PRICEWATERHOUSECOOPERS

# InfoComm Review

Volume 4, No. 3

## The Innovator's Dilemma for the Telephony Industry

ALSO INSIDE:

EXTENDING OUR EYES

FICTIONAL FUTURES

SMALL WORLDS, BIG STORIES

Volume 4, No. 3

# InfoComm Review

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T H E M E N

MESSAGE FROM
THE EDITOR

Sometimes "good" does not prevail.

In a variety of industries populated by strong, well-managed companies, "inferior" technologies have taken root in certain applications appropriate only to niche markets. They've gradually improved and evolved to serve users farther upmarket. And, eventually, they have encroached on mainstream markets, challenging, even wounding, the industry leaders. It happened in the steel industry, in the disk drive industry, and in the excavator industry. Other industries, too, have faced the effects of these "disruptive technologies."

We think there is reason to question whether the technologies developed by the Internet value network could represent a disruption to the telecommunications industry. Recently, we explored this idea at our "Voice-Over-Data, Data-Over-Voice" Executive Retreat in Pebble Beach, California. At the retreat, industry executives, analysts, and academics debated the technology issues, business models, and possible future applications of IP-based services.

In our lead article—"The Innovator's Dilemma for the Telephony Industry: Will the 'Bad' Technologies Win?"—we explore the directions in which these technologies may develop and how the telecommunications industry might respond. We borrow from the insights of Clayton M. Christensen of Harvard University, who has carefully researched the disruption in other industries and documented them in his book *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail.* Professor Christensen was kind enough to spend time with a small group of my PricewaterhouseCoopers colleagues and me. Some of his comments from our discussions were presented at the executive retreat and are shared here.

In addition, Jim Crowe, president and CEO of Level 3 Communications, has written in these pages regarding his company's strategy for a far-reaching IP network. Jim, who was one of our speakers at the executive retreat, says that the challenge is too great to go it alone. Level 3 will build an upgradable network and will carefully select the customer segments it targets, leaving it to other providers to serve other customers using Level 3's network.

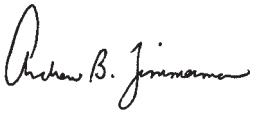
Because IP-based applications are just emerging, we have included a Primer that explains some of the terminology entailed and that also lays out some of the trends and developments in IP telephony in the United States.

Continuing our look into the future, we asked Mikael Edholm, director for corporate business development at LM Ericsson, to tell us about Ericsson's use of scenario planning as a complement to its regular strategic planning techniques. Scenario planning, says Edholm, is helping Ericsson attain the organizational flexibility it needs as it heads into a rapidly changing environment.

And on the subject of possible futures, our own Emergent Solutions Group (ESG) is developing synthetic worlds that allow managers to view the complex adaptations that occur in the marketplace among consumers, within companies, and within industries. We've reprinted an excerpt from the book *How Hits Happen: Forecasting Predictability in a Chaotic Marketplace.* The author, Winslow Farrell, is the head of our ESG and an expert on the use of agent-based computer simulations.

Finally, just a few words about the merger this past summer of Price Waterhouse and Coopers & Lybrand and what this means for our clients. Through this combination, we've extended our global reach and enhanced our capabilities so that we can better serve clients at all stages in their business endeavors with a broad and deep range of professional services. We are very enthusiastic about the rapid and successful integration of our respective InfoComm practices and I hope that you will experience the benefits of our merger in the months ahead.

Best regards,



Andrew B. Zimmerman
Editor
Global Information and Communications Sector Leader
PricewaterhouseCoopers LLP

*Could Internet technologies pose a threat to telephone companies?*

# The Innovator's DILEMMA for the Telephony Industry

*Will the 'Bad' Technologies Win?*

Do Internet-protocol (IP) technologies pose a threat to telephone companies? Surely the small inroads that Internet service providers are making into long distance telephony, taken alone, don't amount to enough market share to set off any alarms at the telcos, which have set the standards for high-quality and reliable transmission.

But providers of IP-based services are only beginning to tap the potential of their new technologies. The trajectory of improvement of packet-switching and companion technologies has been astounding. IP service providers are building networks and business models that will enable more and more applications that will be attractive to users, businesses and consumers alike.

Here, Andrew B. Zimmerman explores the hypothesis that IP capabilities may qualify as "disruptive technologies," as defined by Professor Clayton M. Christensen at Harvard University. Christensen describes the ways in which initially "inferior" technologies can infiltrate a market and cause havoc for the industry leaders, and in these pages we include observations he made in conversations with PwC consultants regarding the steel and telecommunications industries.

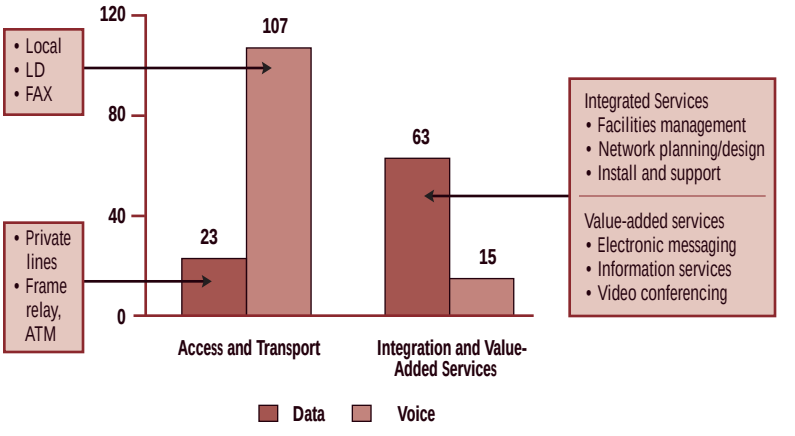
*by Andrew B. Zimmerman*

Why do bad technologies win? Recent research suggests that technologies that perform poorly for mainstream applications may find attractive niches. These technologies evolve over time and eventually, and surprisingly, supplant the traditional technology value stream.

These technology upstarts have been termed "disruptive technologies" in recent work by Clayton M. Christensen, author of *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail* (Harvard Business School Press, 1997). A disruptive technology is one that has been around for a while; that does not meet the needs of mainstream customers in a market, but finds a niche and evolves, improving over time; and that eventually challenges the market leaders. This article explores whether IP telephony could be a disruptive technology.

Remarkable improvements have occurred in voice over the Internet and especially over IP-based private networks, and these will continue, improving the quality of IP telephony. But the share of the voice market claimed by Internet service providers, though growing, is not significant—various analysts predict worldwide revenues for IP telephony service providers in the neighborhood of US$2 billion to $8 billion in five to six years (by comparison, standard telephony service worldwide drew revenues of US$495 billion in 1997, according to the International Telecommunications Union, which predicts total spending of $850 billion by 2005).

**GROWTH IN SERVICE-RELATED REVENUE FROM 1998 TO 2003 (US$ BILLIONS)**




**Most of the data communications value creation may take place outside the network.**

*Source: PricewaterhouseCoopers, analyst estimates*

Overall, in addition to regular IP telephony, data traffic is exploding, doubling yearly on public switched networks and increasing 1,000% annually on the Internet. But this isn't driving corresponding shifts in revenue; access and transport revenues for data are expected to rise only modestly, from 10% in 1998 to just 13% to 15% in 2003. As the chart at left illustrates, over the same time frame, far more revenue can be expected to come from integration and value-added services in data communications than from transport and access. The data world beckons with opportunity, and there lies the incumbents' dilemma: how to play a key role in this exploding data market.

## Value networks

The traditional telco value network includes service providers (in the United States, these are the local exchange carriers, known as LECs, and the long distance companies, or interexchange carriers, IXCs) and equipment manufacturers, such as Lucent, Tandem, and Nortel. Given that the industry is in part regulated, the government can also be viewed as a player in the telephony value network. The prominent companies in the industry have a common heritage, so there is little surprise that a set of strongly held common beliefs has guided the telephony industry from the time of the AT&T breakup in 1984.

Value pricing has greatly influenced innovation within the telephony industry, perhaps more so than is generally recognized. The telephone companies have become increasingly sophisticated in pricing services based not on what they cost, but rather on how much they are worth to the customer. Touch-tone dialing, for instance, actually decreases the cost of phone service by requiring only about one-eighth as much switch capacity. Yet, for years the LECs were able to charge residential customers up to an additional $2 per month for touch tone as a value-added service.

Given that basic service offerings were highly regulated and offered below fully absorbed costs, one of the industry's ways of extracting payment for its innovations has been to charge consumers incremental fees for enhanced services. Regulators have been open to value pricing of these services, without regard for the underlying costs of the services. The industry was fast to realize that there were two groups of customers that they should listen to and develop services for:

- Companies that operate from many locations or those that are highly dependent on communications for their profitability
- Small businesses and higher-income consumers who are heavy users of communications services or who like electronic gadgets

In short, innovation by the telephony industry has many times meant carving out a definable service from the core network and packaging it as a value-added service. This approach to innovation now accounts for such major industry revenue sources as private networks, frame relay, SONET, Internet access, and a proliferation of long distance packages for consumers and businesses.

To support its service carve-outs, the industry has invested in technologies such as sophisticated metering systems that measure traffic by both time and bandwidth, billing systems that accommodate the complexities of multiple service offerings, and analytic systems that match service offerings to the needs of target markets. The industry has also invested in marketing channels, such as direct sales, affinity marketing, sophisticated call centers, and direct mail direct response campaigns. This infrastructure to support value-added services, representing a substantial percentage of costs, is very much at the heart of the telephony industry's vision of the future. Today the industry has a new generation of value-added services on the drawing boards that use these facilitating technologies to slice and dice the telecommunications service into discrete packages that can be priced on very fine metrics of value. For example, Sprint recently announced a digital subscriber line service for which residential customers will pay a monthly service

← *open flap*


DISRUPTIVE SCENARIO
CONSUMER
DEMAND
SUPPLY
Adoption / Key Segments
Key Applications
Key Demand Drivers and Trends
Competitive structure
Technology
Pricing
Key Interactions and Drivers
Regulation
Hot Zones and Key Issues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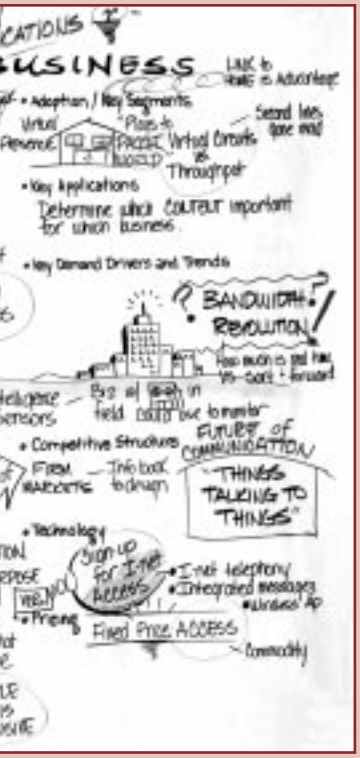


# Disruptive Scenarios:

## Executives visualize the future

At PricewaterhouseCoopers' recent "Voice-Over-Data/Data-Over-Voice" Executive Retreat in Pebble Beach, California, industry executives brainstormed about future scenarios and discussed what "disruptive" conditions could and do apply to the telecommunications industry.

