendor if it's possible for you to go to a customer site and listen to actual phone calls to evaluate the voice quality yourself. Or ask customer references specifically if anybody knows they are on an IP telephony system or if it is assumed that it is a traditional system. Customers are usually willing to share the downside of the solutions they've chosen, as well as the upside.

Easy scalability

Make sure that the vendor you choose knows exactly how you will need to scale the system for your specific needs. For instance, if your organization often grows and shrinks during different times of the year or in some other cyclical manner, ask how new users would be added to support your growth needs. Will new hardware need to be added and removed each time you grow and shrink? Or will the system support your needs up to a certain point, regardless of how many times you change size?

Multi-vendor interoperability

Some vendors are known for requiring a full infrastructure overhaul to accommodate the new IP telephony system. Be certain that you can use your existing network equipment with the new solution, and make sure that when you add new gear, you can do so without needing to consider the IP telephony system. IP telephony is only beneficial if it's truly part of the network and it doesn't bring you new headaches or worries further down the line.

Full suite of communications features & business-enabling applications

Cost savings, as discussed in chapter one, are not simply a result of toll charge avoidance. Most cost savings come from the additional features that you get with an IP telephony system. Will the system provide value-added services like call history logging, conference call capabilities, document sharing, follow-me features, etc.? Compare the checklist of capabilities of each system. This is not to say you should simply compare how many features, but rather decide on which ones are most important to your organization and come up with the vendors that meet the majority of your requirements. A simple ranking system for each system offering should work well (see Figures 2.1 and 2.2 for an example using a 1-10 rating system).

Ease of implementation/management/maintenance

IP telephony systems should make life easier for the IT team, not more difficult. Because the new system works on the existing network, everything is managed similarly. If management of the

IP telephony solution is not straightforward and intuitive, how long will it take your team to ramp up to the point that the system will be supported adequately? It's imperative that changes be made quickly and easily so that the addition of a new system doesn't add burden to busy IT personnel. Some of the most important factors of convergence are how it simplifies life and how it saves organizations in terms of management time and money. Does your staff need to train with the vendor every month, and can you afford their time out of the office? How difficult is it to train users on features of the system, and will they be calling for help more often than usual because of the IP telephony implementation? In reality, users should be calling your help desk less frequently with a new IP telephony system. Even employee moves, adds, and changes (MACs) should be simple for either the user or one IT staff member to make within a few minutes. You should also no longer need a service provider to make these alterations for you—this will save you money and time.

Efficient, integrated multi-site networking

You will want to make sure that architecturally, your solution is built around a distributed design. A centralized solution that distributes applications over the network to other sites is inefficient as far as consuming capacity on the WAN. If a vendor is proposing a centralized approach and suggests "simply adding bandwidth" as the way around reliability issues, remember that bandwidth costs are not insignificant and insist on a solution that is designed for optimal bandwidth utilization. Multi-site organizations inherently require a distributed, as opposed to centralized, solution.

Favorable overall cost and payback interval

You can use information from Nemertes Research "Convergence & Next-Generation WAN Technologies" report to compare total cost of ownership data for the four leading vendors (Avaya, Cisco, Nortel, and ShoreTel). Nemertes Research analyzed these vendors in specific areas, including total hardware costs, network upgrades, IP handsets, management tools, and conferencing/collaborative applications, calculating the total cost of ownership (TCO) by vendor solution (see Figure 2.3).
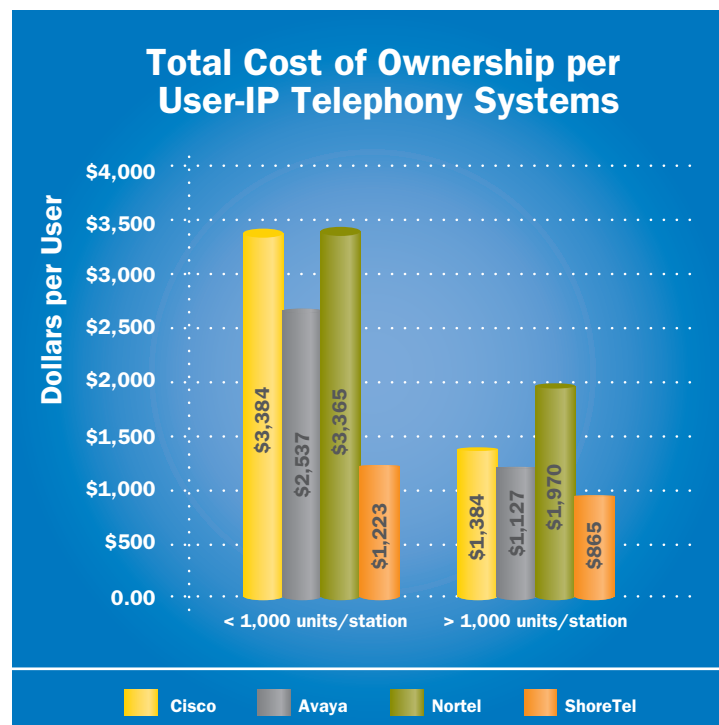

Figure 2.3 Total Cost per User   Source: Nemertes Research

Last but Not Least: Ease of Use

Another factor you'll want to consider carefully is ease of use for end users. While you will undoubtedly need to familiarize employees with the system, training should not be cumbersome or lengthy. The IP phones and call control software should be intuitive and easier to use than the analog phones being replaced. Features like on-the-fly conference calling, drag-and-drop call transferring, and the forwarding of voice mail messages via e-mail should be simple for employees, even those who cannot attend training and have to learn the system on their own. You will likely have remote users logging in and using the system, and it will be difficult, if possible at all, to get those people to a training session. In these instances, you'll appreciate a solution that users can easily navigate so they come up to speed and begin capitalizing on features that enhance your company's employee productivity and customer service as soon as possible.

The Bottom Line

The most important things for you to remember during the evaluation process are the main business drivers of convergence. Make sure the vendor you choose is committed to making these perceived benefits a reality for your organization:

- Lowering total operating costs
- Enhancing end-user productivity
- Improving IT organization efficiency
- Reinforcing market differentiation and brand image

The next chapter will explore the IP telephony implementation from beginning to end, starting with research and vendor evaluation and ending with the actual deployment, and will include a helpful timeline for you to use.

Planning:
The Implementation Calendar

ShoreTel™

This chapter provides you with a high-level timeline for the implementation, from research to actual deployment.

Planning: The Implementation Calendar

Chapter 3

Roadmap to IP Telephony*

12 Months	Read, Learn, and Ask (read about the technology, ask experts)
10 Months	Head for the Internet (scour vendor websites)
9 Months	Call in the Vendors
8 Months	Demonstration and Trial Period
7 Months	Do an Inventory
6 Months	Request Vendor Proposals
5 Months	Choose Vendor
4 Months	Gauge your Network's Readiness
1 Month	Pilot Installation and Testing
0 Days	Go Live

*This schedule can be accelerated to fit needs. For instance, if your organization decides to move locations and the timing is right to implement IP telephony, this schedule can be altered to fit a three month schedule.

The Road to IP Telephony
12 Months to Deployment: Read, Learn, and Ask

The first step is research. The fact that you've reached this chapter in the book indicates you are fairly certain about deploying IP telephony at least sometime in the future, if not the near future. It is best to be making that decision about 12 months before you want to deploy a new phone system, IP telephony or otherwise. At this time, you'll want to get your hands on as much unbiased research and as many reports from reputable consultancies as possible. Read the research with the goal being to decide if IP telephony is right for you. For now, pass up reports that talk about vendors, and get your hands instead on technology articles, technical papers, industry event presentations given by independent technologists or long-term experts, etc.

The following resources can be helpful in your search for IP telephony information.

