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The Definitive Guide™ To

Successful Deployment of VoIP and IP Telephony

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Jim Cavanagh

Introduction to Realtimepublishers

by Don Jones, Series Editor

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Chapter 1: Forward…Into the Past!

Telephony is changing. Packet-based voice is inevitable. Being in traditional telephony today is akin to being a telegraph engineer in the late 1880s—wondering what that odd couple Bell and Watson were doing with your telegraph cables late at night. Only in our case, there are no thick metallic cables strung from wooden poles. Today, we have wireless signals completing the trip that started on thin strands of glass and may end on MOCA-flavored coaxial cables or twisted pairs of copper wire in residences or smaller fibers in the walls of offices, dorms, manufacturing plants, and laboratories.

You are reading this guide because you already know that the traditional telephony era is drawing to a close and you are looking for guidance on how to migrate to the next era as quickly and painlessly as possible—maybe personally as a career move, or professionally on behalf of an enterprise or other organization. Chapters 2 through 8 of this guide are all about how to do just that. But first we must set the stage.

Speaking of setting the stage: several years ago, I saw a Broadway musical called Pippin, about the son of Charlemagne. Recalling a Broadway musical about the life of the son of Charlemagne must seem an odd way of starting a book on the successful deployment of Voice over IP (VoIP) and IP Telephony (IPT), but stick with me, there are some interesting parallels. For one, the story of Pippin is one that is fairly well known, albeit with its share of misconceptions and historical fuzziness, similar to the 100+ year history of telephony. The musical tells the story from a unique, yet enlightened, and enlightening, point of view: it chronicles Pippin's personal search for excellence and his desire to make an everlasting contribution. Lastly, at the very beginning of the musical, the Lead Player requests, "I beg you; cast all previous misconceptions aside and accept what we enact for you today." In this same spirit of embracing a new way of looking at things you think you already know, cast aside your previous misconceptions as you read this guide. This book represents a fresh, and I hope enlightened and enlightening, view of the next evolutionary step in human communications.

This guide explores beyond simply replacing dial tone on circuits with dial tone in packets, though it addresses this basic function because basic dial tone is often all that an organization needs. This book challenges a lot of what the market has been feeding us and a lot of what we think we know and "remember." The view is a simplistic one, really, which asks questions such as "Why are we doing this?" and "What is our Return on Investment?" This book represents a view based upon experience, based upon listening at least as much as talking, and based upon thinking—probably way too much thinking—about why things are being done the way they are and less about starry-eyed amazement at what technology can do and how it will transform society and forever change the way humans interact with each other.

This book is written neither for "Bell-head" nor "packet-head" but rather for the next generation of communications professional who will recognize these former terms only in their historical context, "back when" there was a difference. Today's communications professional is more interested in session initiation, and has a protocol for such things; they are interested in voice as one of a rich palette of communications methods to solve a specific set of problems in the bigger picture of instantaneous access to information generically called multi-media, or often called the voice, data, and video triple play. Oh, and this is the first and last time I will mention H.323 because after this chapter we will only be looking ahead, not backwards.

To further set the scene, please allow me to enumerate the observations that form the foundation for this book. The basic underlying premises:

- In the early phases of VoIP, there has been a tendency to accept mediocrity for cost savings and to embrace lower quality for convenience, but this will soon give way to quality as a differentiator of products and services.
- "Free" is a great concept but is not sustainable, and VoIP is not often as cost-effective, or as nearly "free," as advertised.
- VoIP is a stop along the journey to packet-based telephony, not the destination.
- IPT is the real objective for business and organizational users and will revitalize, rather than kill, all the best aspects of traditional telephony.
- Telephony is becoming an application like spread sheets, word processing, browsers, and Instant Messaging, and, like the other applications, has common elements as well as special requirements needed to make it truly successful.
- End-user organizations are shifting to some degree to playing the role of telecommunications carrier for their end users or, at the very least, providing a stronger, less transparent, liaison role between their user community and managed service providers.
- Internal customers must be handled with the best practices that world-class carriers and service providers over the years have applied to their external customers, including Service Level Agreements (SLAs) and the underlying measurement and reporting of performance and service troubleshooting.
- Traditional telephony knowledge and skills are as valuable now as they have ever been and are increasing in value as the number of people who possess this special knowledge is decreasing in the job market.
- You might as well plan your trip to packet-based telephony and make the migration as smooth and painless as possible because, voluntary or not, you are going there anyway.
- There is no need for most organizations to rush to packet telephony. Older telephony systems should be kept around as long as they make business sense and as long as they can be coaxed into providing dial tone.

This chapter begins with a high-level overview of electronic human voice communications; subsequent chapters delve into the details of what is needed to make the future better than the past, how—specifically—to implement business voice communications, and how to measure performance and use it as a part of a feedback loop for service optimization. The emphasis will be on midsize to large, national to global enterprises, but smaller users, carriers, and service providers will find their share of readily accessible knowledge in these words, as well. After reading this chapter, you will understand the basis for the rest of the book and will be better able to apply what you read in the remaining chapters.

VoIP vs. IPT

The dramatic shifts and uncertainty in today's telephony marketplace can be attributed to two distinct phases of telephony technology deployment, each occurring at key points in time, with a very important transitional period occurring between the two. The two phases are the "circuit phase" and the "packet phase," with an intervening transitional period I will simply call VoIP. To make the point clear, you can also call the circuit phase the uni-media phase and the packet phase the multi-media phase.