Facilitated by PwC partners, with graphical support by Grove Consultants, two groups worked in parallel to develop disruptive scenarios for the consumer and business markets, taking into account the demand and supply conditions. The illustrations at left show what each group identified they expected to happen in the two major market segments. Uncertainties and issues for which the group did not reach agreement were cited in the "Hot Zones" area in the center of each illustration.

Although not everyone was convinced that the scenarios would become a reality or, if so, by when, the out-of-the-box thinking led to interesting ideas and lively discussions about a hypothetical future.

*"This is the first time I have ever used such high ratings in any evaluation survey...you provided an 'out-of-the-box' thinking opportunity."*

*—Conference attendee*

charge and an additional amount for the number of bits that flow through the system.

Not only do value-added services generate substantial revenue on their own, but they also drive demand for the industry's core network services. However, part of the industry's success in value-added services is accounted for by its control over the core network—a control that is rapidly weakening as regulatory pressures make the network more open and as new entrants gain knowledge and sophistication about how the network works and how to take advantage of its features.

## A new value network

Recently, a new value network has grown up around the companies that are driving the expansion of the Internet, including the following:

- Service providers, such as America Online and EarthLink
- Systems developers such as Intel, Sun Microsystems, Hewlett-Packard, Cisco, and IBM
- Systems software developers such as Microsoft, Novell, and Netscape
- Application software developers such as Oracle, Real Networks, and Verisign
- Systems integrators such as USWeb, Cambridge Technologies, and PricewaterhouseCoopers

This value network differs dramatically from the incumbent telephony world. The Internet has done a good job of serving people who seek low-end basic services and a low level of support, and who do not require highly sophisticated applications. Yet, anyone who has used the Internet is familiar with its faults: slow, unreliable performance; security loopholes; applications that frequently crash; and ambiguous privacy standards.

Whereas telephone companies make money by selling services, Internet companies are accustomed to giving them away to gain market presence or to sell hardware, software, advertising, or e-commerce. If the Internet value network should succeed in infiltrating the telephone companies' mainstream markets, then this very different approach could ultimately wreak havoc with the telephony industry's strategy of value pricing where the two value networks' services overlap.

## When value shifts occur

At this point, it is useful to view what has happened in other industries when a second and disruptive value network has emerged. Christensen, in his research and book, describes what happens in industries in which new value networks arise and radical shifts eventually occur, such as the steel, disk drive, and excavator industries. (See sidebar on page 20.) First, successful companies participate in a "value network" of suppliers and competitors that share a common view of where their industry's technology is headed. Their perception of the future is strongly shaped by the needs of the industry's best customers—the ones most willing to pay the highest margins for incrementally better products. By listening to their customers and responding with what Christensen calls *sustaining* innovation, companies can become great and dominate their industries.

Then, in the industries Christensen observed, other players gained a foothold in the lower end

**SOME ATTRIBUTES OF DISRUPTIVE TECHNOLOGIES:**

- They result in worse performance, at least initially, compared with market-leading technologies.
- They take root in small and emerging markets.
- Initially, they do not appear financially attractive to incumbents.
- They enjoy rapid performance improvement as they move up the value hierarchy.

of the industries' markets using *disruptive* technologies. These companies might have been around for years, serving a part of the market where margins and market size were too small to interest the industry leaders. Starting from a lower technical base, these companies continued to improve what was once a clearly inferior technology until it reached a level of performance that was acceptable to the more demanding and more desirable customers within the industry. At this point, the traditional industry leaders were in a difficult position and vulnerable to being toppled. Usually their problem lay not in the ability to match the technology, but in their inability to match the cost structure of the disrupting companies. Leaders that once dominated their industries found themselves relegated to serving small, high-end niche markets.

In Christensen's construct, the "innovator's dilemma" occurs at the point where the low-end niche players' technologies allow them to begin moving upmarket; at this point, the industry leaders must decide whether to allocate resources to capitalize on today's market opportunities, or to diversify their efforts and attempt to head off tomorrow's potential competitors.

## Voice over IP: A value shift?

The question today for the telecommunications industry is, Is there a value shift occurring, and do the technologies pursued by the Internet value network represent disruption? Clearly, voice over the Internet is an inferior—but improving—technology. The most difficult technical problem holding back the transmission of voice over the Internet is the latency that results from digitizing the voice signal, placing it in a sequence of packets, routing these packets to their destination, and finally reassembling the packets at the receiving end of the conversation and converting them back into an audible signal. (See "Voice Over IP: A Primer" on page 25.)

The latency problem makes Internet voice an unacceptable technology to the mainstream of the voice market that is accustomed to the

**THE PATH OF DISRUPTION**

1. Well-managed companies dominate their markets with sustaining technologies.
2. Lesser, inferior technologies arise that serve the distinctive needs of only a few customers.
3. Value shifts occur in these niche markets. Price, quality, or unique functionality make the lesser technologies increasingly attractive.
4. The inferior technology improves quickly and suppliers push upmarket. Incumbents may feel freed to invest in more expensive technologies and to pursue higher-level customers.
5. New entrants move upmarket to the point where they compete with incumbents in some products and services and offer other, attractive products.
6. The market leaders seek to match these new services, or try to offer greater value or competitive prices for existing services now offered by both incumbents and new entrants.
7. If they wait too long to react, market leaders may be unable to match the new entrants' cost structures and expertise in the new applications.

**SURVIVAL BY SPINOFF**

In the face of a disruptive technology, it may be possible for a company to stake a claim by building a separate organization to develop the very technology that threatens its traditional markets.

That's what Hewlett-Packard did when ink-jet printing technology emerged. In the mid 1980s, HP had already begun building a successful laser-jet business. When ink-jet technology appeared, controversy swirled around which technology would prevail. Ink jet was, in Clayton Christensen's words, a classic disruptive product. It was not as good as laser-jet printing; it was less expensive and thus promised lower gross margin dollars. But it was good enough to meet the demands of the market.

Rather than bet on just one, or try to commercialize ink-jet printing from within its existing printer division, HP decided to create an autonomous organization to make ink jet a success. The two divisions compete against each other. And each has behaved according to Christensen's model of what happens in markets with disruptive technologies. The laser-jet division has aimed far upmarket, building in a wealth of sophisticated capabilities, plus greater speed and resolution. Meanwhile, ink-jet technology has improved sufficiently so that, even though it still doesn't produce the quality that a laser jet does, it meets the needs of many professionals and others who would previously have been laser jet users.

nearly flawless, high-quality service provided by the telephony value network. Significant quality improvements have occurred, especially using IP-based technologies over private networks. But to date, Internet voice has probably found its greatest acceptance among foreign students who use it to talk with their friends at home and other niche, "low-end" segments.

There are probably hundreds of projects on the telephony industry's agenda that could produce greater return on investment among current customers than Internet voice—and traditional thinking about the "right" steps in well-managed companies would dictate that these are the projects the telcos should pursue.

Just as the well-managed market leaders in the steel industry did when minimills began making low-grade steel from scrap, some of the companies in the telecommunications industry value network are simply ignoring this threat and going on with business as usual. Others are developing high-end systems that reduce latency on IP networks to the point where it is acceptable to mainstream large-business customers. (Perhaps not surprisingly, telephony companies that are going down this route have pronounced that voice over the Internet really doesn't offer the cost savings that consumers expected.)

Meanwhile, the Internet value network, fueled by early successes, is innovating and is focusing on applications that are valued for convenience and low cost over voice quality. Some of the early development applications we know about could result in services that can be far more efficiently provided via packet-switched networks than by the circuit-switched network. An example: Manufacturers are developing electronic devices for households and businesses that will be capable of processing information about their own capacities and maintenance needs and communicating this information to homeowners, back to their manufacturers, or to other devices and appliances. One of the most intriguing innovations to emerge from the Internet value network may be the Jini protocol developed by Sun. Jini will enable communication among tele-

phones, televisions, computers, and a wide array of appliances and electronic monitoring devices. As such, it could be the technology that links all of these devices.

Imagine the furnace checking the forecast with the National Weather Service and then alerting the homeowner that a fuel delivery may be necessary sooner than expected. Imagine a house full of such devices, a network unto itself that also connects to external networks. Instead of one phone line, this home would need hundreds of circuits. These communications would be short, possibly frequent, and would require little bandwidth. This added load could paralyze the circuit-switched networks of the traditional telephone companies. The Internet, or private networks using Internet protocols, could be ideal.

Eventually, if the pattern Christensen has observed in other industries holds up here, it is more likely that these future applications will gradually reach the market by way of the Internet value network, rather than through the sophisticated efforts of the telephony value network. A technology that currently offers CB-radio-like international services to financially strapped students could evolve into the sweet spot of the data value network. It could be the center of personal and home messaging and statusing networks. And with its lower cost structure and the momentum of continuing innovation, it also could be poised to attack the high-end, more sophisticated corporate networks.

Or, in short, *the bad technology will win*. If the telcos move too late to counter these technologies and applications, then the upstarts will have the advantage of early experience and far lower cost structures. If the telcos have not responded in time, then they will either lose the opportunity to compete, or compete at a significant disadvantage and probably face unwinnable price wars.

## What to do?

The telephony industry's ability to continue value pricing value-added services could be lost if alternative providers arise, thus turning these premium services into commodities. Its core business of providing voice service is being challenged by a disruptive technology from a set of new market entrants that are used to lower margins and faster product development cycles.

The good news is that the overall market for both data and voice telephony services is booming and is likely to benefit from the demands of an information-intensive society for the foreseeable future. The question is, How will the telephony value network get a suitable share of the emerging market? Viewing the question in the context of Christensen's work, we can surmise that the telephony industry will *not* get its share if it ignores the emerging technologies and remains focused on the needs of the customers at the top end of its market. This strategy led to the downfall of 14-inch hard drive manufacturers, integrated steel mills, and much of the excavator industry.

Furthermore, it will not happen if the telcos wait until the disruptive technology is good enough to sell to current customers as a replacement for the current technology. In this sort of late, downmarket move, the margins required to support the telcos' cost structure probably won't be attainable, whereas the Internet value network's cost structure will already be geared to this level of the market.