- CIO Magazine (www.cio.com)
- Network Computing (http://www.networkcomputing.com)
- Network World (www.networkworld.com)
- VoIP Magazine (www.voip-magazine.com)
- ComputerWorld (www.computerworld.com)

Trade magazines and their online counterparts do cover vendors, of course, but you can find unbiased technology primers and overviews. It's also helpful to read customer case studies about deployments to learn about the experiences of those companies that have deployed IP telephony. Read case studies for technology tips first, vendor specifics second.

After you've searched on the Internet and leafed through your stack of technology publications, invest in some time with industry experts and analysts. For lengthy conversations, you may have to invest more than time—research analysts can be hired on a project basis to provide you with valuable information and insights. But be sure to keep a keen ear out for biases because often analysts are paid consultants for specific vendors and because they know the vendor, they'll tend to reference them more often than others. Keep your questions, at this point, in reference to the technology. Learn all you can from these experts about organizations like your own that have deployed IP telephony, what their specific challenges were, and what the results have been.

10 Months to Deployment: Head for the Internet

After you've completed your technology research, visit the web sites of the vendors you've heard about. Read about offerings from the industry leaders Avaya, Cisco, Nortel and ShoreTel. Learn about smaller companies and what the benefits and drawbacks to their systems are. It's recommended to take and keep good notes so that by the time you're looking at the eighth vendor and you've forgotten which solutions do what, you'll have detailed notes to refer back to. This is where you want to establish a long list and then whittle it down to a short list.

You'll read about each solution with your own organization in mind. Jot down questions as you click through vendor web pages. You may get the answer to the question quickly, or it may remain on your list until you eventually meet with the vendor. If your organization has many offices across the United States, for instance, look at solution descriptions with scalability, flexibility, and ease of deployment mentioned early. If your organization rarely changes in size and has a limited number of telephony requirements, look for solutions that offer the basics at a very affordable price point.

Next, create a checklist or table with some common features. For instance, most IP telephony solutions offer standard features like caller ID and three- or four-digit dialing. As you exhaust the common feature list, start adding unique features that matter to your organization. Learn (or try to learn) what differentiates each vendor you're considering. If you save the differentiation for the vendor presentation, you likely will get a skewed answer to the question, "What makes your solution different and superior?" This checklist is just the beginning and you won't do anything with it until the RFP phase.

Read articles about each vendor and mark items off your checklist as you determine what each offers. Start with articles that the vendor links to (usually found under headings like "press coverage," "news coverage," "case studies," "success stories," and "customer solutions" on the website). However, vendors obviously will only highlight their true success stories. Use an Internet search engine to do a little sleuthing yourself—you may find three or four stories about users' unhappiness with a certain vendor. Dig for the dirt. Use all of this information for your checklist and research notes.

9 Months to Deployment: Call in the Vendors

After you've looked at your checklist and decided three or four vendors probably offer the best solutions for your organization, invite each of them to come in and give you an overview of their solutions and a demonstration if possible. You will hear a sales pitch, of course, but you may also hear features you hadn't learned about, or you may hear the names of customer references that have organizational needs like yours. Whenever a sales person drops a customer name, ask for the contact person to speak with after the vendor presentation. If you are told the customer cannot be a reference, (which is understandable—many

companies will not speak as a customer reference by policy), ask for a similar customer that you can speak with. If your organization is a bank with 23 branch offices, ask to speak with a similarly sized bank reference. If the vendor is not able to give you even one customer reference right away, take note and be cautious.

8 Months to Deployment: Demonstration and Trial Period

After you've seen each vendor's presentation (and possibly after you've spoken with customer references), inquire about an onsite demonstration and also a trial period. Some vendors, after they've shown you how their system works, are willing to deploy a sample set-up so you can test the solution in your office. Some vendors give you just a few days or a week. Often, as the trial period nears the end, you can easily get an extension just by asking. A reputable vendor does not put a deadline on your decision. They want you to be happy with your choice of their solution; an extended trial period is not a huge cost to them.

Crucial Tasks - Do Not Skip

- Talk to multiple customer references: insist on recent customers as well as success stories.
- Get each vendor to bring an RFP into your office, in person, to discuss details.
- Talk to colleagues at other organizations that have deployed VoIP (beyond vendor references).
- When you're close to choosing vendor, obtain equipment for a trial period.

7 Months to Deployment: Do an Inventory

Assessing your current network is crucial to a successful IP telephony deployment. There are a number of things to keep in mind and questions you'll want to answer about the organization's telephone usage. The following checklist will help ensure you think of everything.

1. **Determine your business requirements.** How will the system be used? How many calls per month (or day) are made out of your office? Are those calls to customers or internal employees? How many offices will you have on a system? Are there remote offices to consider?

2. **Look at your LAN.** What equipment are you using? Do you have an up-to-date network diagram? Is the equipment current or outdated? Are you using Virtual LANs (VLANs) for security or performance issues? VLANs improve voice quality by prioritizing voice traffic.

3. **Assess your WAN.** How much WAN bandwidth do you have between offices? How many home or remote offices do you have and will you need dedicated circuits or will DSL suffice? Consider whether managed IP services are a fit for your organization as an alternative to traditional dedicated circuits.

6 Months to Deployment: Request Vendor Proposals

If you work with a network integration partner or consultancy, you may want to call on them to help you with the Request for Proposal (RFP). You may also request a sample RFP from any of the vendors you'll be evaluating, but make sure the one you use is comprehensive and not skewed toward any one vendor. If you decide to write the RFP yourself, chapter 2 of this book includes an outline on how to go about it.

The next step, after issuing the RFP is to closely review the proposals from each vendor. It will be helpful to use a weighted ranking system to score each vendor based on your long list of requirements. Again, see chapter 2 for ideas about creating these checklists and spreadsheets. After you've narrowed down the vendors to a short list, ask to see a demo and request a sample set-up to test the solution in your office. Most vendors will give you a free trial period so you can get more comfortable with the system.

Once you've collected all of the information and carefully evaluated your short list of vendors, think carefully about your organization's priorities in general and start talking to customers. Be sure you get customer references that have similar networks and similar business requirements to your own organization. Again, ask to speak with recent customers: It's easy to give you a list of happy customers. Ask for a list of the most recent customers signed on—within the last three months, for instance—and call them about their experience.

5 Months to Deployment: Choose Vendor

After you've taken all these steps, created a feature checklist, and determined which vendor best meets your feature/functionality requirements, you should be ready to make the decision. Be sure and ask any remaining questions before you indicate that you are leaning towards that vendor. It is very important to review the vendor's website, including where they post press releases. If there have been any recent upgrades or new product announcements, ask how customers are responding and call customer references again. This will give you the freshest input, and you'll be able to make the most educated decision on the right vendor for you.

4 Months to Deployment: Gauge your Network's Readiness

By testing your data network's ability to successfully support IP telephony traffic and discovering potential performance problems before your system is installed, a network assessment helps you plan, design and implement a successful IP telephony solution. The assessment can be administered by the solutions partner or by the vendor you choose, since both have a wealth of experience with IP telephony that they apply to interpreting the test results. Regardless if you use the solutions partner or the chosen vendor, an expert voice readiness assessment is required prior to installing a new IP telephony system across multiple sites.

In order to achieve toll-quality voice, you need to deploy IP telephony over a properly architected network infrastructure - i.e., it has to provide sufficient throughput and meet latency, jitter and packet loss requirements.

Throughput: How much bandwidth you need depends on the how many simultaneous calls your organization has going on, the voice encoding scheme used in the IP handset or soft phone, and the signaling overhead.

Latency and Jitter: Latency is the time it takes for a caller's voice to be transported (packetized, sent over the network, de-packetized, replayed) to the other individual. Distance and lower-speed circuits can cause delay. Latency that's too high interrupts the natural conversation flow (you may have spoken with someone using VoIP - you think they have stopped talking but they haven't-that's latency). Latency cannot exceed 100 milliseconds one way for toll-quality voice. Acceptable quality voice can go up to 150 milliseconds and participants can still carry on a decent conversation.