This is not to say that no one did multi-media with circuits, quite to the contrary; rather, the distinction between the two phases focuses on the capabilities inherent in a single connection. The uni-media phase, a term invented by this author solely as a vehicle for making this comparison, is characterized by a single circuit delivering a single type of information: a circuit or channel for voice; another, separate, circuit or channel for data; and another, separate, circuit or channel for video. The treatment of each circuit as a single information pathway, largely independent of each other in transmission and possibly synchronized at the end points is fundamentally different than the multi-media view of treating all connection types as variations on the packet theme with appropriate allowances being made along the way for the needed Quality of Service (QoS) for each. In the uni-media phase the separation between different types of media is more rigid and enforced at a much lower layer in the network.

The Uni-Media Phase

The uni-media phase of telephony is defined as beginning March 10, 1876—the invention of the telephone—up until mid-1994 when engineer/hobbyists who would go on to form VoIP pioneer VocalTec made the first PC-to-PC voice call from Princeton, NJ to Israel and VoIP emerged. The only major change in telephony up until that time was the shift from the analog network to the digital network. Though VoIP represents a major change, the fundamental achievement was still a point-to-point call from one human to another.

The uni-media phase of telephony is characterized by fast, reliable, guaranteed QoS circuit switching, which was originally analog and eventually digital. The first phase delivers a 99.99+ percent reliable range of services to most areas of the world through a vast, carefully constructed global network based on standards that segregate the circuits into their own, dedicated, protected uni-media lanes in the network highway. The uni-media phase is also characterized by a rigid, standardized, hierarchically structured geographically aligned numbering system designed in five layers that allows any-to-any connectivity globally with a minimum number of steps.

The Multi-Media Phase

The multi-media phase is disruptive and challenges the established order but goes beyond VoIP. VoIP was thought, at one point, to be the multi-media phase, but VoIP has turned out to be more of a "living laboratory" and has become a transitional step from uni-media to multi-media and not a full-blown revolution unto itself. More than anything else, the advent of VoIP kicked off the new thinking about the future viability of circuit-switched telephony in light of customer demands for integrated multi-media applications, such as presence and unified messaging, and put us on our current trajectory toward all-packet/non-circuit multi-media networks.

The multi-media phase cannot rightfully be called the multi-media phase "of Telephony" because at least two other media are involved, each having a variety of flavors. Beyond voice, there is data and video, and each has real-time, near-real-time, and non-real-time variants. The multi-media phase is represented by the ad hoc use of the global Internet and other IP intranet and extranet networks for a mixture of telephony, data, and video in a service package often referred to as the "triple play." This direction is as true of residential or personal communications as it is of business communications, the difference being that in the residential context, the triple play has a decidedly entertainment spin, and in the business realm, the emphasis is on strategic and tactical applications that will either save or make money.

At the present time, early in the multi-media phase, Internet telephony services are immature, network reliability is lower than in the uni-media phase, and QoS—and the resulting Quality of Experience (QoE), are measured differently than in the uni-media phase, yet there are some compelling reasons to move to a packet-based architecture. Among those reasons are true on-demand multi-media applications; transparent service ubiquity over metallic, wireless, and fiber delivery systems; and lower cost/higher efficiency consolidated (I dare not say converged) backbones, all of which show a lot more business benefit and potential longevity than the early VoIP cost-focused discounting models that have already failed.

As we move further into the multi-media phase, next-generation carriers will start to compete on services, not price, over both PSTN and IP network infrastructures. This is the hallmark of the next phase—a value-added services framework that delivers enhanced telecommunications capabilities to the marketplace as services, not as boxes and wires that must be further integrated by customers to provide services. And with a scalable and flexible enhanced service architecture solution riding atop these new-generation networks, it will actually be possible for the IP-centric network implementations to increase their competitive advantage over circuit-switched network providers and beat the analyst projections for market share and revenue growth.

VoIP

Traditional telephony had changed little in concept or common practice from the very first telephone call in 1876 until the first VoIP call in 1994. The major breakthroughs had been the introduction of digital switches, implementation of digital telephony, use of fiber optics for communications, and the use of out-of-band signaling methods, such as SS-7/CCS-7 and the ISDN D channel. These are all evolutionary improvements on the basic theme of an end-to-end circuit switched call. Other important recent changes have occurred in the regulatory environment. These implementations were made possible by advances such as fiber optic networking and SS-7 signaling.

Were it not for the advent of the Internet and IP-based telephony efforts, traditional telephony would probably have stayed the course for many more decades to come. However, traditional telephony and IP networking did cross paths, which, concurrent with deregulation in the United States and elsewhere, caused a number of tangible changes.

The largest change has been the precipitous decline in the cost of circuit-switched long distance service, in not only the United States but also in many other countries around the globe since 1995 to present. Where 20-to-25-cent/minute prices for long distance calls were common in the U.S. in 1995, now sub-2-cent/minute prices are the norm with companies such as major disruptor Vonage offering residential flat-rate plans to the U.S., Canada, and Puerto Rico for US$24.99 per month and similar business plans for $49.99.

Technical Definition vs. Market Definition

A careful analysis of the foregoing discussion speaks to the issue of the two distinct definitions for VoIP. One definition, a market definition, includes a general, collective, label of VoIP for all the market, legal, and regulatory forces and technologies that have caused the revolutionary and dramatic changes in global phone calling, freeing the consumer or business user from having to understand the details. The second definition, the technical definition, includes a vast number of technological innovations that have enabled the business definition but of which the thing called VoIP is only small part. There is not, for instance, a VoIP protocol, per se, but rather a number of choices, all of which will be examined, contrasted, and compared in subsequent chapters.