This leaves the telephony industry with several options that Christensen's research suggests have a better chance for success.

1. Set up separate, independent organizations for the development of disruptive technologies. These groups should be of the scale that, using Christensen's number, a $50,000 sale is significant. Hewlett-Packard's entry into low-cost ink-jet printers is a successful example of this strategy. (See sidebar at left.)

2. Wait until the markets for the alternate applications are big enough to pursue, then acquire the necessary technology and expertise. This could be accomplished through acquisitions and alliances.

3. Embrace its strength, the management of the core network, and accept and encourage the proliferation of third-party providers. Although this approach is complicated by the regulatory climate, it is possible that the demand for wholesale services could make this the most financially attractive strategy. One LEC, for example, is experiencing triple-digit growth in providing core transport and other services to Internet service providers and achieving margins in excess of its average service lines.

A radical response to the innovator's dilemma for the telephony industry might be to stimulate the value-added markets as the "bad" technologies inevitably move upmarket and improve, but to sustain ownership of the legacy "good" technology—the core network.

*Andrew B. Zimmerman is the Global Information and Communications Sector Leader for PricewaterhouseCoopers LLP.* *The author acknowledges contributions to this article by Bill Battino, Doug Kester, and John Patberg.*

*For more information on PwC's experience with IP strategy development, please contact Andrew B. Zimmerman by phone at +1-212-259-2224 or by e-mail at andy.zimmerman@us.pwcglobal.com.*

# Losing the war by doing all the right things

## The steel industry: an analog?

A disruptive technology typically is something that's cheaper and simpler than established products, that isn't as good, and therefore can't be used in a mainstream market. Typically, the profitability that it promises in terms of gross margins isn't as good as the profitability that established competitors can make with their current customers. Steel minimills employ a technology for making steel in low volumes at costs that are 15% to 20% lower than the costs of an integrated mill. And the technology is not difficult.

You would think, because this technology is simple, widely available, and inexpensive to install, that the very best, most aggressive steel-making companies would have latched onto it. But none of them have. The reason is that as the technology emerged, it could only be used to produce the lowest grades of steel. The minimills first took on concrete reinforcing bar. Then, with improvements to their technology, which allowed them to control the metallurgical content of their products, they turned to angle iron and other simple structural shapes, and then structural beams. As the minimills attacked the bottom end of the steel markets, the integrated mills, which formerly had sold their products across the whole spectrum, simply got out of the lower end.

The integrated steel makers were freed to concentrate on production of high-quality sheet steel, for which auto makers were willing to pay a premium. Wall Street endorsed this because the big mills were getting out of low-gross profit lines and putting their investment capital into the very high end of their business.

The problem is, that as the minimills came up underneath them, these new businesses had exactly the same motivation—but a lower cost structure. So just as it made sense for the integrated steel mills to withdraw from making structural beams because it was the lowest profit part of their product line, as the minimills emerged, steel beams loomed as the highest profit part of their product line, and they were very motivated to go after it.

Further technological developments have enabled the minimills to make good sheet steel, and today the most sophisticated auto manufacturers in the world buy minimill steel made from scrap. In the last three years, another 12 companies have announced they plan to go into sheet steel with this improved technology.

The capacity in the steel industry is going to increase by 40%. U.S. Steel cannot keep migrating upmarket. Its big cash generator is essentially dead. Its degrees of freedom are completely gone. Back in the 1985-'88 time frame, U.S. Steel and the other integrated steel makers had the flexibility to build minimills. But they didn't do it, and now they no longer have the flexibility.

## Christensen on telecommunications

In telecommunications, it is possible to measure the performance improvement of the technology—of a packet-switching technology versus a circuit-switching technology. What's hard to measure is what improvement or what level of performance various tiers in the market need. You don't overshoot a market in a discrete event. It's a continuous process. As a company tries to add value to its customers every day, it reaches up and offers more and more performance and value-added services. But in doing so, it leaves behind or over-serves customers at the low end of the business who don't need all of this added value. And it's those customers who are the most likely to embrace the disruptive technology when it emerges. To tell that this is coming, you have to have a different view of who your lead customer is.

A telco's lead customers aren't the sophisticated, demanding telecommunications-intensive global companies. It's the people at the bottom of the market who need the least in telecommunications services who are going to be the most susceptible to switching over to the disruptive approach. And then follows the tier of the market above them, and the tier of the market above them. You have to keep your ear to the bottom of the market, not the top, to sense whether a technology is a disruptive threat or insignificant.

The telecommunications companies keep moving upmarket to provide more and more services and higher-value products to their most sophisticated clients. Which is just exactly the right thing to do. But in the end, when there's nothing above them in the marketplace, and they've created the room underneath them for lower-cost providers to move into the mainstream, at that point, when they feel the pain, their ability to react will be gone.

*Clayton M. Christensen*
*Harvard University*

# Extending Our Eyes

## Level 3's View of an IP Revolution

*by Jim Crowe*

At Level 3, our aim is to build an upgradable, IP (Internet protocol)-optimized network with our own transport so that we control costs and so that we can control the pace of technical roll-out in an environment of exponential change.

We want to address the whole of the market. Today we're going directly where the money is: PSTN (public switched telephony network)-quality voice and PSTN-quality fax, and what we might ironically call "traditional" IP services. I have no doubt that five to ten years from now, we will see an array of enhanced services over IP that we can't even imagine at the moment. As the cost of bits drops, these new services will proliferate.

In the meantime, Level 3 plans to spend somewhere between US$8 billion and $10 billion to build our network. To get a return on this kind of investment, you have to get at the 92% of the market represented by voice.

But we will not attempt to serve all market segments directly. At this point, it would be too difficult to start from the ground up and try to serve everybody unless you had a monopoly. We think we know how to sell and market to businesses, particularly bigger businesses. Not coincidentally, we can afford to build our own fiber to those bigger businesses. So that is where our direct sales force is aimed.

The rest of the market—medium and small businesses and consumers—we will sell through third parties. Unbundled network elements, unbundled loops, digital subscriber lines, cable modems, and the like don't scale today. In addition, the phone companies have little incentive to unbundle their network elements to sell to other providers (who want to take their customers away).

So we plan to sell to hundreds of other businesses and let them take on the job of deploying wireless, wired, cable, and broadband access to consumers and residences. We would rather have 100 or 200 companies working at it than to try to do it all ourselves.

Because speed to market is important, we are leasing an upgradable national high-speed network from Frontier. They own 24 fibers in the Qwest network. At the same time, we are building a 15,000-mile network linking 50 U.S. cities. We are also building a pan-European network, eventually spanning 3,000 miles and initially connecting 13 international financial centers. In addition, we are deploying self-healing SONET rings and dense wavelength division multiplexing (DWDM).

We will use no circuit switching, however. Deploying circuit switching is simply a way of buying into an untenable cost structure. IP is a more efficient technology and it's not simply a matter of unplugging circuit switching and plugging in routers. Circuit switching affects your entire business structure. We don't want to give up the advantage of a whole new platform based on a whole new approach.

*The next phase is about extending our eyes around the world at a reasonable price. We're at the very beginning of this phase.*

The second approach that distinguishes us is that we will serve customers end to end. We are building for both local and long distance. The line between local and long distance in the United States is simply an artifact having to do with a court ruling. It has nothing to do with customer buying patterns. Customers prefer "phone service." They don't need two providers. The fact that we will move from circuit switching to packet switching isn't going to change that dynamic.

The third characteristic that makes us different is the planning we are doing for the future. Over the past 10 years, many a company has come to the market with the following business plan: Technology, fibers, and electronics have changed. Let's build a brand new network and have a better cost structure than those that have come before. Then, a year later, another company comes along and says that fiber and electronics have improved. Now it is possible to have a better cost structure than the organization that started a year before. This has happened over and over.

Why is it that new entrants continually compete on a unit cost basis with incumbent companies that have much bigger cost bases? Because the assumptions about average asset life in this business are absolutely incorrect. During this period in which we've seen such rapid improvements in throughput for relatively low incremental cost, we have also seen average asset lives and implied capital investment and turnover based on 11, 12, and 13 years. Of course, what happens is that service providers leave a huge vacuum for competitors to come in, deploy new technology, and have a better cost structure.

Level 3 is using a whole new business model, driven by continuously decreasing unit costs and prices and skyrocketing demand. These factors mean that it is absolutely necessary to continuously upgrade our network. Not only will we need a great deal of capital turnover to support this model, but also the kinds of margins that can support the turnover.

We're witnessing a transition from a market that has been price-regulated and price-rationed to a new era in which service providers are going to try to meet their customers' needs in terms of bits.

Consider the potential: For the last 100 years, we've been building a network that extended our ears around the world at a reasonable price to the customer. The next phase is about extending our eyes around the world at a reasonable price. We're at the very beginning of this phase.

Your auditory nerves have a bandwidth of about a T1, about one and a half megabits on either side. Scientists haven't determined with precision the bandwidth of the optic nerve, but there is general agreement that it's in terabits per second. Until we can get terabits per second to consumers, we're not going to run out of demand. There is no reason why a caller shouldn't have a conversation with full interaction, with all of the nonverbal content that occurs when two people are in the same room—except that bandwidth costs too much today. The demand is there.