Packet Loss: Packet loss results in a metallic sound or conversation dropouts. It's caused by congestion, distance and poor line quality. Because IP telephony is a real-time audio service using Real Time Protocol (RTP) running over User Datagram Protocol (UDP), there's no way to recover lost packets. A mere one or two percent packet drop degrades voice quality.

A thorough assessment uses active application traffic across the LAN and WAN in order to reveal what's going to happen when IP telephony is introduced into the mix. Test agents send a variety of network traffic packets - using different application protocols, packet size, packet spacing and quality of service (QoS) levels. The tests simulate the various types of IP telephony traffic that are likely to occur on a live network. In addition to measuring peer-to-peer traffic, the agents can also generate real-time client transactions against production servers, including communication with IP PBX servers. This comprehensive approach enables the test engineer to pinpoint the source of potential problems and make recommendations for resolution, thus avoiding unwelcome surprises following the implementation.

1 Month to Deployment: Pilot Installation and Testing

If you have an integration partner or the vendor you have selected works with regional resellers and consultants, call and schedule a time to determine your needs list. If your organization or the vendor does not have an integration partner, get an engineer from the vendor in to help you with this list. With this person (or people), look closely at the current design of your network and make a list of any equipment upgrades or new purchases you'll need to make in order to optimize the infrastructure for IP telephony.

Update any existing network diagrams you'll be using. Be sure to label it so you know it is the original (pre-IP telephony). Next, sketch your new network diagram with the gear included. Determine if there is any overlap and if perhaps you don't need as many switches as you thought. If you're not working with an integration partner, you may want to invest some money in having a technology expert take a look at your new proposed network diagram. It's better to make major changes in the planning stage as opposed to after you've taken delivery of your IP telephony equipment. An expert can also make sure you maximize your equipment purchase and may make modifications to your diagram that will save you money in the long run.

After you've come up with your new network diagram, begin deploying the gear onto a test network. This will not only help ensure the new system works optimally, it will help you get accustomed to the new equipment so other deployments (to other locations, for instance) go smoothly. At the beginning, the test network should not affect anybody's workday. During the second phase, transition some non-critical employees or departments to the test network. This will help you further test the system in a real-world scenario and also gets users familiar with it.

0 Days to Deployment: Go Live

After you have played with the system for a few weeks or months and made appropriate configuration changes to adapt to your entire organization, begin rolling out IP telephony company wide. An installation in phases tends to work best, even if the phases are over one week. The larger your enterprise, the longer it will take and the longer you may need between phases.

After the rollout, it's imperative that you schedule end user training. You may handle this by department or location, depending on your organization. Vendor representatives are often available to be onsite to provide expertise and demonstrations during end user training sessions. While your choice of solutions will likely be rich in features, these features should also be intuitive to the end user; therefore training should take just two or three hours, as opposed to all day.

Make sure that the team you've put together is available for the duration (right through user training), at least on some level. If you've chosen a project leader, this is the person who will know all the details, even if he or she is not working daily on all of them. Once you've made the switch, so to speak, sit back and start enjoying the benefits of IP telephony.

The Bottom Line

You want to take your time implement IP telephony. A year may seem like a long time, but the more time you invest up front, the less money you're likely to waste overall. However, if you do not have a full year, this schedule can absolutely be accelerated—but do not skip steps, just shorten each cycle to fit your needs. The next chapter will go into more detail about reliability and what's required in order to ensure maximum uptime. Topics to be covered include redundancy, mean time to repair (MTTR), mean time between failures (MTBF), and network and applications reliability.

Ensuring Reliability in IP Telephony

ShoreTel™

This chapter covers varying IP telephony solution architectures, mean time between failure, mean time to repair, network reliability, and application reliability.

Ensuring Reliability in IP Telephony

Chapter 4

The most crucial characteristic of a business phone system is reliability. You must pick up the phone to a dial tone, you must be able to successfully place outgoing calls, and calls must effectively reach your organization. This chapter covers varying IP telephony solution architectures, mean time between failure, mean time to repair, network reliability, and application reliability. It is meant to help you dig deeper into the solutions you've narrowed down to your short list so that you can choose the one that fits best into your organization and existing infrastructure and provide you with maximum uptime.

How is Reliability Different from Availability?

Usually when reliability is mentioned in terms of a voice system, the reference is generally about hardware. Without hardware reliability, the system cannot be reliable. Reliability is determined by calculating how often the system fails compared to the percentage of time the system is available. In the telephony world, "five-nines" reliability is the acceptable benchmark. This means the system is available at least 99.999 percent of the time.

Availability, on the other hand, is predicted based on the probability of a hardware component failure. It is predicted by taking into account the type and number of hardware components in a system and calculating the mean time between failure (MTBF). So, if an IP switch has a predicted MTBF of approximately 135,600 hours, and each failure requires one (1) hour of mean time to repair (MTTR), we would use this simple computation to estimate the availability:

$$\text{Availability} = \frac{\text{MTBF}}{\text{MTBF} + \text{MTTR}} = \frac{135,600}{135,600 + 1} = 99.9993\%$$

This demonstrates that this particular unit will achieve "five-nines of availability." Alternatively, this switch is predicted to be unavailable for one hour every 10 years.

Let's take a household example. Consider a toaster that works for a year (an average year is 365.2425 days = 8,765.82 hours or 8,766 hours), and then it breaks, so you have to replace it: MTBF = one year. You take it to the store for a replacement the next day: MTTR = 24 (one day).

$$\text{Availability} = \frac{\text{MTBF}}{\text{MTBF} + \text{MTTR}} = \frac{8.766 \text{ hours}}{8.766 \text{ hours} + 24 \text{ hours}} = 99.7\%$$

This indicates two-nines availability. However, if you keep an extra toaster on hand, MTTR could be as little as fifteen minutes (.25 hours). While this increases the cost of equipment, it also increases the availability fairly significantly.

$$\text{Availability} = \frac{8.766 \text{ hours}}{8.766 \text{ hours} + .25 \text{ hours}} = 99.997\% \text{ or four-nines of availability}$$

Back to industry terms, there is no ordinary telephone system that can achieve five-nines. Since state-of-the-art MTBF for systems is 100,000 hours and MTTR is 24 hours, you would need to deliver 2,400,000 hours between failures to achieve five-nines.

$$\text{Availability} = \frac{\text{MTBF}}{\text{MTBF} + 24} = \frac{2,400.000}{2,400,000 + 24}$$

Even repairing the problem in 4 hours doesn't make it much easier to accomplish:

$$99.9990\% = \frac{400,000}{400,000 + 4}$$

You would still need 400,000 hours between failures. These examples are far beyond state-of-the-art. The way to meet these demands is via redundancy. Read on for a section on redundancy and specifically n+1 redundancy.

