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The Rise and Demise of Lucent Technologies

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1. From boom to bust to Boétie

In 1999, as the Internet boom was approaching its apex, Lucent Technologies was the world's largest telecommunications equipment company. With revenues of \$38.3 billion, net income of \$4.8 billion, and 153,000 employees for the fiscal year ending September 30, 1999, Lucent was larger and more profitable than Nortel, Alcatel, and Ericsson, its three major global competitors (see Figures 1 and 2).¹ In fiscal 2006, however, Lucent's revenues were only \$8.8 billion and its employment level stood at 29,800. Both figures were lower than those of its three major rivals, even though all of the companies had gone through wrenching declines as the Internet boom turned to bust in the early 2000s.

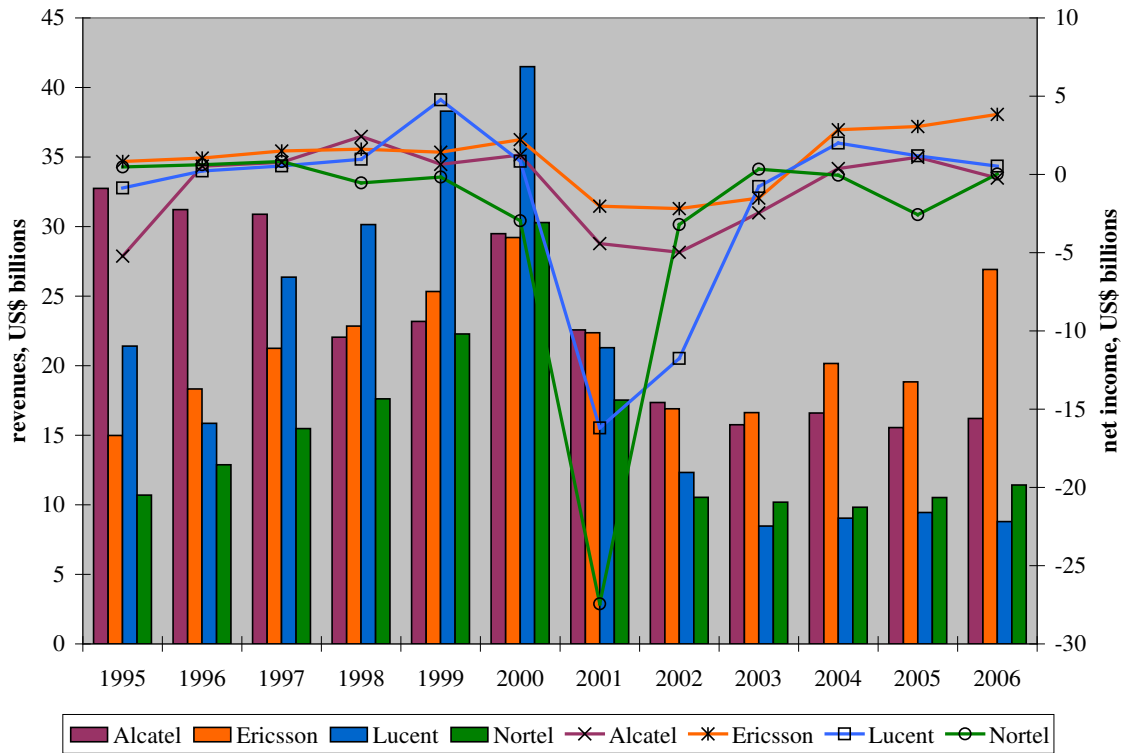
Like Lucent, both Nortel and Alcatel struggled to return to profitability after the depths of the downturn in 2002-2003. But on December 1, 2006 Alcatel was almost twice the size of Lucent in terms of revenues and employees when the merger that created Alcatel-Lucent took place. Lucent became a wholly-owned subsidiary of Alcatel. Although Lucent CEO Patricia Russo was named the first CEO of Alcatel-Lucent, she occupied her new position at Alcatel headquarters at 54, rue La Boétie in Paris.

In this paper, we analyze the rise and demise of Lucent Technologies from the time that it was spun off from AT&T in April 1996 to its merger with Alcatel in December 2006. The analysis, contained in the three sections that form the body of this paper, considers three questions concerning Lucent's performance over the decade of its existence.