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*Jim Crowe is president and CEO of Level 3 Communications, Inc. He recently spoke to a select group of telecom industry leaders at PricewaterhouseCoopers' executive retreat in Pebble Beach, California.*

# Voice Over IP: A Primer

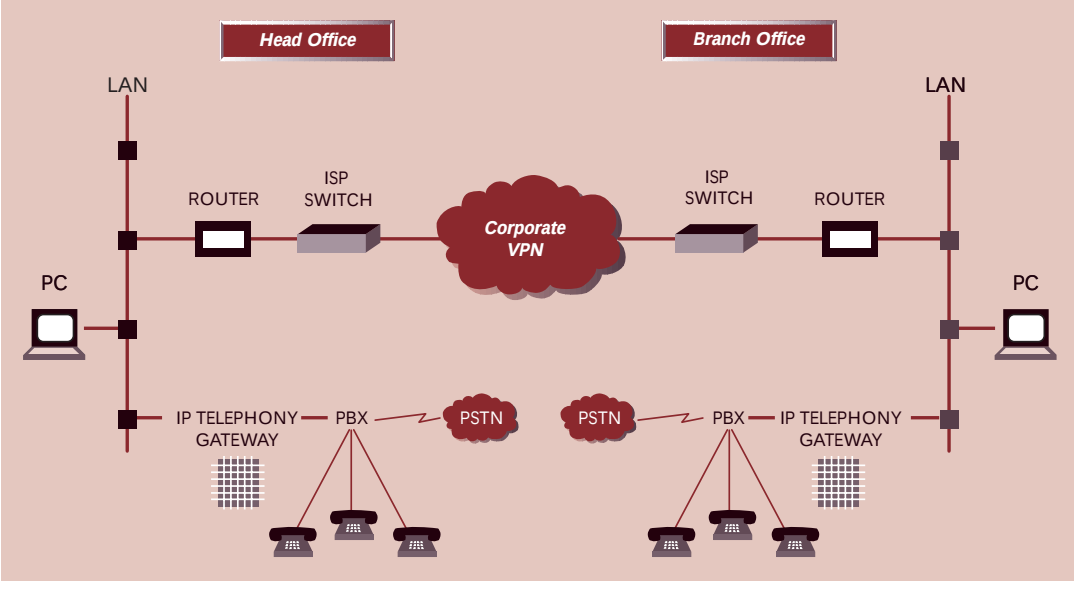
*by Ashish Kapur*

Voice over IP, or VoIP, refers to the transmission of voice communication signals over an Internet-protocol (IP)-based network. Asynchronous transfer mode (ATM) and frame relay are two competing protocols that can also be used to transmit voice packets. The underlying network for VoIP could be the public Internet or a managed IP backbone. IP can also run over an ATM-based network.

In traditional voice communications over the public switched telephony network (PSTN), a dedicated circuit is established between the caller and the called party. In VoIP, the voice signals are converted into packets and are transmitted over a shared infrastructure using IP. In a given call, the voice packets can travel on different paths; they are reassembled once they reach their destination.

Figure 1 (below) illustrates the two basic mechanisms for carrying a voice call over an IP-based network. Voice moves over a corporate data network, whether dedicated or virtual (that is, shared with other users). This requires the use of a VoIP gateway coupled with the corporate PBX. The gateway is programmed to recognize the phone numbers of the corporation's branch offices. A call to a branch office is converted into packets and routed over the corporate intranet instead of the PSTN. A gateway and PBX on the other

**Figure 1**




**Voice over a corporate data network.**

end translate the packets back into voice. The quality of the transmission can be managed. For calls from employee to employee, corporations may be willing to trade off some quality for the cost savings. However, the quality of service over such networks may be as good, or nearly as good, as that on carrier circuits.

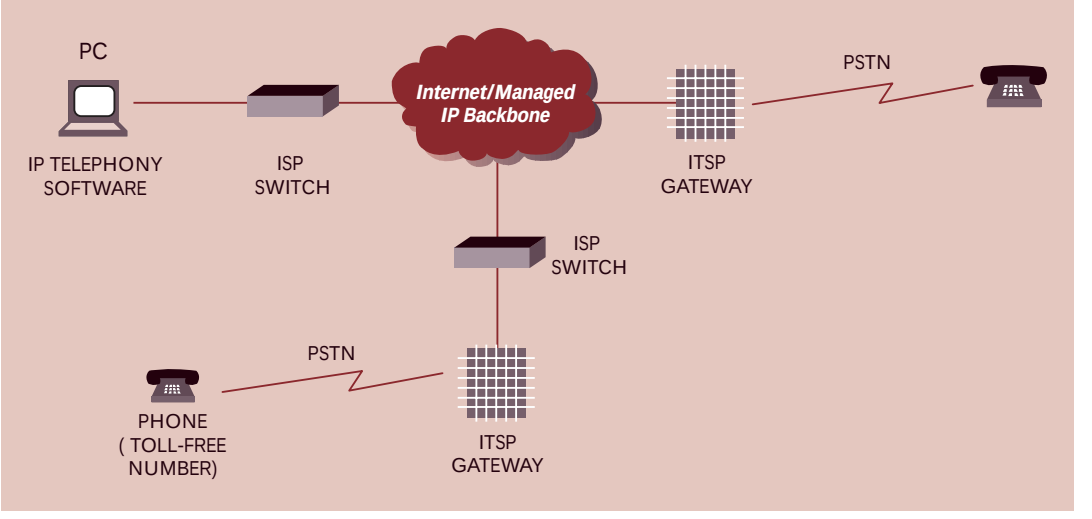
In the second approach, shown in Figure 2 below, Internet telephony service providers (ITSPs) configure VoIP for their customers. Customers connect to the local ITSP via a PC running the VoIP software or by using a telephone to call a toll-free number. The voice signals are converted into packets and carried over the public Internet or over the carrier's managed IP backbone. On the terminating end, an ITSP gateway interfaces with the PSTN and converts the packetized voice back into analog signals. The domestic and international reach of the ITSPs thus depends on the providers' ability to deploy gateways and to reach agreements with local operators to terminate IP minutes.

As traffic on the public Internet grows, it becomes increasingly more difficult to achieve carrier-grade quality of voice communications over it. However, voice over private IP networks (company private networks) or across a managed IP backbone can now be provided with carrier-grade quality.

## Who are the key players in this market?

The VoIP market has seen the evolution of a new breed of players, the ITSPs, some of whom aspire to become the next generation of telecom carriers. These players pursue a variety of market positions and strategies. Some, such as Concentric Networks, Delta Three/RSL Communications, Qwest Communications, and Telecom Finland, manage their own backbones. Some, including GRIC Communications and Global Gateway Group in the United States and Ozemail in Australia, run voice traffic over the public Internet. Others wholesale capacity on their networks, including Glocalnet in Sweden, Poptel GmbH in Germany, and VIP Calling in the U.S.

Figure 2




**Consumer application of voice over the Internet.**

Besides the new emerging carriers, some traditional telcos, including Deutsche Telekom, France Telecom, AT&T, MCI WorldCom, and Sprint, are also testing the waters.

Telecom equipment makers are also participating in the VoIP revolution. The traditional switch manufacturers, such as Lucent and Nortel, and the traditional packet router manufacturers, such as Cisco and Bay Networks, are all trying to make the transition into the new domain of packet telephony. Both groups face challenges. On the one hand, traditional phone switches are very accurate and controllable, and their performance is typically measured in "5-9s" (they are 99.99999% accurate); however, they cannot handle data very effectively. On the other hand, routers are very efficient, but do not provide on-time guarantees; and they do not recognize the pervasive SS7 (signaling system) protocol necessary to interface with the PSTN. The quick way for these companies to overcome these challenges is through acquisitions, several of which have taken place recently. Ascend Communications, for instance, through its acquisition of Stratus, attained new capabilities in circuit-switching technologies. Nortel purchased Bay Networks, gaining packet switches, routers, and IP solutions.

## What applications does VoIP enable?

The current demand for VoIP is being fueled by applications that are direct substitutes for traditional telecom products, such as data VPN (virtual private network), on-net voice and fax for business customers, and domestic and international long distance over IP for consumers.

However, the greatest potential of VoIP is expected to come from enhanced applications that integrate some forms of voice, video, and data communications. Some companies are experimenting with voice-enabled Web sites for their call centers that allow the user to set up a voice channel with a company representative by pressing a "talk to me" button. For consumers, IP can provide unified messaging, allowing them to access fax, e-mail, and voice messages through one integrated interface. Other enhanced applications for consumers might include distance learning and collaborative communications. (See "The Innovator's Dilemma for the Telephony Industry" on page 10.)

The VoIP application attracting the most notice lately, of course, is Internet telephony. Consumers are being offered Internet telephony rates as low as $0.08 per minute in the U.S. and even greater discounts on some international routes. ITSPs can offer lower prices because they do not pay to originating and terminating carriers the access charges that make up most of the cost of a circuit-switched long distance call. ITSPs also bypass the complex accounting settlement system set up for international calls. This tariff arbitrage is the key driver for Internet telephony today, but there is considerable disagreement as to whether there are inherent cost advantages of IP over the PSTN.

In terms of enhanced applications, such as collaborative communications and Web-enabled call centers, the computer and the Internet are key components. For VoIP providers of enhanced services, the IP versus PSTN cost comparison for a voice call is less meaningful.

## How will VoIP affect traditional telcos?

Various analysts estimate the size of the VoIP market in the U.S. at US$2 billion to $8 billion in five to six years. These analysts say the revenue risk is greatest for interexchange carriers (IXCs, the long distance providers in the U.S.), which could lose to ITSPs as much as four times more revenue as could the incumbent local exchange carriers (ILECs). Most of the migration is expected to occur in international and domestic long distance because of the opportunity to bypass settlement rates and access charges.

Research by PricewaterhouseCoopers suggests that tariff arbitrage opportunities will end in

three to five years and that the true impact of VoIP is going to come from the enhanced applications that it enables and not from the pure substitute applications.

## What are the hurdles VoIP faces?

Several quality of service (QoS) issues remain to be resolved before VoIP can match the quality of the time-tested PSTN. Recent developments promise to solve these issues and could take VoIP quality a step closer to carrier-grade quality.

**Delay** causes echo and overlap in voice conversations. The consensus is that a one-way delay of 100 milliseconds (ms) is not noticeable, that a delay lasting 100 ms to 200 ms is noticeable but tolerable, and that one longer than 200 ms is annoying. (By comparison, the delay for a domestic PSTN call ranges from 50 ms to 70 ms; the range is 150 ms to 500 ms for international calls.) Overlap of voice signals, and thus confusion, becomes significant when the delay becomes greater than 250 ms.

**Jitter** occurs because packets travel different paths over the network to their destination and arrive at variable intervals. Jitter can be removed by holding the packets in a buffer until all of the packets arrive. However, this approach increases delay.

**Packet loss** occurs when the Internet is carrying peak loads. An IP network treats voice packets in the same manner as data packets. Data packets are not time-sensitive and can be regenerated and retransmitted. Voice packets cannot be dealt with in this manner. The industry is making rapid headway in overcoming these technical hurdles. For example, prioritization protocols have been developed that distinguish voice packets from data packets and put them in front of the queue. This reduces delay of voice packets on congested nodes. Prioritization protocols also enable service providers to charge differently for different levels of service. Customers who purchase premium services will have their packets routed ahead of lower-priority packets. Gigabit routers are also being developed to speed Internet traffic. However, IP providers use a variety of routers and prioritization protocols; unless these are standardized, transmissions from one type of system to another will continue to experience delays.

The QoS capabilities will continue to improve, driven by the following factors:

- Improved gateways
- Faster routers
- Deployment over private networks
- Internet development

Regulation and policy play an important role in the VoIP market. Because Internet service providers (ISPs) in the U.S. are classified as enhanced service providers, they are exempt from regulations that require telecom carriers to pay access charges of around $0.06 per minute to local exchange carriers at each end of a call. The America's Carriers Telecommunications Association has asked the U.S. Federal Communications Commission to require ISPs providing telephony service to pay access charges. VoIP proponents claim that regulation of the industry would hinder innovation. They assert that Internet telephony is an emerging alternative in the traditional voice telephony market and should be allowed to develop without intervention from regulators.