Distributed vs. Centralized, Chassis vs. Modular

IP telephony systems differ in their architectures: Some are centralized while others are distributed. In a centralized setup, the centralized call control server provides dial tone for all phones, whereas a distributed model is one where end points are handled by multiple call control servers. In this solution, call control is provided by each switch in the system. See figure 4.1.
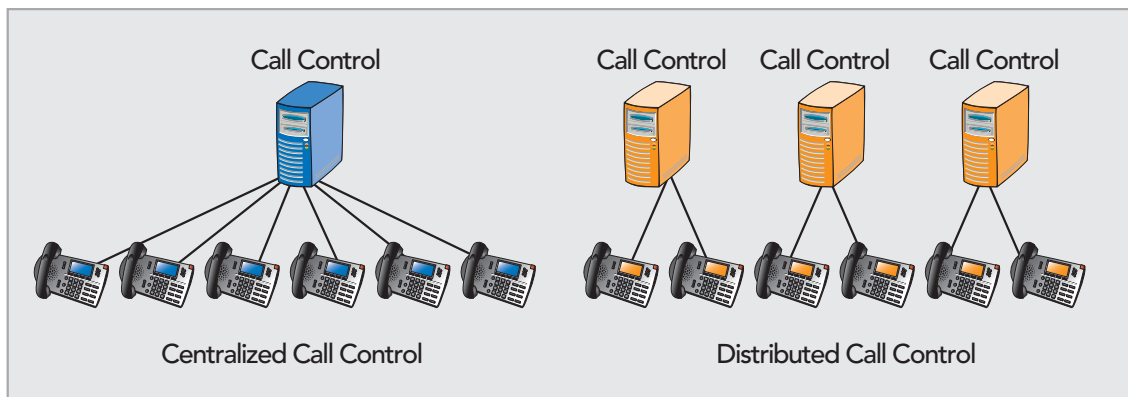

Figure 4.1. Centralized vs. Distributed Call Control

A classic chassis includes a number of circuit boards, with most of them providing telephony interfaces and one consisting of a specialized computer system, while some modular units contain a single board. The classic chassis can be compared to a string of holiday lights: If one bulb fails, the entire segment fails. The more lights on the string (number of circuit boards in the chassis), the more vulnerable it becomes to failures.

A typical chassis model, because you have to take into consideration the reliability of their components, typically has an MTBF in the 50,000 range, which is four (not five) nines availability. This can be raised to five-nines by adding switches for redundancy (costly but effective). More on this will be discussed in the n+1 redundancy section later.

In contrast, a modular architecture includes small, simple and reliable hardware. This modularity is more reliable and also offers more freedom in the design stages of an IP telephony implementation. Look at both modular and chassis-based systems, but keep in mind your specific reliability needs and remember that modular systems generally make configuration changes simpler and seamless.

The Bathtub Curve

Electronic product failures historically demonstrate a failure profile known as a "bathtub curve." See Figure 4.2 for a depiction of the bathtub curve. Because of a number of reasons, including stress, electronics tend to have a short life before they start failing. At the beginning of the lifecycle (the left side of the diagram), manufacturing defects, defective parts, contamination and other factors cause failures, before these settle to a much lower level (the middle of the diagram). The other end (on the right) signifies the end of life or wearing out of the product.
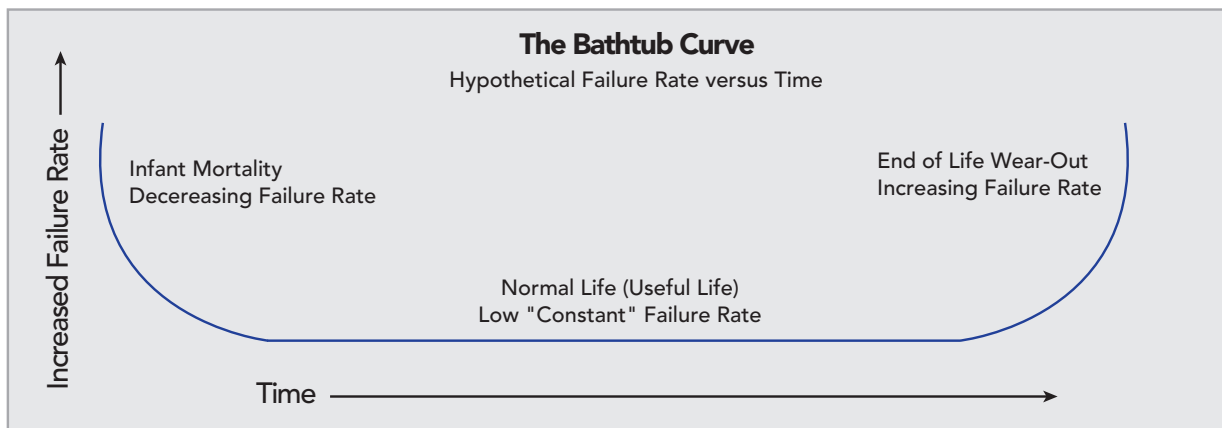

Figure 4.2 The Bathtub Curve

Be sure and ask vendors about their failure rates and how long a product lasts before end of life. If a vendor does not give you a concrete number based on scientific calculations (not marketing hype), ask more questions or talk to someone at the organization who can give you that information.

Mean Time To Repair (MTTR)

When a product is down, the entire system's availability percentage is dramatically affected. Consider the following example, where MTTR goes from 1 to 24 hours.

<div style="border:1px solid black;">

Long Repair Times Slash Availability Ratings

MTBF = 135,600 hours
Availability = MTBF/(MTBF+MTTR)

Availability with 1-hour MTTR = 135,600/(135,600+1) = 99.9993%

Availability with 24-hour MTTR = 135,600/(135,600+24) = 99.9789%
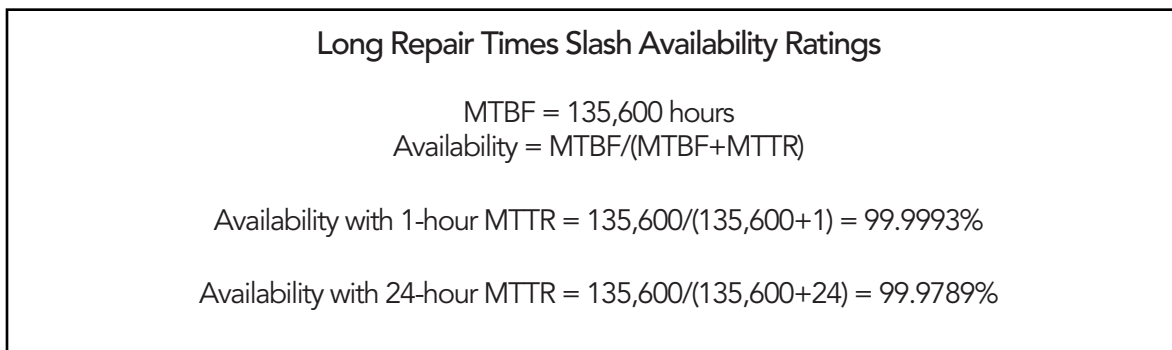
</div>

Figure 4.3 Comparing MTBF with varying MTTR

The more complex an IP telephone system, the longer it's going to take to identify what's going wrong during a failure. Only when you've identified what's wrong can you get a replacement for it, which can take even more time, and then there is the time it takes to get the system back up and running. Because of this, chassis systems described earlier in this chapter require personnel with significantly more expertise to ensure the system remains functional.

A 4-hour MTTR is industry standard, which creates a problem for IP vendors that want to maintain five-nines of availability with a 4-hour MTTR. Redundant systems are usually added to ensure this availability because a 4-hour MTTR requires a 400,000-hour MTBF to achieve 99.999% availability. (Availability = MTBF/(MTBF+MTTR) = 400,000/(400,000+4) = 99.999%.) Modular, distributed systems tend to make system repair easy, which results in a lower MTTR. These systems only require one power source and two or three cable connections.

Moving Parts and Complexity

Another thing to keep in mind is the number of moving parts there are in a system. For instance, adding a disc drive (rather than flash memory) with a 500,000-hour MTBF cuts the system's overall MTBF in half. Moving parts are also likelier to wear out faster than non-moving parts. For instance, the bathtub curve for disc drives is steep and it's often recommended they be replaced well before end of life to avoid failure. In the case of an IP telephony solution, you'd be replacing a disc drive during the time you have it on your network, since most disc drives last five years. Ask each vendor how many moving parts there are in each system. Again, insist on getting the information from another company source if the sales team does not have this information readily available.