VoIP is Revolutionary

VoIP began in what can best be described as the hobbyist realm. Early VoIP software was produced in spare bedrooms, garages, and office cubicles and used existing hardware that was cobbled together to accomplish the task of putting voice over the ubiquitous and inexpensive Internet without any regard for, or in most cases knowledge of, traditional telephony switching, signaling, or other systems considered vital to high-quality, highly reliable universal telephony.

Use of the primarily flat-rate Internet, instead of the metered telephone network, allowed VoIP users to avoid paying long-established tariffs on the traditional local, national, and global voice networks. The desire was to put voice on the Internet as one more application of the globally connected Internet, which could lower costs and, potentially, put more people in touch with each other at a lower cost than keyboard actuated IP tools such as email alone had been able to do. Calls in this phase were mainly PC-to-PC.

The second step of the transition was "toll bypass," and was predominantly the use of existing telephone hardware with customized software, which allowed avoidance of toll charges and a growing perception that VoIP was basically regular toll voice at a lower price. Calls in this phase continued from PC-to-PC, phone-to-PC, and PC-to-phone, but began to include phone-to-phone calls using the Internet for the long-haul, long distance part of the call. International calls were offered at particularly attractive pricing. Toll bypass naturally morphed into "free voice" for everyone.

The result of the widespread news of "free voice" was that traditional carriers slashed their prices to retain customers and avoid disappearing completely, which turned out to be an over-reaction on their parts, but appeared to be an entirely sane move at the time. In retrospect, we see that price reductions were mandatory, but a less instantaneous, more gradual approach would have still worked in the marketplace and would have presented less risk to the financial health of the traditional purveyors of voice services. In turn, lower prices for traditional telephony had a significant dampening effect on new world carriers planning to implement VoIP networks because most of the initial economic models of early VoIP implementers were predicated on providing a lower quality and reliability service, compared with traditional circuit-switched phone networks, but at significant discounts. These plans were put into question when the traditional, high-quality and reliability services became available but at competitive prices.

The biggest problem with VoIP is that residential and business customers alike are learning through difficult, real-world experience that VoIP is not "what you were getting from the phone company, just cheaper." VoIP lacks the reliability, scalability, standards, signaling, services, ubiquity, and capability of the uni-media phase. What VoIP pundits fail to realize is that it is not possible to reproduce in a weekend what it took over a century to produce in the uni-media phase and then to easily apply it to multi-media applications, many of which are not yet fully understood. VoIP, though, does provide a real-world telephony laboratory and a natural bridge to the multi-media phase, where the real issues of transitioning to a new world order of Telecom are addressed.

It turns out, however, that the keys to success in the coveted multi-media phase lie not as much in the hardware but in the higher-layer application software architecture, including the Session Initiation Protocol (SIP), IP Multi-Media Subsystem (IMS), and Parlay-compliant Applications Programming Interfaces (APIs)—and there is still a lot to be done before the current state of the art replicates what we currently have in the uni-media phase, let alone surpasses it and brings new and engaging applications to light.

This guide will use VoIP in the more generic sense, but will focus on more specific items under the umbrella of IPT. Why? Because VoIP was originally intended for PC-to-PC voice messaging and was never intended to replace global telephony. The idea of "free voice" was compelling and simple, yet the model is not sustainable. There is still the underlying fact that someone has to pay for the global Internet to carry voice and that as a niche, hobbyist toy it is possible to sneak some voice in with data, but in the quantities that are needed to fully shift global telephony traffic to the Internet, the voice packets will be noticed and must pay their own way.

VoIP is really more about the edge of the network. VoIP, in our definition, is a very visible, tangible thing and requires new devices and a change in the traditional ways of communicating. It requires PC-based agent software, SIP phones, or PDAs with VoIP capability, but is this not just a new way of providing dial tone? And, if so, and this author feels that it is, is there anything compelling about VoIP from a business standpoint? Does it enable you to do anything that you have not been able to do before? Not in its early stages, but it holds out the hope of advanced applications in the future and it is the new, advanced applications that are needed to make this thing generically labeled as "VoIP" to be successful.

Multi-media and wireless are crucial to VoIP success, as VoIP plays an important role in voice-enabling multi-media and the traditional data-only wireless systems already in widespread use in business and personal communications.

VoIP Business Aspects Not Clear

VoIP may or may not cost less than traditional telephony, but that is not always the main objective. Take the case of Heritage Bank of Alabama. Heritage was faced with a choice of not being able to adequately support their growing client base or investing in old PBX technology or taking a risky step as an early adopter of VoIP. Although VoIP systems have dropped in price and the quality and variety of sources of implementation expertise have grown since Heritage first took the leap, it is still true that the changes in training, operations, culture, and user acceptance all represent big hurdles. It is also true, as shown in the following case study, that a shift to VoIP is often inopportune and does not always yield the compelling 30 to 40 percent benefit demanded by today's businesses. In many cases, the issues are more practical than a compelling savings and are more about the survival of the business because voice communications is a fundamental service without which a business cannot function. Shown in this light, a savings of less than $10,000 per year for a regional bank is better than a loss but is not the focus.

Growing Up with VoIP at Heritage Bank

Heritage Bank, based in Birmingham, Alabama, realized some cruel facts about being forced into VoIP prematurely by exhausted traditional technology. There are more lessons than may be obvious for any company that is not considering the age and obsolescence of the existing system.