In the European Union, Internet telephony is not subject to regulation. Several criteria are used to determine which types of communications providers fall under regulatory oversight. One of these criteria stipulates that regulated communications involve direct transport and switching of speech in real time. Because of the delays that occur in Internet transmission, Internet telephony does not, for the time being, constitute real-time communication.

Eventually, ITSPs are likely to pay some access charges; however, the more lucrative enhanced applications may continue to enjoy unregulated status for a long time.

## Glossary of Terms

ATM Asynchronous transfer mode, a technology that enables secure and manageable bandwidth on demand and features seamless local and wide-area network integration; a high-speed, connection-oriented networking standard designed to let one network handle a variety of applications (for example, voice, video, fax, and data) having different quality-of-service requirements.

Circuit-switched services Telephony transmitted over the switches/exchanges used in the public infrastructure; establishes an end-to-end connection with no other traffic carried on the same part of the communications link for that time; said to be synchronous.

DWDM Dense wavelength division multiplexing is a transport technology that allows different streams of data to be carried at different wavelengths. This is in contrast with conventional fiberoptic systems in which just one stream of data is carried over a narrow bandwidth window. Facilities-based long-distance carriers are using DWDM to increase the capacity of their embedded fiber by several multiples by carrying several streams of data at different wavelengths.

Frame relay A wide-band (64 kbps) packet-based data interface standard that transmits bursts of data over wide area networks. Networks provide end-users with high-speed virtual private networks capable of supporting applications with large bit rate transmission requirements.

IP Internet protocol defines the unit of information passed between systems that provide a basis packet delivery service. IP permits the exchange of traffic between two host computers without any prior call setup. IP is emerging as the standard for data communications in wide area networks and corporate intranets.

ITSP Internet telephony service provider, an emerging alternative telecom provider offering various services (e.g., voice, video, data) over a network utilizing IP standards (e.g., Qwest, Level 3, Delta Three).

PBX Private branch exchange, a customer premise communication switch used to connect customer telephones (and related equipment) to phone company central office lines (trunks) and to switch internal calls within the customer's telephone system. Modern PBXs offer numerous software-controlled features, such as call forwarding and call pickup.

PSTN Public switched telephone network, the voice telephone network accessible to all with telephones.

QoS Quality of service

SS7 Common channel signaling system No. 7 (i.e., SS7 or C7) is a global standard for telecommunications that defines the procedures and protocol by which network elements in the public switched telephone network (PSTN) exchange information over a digital signaling network to effect wireless (cellular) and wireline call setup, routing, and control.

SONET Synchronous optical network, the North American standard for telecommunications transmission using fiberoptic cables. It provides a uniform set of protocols for the management of high bandwidth services. It includes a multiplexing structure, optical parameters, service mappings, and operations support for existing and future services. In addition, standardized interfaces allow vendor-independent interconnection of terminal and subsystems.

*Ashish Kapur is a senior associate in PricewaterhouseCoopers' InfoComm Consulting Group. He can be reached by phone at +1-212-259-4813 or by e-mail at ashish.kapur@us.pwcglobal.com.*

# Fictional

# Futures

## *How Ericsson Uses Scenario Planning as It Looks Ahead Into a Complex and Rapidly Changing Market*

Scenario planning, a practice started by the military four decades ago as an exercise in "thinking the unthinkable," allows strategists to test decisions under a variety of conditions. Few businesses have used the practice to its full effect; a notable exception is Royal Dutch/Shell, which looked to scenario planning to help it deal successfully with the oil-price explosion of the mid 1970s.

Traditional planning is based on the assumption that there is one "right" future, one that will be like the present. The main question is *when* a set of events will occur, not *whether* they will. In a predictable environment, and with a good portion of luck, such an approach might actually work. But in a rapidly changing environment, prediction becomes difficult, if not impossible. An unexpected political event may throw a longtime regulatory regime off track. A breakthrough technology might make a currently successful product instantly obsolete. Suddenly performed mergers and acquisitions can dramatically alter the competitive landscape.

Recently, telecom equipment manufacturer LM Ericsson decided it needed to augment its strategic planning because traditional methods did not take into account the myriad possibilities that could arise in its highly complex markets. Today Ericsson is aggressively preparing for its future by using a comprehensive continuing strategy effort built around three possible scenarios. The scenarios comprise varying assumptions regarding consumer preferences, business opportunities, environmental issues, technology developments, competitor actions, and regulatory shifts.

Over a two-year period, more than 500 people at Ericsson joined the effort to create not only an analysis, but also an entirely new strategic framework for the company. Ericsson calls the program "2005" for the time horizon covered in its scenarios.

Here Mikael Edholm, Ericsson's director for corporate business development, describes the company's multistoried approach to planning for the future.

*by Mikael Edholm*

Many of the world events that have occurred since 1985—the collapse of the Soviet Union and the fall of the Berlin Wall, for instance—have been impossible to forecast. The same could be said about technological developments. Who, in 1985, could have predicted the worldwide rise of mobile telephony or the incredible increases in communications bandwidth we've seen over the past decade?

Scenario building, however, might very well have been able to indicate the possibility that some of these events would take place. Even though you can't build an exact scenario—a true description of the future—you can create the organizational flexibility that allows a company to handle both likely, and sometimes unlikely, events.

The outlook we call 2005 began as a regular strategy study, an attempt to identify sustainable and profitable business opportunities. It rapidly turned into the most revolutionary process ever undertaken at LM Ericsson.

In an unpredictable environment, we need a strategic "ready response menu" that we can pull out and choose from once the future materializes. Futures research, and scenario planning in particular, can complement strategic planning.

Scenarios are used throughout the organization, at all levels. Each planning unit—whether an R&D lab, a product development group, a marketing department, or another—makes plans for the future on a yearly basis. These include forecasts, product plans, and strategic plans. The early stages of this process now include scenario planning. The three scenarios used by Ericsson are descriptions of three alternative futures, different but equally possible.

Using scenarios as a framework makes it much more difficult to just extrapolate the present into the future. The process ensures that most basic assumptions are questioned, not just taken for granted. Consumer needs are different in the three scenarios, and market segments and sizes are different. Thus, Ericsson's products and services would have to be different.

The Ericsson scenarios are based on some known current trends. For example, electronic devices are expected to develop according to Moore's law and become increasingly more capable than they are today. The Internet is one of the fastest-growing man-made creations ever seen, and it is expected to continue to expand the technology horizon. On-line consumer information and electronic commerce will continue to find and define mass markets. Mobile telephony has already become pervasive and is well on its way to becoming ubiquitous. Emerging markets, for all their temporary setbacks, will continue to increase worldwide consumer demand.

These facts are given. What the scenarios have to take into account is all of the uncertainties. Who will win "the battle for the consumer"? How far will wireless access grow? How will telecommunications be deregulated?

Each of our scenarios represents a time line running from today to a fictional 2005. At various points on these time lines, we position key events that drive the evolution forward in the direction of a particular scenario. We call them trigger events. These might include technological breakthroughs, political events, or market developments.

## Developing the scenarios

Ericsson's 2005 scenarios were built using three basic steps. First, we took a hard look at the present, at the industry environment and the world around us. Facing a convergence among the telecom, computer, and media industries, we identified value chains and value webs. We developed a matrix of the competitive landscape, showing intersecting value chains. One value chain represented the customer base, ranging from information creation, through manipulation, distribution, and packaging, to presentation. This was the horizontal value chain. Feeding these elements of the horizontal chain were five vertical value chains, one per horizon-

tal segment. These vertical chains were divided into three stages: from components and subsystems at the bottom, through complex systems and operating environments in the middle, to the applications and professional services at the top.

Customers and competitors could be plotted on the matrix, and then we could identify relative strengths and weaknesses for each coordinate. What is a strength in one place may actually be a weakness in another.

The next step was to look ahead. We chose to create three scenarios; in the experience of other companies we had observed, two scenarios were too few to yield much more than traditional strategic planning already provides. With more than three scenarios, it becomes difficult to communicate the process effectively.

We built the scenarios using data from a massive number of interviews and analyses. In each scenario, 15 to 20 significant business opportunities were listed and grouped.

Then, as a third step, the five most important capabilities needed to become successful in each business opportunity were listed and grouped. The resulting "capability gaps" showed us where we needed to improve in the future. We looked at the gaps between current organizational competence and what we deemed would be necessary at the three points in the future. We also looked at the gaps between our competence and that of our competitors, given the business intelligence we had.

The process clearly showed that some scenario and business segments were more attractive than others. "Attractiveness" was defined by our assessment of the segment size, growth rate, technology, and other factors versus our capabilities in terms of competitiveness. It also became evident that in order to survive, not to mention prosper, a number of critical issues had to be dealt with in each scenario. These mainly related to organizational flexibility and adaptability. How quickly could we change direction if a certain scenario became more likely than another? Other issues were related to products and services. For instance, how quickly could we develop or acquire the technology necessary for a business segment that existed in only one scenario?

## The scenarios

The scenarios had to be described, communicated, and understood throughout the organization. Each scenario was viewed as a distinct, but equally possible, world. Each was given a simple name and a consumer-oriented story line. The organizational implications of each were clearly outlined and communicated to the entire population of 100,000 Ericsson employees. Numerous workshops were held around the world to teach scenario planning techniques. Participants came from marketing departments, product development organizations, R&D laboratories, and human resource offices, to name just a few entities. At every

**THE ART OF THE LONG VIEW**

| Futures Research | | Strategic Planning |
|---|---|---|
| Long term | ⟷ | Short term |
| Alternatives | ⟷ | One "right" future |
| Broad vision | ⟷ | Detail focused |
| Wildcards & discontinuities | ⟷ | Assumes present continues |
| Trend interaction | ⟷ | Trend extrapolation |
| Possibility oriented | ⟷ | Solution oriented |
| Pan-disciplinary | ⟷ | Industry focused |

**In an unpredictable environment, futures research, and scenario planning in particular, can complement strategic planning.**

The organization that can quickly visualize future business environments around the world and rehearse what it would be like to operate in them will gain substantial competitive foresight. Within the parameters of a set of scenarios, future business operations and strategies can be simulated to assess the following:

- Changes in consumer disposition
- Speed and path of technology introduction
- Impact of government regulation
- Changes in importance of parts of the value chain
- Competitive dynamics
- Capability gaps
- Optimal alliance partners and acquisition candidates
- Corporate and business unit options

—From *Developing Strategy in Rapidly Changing Markets: A Case Study in Scenario Envisioning*, by Saul Berman, Karthik Rajaram, and Steve Redwood, published by PricewaterhouseCoopers.

level of the organization, we introduced scenario planning as a process, a tool necessary to ensure future flexibility and adaptability.