Redundancy also impacts the failure rate, ironically. While vendors often add redundant parts, such as disc drives and power supplies, to their systems, the very fact that the number of parts are being doubled in itself can increase the chance that the system will fail (increase the MTBF). When you are considering an IP PBX system for your organization, be sure to look at how complex each system is. The more complex, the longer it takes to repair because problem diagnosis, part replacement, and system restoration can be difficult. Look for modular systems that are easy to manage and troubleshoot, with specific built-in tools to ensure quick and easy diagnosis and repair.

## N+1 Redundancy and No Single Point of Failure

Look for a solution with a distributed architecture that allows for the use of n+1 redundancy, which means that extra parts—as opposed to entire units—can be added to provide redundancy. Some vendors have 1:1 redundancy, which means twice the hardware is used to accomplish redundancy. Other systems use n+1 redundancy—which improves reliability since it is not doubling the hardware. For instance, the n+1 redundancy solution may need two extra units (where parts to the IP telephony system are duplicated within the two units), while a 1:1 redundancy solution needs five extra units because each unit is duplicated in its entirety. Essentially, using n+1 redundancy creates a multi-unit system with no single point of failure.

In addition to a distributed architecture that provides n+1 redundancy, look for a solution that interconnects each module using IP rather than cards in box slots. This design uses the Internet as a bus rather than having a proprietary backplane, which allows you to use a wide variety of chips and software and also reduces the costs and increases speed because of the use of IP and Ethernet. This design also allows you to seamlessly scale your system to meet organizational growth demands, just as the Internet allows for growth. Finally, look for a system that provides most of its feature upgrades via software so that there is minimal time between the release and your organization's use of these features.

Principal: N+1 Redundancy

Instead of duplicating entire hardware, modularize into "N" modules, and add 1 more

Example: 600 user System
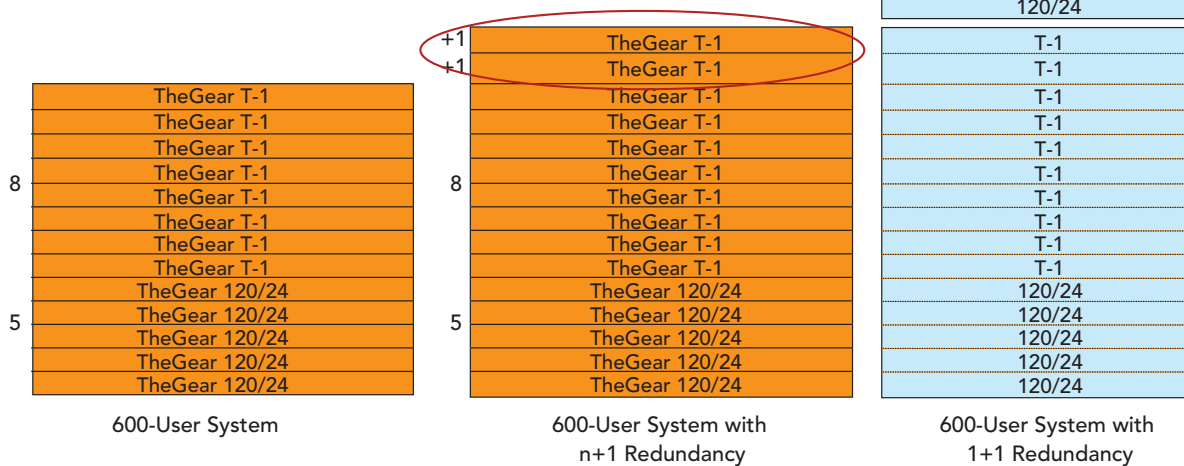
Availability of N+1 system = 99.9 999 999 92%, that's "10-nines" or 4 million years

Using a spare gives n+1 availability, increasing availability far beyond 5-nines

The goal of five-nines reliability is impossible for most systems because redundancy requirements can be complex and expensive. Using n+1 redundancy is not only more cost-effective, but it is less complex, which in turn reduces the chance of failure.

Network Reliability

The biggest hurdle when implementing an IP telephony solution is ensuring it works properly with the existing underlying infrastructure. LANs and WANs have lower reliability than telecommunications systems and are prone to quality-of-service (QoS) issues that make IP telephony solutions unreliable. LANs have multiple serial components, which negatively affects the reliability (typical LANs achieve three to four nines of availability), but it is possible to achieve five-nines availability on a network by using a redundant aggregation switch with redundant paths. After all, four-nines reliability translates to two hours of downtime per year. Can your organization afford that? Most 24/7 operations cannot. Focus on solutions that allow these redundant paths to an aggregation switch.

WANs cause the biggest headache because WAN links are generally available only 99% to 99.9% of the time, and voice quality availability can be as low as 98%. If your employees depend on superior voice quality for their many conference calls, for example, this is going to be a problem. Some solutions exist that distribute call control to local switches, which means that if a WAN link goes down, a remote switch can handle the calls because call control, business logic and system database information are all available within that switch.

A system with centralized call control relies heavily on its WAN connection because when it goes down, remote sites have no call control, which means calls cannot be made unless a backup system is in place. Look for a distributed solution that provides full and seamless call control functionality even during a WAN failure.

Application Reliability

In addition to ensuring your system is reliable in terms of hardware, you must also ensure that IP telephony system applications, including auto-attendants, voice mail, and desktop integration, work all the time for your employees. Look at systems that offer one application server for a full range of applications. You can use more than one server depending on your organization size, but make sure that it is not one feature per server, like some solutions may force you to do. A truly reliable system, in terms of applications, uses a site hierarchy, which means the first application in a user's hierarchy is used, and each application server has access to the configuration database in a central server. This design is highly reliable because each application server caches the configuration database, making information and applications available even during network downtime. For example, in the case of a network outage, remote users with their own server are unaffected by a failure in another server so that individual sites can serve features like auto-attendant.

The Bottom Line

There is always the possibility that a system can be completely unreachable because of multiple LAN and WAN problems (remember the saying, "never say never"). Look for solutions that allow you to build into your system a backup plan, such as the ability to implement failover trunks, switch failover, and copper bypass for emergency service. There are lots of vendors out there offering piecemeal solutions that could leave you dealing with increased complexity and decreased reliability. A distributed architecture is a good fit for multi-site organizations, and n+1 redundancy designs will keep your costs—and your chances of failure—way down. The next chapter will go over system handsets, including analog and IP telephones as well as hard and "soft" phones.

ShoreTel™

This chapter outlines the many benefits of todays' well-designed and highly functional telephones.

Handsets and Interfaces

Chapter 5

Think about your home telephone, your cell phone, or any one of the multiple electronic devices you use everyday. You expect—and appreciate—a well-designed product. You shop for these items with design and functionality in mind. With IP telephony, you can now bring the same high expectations into the office and into your search for handsets. Mediocre office telephones are a thing of the past because IP telephone handsets introduce so many more features and benefits.

The Need

Business workers rely on the telephone many hours out of the day, from collaborating with business partners and co-workers to interacting with and helping customers and suppliers. Call center professionals literally spend the entire day on their telephones. It's not enough to "make do" with a standard, feature-lacking desktop handset. To make employees more productive—and happier—you need to provide them with the tools they need to do their jobs optimally. You'll only do this when you present them with a handset that is ergonomically well-designed, has great sound quality, and features a multitude of capabilities at the touch of a button.

Ergonomics

Ergonomics is the science of designing products, machines and systems to maximize the safety, comfort and efficiency of the people who use them. Ergonomics takes into account psychology, physical measurement, environment, and more to ensure that products are adapted to suit workers and their specific needs. Keep ergonomics in mind as you look at the handsets and graphical user interfaces (GUIs) of each vendor's solutions. If your organization is a machine shop, the most important feature for your handsets may be a very loud ringer. If you have a call center staff, a bevy of features that help shorten the call cycle will be most beneficial. A law firm may require a system that logs incoming and outgoing calls and keeps this information on record for future reference. A recording studio may require ultra-clear sound quality to ensure recorded voices are pitch-perfect. Look at your organizational needs in terms of what you need a handset and GUI to do for your employees.