ROI

The manufacturer gave Heritage Bank price concessions in compensation for substantial problems early in their implementation cycle. The ROI presented takes into account the price concessions but not price reductions since 2002 and, therefore, may represent a reasonable expectation of ROI for a system that is implemented in today's competitive pricing environment.

The following rough-order-of-magnitude ROI analysis shows the hard savings the bank has realized from their consolidation of service providers and shift to VoIP. In addition to the hard dollar savings, there are increases in customer satisfaction, system supportability, and security and enhanced internal user confidence that are impossible to measure. Heritage Bank's ROI has two components, both of which complement the other: service consolidation and VoIP.

It is customary and prudent to separate the ROI components to clearly show the impact of the service consolidation and VoIP separately. It can be argued that VoIP can be implemented separately from a service consolidation and vice versa. In most cases, this is true, but in the case of Heritage Bank, there were so many inter-related elements that the project must be taken as a whole.

A further argument could be made that the bank could utilize VoIP-enabled low-cost voice services to further lower their costs. This may well be a future initiative but the bank is extremely happy with the quality of their current service and support presently being provided and will approach such an initiative very warily. Such an option was unrealistic in 2002.

A 46-month ROI is high; the norm today being 24 months or less. What the ROI hides, however, is that the old system was at its limits: it was unable to sustain Heritage's growth. An outside observer could quickly tell the strategic importance of this project to the bank by the fact that they spent just more than US$200,000 for consulting and services.

TCO

A TCO comparison of the old key system and the new VoIP system provides further evidence that the bank's move was more strategic than simply cost savings and correlates well with the ROI analysis. Total savings after 5 years, not adjusted for inflation or any other economic factors, was a mere $40,000, but the bank is still in business and thriving.

IPT

IPT was born of VoIP and proved compelling for traditional carriers, Internet Service Providers (ISPs), and end-user organizations with stricter TCO and ROI guidelines for new technology adoption. Right out of the gate, IPT was intended for both PC and non-PC device interconnection, was designed to replace traditional telephony because it incorporated key functions ignored by VoIP—such as signaling, and can be used as a transitional technology harmoniously and seamlessly providing a telephony environment of mixed legacy and VoIP devices.

IPT is complex but well understood and can be successful simply by providing traditional dial-tone over cost-reduced multi-media packet infrastructure. IPT can be used as a stepping stone to a future multi-media and wireless environment, or can be used to create a mixed environment. IPT can provide cost reductions of 20 to 40 percent over traditional telephony, and TCO and ROI models are well understood, as shown in the two examples that follow—one is an example of a packet voice infrastructure at a county school system and the other is a PC-based application at a global consulting firm.

IPT at Paulding County Schools: A Formula for Success

Paulding County School District in Paulding County Georgia has implemented a school system-wide VoIP setup with an IPT emphasis incorporating almost 600 phones and completely replacing their older PBX and CENTREX service and the entire physical infrastructure in all schools.

ROI

There are three ways to approach the ROI for this project. The first model is Voice Rides Free, the second is Port Allocation, and the third is Capacity Allocation.

Sources of Savings: Although the system provides additional "soft" benefits, the ROI and TCO calculations are treated as if this is a straight functional replacement of a phone system. No savings will be calculated for the move of PRIs to USLEC—this could be achieved without a migration to VoIP.

Voice Rides Free: The first model assumes that the system needed to be installed for data and, because it was so substantially overbuilt, the VoIP traffic represents a small impact. Therefore, the ROI can be calculated as the cost for VoIP systems and phones of $450,000 divided by the $33,000 per month savings to yield an *ROI of 13.6 months*.

Port Allocation: The alternative to Voice Rides Free is for both voice and data to share the costs of the system. In this first allocation model, Port Allocation, costs are allocated based on the total number of ports. If you were allocating the costs of a road system, this would be the equivalent of splitting the total cost by the number of driveways, regardless of the type of vehicle that would use the road. With a total allocated cost of $716,850 and a savings of $33,000 per month, the *ROI would be 21.7 months*.

Using these figures, an organization considering a new system can calculate the rough costs of their own converged voice and data solution. Keep in mind that financial modeling shows these costs to be roughly consistent with the costs of a traditional PBX, so these figures are not valid for comparing VoIP and PBX. If a change of telephony system is mandated, the numbers show a move to VoIP is viable, while a more reasonable decision point might be the answer to the question "Are there compelling reasons for a move to a new telephony system now or can we wait?"

Capacity Allocation: Capacity-based allocation takes into account the demands placed on the network by voice and data and shares the cost of both network use and network idle capacity. If the network were a road system, this is the equivalent of allocating costs based upon the size of the vehicles using the road.

Based upon an average demand of 384 thousand kilobits per second (kbps) per data user and average demand of 70kbps per voice user, we could allocate 18 percent (70/384ths) of the infrastructure costs (18 percent of $1,452,000 or $261,360) to voice, add the $450,000 cost of VoIP equipment, and divide the total of $711,360 by the $33,000 of savings per month to yield an *ROI of 21.55 months.*

TCO

TCO is always a tricky calculation but a very useful one, especially when used to compare two or more systems for which the TCO has been calculated using the same algorithm. In the case of the Paulding County School District VoIP project, the system life of 5 years will be used for calculation of all recurring costs. Because there is no dedicated staff, no personnel overhead will be calculated, but the outside maintenance fees will be considered. A useful figure for comparison purposes is the total cost/user, and this will be calculated based upon 450 users. Fixed costs will be based upon the Port Allocation method shown for the ROI calculation.