## Scenario 1: *Service Mania*

This story is a "content is king" scenario, in which an abundance of information makes it difficult to arrive at informed choices. Consumers have too many choices and too little time. Businesses contract with specialized communication networks. Consumers do most of their business with brokers or agents, rather than with the original providers of content and communications. Consumers are offered multiple alternative methods to access information; several network architectures co-exist, as do providers of the underlying technologies. Network operators are all but invisible to the consumer.

Economically, companies that supply original content and services are the big winners in this world. The value chain is dominated by content developers and by brokers at various levels. Plain connectivity or basic transportation of information is increasingly unprofitable and attracts few independent players. Consumers are fairly open to change and readily accept new technology, based primarily on entertainment value, rather than information value. Consumers pay for packaging, but are subjected to increasing amounts of advertising.

In this scenario, the backbone operators consolidate to gain economies of scale. Only a few remain. Access network operators proliferate, but may be owned by a packager that bundles access with tailored content.

## Scenario 2: *Gran Tradizione*

Traditional values are the controlling factors for consumers in this scenario. It has often been said that human beings are basically conservative. If unwillingness to adapt and change prevails, in spite of rapid increases in technological capabilities, then consumers will stay with what is tried and true. Consumers of phone services remain subscribers; providers of services remain operators. Behind this behavioral pattern, there is a strong tendency to place greater emphasis on such values as the environment and the family, rather than on the technology. While novelties like satellite telephony and Internet chat might become accepted parts of life, the basic value chain of today does not change. The money focus remains with the scarce resource—the network—and the Gran Tradizione world looks remarkably similar to today. Only more so.

The Gran Tradizione scenario projects declining prices for communications services, compensated by increased traffic and continued cost rationalization by network providers. The result is a sharp reduction in the number of operators in the market, as consolidation sweeps the industry. Both forward and backward integration from the network will take place. Surviving operators will be financially strong companies, skillfully leveraging economies of scale and scope.

## Scenario 3: *Up and Away*

In this future, consumers gain access to sophisticated communications solutions virtually free of charge. These will include a wide variety of personalized services tailored to the individual. A car will talk to the garage, informing it about its condition. Information appliances in the house will talk to their manufacturer during warranty periods, and, in turn, the manufacturer can upgrade them as necessary.

The only items for which consumers will pay will be their information appliances: phones, personal computers, electronic organizers, television sets, and the like. Equipment manufacturers will bundle communications with the devices and provide consumers with wired and wireless access.

As in the Service Mania scenario, advertising and commercials will cover the cost of basic content and its presentation. Premium services, more or less commercial-free, will be available for a fee, and the successor to the Internet of today—FutureNet—will, although omnipresent, fragment into a seamlessly interconnected multitude of specialized communities.

Rapid technology deployment and acceptance creates an abundance of network capacity and an oversupply of information content. Traditional network operators fall by the wayside. Presentation and filtering of information becomes the key part of the value chain. Active, informed, and motivated consumers increasingly tailor communications and content to fit their individual lifestyles.

## Conclusion

We at Ericsson use these scenarios to help our organization become more flexible, in thought and in deed. We use them as a context when talking with our customers, to help us better understand their view of the future. We communicate the scenarios to the general public in order to maintain an image of Ericsson as a forward-looking organization.

The Ericsson 2005 is neither an etched-in-stone forecast, nor a traditional, rigid 10-year plan. It's an attempt to improve organizational understanding of future business conditions. It is also the most ambitious effort in the 100-year history of the company to prepare for and to adapt to a new reality. We've carefully avoided picking a "preferred" future; the scenarios help us remain open to the nearly infinite number of conditions that could unfold. The knowledge and the insights provided by 2005 have enabled the company to more swiftly react, adapt, and proactively influence its environment. It has made the company more flexible and fleet of foot.

Large organizations frequently run the same risk that victimized many prehistoric creatures that couldn't adapt to change. Through the 2005 effort, Ericsson strives to avoid that fate, to survive and prosper.

And, ultimately, to manage change.

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*Mikael Edholm is director for corporate business development for LM Ericsson. He can be reached by phone at +1-650-463-6093 (U.S.) or +46-8-404-7859 (Europe) or by e-mail at edholm@compuserve.com.*

*For information on PricewaterhouseCoopers' work in scenario envisioning, please contact Saul Berman by phone at +1-310-201-1909 or by e-mail at saul.berman@us.pwcglobal.com.*

# Small Worlds, Big Stories

Winslow Farrell, the head of PricewaterhouseCoopers' Emergent Solutions Group, has worked with a variety of companies, including telecommunications companies, to build strategies and apply complexity theory to modern-day competitive situations. Earlier, he developed the telecommunications industry simulation TeleSim™, which helps clients observe the interplay of events, regulatory factors, company actions, and competitor reactions in a complex environment. Recently, the Emergent Solutions Group has developed synthetic environments that more directly support real-world decision-making. The Group is working with clients in retail, entertainment, and telecommunications. One client has used a simulation to assist in decision-making regarding land-use issues.

In a synthetic world developed for an entertainment industry client, agents have been created on the basis of interviews with a variety of real-world consumers regarding their preferences. Then, the agents, through their likes and dislikes, choices and rejections, help planners forecast box-office revenues. This, in turn, informs their decisions about the timing of movie openings and about marketing. Having continually improved the simulation over several months, the Group had, by the end of summer, achieved accuracy levels 20% to 30% greater than those attained with more traditional weekly box-office forecasting techniques.

The information gleaned in this simulation can provide valuable input for decision-making about spending on media advertising and about distribution. For instance, the actions and reactions that occur in the simulation can help studios decide which weekend to release a movie and in how many theaters.

In the following pages are excerpts from Farrell's book *How Hits Happen: Forecasting Predictability in a Chaotic Marketplace.*

*by Winslow Farrell*

* * *

Computer simulations built as complex adaptive systems offer a fundamentally new approach to understanding how a system behaves: from the ground up. With their ability to replicate the step-by-step and often unpredictable process by which agents like humans interact, simulations help [provide] insight into emergent behavior and its attendant nonlinear events.

Many people have tried to represent how a market works, for example, by writing equations that represent stocks and flows. Yet the actual workings of a market are generated through a more intricate and less predictable set of interactions between consumers and advertising, buyers and salespeople, or consumers and the overall sales environments. It is impossible to understand how the market behaves by looking at it from the top down. As properties aggregate, they change. Over the years, for example, economists have produced countless numerical analyses on the generation of queues. They all provide a straightforward set of equation-driven models. While many provide an equation that describes how groups of people cluster into lines, none analyze how these individuals learn and adapt as they form queues.

....We have seen how emergent behavior is often decentralized, adaptive, and emanates from both the agents in a system *and* their interactions. This type of emergence simply cannot be understood or represented by taking a large system apart and then putting it back together again. As Chris Langton [a scientist at the Santa Fe Institute and a leading thinker on artificial life] has asked somewhat facetiously in his lectures, What do you get if you dissect a squirrel and then put it back together again? Certainly not a live squirrel—but a mess. Therefore in our work we don't seek an equation that describes the market: *We try to enable the market to describe the equation.*

How do you learn about complexity in our natural world? By building an agent-populated artificial one. The very nature of the dynamics of complex adaptive systems calls for new tools of understanding. As John Casti, professor of operations research at the Technical University of Vienna, writes in his book *Would-Be Worlds:*

*"Each complex system consists of a large number of individual agents—investors, virus molecules, genes—that can change their behavior on the basis of information they receive about what the other agents in the system are doing. Moreover, the interaction of these agents then produces patterns of behavior for the overall system that cannot be understood or even predicted on the basis of knowledge about the individuals alone. Rather, these emergent patterns are a joint property of the agents* and *their interactions—both with each other and with their ambient environment. The ability of such systems to resist analysis by the traditional reductionist tools of science has given rise to what is called the sciences of complexity, involving the search for new theoretical frameworks and methodological tools for understanding these complex systems.*"

These new tools are the artificial "would-be" worlds of computer simulations.

By setting synthetic customers into motion with one another, one can glean insights into a complex system that are far more surprising and robust than one can gain from observing our "carbon-based" world. There are many reasons why. By providing time flexibility, artificial worlds enable us to recognize patterns in myriad business metabolisms—enabling one to back time up, slow it down, and turn it around. By comprising virtually every possible outcome among the complex interactions of players, artificial worlds help us ask better "what-if" questions. And by enabling us to observe equations as they emerge from the ground up, artificial worlds help us recognize patterns in

real time—affording people what John Holland [a member of the Santa Fe Institute] calls "lever points" that realize disproportionate effects.

Although conventional business tools such as spreadsheets or regression analysis can provide tremendous value to managers, they are and will always be *linear approximations of nonlinear events*. Though they provide tremendous analytic value, these tools fail us when we most need them—at the moment when nonlinear changes occur, when it feels like the ocean suddenly ends and a cliff appears. Years ago, I consulted with Nevada Bell, which, like all telecom companies, is faced with fierce competition from all sides. My job was to persuade senior executives of one potential outcome: that the company's market share definitely could drop below 60 percent. This fall from near-monopoly status was inconceivable, simply beyond their imaginations. Yet computer models helped show that yes, this future could still happen.

*By comprising virtually every possible outcome among the complex interactions of players, artificial worlds help us ask better "what-if" questions.*

Models allow us to broaden our viewpoint beyond our fixed notions, based on current reality, of what can transpire. These scenarios help expand our linear expectations to include all the possible futures we may encounter.

Moreover, computer simulations help people who are all too often (and with good reason) afraid to tamper with real systems, since even the most preliminary tests may create unforeseen or unintended consequences. Models, on the other hand, reveal potential outcomes—without any harmful consequences. And, in fact, the robust simulations now possible enable us to produce models with substance and relevance.

For example, software developer Ken Karakotsios, who helped create the Simlife game, has designed a chemistry-set program for high school students to learn how to make chemicals like mustard gas and chlorine. The Bunsen burners can be digitally lit, are tied to a digital gas stream and put under an icon of a beaker that has a mixture of benign components that can produce the noxious gases—without harming the student. This may sound straightforward, but it has true value for all of us who have had to evacuate organic chem [labs] thanks to careless colleagues. Likewise, one can't underestimate the importance of trying out business changes in a practice arena before these changes are put into the real world.