Sound

IP telephony, with its packet-based design, is able to deliver better than toll-quality sound with hi-fidelity audio and innovative design. Better sound translates into productivity gains – shorter calls with fewer errors, increased sales because of the clarity of conversation between a sales person and customer, and increased caller satisfaction. Wideband audio is preferable over narrowband, because it has an increased range on the low end (50-300 Hz) and makes conversations sound less tinny and reduces error in translation. Look for a solution that supports both wideband and narrowband.
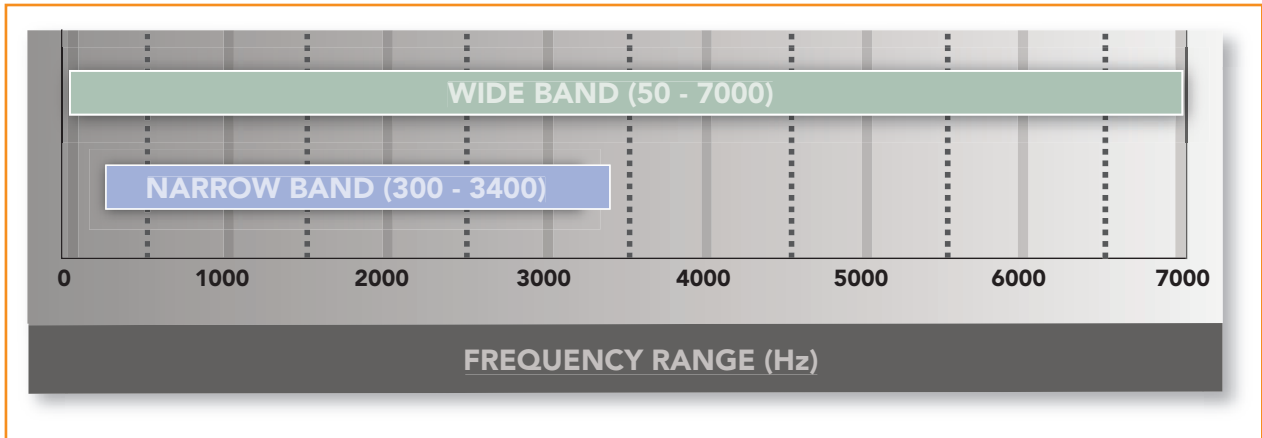
Figure 5.1 Wideband audio technology provides bandwidth from 50Hz to 7,000 Hz; narrowband provides 300 Hz to 3,400 Hz. Wideband delivers superior speech quality.

Speakerphone microphones are also an important part of sound quality consideration. Look for a solution that supports hi-fidelity sound and has a full-duplex operation speakerphone so audio flows freely on both ends (no delay if one speaker talks over another). Not all IP speakerphones are able to do this. In addition, ensure you choose a handset that meets the Americans with Disabilities Act (ADA) regulations for the hearing impaired, regardless of whether you have an immediate need or not. (More on ADA compliance will be covered later in this chapter.)

Screen Interface

IP telephones act more like computers than telephones—they have a bigger screen and more functionality attached to the screen. This screen also delivers more information about each call and prompts the user through the call with various options appearing on the screen. The user simply presses a corresponding key below the screen to accomplish any task while on the call (call forward, conference, etc.).

Make sure to consider carefully the size of the screen, with your users in mind. Is it big enough that after a long day of work, it's still pleasing to the eye? Is the display big and bright enough to see clearly after four hours on the phone? In addition, work with the phone and test what features are available and how easy those features are to access for a call center worker taking up to 50 calls an hour. Is there a message waiting light to ensure no message is missed?

User Considerations

Another characteristic to consider is the feel of the phone, since that is another source of fatigue for users. The phone should minimize shoulder and neck pain and fatigue, and it should essentially fit most users comfortably. The handset should not be too light or too heavy—try and get a phone with a balanced weight of about 170-190 grams. Also, consider a handset with a grip that is covered with a smooth rubber material, as opposed to the slippery plastic kind that can become uncomfortable during long telephone calls.

Keypad Functionality

Many systems will come with fixed-feature keys. Make sure those features are the one most pertinent to the needs of your employees. Fixed features usually include transfer, conference, intercom, voice mail dialup, directory, and redial. If a system relies mostly on soft keys, consider how difficult it may be for all your users to get those soft keys set up and working. Will you end up having to go around to every employee's phone to program two or three soft key functions? Soft keys are beneficial to have, but they should not be used for standard functions—these should be on hard keys. Some functions that you should look for on fixed-feature keys include:

- Directory: This key should be linked to a quick-dial program that allows a caller to dial by name using the telephone keypad (7 for S, 2 for A, 6 for M, which would bring up names that match beginning letters "SAM").
- Redial: This function key should do more than simply dial the last number dialed—it should allow you to press it and see an historical list of outbound, inbound and missed calls.
- Personal options: This feature key should allow for easy management of personal options, such as ring tone and call handling preferences.
- Voice mail: This key should provide quick and easy access to voice mail messages.

Soft Keys

Soft keys are multi-function keys that use part of the telephone display to identify their function at any moment. They are usually located directly underneath the display and their use changes depending on where the user is in the call process. You can set some soft keys for use by all of your employees, and you can choose to leave some to the discretion of each user. Make sure the setup of soft keys is straightforward before allowing users to set up their own. If the IP telephony system you've chosen does not offer handset soft keys that are easy to set up or change, make sure the solution allows you to either set the soft keys for each user (or block users from trying to set up their own) or the ability to choose not to use the soft keys at all. This will minimize user confusion and frustration if the solution is difficult to edit.

Business vs. Basic Phones

Basic phones differ greatly from business phones in that they offer few or no additional functions beyond answering and hanging up. Business phones streamline tasks and offer users productivity enhancing features. You'll find that some vendors offer most functionality via soft keys, while others rely on numerous hard keys—one function per key. Your employees may fare best with fixed function keys, or classic business phones, which generally have a button per task. Some vendors do not offer this, however, relying mostly on soft keys. Still other phones offer a fixed number of hard keys and some extra hard keys that you can program to fit your organizational needs. These are optimal for organizations with workgroups that need specific functions to be programmed into keys.

Easy to Manage

You want to make sure the phones you are getting with the IP telephony system you choose are plug-and-play, particularly if you have a large organization with many locations, some of which have no technical staff on-hand for installation support. Non-technical employees should be able to plug in their phone and start working. When it's plugged in, the phone should automatically get its IP address, subnet mask, and gateway, as well as the accurate time from a time server. Handset updates should be equally as hands-off for employees—updates should be automatic as they are released by the vendor.

Aesthetics

While most businesses do not place emphasis on how a phone looks over the functionality, it is still an important consideration. A phone that is pleasing to the eye is as impressive as a beautiful desk or sleek-looking computer. Consider your options with your chosen vendor and ask about variety. What colors do their phones come in? Are there smaller versions for users who need minimal functionality? Are there ruggedized versions of the IP phones for public area usage? Look for a solution that will fit all your needs, with phones that are consistent in appearance and look classy throughout your organization.

Phone Choices

In an IP telephony solution, the IP-PBX manages telephones throughout the enterprise and acts as a gateway to both voice and data networks. Any kind of telephone, whether it be analog, IP or a soft phone, can connect to the IP-PBX via the network and calls are routed via the network instead of the public switched telephone network.