Based upon these rough order of magnitude calculations, for budgetary purposes, the cost to provide VoIP-based phone service for a single Paulding County School District telephony user is $2953 for 5 years, or $49 per month; a figure substantially below the $74 per month cost of the Centrex service being replaced.

There are two forces at play. The first is the usual impact of replacing a 10-plus year-old technology with a new technology: the double impact of a lower price and more capability. The second force is the financial impact of Paulding County's very favorable monthly fiber cost. With normal fiber pricing, a budgetary figure of $80 to $100 per month per user to provide VoIP-based phone service would be more realistic for an organization of similar size, which would mean that even traditional Centrex may be more cost effective and the cost difference may have to be justified based upon strategic application benefits or on a "Voice Rides Free" strategy, which also makes sense for many organizations. This example clearly highlights the importance of keeping infrastructure costs under control.

The Paulding County Schools example is a compelling one, especially when considering the TCO on a per-user basis. Calculating TCO per user allows a direct comparison of costs from the IPT system to the traditional system and provides very convincing evidence that Paulding County Schools made the right decisions along the way. This example shows that much of the value of IPT projects can come from the infrastructure part of the project and that all aspects of the system implementation are inextricably interwoven and must be thought of differently than traditional voice or data or video projects—projects often accomplished by multiple standalone departments.

The next financial case study represents substantial savings with a shift to PC-based IPT. A group of globally dispersed consultants were able to use VoIP application software to overcome the inherent limitations of their cell phones, leveraging the global ubiquity of 802.11 LAN standards. One can only imagine the positive shifts that will occur as WiFi hot spots continue to proliferate globally, and how the convenience and ROI will improve as the engineers increase their use of wireless for VoIP, data, and video.

Semco Maritime Does Global VoIP—Without Phones

Semco Maritime, a global engineering services firm primarily serving the energy and shipbuilding industries, has harnessed the power of IP to create a high-quality, money-saving, PC-based VoIP service for their 600+ geographically dispersed employees. The two-tiered service combines MPLS and Internet-based VPNs in a true VoIP solution.

ROI

ROI for Semco Maritime was only a secondary consideration: they required global voice connectivity but soon learned that it was accompanied by an impressive ROI: the initial investment of less than 600K Euros was paid back in 4.8 months. This ROI is based on the clients' own numbers and savings figures of 200 Euros per month per engineer. In the author's anecdotal experience, hotel room phone charges are much higher than the 10 or so Euros per night saved on an average 20-hotel nights per month. My own calculation is that at least 30 Euros per night would be saved, except by the most frugal and disciplined engineer, who always makes calls from a lobby phone with a phone card and does not use the room phone. If this were the case, the ROI would be 1.6 months.

	Qty	Euros	Dollars
Alcatel OmniPCX	1	540,000	666,800
Alcatel 4980 Soft phones	600	39,000	48,000
Total Initial Cost:		**579,000**	**714,800**
Savings/month/engineer		200	247
x Total engineers		600	600
Total Savings/Month:		**120,000**	**148,200**
Return on Investment:		**4.8 months**	

TCO

Although the TCO calculation shown below could easily be challenged by any competent accountant, it does provide a rough order of magnitude idea of Semco Maritime's TCO for this application. Additional considerations could include allocating current IP data costs to voice based upon percentage of traffic or bandwidth and similar calculations, but those arguments could be countered by saying that the data expense already exists and, therefore, voice rides for free. The fact remains that Semco Maritime's total cost per user per month for as much global telephony as they can use is in the range of 20 to 30 Euros.

	Qty	Euros	Dollars
Alcatel OmniPCX	1	540,000	666,800
Alcatel 4980 Soft phones	600	39,000	48,000
Total Initial Cost:		**579,000**	**714,800**
Annual Operating Costs		60,000	74,090
x Five Year Life		5	5
Total Operating Cost:		**300,000**	**370,450**
TCO:		**879,000**	**1,085,250**
TCO/User:		**1,465**	**1,809**
TCO/User/Month:		**24**	**30**

An analysis of companies moving to IPT, in most cases, shows a decided price/performance advantage. Price/performance advantage tends to highlight the word "price," or more importantly for carriers, service providers, and larger end-user organizations providing services to internal customers, the underlying "cost." The most important aspect of the multi-media phase, however, must be the price (or cost) to performance ratio. It seems to go, almost without saying, that the economies of scale and benefits of integrated network measurement, troubleshooting, management, and operations created by running voice and other enhanced multi-media services over high-bandwidth shared IP networks should be able to provide efficiency at low cost. What we have learned during the transitional VoIP period, however, is that it often does go without saying, but shouldn't, as the "converged network is more efficient and lower cost" argument does not always work: problems and unforeseen costs scale up as well as savings in large networks and are magnified for larger organizations—and not always in direct proportion to the size of the network.

For many organizations who have maintained a largely unchanged traditional telephony infrastructure, there is an immediate and positive impact of a change to a new, modernized system simply due to Moore's Law, which states that there is a natural price reduction accompanied by an increase in capabilities that is simply a byproduct of the advancement of technology. Beyond that, wild claims of "free voice" and "elimination of voice personnel" have created unrealistic expectations that are very difficult to overcome, often leaving those who are to finish crossing the VoIP bridge to the multi-media era with insurmountable problems, primarily in terms of user and management expectations that are critical to a successful transition. Without proper expectation management, any project, and especially one that impacts such an important capability as human-to-human communication, is doomed to failure. This includes proper expectation management in terms of cost savings, operational simplicity, voice quality, and many other areas.