Today's computer simulations exponentially expand our capabilities to foresee possible outcomes. In his book *Emergence*, John Holland describes how the breathtaking evolution of computing power has enabled people to create and inhabit an infinite number of potential scenarios. As a young scientist in the '50s, Holland and his colleagues first explored models with the available technology: paper and pen. Yet as the first rudimentary computers opened up the potential of modeling, Holland and his peers found themselves speeding up the process enormously. Today computers are of such speed and power that they can quickly reveal the behavior in a complex system and create thousands of potential outcomes that derive from the same starting point, with the same set of rules.

* * *

## Systems thinking

This type of approach butts up against classical systems thinking, a school of thought developed by engineers who sought to understand how, in a large system, various energies and actions could be causally linked. Based on Newtonian physics, this school seeks rational solutions to phenomena, and is appropriate in closed systems of simple behavior.

From the point of view of the scientist or mathematician, however, complex or nonlinear systems are a logistical nightmare because most

cannot be understood analytically. Often no set of equations can be posed and solved to relate the characteristics of a complete system. Even when one can gain some understanding of how nonlinear systems work, they often remain unpredictable. However much one understands stock markets or the properties of sand, it will still be impossible (in principle) to predict the timing of a crash or a landslide. The only generally effective way of exploring nonlinear behavior is to simulate it by building a model and then running the simulation.

A closed system is surrounded by a tight membrane or boundary, where all the forces that define the actions of that system are contained. Innovation may have a lot or a little to do with existing competitive rivalry. Does innovation arise spontaneously, over time, like the in-bottle fermentation of a fine wine? Not usually. Innovation arises from the interaction of rivals that are contained within a bottle; while it takes the combined efforts of the agents, innovation reflects more than simply their aggregated qualities.

*Probably the most dangerous and fallacious of all the hidden assumptions in business models is that today will be the same as tomorrow and every day thereafter.*

In trying to make economic sense of the world, economists have relied upon the attributes of closed systems to help define interactions and constituents completely, and to attach a deterministic outcome (if this happens, then that will occur) to interactions within the system. This closed system is familiar to economists who describe the world in a mathematical model of a series of equations. A closed system can settle down toward a steady-state of equilibrium—where things happen in a relatively linear fashion. Even Michael Porter's model of strategy draws boundaries around the internal rivalry among competitors, with external forces (say, from suppliers or buyers) upsetting the balance.

The fundamental myth behind many business analyses is the notion of the equilibrium position, or steady state. Analysis is meant to determine conditions, and especially causation in the equilibrium state. Yet far too many models—most prominent among them Michael Porter's competitive diamond—assume that business conditions are independent of time. Emergence shows that the environment is time-dependent. Probably the most dangerous and fallacious of all the hidden assumptions in business models is that today will be the same as tomorrow and every day thereafter.

To find the boundaries of hidden assumptions, we can alter various aspects of a model, such as the rate of time, to find hidden patterns in company and industry behavior, like times of peak activity. By changing the resolution or fidelity or time-step, one can take large things apart and see the structure underneath. There is now a movement afoot to formalize this synthetic approach to performing science that differs markedly from the "scientific method" we've all come to depend upon.

For a telecom company like Pacific Telesis [now SBC], it means understanding fundamental competitor behaviors, and examining unusual trajectories of "future history" with the onset of full-fledged competition. It means creating an explicit knowledge about the set of assumptions and entry strategies and financial assumptions from the competitor's point of view. And it means preparing for guerrilla warfare, understanding the importance of the unfolding of competitive dynamics as events occur, and not predefining the "battle plan" for one all-out "assault."

Where are we going to find this evolutionary process of selection if we, as builders of these worlds (in our heads or in computers), don't define them with equations? We need to turn the job of strategic selection over to the world itself—to build a world with convolution of problems and solutions. Strategies are not good or bad in and of themselves—what matters is who we're playing our strategic games with, what they know and don't know, what

they think of themselves that may be true or myth, how good they think their strategy is, and how likely they are to change it.

Overall, these artificial worlds, and maybe the real worlds they are trying to emulate, set their own boundary conditions—they self-organize, maintain homeostasis, and build structures that can adapt, like companies. Maybe Chris Langton is correct when he surmises that we may be evolving toward an ecological mixing of humans and machines in organizations.

In our work, we have sought to build models of these artificial worlds that explore these problems. We have tried to avoid using equations that define systems thinking as proposed by Professor Jay Forrester and his followers from MIT [the Massachusetts Institute of Technology]. We set out to let the equations write themselves, and for the dynamics of the market itself to determine the outcome. What we did not want was some external boundary condition developed by a human programmer to taint the experiment.

The alternative, digital world would probably feel more familiar than the world inhabited by rational thinkers and optimizers who live in equilibrium. These worlds would distinguish individual actions from macro-based impersonal markets. Agents that have different styles of thinking and different histories of experience, and act in a social structure where independence is coupled with social convention and cultural rules, would inhabit the artificial world.

* * *

## Ground truth

Years ago, I was a geologist who interpreted satellite images of rocks and vegetation, a field called remote sensing. Part of the challenge in this field was accurately interpreting images taken hundreds of miles from the objects themselves, which were much smaller than the field of view. The resolution was poor, and individual objects like houses, cars, driveways, and people were mashed together in a blurry continuum that had to then be pulled apart and classified as suburban neighborhood, golf course, mall, and the like. In a way, it's not too different from the classifications and interpretations we as humans make of the world around us. At a glance, I can distinguish a '57 Chevy from a '56 or '58. I can tell an authentic Googie-style coffee shop like Norm's on La Cienega in Los Angeles at 50 miles an hour. I can also link these two objects into a period landscape representative of an era long ago. When the resolution begins to blur, classification becomes difficult—categorization becomes harder and harder. What makes the Chevy and coffee-shop signatures recognizable is the ability to take a selective ground truth sample—to occasionally dip down and know for sure what is there, to examine a small example in order to make a wider, more sweeping interpretation.

*By providing time flexibility, artificial worlds enable us to recognize patterns in myriad business metabolisms—enabling one to back time up, slow it down, and turn it around.*

In our attempt to build a lifelike population of virtual customers, we view primary research as a mechanism of remote sensing that is accompanied by confirmation of ground truth. This quality can be built in through the use of incredibly specific and robust data. Our approach differs from traditional research techniques. We have developed a powerful computer simulation program that is designed to capture and make sense of ground truth. Our program contains a population databank of over 150,000 synthetic individuals—silicon-based "people" who represent real people and their purchasing preferences in a variety of extremely detailed categories. Cognitive scientist Andy Carr of Washington University in St. Louis calls people "fast pattern completers." We are really wonderful as humans at completing patterns. We get a

hint and then fill in the rest. We see a black tail swishing around a corner and we assume it is a cat. We get a whiff of water upwind and we assume there is a spring nearby. Our very survival depends on this way of thinking.

We have endowed our artificial humans with the same fast pattern-completion capability. These artificial agents don't know everything, but they can smell something in the wind. Of course, they don't have the full cognition of human beings. They can't multiply two numbers. But that's not cognition. In addition to these capabilities, these agents have primitive emotion states, and they have small but important demographic differences. In aggregate, these differences add up to the enormous variety of reactions to product introductions—in other words, to the buzz that can produce a hit or a flop.

The profile of each silicon-based individual starts as a real person who answered questions about what type of clothes, dishwashers, or beer they preferred, why they bought certain items, and when. We thus create a set of purchasing patterns tied to demographics. So, before we add any cognitive capabilities to these individuals, we capture an accurate pattern of behavior that is both statistically valid and is demographically representative of a sample population of the United States. We build an artificial world that contains these digital buying signatures, each one imbued with the characteristics that reflect what real people said to interviewers at a point in time about particular buying habits. We stuff each response into the memory of individual digital consumers. Each agent then represents the exact beliefs and attitudes from the time when that interview was conducted. We don't mash the individual answers into categories, market segments, and cross-tabs. We keep the resolution at the ground level. This enables us to combine the respondent's demography with the primary research response. We can match beliefs, attitudes, and demography on an individual basis, and create a population, a society of individuals who reflect what real people said they had done and were going to do, and why.

Starting with this vast artificial society, we then use a digital version of the claw from the movie *Toy Story* to pluck out samples from this population. Often we gather a group of buyers from a particular locale—say, from Albany, New York—to see how what they had bought differs from another sample—say, in Abilene, Texas. Each of these interviewees is part of the ground truth. We know what interviewees said they had done and would do. We then can clone these individuals, change their gender or age, mate them with one another to create families, groups, and couples. We can then create disembodied memory banks that we can attach to cognitive engines that can drive future decisions and create emergent markets.

*We can match beliefs, attitudes, and demography on an individual basis, and create a population, a society of individuals who reflect what real people said they had done and were going to do, and why.*

In one case, we sampled the ground truth about consumer buying habits and listening history of a number of retail stores and radio stations across the country. We wanted to re-examine whether we could create an accurate historical pattern before we endeavored to project the future based on our population-growing technique. We used this primary survey information to form the kernels from which we grew a population of synthetic individuals that embodied these buying and listening habits. We then compared these samples with remotely sensed actions from the real world through scanner tapes and airplay records. In comparing the remotely sensed actions of our artificial buyers with the remote sensing signature that classified the actual buying public in the real world, we were able to ask whether real humans did in the artificial world what they said they would do in the real world. We were also able to determine whether the artificial world was indeed a reflection of the real world, and in either case, we were able to find out why, down to the individual level.

In the real world, we have only the tools of remote sensing and ground truth available to us to sense phenomena as they occur. Look in the wrong place, at the wrong time, with the incorrect resolution, and you can miss the formative stages of patterns. With our actual senses of sight and hearing, we can sense broad vistas and listen to remote calls, and with our ground truth senses of taste and touch, we can sample tidbits and remnants of data. We can broadly gauge market-share changes and sample the shift with mall research and exit polls. Yet we can make sense of these different sensorial methods only through the inference that ties ground truth to remotely sensed images of the whole.

So too in the artificial world, we can remotely sense the emergent phenomena of markets as they arise and decline. We can perform ground truth tests against individual synthetic buyers that cause markets to take off or fall flat. In this sense, we can study models of causation of emergent phenomena that are rarely possible in the real world, where longitudinal studies of consumer behavior may be impractical. In artificial worlds, the notions of remote sensing and ground truth are extended to the visualization of emergent phenomena that arise from coordinated actions of groups of artificial individuals. And, because these buyers reside in a computer, we can conduct experiments on them, take advantage of our ability to alter our resolution and focus, and so more directly manipulate time and space.