Analog phones

A regular analog telephone, the same ones you've been using throughout your organization until now, can be used in an IP telephony solution to input the caller's voice into the system. Once in the system, a series of analog-to-digital conversions and other processes change the voice signals into data, which is then transmitted over the LAN, WAN, or Internet. The voice data is then converted back into sound by the recipient's phone. Most IP telephony systems will allow you to use your existing analog telephones with the solution—forever or until you are able to afford and/or replace them with IP telephones. Be sure that your vendor will allow you to phase out older analog phones with their IP phones over time so you can maximize your existing equipment.

IP phones

IP telephones (or IP endpoints) actually perform the analog-to-digital and/or digital-to-analog conversions and can plug directly into the LAN or WAN. VoIP system vendors usually offer a variety of IP telephones so that you can choose different models based on various segments in your user population. Your legal department may need multi-line handsets with easy conference call capabilities. A manufacturing floor needs a phone with fewer bells and whistles but good, loud sound and a rugged exterior. Receptionists need handsets with many more fixed feature buttons so that they can handle calls quickly and accurately.

Soft phones

A soft phone is essentially software that is used to make calls over an IP telephony system using a personal desktop computer and either a headset connected to the computer's sound card, or a telephone connected to the computer using an adapter. It behaves like a traditional phone but usually offers much more information to the user, depending on the vendor's GUI. When a call comes into a station with a softphone, an icon appears on the computer screen, which allows the user to either answer it by clicking on an icon, or ignore the call by clicking on another icon, which in turn sends the caller to either voice mail or another employee.

Often, vendors offer an application that allows traveling employees to gain access to the robust feature set of their desktop computer from wherever they are working—at home or on the road. A user simply logs into the system from the local phone and has access to all of the same functions he or she would enjoy while in the office.

WiFi phones

WiFi phones use signals much like those used by cordless telephones. The WiFi phone receives signals which allow you to wirelessly connect to the network via wireless access points (APs). Unlike traditional cell phones, the technology of WiFi phones allows them to transmit data at really high speed, but areas of coverage are limited by the reach of the AP being utilized. There are also hot spots available in various locations (restaurants, Starbucks, libraries, etc.) that allow you to access the Internet using your own WiFi service (or a service utilized by your organization).

One drawback to WiFi phones is the fact that some things can impede on the quality of the calls, such as how many people are using the same hot spot, how close the WiFi phone user is to the access points, WiFi card capabilities, and possible obstructions to the AP (such as a wall). Another drawback is that WiFi technology does not offer the level of security offered with standard Internet access. More on security will be covered in the following chapter.

Want a SIP?

Session Initiation Protocol (SIP), a signaling protocol, is used for establishing a session in an IP network—from a simple two-way telephone call to a multi-media conference call session with many participants. The IP telephony industry has recently adopted SIP, an RFC standard (RFC 3261) from the Internet Engineering Task Force (IETF), as the protocol of choice for signaling because of its ability to facilitate Internet applications by working with other protocols. It is not the be-all and end-all of protocols—it was designed to be a facilitation mechanism, not an all-inclusive solution. Its flexibility is what makes it so powerful, and an all-inclusive approach does not offer this level of flexibility.

Essentially, SIP establishes, manipulates and tears down sessions, and its main purpose is to help session originators deliver invitations to potential session participants wherever they may be. It uses URLs to address participants and SDP to convey session information and it's easy to combine SIP with other applications, like Web browsers and messaging. The bottom line is that it's a modular approach to maximizing IP telephony protocols. SIP can find and invite call invitees wherever they are. It facilitates multi-media calls with many participants who may join and leave at will.

American Disabilities Act (ADA) Compliance

Your IP telephony system must comply with the American Disabilities Act (ADA) of 1990 and associated regulations issued by Federal agencies that define guidelines for accessibility by individuals with disabilities. These guidelines include requirements for telephones and telephone systems, and they include the "ADA Standard for Accessible Design" (Pt. 36, Appendix A, Section 4.31, Telephones) and the 508 provision for TDD/TTYs. A few of these requirements include:

- Volume Control: Telephones should have volume controls that provide a gain adjustable up to a minimum of 20 dB. The telephones should provide at least one intermediate step of 12 dB for incremental volume control.
- Automatic Volume Reset: The telephone should automatically reset the volume to the default level after every use.
- Hearing Aid Compatibility: The telephone must have a means for effective magnetic wireless coupling to hearing technologies.
- Minimized Interference: Interference to hearing technologies, including hearing aids, cochlear implants, and assistive listening devices, shall be reduced to the lowest possible level that allows a user of hearing technologies to use the telephone.

- Support for TDD/TTYs: Products that transmit or conduct information or communication shall pass through cross-manufacturer, non-proprietary, industry-standard codes, translation protocols, formats or other information necessary to provide the information or communication in a usable format. Technologies which use encoding, signal compression, format transformation, or similar techniques shall not remove information needed for access or shall restore it upon delivery.
- Controls and Keys: Controls and keys shall be tactilely discernible without activating the controls or keys. These controls and keys shall be operable with one hand and shall not require tight grasping, pinching or twisting of the wrist. The force required to activate controls and keys shall be 5 lbs. maximum. If key repeat is supported, the delay before repeat shall be adjustable to at least 2 seconds. The status of all controls or keys should be visually discernible, and discernible either through touch or sound.
- The cord from the telephone to the handset shall be at least 29 inches (735 mm) long.
- A wall-mounted object should not protrude into the walkway more than four inches to ensure visually impaired individuals do not run into them.

The Bottom Line

By now, you have either chosen your IP telephony vendor or at least narrowed it down to a short list. Take the telephone characteristics into account to help you finalize the decision. If you have already made your choice, look carefully at all of the models your vendor offers and choose the right phone for each user in your organization: Multi-function telephones for receptionists, soft phone licenses or WiFi phones for travelers, basic but ruggedized phones for warehouses and manufacturing floors. At this stage in the IP telephony game, you have more options than ever and you don't need to make one model work for everyone. What you do need to do is make sure your users are more productive because of the phones, and that your choice complies with the ADA. The next chapter will cover how you can secure your IP telephony communications.

Chapter 6

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This chapter highlights the steps one should take to ensure
IP telephony traffic is secure against outsiders and
unauthorized individuals.

Security 6

Chapter 6

Anybody who's connected to the Internet or who owns a PDA/multi-function cell phone knows that they're at risk of getting viruses, worms, spam and other malicious threats. In addition to the potential damage these threats introduce in terms of lost data or corrupted files, there are now regulatory issues associated with ensuring protection. Healthcare has its own privacy regulations in the form of HIPAA (Health Insurance Portability and Accountability Act of 1996), and infringements can result in significant punishments and fines. The bottom line is that you have to protect your organization's devices and network. IP telephony is no different – the only difference is the form of the traffic: voice versus data. All traffic crossing a network can be stolen, manipulated or blocked if proper network security precautions are not put into place. This chapter will highlight the steps you should take to ensure your IP telephony traffic is secure against outsiders and unauthorized individuals.

Evaluate your Risks

The first step to determining the right network security strategy (VoIP or otherwise) is to determine the risks your particular organization faces. (Because of the increasingly complex network security threats and solutions out there, you may want to get a network security expert on board to help with the assessment.) For instance, a healthcare organization faces different regulatory requirements than a legal or accounting firm. An e-commerce organization has altogether different privacy and security requirements. Once you determine what your risks are, you'll be better able to determine the best multi-layer defense against attacks, eavesdropping, service theft and other evolving threats for the entire network, including the IP telephony system being utilized.

IP Telephony - Specific Considerations

Network-Based Attacks. IP telephony is susceptible to Denial of Service (DoS) attacks because these can cripple the network to the point that nothing, including voice calls, can get through. (It is generally recommended that every organization using IP telephony have backup telephone lines in the case of an out of control DoS attack or regional power failure.) Spam, spyware and phishing are other network attacks that are commonly used to commit identity theft and other fraud. Finally, viruses and bots can destroy data or devices or even hijack phones into a toll fraud scheme.