Major Changes

Sorting out all the changes and putting them into categories, we see that the two major changes are that telephony is becoming an application, rather than a service and that end-user organizations are accepting more responsibility for voice applications than even organizations with historic PBX infrastructures. We can also observe that the shift from a service, provided largely by outside organizations, to an application, traditionally managed by internal organizations, also heralds the second major change, a shift in responsibility placing the larger end-user organization in the role of carrier or service provider to internal clients.

Telephony Becomes an Application

It has long been assumed by the IP crowd that the migration to Everything over IP (EoIP) is almost an evolutionary "given," more so, even than a revolutionary coup, but the arguments have been more emotional than real. The argument has always pivoted around the superiority of IP over circuits coupled with the name recognition and market acceptance of the Internet and its underlying protocols. The piece that has been missing, however, is that the real benefits of the Internet, and the market's fascination with it, come from its simplistic interfaces and software capabilities, and not from its underlying architecture. If the truth be told, wouldn't each and every user want a dedicated, guaranteed-performance path from themselves to each other system with which they interact? And isn't this exactly what a circuit offers them? No, users are not enamored with IP and its switching characteristics; they are in love with the applications, which can be characterized by two words: simple and multi-media. And these applications will be offered in packages that are simple and easy, possibly under the banner of Virtual Private Network (VPN) services, and quite possibly offered seamlessly over a variety of transports, both wireless and wireline.

Migration from traditional telephony to the multi-media Voice over Packet model should be strictly an internal network issue and should be transparent to the actual user of the service. The migration should be seamless, and the only evidence that a subscriber should have that the migration has occurred is that they now have a menu of new, meaningful multi-media services that were not previously available.

Another key point of consideration as end-user organizations take a greater responsibility for their voice services is that monitoring and management tools are no longer embedded in the network but rather form a new part of the skill set the end-user organization must adopt. As the responsibility for services shifts from the carrier and service provider to the enterprise organization and eventually to the end user, and as the end user becomes empowered and more sophisticated, so too, must the monitoring and management tools provided by the network. If there is one thing that VoIP has taught us, and a mistake that cannot be repeated, is that although it is possible to render voice waves and bits and to put them into packets that there is a lot more to the entire puzzle than just this. Voice is an IP application, but it is not "just another application." We have learned that "cheap" alone won't make voice on the net work, and that the next phase must include much more of traditional telephony monitoring and management, coupled with new tools, than we ever thought possible before.

Responsibility Shifts from Carrier to End-User Organizations

The technical challenges of running advanced enhanced services across large, often multi-carrier, IP networks are magnitudes of order higher than providing vanilla VoIP PSTN-replacement call connectivity. When implemented by "traditional" enhanced service platform providers, the database-centric execution of many popular enhanced services, such as phone/debit calling cards and ubiquitous unified messaging, holds the unpleasant promise of introducing new orders of call latency that equipment suppliers just thought they were close to "solving."

Within the VoIP transition, the actual users have only had a glimpse of the problems, while the service providers face scalability issues every day. The first-generation client/server service platforms have extreme scalability limitations, typically being able to run a half dozen or so "remote" switches before they experience melt down. There are, at present, no VoIP or multi-media phase networks that even approach the scope or scale of traditional uni-phase networks. Consider that the leading VoIP provider, Vonage, just passed a million subscribers in Spring 2006, and that a million is not equal to a single midsize United States city. In addition, existing VoIP signaling protocols don't address potentially service crippling latency issues within VoIP networks. To more effectively meet latency requirements, multi-media networks must not only provide fast database access but also distribute control intelligence throughout the network, a lesson learned from uni-media.

We have also learned that multi-media networks are complex organisms requiring specialized monitoring intelligence, and that manufacturer-provided monitoring tools are a part of the solution but do not take into account the nuances and subtleties of the overall system. However, generic monitoring and management tools are insufficient—to be truly effective, third-party tools must be constructed with a knowledge of the individual manufacturer's systems being maintained in order to provide a system-wide, end-to-end view of system performance.

The key areas that next-generation monitoring and management tools must cover are:

- Pre-deployment simulation and modeling
- Manufacturer-specific monitoring and management
- Real-time business views
    - Call detail records
    - Calls in progress
    - Delay-to-dial-tone rates
    - Gateway channel utilization and loading
- Real-time call monitoring
    - Phone and multi-media device availability and monitoring
    - Successful vs. failed call completion rates
    - Poorly performing components
    - Service level breaches and SLA compliance
    - Real-time interface to Manager of Managers (such as HP OpenView)

- Summary and exception reporting
    - Utilization trends over time
    - Managed devices by company, department, and location
- Asset tracking
- Capacity planning
    - Incoming and outgoing calls
    - Loading by dial plan, routing rules, and gateway
    - Bandwidth utilization
    - Delay and delay variation
    - Packet loss
    - Route patterns, utilization, and availability

The IPT Life Cycle

In order to be successful in your next-generation network venture, expectations should be set as follows. Only in so doing will the results you achieve have any hope of being judged a success when compared with the expectations you set:

- Users—Different is not bad. The new system will initially provide all the important functions of the current system and then, after the baseline is established and the migration is complete, will provide important new capabilities. The system will sound different, but this is not necessarily a bad thing. The system voice quality will be (not as good as, nearly the same as, better than), fill in the blank based on your objectives, and the new system will be more flexible and give you more freedom while allowing you to stay connected.
- Management—The cost of the new network, when taken as a whole, may be the same or higher than what we are paying now but we must move forward to assure the continuity of our voice communications and eventually acquire advanced capabilities of strategic benefit, though our unique combination of geographic coverage and scale may allow us to realize overall raw cost savings. There will be four specific phases, each with its own specific objectives. Investing more time, effort, and attention in earlier phases will lower the overall costs and increase the value to our organization. The phases are planning and assessment, pre-deployment testing and implementation, ongoing operations, and optimization. Contrary to popular belief, VoIP is not “free voice” and VoIP is not “just another application.”