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*From* How Hits Happen: Forecasting Predictability in a Chaotic Marketplace, *by Winslow Farrell, HarperBusiness, 1998. Reprinted with permission from the publisher.*

*Winslow Farrell is the leader of PricewaterhouseCoopers' Emergent Solutions Group.*

*For more information on PwC's work with complex models, contact Winslow Farrell by phone at +1-212-259-3280 or by e-mail at winslow.k.farrell@us.pwcglobal.com.*

# News

## The 1998 Global Telecoms Tax Profiles

PricewaterhouseCoopers recently released the *1998 Global Telecoms Tax Profiles—A Resource for Business, Tax, and Market Strategies*. This second edition contains 43 country profiles, written by PwC telecom tax and consulting professionals. Each chapter follows a standard format, offering an overview of the telecommunications marketplace and profiling the tax considerations for conducting business or for assessing foreign investment opportunities within that country. New sections cover the status of liberalization and the competitive environment for telecommunications.

Copies may be ordered through John Wiley & Sons (www.wiley.com) at +1-800-225-5945 (U.S. or Canada); +44-1243-779-777 (UK); +61-7-3859-9755 (Australia). The retail price is US$150. Please refer to the title or ISBN code 0471-31841-8.

**For more information, contact Maggie Burke by phone at +1-215-963-8605 or by e-mail at margaret.a.burke@us.pwcglobal.com.**

## Consumer Communications Preferences Survey

A majority of consumers prefer to purchase multiple or bundled communications services from a single company on a single bill, according to a recent independent survey conducted by PricewaterhouseCoopers and Kenan® Systems Corporation, a leading provider of billing, customer care, and customer analysis software. The survey polled 1,005 consumers on a variety of issues related to their long distance, local, wireless, satellite, Internet, and cable communications needs including purchasing decisions, customer service, pricing, and usage patterns.

Of the consumers polled in the *PricewaterhouseCoopers/Kenan Systems Communications Preferences Survey*, 55% said they would prefer to purchase local, long-distance, and wireless telephone; cable and satellite television; and Internet and other communications services from a single company, as opposed to 30% who would prefer multiple companies. Seventy-two percent of respondents said they would prefer to receive a single bill for multiple communications services, as opposed to 25% who would prefer separate bills for separate services.

The telephone survey was conducted by Opinion Research Corporation between August 14 and August 18 among a national probability sample of 1,005 adults 18 years of age and older, living in private households in the continental United States. The information presented here is unweighted. The final survey results will be available in October from PricewaterhouseCoopers.

**For more information on the survey, contact Peter Winkler by phone at +44-171-939-5194 or by e-mail at peter.m.winkler@uk.pwcgobal.com.**

## PwC, Oracle, and Sun Microsystems offer complete enterprise solution

PricewaterhouseCoopers has formed an alliance with Oracle Corp. and Sun Microsystems, Inc., to provide Compas, a complete enterprise solution for communications businesses and operators in competitive markets around the globe. Compas, which can be implemented in as little as six months, provides operators with a fully integrated suite of applications in such areas as customer care, billing, data warehousing, financial, procurement, and human resource management.

The Compas solution has been developed specifically to address the critically interrelated issues facing new and emerging communications businesses:

- Minimizing time to market while maximizing service quality
- Minimizing cost of ownership while maintaining technological advantage
- Managing rapid growth while maximizing profit per customer

Since many prime candidates for Compas are on the verge of achieving rapid subscriber growth in their new operations, PwC, Oracle, and Sun have built flexibility into the solutions integration and application license fee structure. As the new communications business customer base grows, the system can grow with it and be increased in scale in minimal amounts of time. Similarly, license fees will grow in tandem with the customer base.

**For more information, contact Lauren Kronthal by phone at +1-410-412-7621 or by e-mail at lauren.kronthal@us.pwcglobal.com.**

## Greater Washington New Economy Study

The information and communications sector (infocomm) has emerged as one of the most significant industries in the Greater Washington Region (GWR) economy, with total employment almost that of the federal government, according to a study conducted by PricewaterhouseCoopers LLP. The Potomac KnowledgeWay sponsored the study, along with Hale & Dorr LLP, Virginia's Center for Innovative Technology, and the Greater Washington Initiative/Board of Trade.

The study, which was undertaken in order to produce a baseline report on the New Economy in the GWR, is part of a long-term initiative to promote the region's economy and attract new businesses.

Among the findings highlighted in the study:

- Infocomm companies employ one out of seven workers. The infocomm industry generates US$90 billion in annual sales.
- The GWR, birthplace of the Internet, leads the nation in Internet services and is the site of many new Internet-related companies.
- There is an exciting and vibrant culture of entrepreneurship in the GWR. It is being sustained by a developing support services infrastructure and an increasingly active venture capital community.

**For more information, contact Maria Brindlmayer by phone at +1-202-822-5848 or by e-mail at maria.brindlmayer@us.pwcglobal.com.**

## Technology Forecast: 1999

PricewaterhouseCoopers' Technology Centre in Menlo Park, California, recently published *Technology Forecast: 1999*. The edition is the largest to appear in the 10-year history of the publication. Available November 5th, the *Technology Forecast* covers everything from microprocessors to ERP packages, with special emphasis on bandwidth, which is covered in five chapters: Internet and intranets, e-commerce, wireline technologies, wireless, and networks.

The *Technology Forecast* is the basis of an on-going PwC program of public forums and private client briefings on technology futures presented by Technology Centre staff throughout the year.

The *Technology Forecast*: *1999* is available for US$450 by calling +1-800-654-3387 (U.S.) or +1-314-997-2540 (outside the U.S.).

**For more information on the publication, contact Gayle Rocklage by phone at +1-650-688-6611 or by e-mail at gayle.rocklage@us.pwcglobal.com.**

## PwC teams with Banta

PricewaterhouseCoopers recently announced a strategic marketing and systems integration relationship with Banta Corporation, a US$1.2 billion leader in printing and digital imaging. Together the partners will serve *Fortune* 1,000 customers, building and integrating large-scale information management solutions for marketers and publishers.

This relationship addresses the need among marketers and publishers for shorter product life cycles, increased market segmentation, and a better set of collaborative tools to customize or version marketing materials or editorial products to a targeted customer base. It brings together the publishing and technology expertise of Banta and its Centrus Enterprise Content Management System with the large-scale system integration, business process analysis, and change-management resources of PricewaterhouseCoopers.

**For more information, contact Lauren Kronthal by phone at +1-410-412-7621 or by e-mail at lauren.kronthal@us.pwcglobal.com.**

## Investor's Guide to Central & Eastern Europe

The telecom industry in countries throughout Central and Eastern Europe is undergoing a rapid transformation. Governments are seeking to attract investment capital to expand networks across fixed, mobile, cable TV, and data markets. To help investors and potential investors understand the dynamics driving this transformation, PricewaterhouseCoopers has published the *Telecom Sector Investor's Guide: Central & Eastern Europe*.

In this guide, the PwC network of offices across the region has summarized the status of each market. Each country chapter includes an overview of investment opportunities, political structure, the economy, the business environment, and telecom markets. The guide is intended to bring perspective regarding the array of investment opportunities available.

**For copies of the guide, or for more information, contact Martin Woodford by phone at +44-171-939-5443 or by e-mail at martin.woodford@uk.pwcglobal.com.**

## Global Convergence Summit

*Business Week* and PricewaterhouseCoopers are cosponsoring the fourth annual Roundtable for executives in the entertainment, media, and communications industries. The 1998 Global Convergence Summit: The New Era of Content and Communications will take place October 28 at the Waldorf Astoria in New York City.

The Roundtable will feature well-known industry leaders, including Eric Benhamou of 3Com, Leo Hindery of Tele-Communications, Joseph Nacchio of Qwest, Steve Perlman of Web TV, Sumner Redstone of Viacom, and Solomon Trujillo of U S WEST.

Panel sessions will cover such topics as content and communications convergence, industry consolidation, and competition. In addition, a panel of industry analysts will share their perspectives on the financial viability of convergence strategies.

**For more information, contact Lynnette McCarthy by phone at +1-212-596-5109 or by e-mail at lynnette.mccarthy@us.pwcglobal.com.**

## Telecom Insider reaches 50K viewers

PricewaterhouseCoopers' Telecommunications Insider on PointCast, launched in January 1998, has already reached the 50,000-user mark. Executives of telecom companies across the globe are among those using the Insider, which delivers telecom industry news and information via the Internet to viewers' desktops. More than 25 content providers participate in the service, which is updated throughout the day, giving users access to industry events as they happen.

**The Telecommunications Insider is free and available for download from www.knowledgedirect.net/telco.html. For more information, contact Marla Sawasky by phone at +1-212-259-3226 or by e-mail at marla.sawasky@us.pwcglobal.com.**

The following books, authored by partners in PricewaterhouseCoopers' InfoComm Group, provide thought-provoking and informative discussions for various segments of the industry and on issues of interest to the industry. If you would like to order copies, please contact the appropriate publisher. Books may also be ordered through various booksellers on the Internet.

**1998 Global Telecoms Tax Profiles—A Resource for Business, Tax, and Market Strategies**
by *PricewaterhouseCoopers Global Telecoms Tax Network*
(John Wiley & Sons, Inc., 1998)

Contains 43 country profiles, offering an overview of the telecommunications marketplace and tax considerations for conducting business or for assessing foreign investment opportunities within each country.

Copies may be ordered through John Wiley & Sons (www.wiley.com) at +1-800-225-5945 (U.S. or Canada); +44-1243-779 777 (UK); +61-7-3859 9755 (Australia).

**How Hits Happen: Forecasting Predictability in a Chaotic Marketplace**
by *Winslow K. Farrell*
(HarperBusiness, 1998)

Authored by the leader of PwC's Emergent Solutions Group, this book explores the world of complexity theory and its applications to modern-day competitive situations.

**Reinventing the CFO: Moving From Financial Management to Strategic Management**
by *Thomas Walther et al.*
(McGraw-Hill,1997)

Presents a framework for finance professionals to reevaluate how they can move beyond internally focused analyses to truly add value to their business by providing insights that deliver competitive value and direction.

**SAP: An Executive's Comprehensive Guide**
by *Grant Norris et al.*
(John Wiley & Sons, Inc., 1998)

With examples of real-life case studies, the authors provide an assessment of the advantages and disadvantages of SAP R/3 software. They supply top management with the information they need to make informed decisions about implementing SAP R/3 in their organizations.

Copies may be ordered through John Wiley & Sons (www.wiley.com) at +1-800-225-5945 (U.S. or Canada); +44-1243-779 777 (UK); +61-7-3859 9755 (Australia).

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