Phone Service Theft. A hacker could enter into an unprotected network and access the PBX to make endless international calls. There have been major cases cited in the news where toll fraud has cost companies millions of dollars. In many instances, the criminals have been caught and prosecuted, but not without major costs to the companies defrauded; and keep in mind, there are always those crimes that go undetected.

Eavesdropping. Without the proper security in place, a hacker could eavesdrop and possibly expose confidential information. A private conversation about financials could be recorded and played for anybody, which could lead to internal and external problems, including punishment from numerous regulatory agencies. Or a personal call from an employee to a florist with a credit card number could lead to credit card and even identity theft.

Power Failures. While outages affect data traffic, of course, there's a difference when it comes to telephony. People expect telephones to work even during an outage because homes often have a non-electronic phone that simply plugs into the telephone outlet. This expectation is generally brought into the workplace.

SPIT. Spam over Internet telephony is an alternative to telemarketing where one message can easily be sent to thousands of recipients with the click of a mouse. In other words, your employees' voice mail boxes can become as overloaded with spam as their e-mail would be without appropriate spam filters.

Other Threats. There are new threats created and discovered daily. One such attack is the spoofing of a phone number, which essentially allows a hacker to look like he or she is someone else, which is one of the easiest ways for this person to steal an unsuspecting person's identity. While individuals have learned not to trust e-mail, it is still generally believed that telephone communications can be trusted.

Network Security Basics

Network security will lead to a secure IP telephony system. Your organization has likely taken steps such as initiating the use of virtual private networks (VPNs) and installing firewall equipment, which protects the organization against intruders and threats mentioned earlier. Since voice is just another application on the network, the same precautions should be taken to secure the IP telephony equipment. Every form of security should be applied, including physical, human, network, and system security.

- Physical security: Buildings, equipment rooms, data servers, and wiring closets should be off-limits to anybody who is not authorized.
- Human security via security policies: Make sure your organization's informational assets are protected against inappropriate or unauthorized use by a renegade employee. Ensure hiring and system usage policies are in place to govern appropriate use. Establish and strictly enforce policies having to do with passwords and system usage.
- Network security: Again, create a multi-layered defense using firewalls, VPNs, and intrusion detection or prevention (IDS/IPS). Make sure wireless access points use the highest level of access control and encryption to prevent intruders from gaining access to your network and its resources.
- System security: Arm every desktop with anti-virus software to fight against spyware and other malware. Utilize host intrusion prevention systems to protect servers against attacks.

Another force to consider is segregating traffic via virtual LANs (VLANs). It is a method of logically grouping devices or departments onto their own LANs. Isolating LANs from one another provides an additional layer of security. It also reduces the impact of multicast or broadcast traffic since there are separate broadcast domains.

Finally, bandwidth management can be utilized to further guarantee bandwidth for business-critical, latency-sensitive traffic like VoIP traffic. Bandwidth management methods include assigning a certain priority to each type of traffic. VoIP packets should be assigned the highest priority to ensure voice traffic gets through.

IP Telephony Security Basics

When your network is secured, take it a step further and utilize best practices for deploying secure IP telephony.

- Firewalls: Make sure the firewalls you're using can handle the latency sensitive needs of IP telephony traffic.
- Switched environment: Use Ethernet switches (not hubs) to connect all your voice devices not only for better performance but also to limit the possibility of a hacker getting onto a call because in a

switched environment, the flow of traffic is between devices and nobody can tap in.

- VLAN assignment: Assign voice to a separate VLAN (or separate VLANs). This segregates traffic for improved performance and security.

- Priority: Prioritize voice traffic over data on these VLANs so that delay sensitive traffic gets through even during a network attack. Ensure your network switches can prioritize based on VLAN tags and support multiple queues.

- VPN: Use a VPN between sites, buildings, or departments to encrypt traffic. This is especially important when it comes to protecting confidential employee information, such as social security numbers. In addition, use software VPNs or VPN appliances for remote users to protect conversations from being tapped. Your system should also offer you the option of completely disallowing remote access for an even tighter security option.

- Port lockdown: Lock down IP telephony traffic on the physical switch ports so that only authorized MAC addresses can transmit over the port.

- Media encryption: Look for a solution that prevents eavesdropping by encrypting voice traffic. This way, even if someone taps a voice stream, they are unable to decode or understand the conversation. Not all IP telephony system vendors offer this but it is a necessity for IP telephony security.

- Voice mail storage: Make sure that your voice mail storage is itself secure to prevent unauthorized access of voice mail files.

IP Telephony System Security

Let's look now at the IP telephony system itself. While you can secure your network in all the right ways, you also need to choose a phone system that is secure itself. Consider moving away from a system that uses Microsoft Windows for call control because of the security considerations. With a constant stream of Windows security updates and patches, you're risking downtime and security breaches.

Another architectural consideration to keep in mind is ensuring your system is distributed, which will mean it has no single point of failure. A distributed system allows continued operation in the case of worms, viruses, or DoS attacks. An attack will not disable the entire system if intelligence is distributed amongst multiple devices.

Your chosen system should offer multiple levels for administrator permissions to limit control and ensure unauthorized individuals do not gain access. Once you've deployed, reserve full access for just a few key information technology employees. Ensure that a web-based management solution supports secure management using Secure Sockets Layer (SSL), which secures communications from the interface to the server.

According to the SANS (SysAdmin, Audit, Network, Security) Institute, a cooperative research and education organization, VoIP servers and phones are at significant security risk. The organization's 2006 annual update, SANS Top-20 Internet Security Attack Targets, indicates that there's been an increase in security scrutiny of IP telephony, especially on typical components such as the call proxy and media servers, as well as the phones themselves. Some products have been found to contain vulnerabilities that can either lead to a crash or a complete control over the server or device. "By gaining a control over the VoIP server and phones, an attacker could carry out phishing scams, eavesdropping, toll fraud or denial-of-service attacks."

How to Mitigate IP Telephony Vulnerabilities

SANS has determined and published a list of things enterprises must do to mitigate the IP telephony vulnerabilities mentioned in this chapter.

- Apply the vendor supplied patches for VoIP servers and phone software/firmware.
- Ensure that the operating system running the VoIP server is patched with the latest OS patch supplied by either the OS vendor or the VoIP product vendor.
- Scan VoIP servers and phones to detect open ports. Firewall all ports from the Internet that are not required for keeping up the VoIP infrastructure.
- Use a VoIP protocol aware firewall or Intrusion Prevention product to ensure that all UDP ports on VoIP phones are not open to the Internet for RTP/RTCP communications.
- Disable all the unnecessary services on phones and servers (telnet, HTTP etc.).
- Use VoIP "protocol fuzzing tools" such as OULU SIP PROTOS Suite against the VoIP components to ensure the VoIP protocol stack integrity.
- Additional caution should be taken at the product selection phase to ensure the VoIP product vendor supports OS patches as they are released. Many VoIP vendors will void support for unapproved patches and may take considerable time before approving them.
- Apply separate VLANs to your voice and data network as much as your converged network will allow. Ensure that VoIP DHCP and TFTP servers are separate from your data network.
- Change the default passwords on phones' and proxies' administrative login functions.

Source: SANS Top-20 Internet Security Attack Targets, 2006 Annual Update

The Bottom Line

IP telephony requires the same level of security as your data network requires. You need to ensure you're receiving calls from trusted sources, you're protecting your infrastructure from toll fraud, and you need to make sure your voice calls get through, even when parts of the network might be bogged down by DoS attacks, viruses, or worms. There are vendors that offer IP telephony solutions with additional layers of security. You don't have to rely solely on network security devices in place. You can take it a step further and protect your IP telephony equipment so that voice communications and resources are as safe as possible from hackers and other criminals. The next chapter will discuss wireless IP telephony, including more on security, as well as QoS, reliability, and coverage areas.

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