We will now take a closer look at each of these phases in the IPT life cycle.

Planning and Assessment

The objectives of the planning and assessment phase are to develop a replacement system that initially delivers replacement functionality and eventually adds important strategic functions. The shift to the multi-media phase is characterized by a new, fresh commitment to traditional telephony characteristics, such as reliability, security, and fraud control and customized services deployment. In addition, desirable new aspects—such as a multi-media focus—will be available on a large scale. All of this must be taken into account in the planning and assessment phase. It can also not be stressed enough that management expectations must be set so that a sufficient amount of time and resources can be invested in this phase to make the phases that follow it successful. VoIP is not just another application that can be launched by plugging in a few IP phones. A proper planning and assessment phase will take all of the needed factors into account.

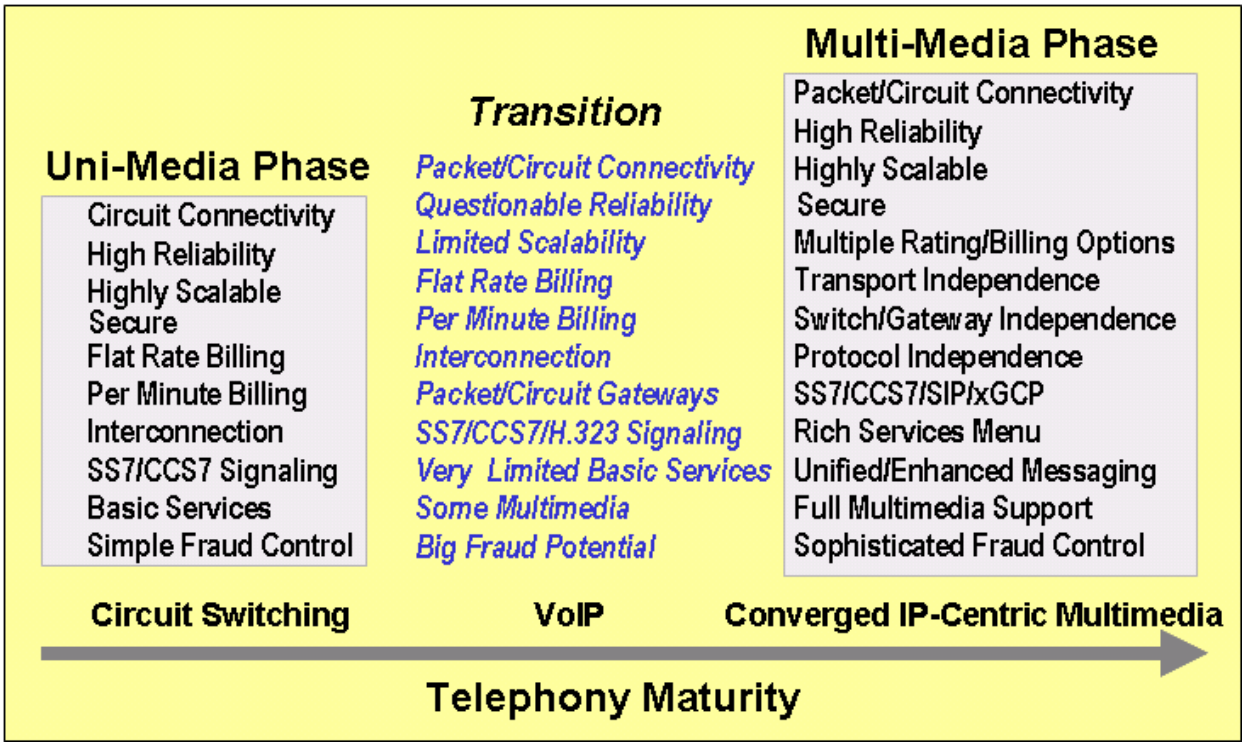

Figure 1.1: The path from uni-media to multi-media.

"Making the move" to multi-media is not a very accurate statement as those carrier, service provider, and end-user organizations adopting multi-media will not, in most cases, actually 'move' at all. In most cases, they will already be providing or using traditional and/or VoIP-based systems and will simply transition to multi-media non-disruptively.

The first step is to ascertain the current services and features that are being utilized in the uni-media phase to assure their accurate reproduction in the multi-media phase. A methodology for accomplishing this step is presented in the next chapter. The next step is to move as quickly as possible through the transition phase, though many organizations would be well advised at this point to skip over the VoIP step and move directly to the ultimate converged IP-centric multi-media IPT phase. This step avoids the risk of being in the transition period and reduces negative user impact.

Pre-Deployment Testing and Implementation

The objectives of pre-deployment testing and implementation are to assure the outcomes from the planning and assessment phase and to determine the impact of adding the new applications to the existing network, then to roll out the new system into the organization. The use of sophisticated, specialized modeling and planning tools in the first two phases will allow us to assure the maximum benefits in the shortest amount of time with the least possible disruption to our operations.

Ongoing Operations and Optimization

Ongoing operations and optimization are two phases with opposite objectives. It is the objective of the ongoing operations phase to ensure consistent functionality across the network, regardless of where an individual is in the organization geographically. Ongoing operations is constantly measuring the network's performance against established benchmarks to ensure unwavering compliance and absolute consistency of network services. Optimization, in contrast, has as its primary objective improving operational aspects of the network services and adjusting the operational baselines to reflect new baselines.

One of the key items that will require revisiting, and refreshing, is the SLA. The SLA is an effective tool the full potential of which has never been realized. In its most basic form, the SLA is a contractual vehicle that, at the very minimum, documents the minimum level of service that a customer is willing to accept before they are due some penalty or refund on their service, but it can, and should, be so much more. It can, and should, also provide a description of the actions taken by a carrier or service provider should the user not keep up their part of the arrangements, such as using a service class for which they have not contracted.

SLAs should also be automatic. At the present time, too few carriers and service providers have embraced the SLA as a strategic customer relationship management tool and require the customer to jump through hoops to get the penalties they are due. SLAs and the compliance information supporting them should be available to the customer when and as needed. We will see a lot more of this in the multi-media future, and sophisticated monitoring and management tools will be required to keep customers apprised as to the QoE delivered by a network, versus what was promised and contracted. In fact, the education process that goes along with this effort should be initiated as early in the process as possible because the process of educating the user on SLA compliance is also the process of educating the user on how to select multi-media services without relying strictly on price.

The process about which we are speaking gets to the heart of the matter of creating a more informed consumer of multi-media services in such a way as knowledge about vehicle performance makes a more informed purchaser of cars. Mean Opinion Score, PQSM, R-Value, and similar voice quality metrics should be as familiar to the consumer of voice services as MPG, horsepower, and fuel options are to owners of vehicles. And this analogy makes additional sense not just in terms of SLA performance but, as previously mentioned, in terms of a more informed purchaser who will forego the commodity approach of "voice by the minute" or "gas by the gallon" for a more informed purchase decision based upon metrics other than pure price. Tools that allow the monitoring of voice traffic and related quality metrics in real-time and provide feedback to suppliers and consumers on an exception basis, using baseline thresholds established in the SLA, are crucial to success in the multi-media future, as they keep the focus off price as a singular differentiator.

One possible model that might emerge is that transport becomes a commodity over which differentiated services flow. In this model, the prior performance of various transports, representing some combination of different QoE offerings from one or more transport providers, is known and the closest QoE to that needed by a given service at a moment in time can be selected, possibly on a "pay as you go basis." An alternative to that would be that bids would be requested, in real time, from available transport services to provide a certain QoE at a moment in time. How would this work in practice?

Suppose that you were in a coffee shop in Milan and needed to make a good night call home that required high-quality, bi-directional audio and real-time video. You would have already made whatever requirements were needed with the coffee shop—free wireless hot spot, pay-as-you-go, used your corporate account with the wireless provider, whatever was needed—for access to the Internet. In this case, you would select the called-to party on your PC/handheld/wireless video phone and a request would go out for the long-haul service needed to handle your call. Because of the low-loss, high-quality needed, you would basically be negotiating for a toll road for your call. The negotiation would be made with a transport service that would provide what you needed, at a negotiated price of .7 cents per minute, right now with no guarantee of this price in the future. Your measurements from prior calls, and/or other users, would be used to validate the bidder and your call is put through. The next call might be a highly compressed voice-only call to check voicemail and might not require the toll road. There might be no additional cost for this service beyond what is included in your basic monthly rate. Anything is possible in the multi-media future.

Optimization

While the ongoing operation phase is about consistency, the optimization phase is about a regular, constant, ongoing program of positive change in network operations. Optimization takes the measurement and SLA compliance statistics gathered during ongoing operations and seeks ways to improve those statistics with specific target outcomes. Desirable objectives will include financial or operational goals, such as releasing resources on traditional telephony networks as calls shift to the VoIP network or even reducing the amount of bandwidth used per call on the VoIP network as newer voice coding techniques are implemented, both of which can have favorable operational and financial outcomes. The process will involve conceptualizing improvements, validating assumptions using modeling or simulation tools, then testing them in a laboratory or isolated network segment before implementing the changes in the actual network. After network performance has been assessed and any needed fine tuning done, the network operational benchmarks are adjusted and new optimization goals are established.

Summary

We are at the end of the first chapter which, as a standalone white paper, would simply be an overview of the possible future of telephony: interesting and academic and about as useful, or useless, as dozens of other white papers on the topic. But, this chapter is so much more. This first chapter has documented the underlying beliefs, philosophies, and observations needed to understand the rest of this guide and will be the last we will see of high-level concepts, abstract ideas, and sweeping generalities. From this point forward, this guide will morph into more of a practical guide, a "how to guide," based on knowledge gained from planning and implementing VoIP and multimedia communications for some of the largest multi-national and global organizations.

Chapter 2 will cover the IPT life cycle, and the following six chapters will follow the life cycle as we describe the processes, best practices, and pitfalls at each step, including planning and assessment, design and pre-deployment testing, implementation and migration, ongoing operations, optimization, and some very nitty-gritty details needed to assure success. Thus, if you are new to telephony or are an industry veteran, stand by for what we intend to be the most detailed, in-depth, and useful guide to VoIP and IPT implementation that it is possible to cram into 200 pages.

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