1. How was Lucent, with over \$20 billion in sales in 1995 as a division of AT&T, able to almost double its size by achieving a compound growth rate of over 17 percent per year from 1995 to 1999?
2. What was the relationship between Lucent's growth strategy during the Internet boom and the company's financial difficulties in the Internet crash of 2001-2003 when the Lucent was on the brink of bankruptcy?
3. After extensive restructuring during the telecommunications industry downturn of 2001-2003, why was Lucent unable to re-emerge as an innovative competitor in the communications equipment industry when the industry recovered?

¹ Lucent's other significant competitors in the communications equipment industry in the late 1990s were Fujitsu, NEC, GEC (Marconi), Siemens, Nokia, Motorola, Tellabs, and newcomers Ciena and Cisco. In fiscal 2000 Lucent, with \$41.4 billion and 157,000 employees, Lucent remained larger than its rivals but for its decision to divest its enterprise division Avaya on the very last day of the fiscal year, and thus record revenues of only \$33.8 billion and employment of only 126,000 billion. In this paper, we correct for this accounting obfuscation.

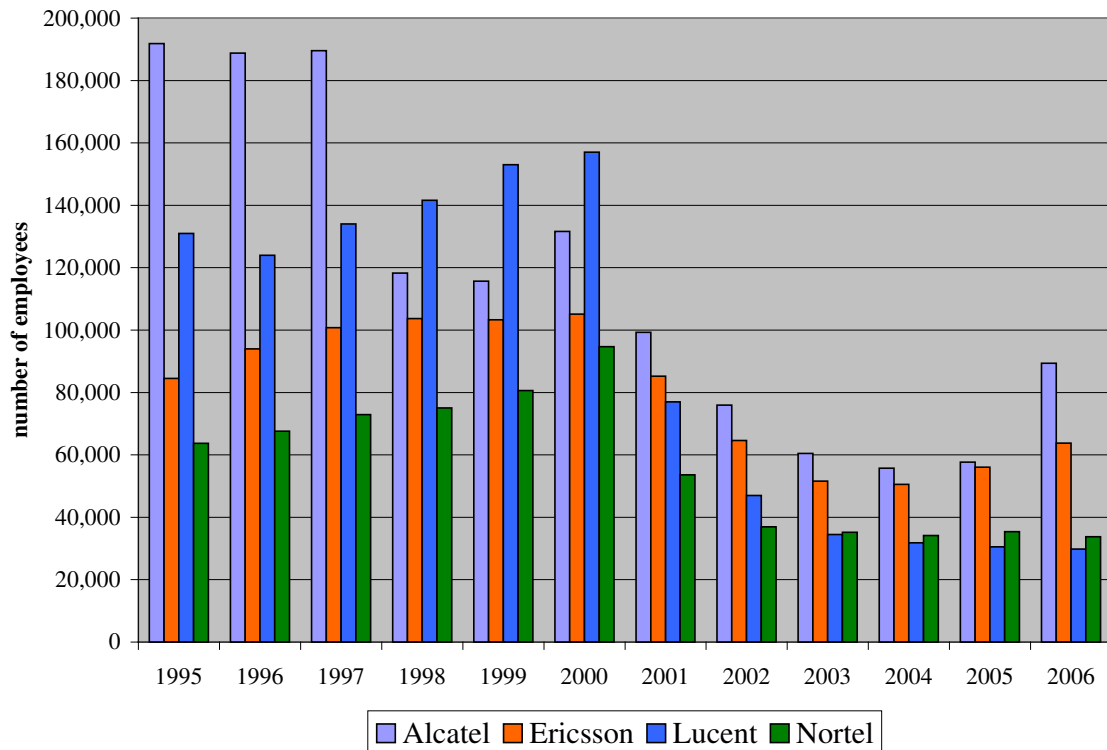
Figure 1: Revenues and net income, Alcatel, Ericsson, Lucent, Nortel, 1995-2006
US\$ billions



Notes: Fiscal years ending September 30 for Lucent and December 31 for Alcatel, Ericsson, and Nortel.
 Lucent's 1995 revenues reflect sales of AT&T activities spun off as Lucent in the IPO on April 10, 1996.
 Lucent's net income for 1995 is an estimate of the net income of the AT&T activities spun off as Lucent, adjusted for the change of fiscal year from ending on December 31 to ending on September 30.
 Lucent's net income for 1996 includes restructuring charges of \$2.8 billion in the fourth quarter of calendar 1995 while it was part of AT&T in anticipation of the divestiture of Lucent.
 Lucent's 2000 revenues and net income include those for its Enterprise Networks division that was spun off as Avaya on September 30, 2000.

Source: Standard and Poor's Compustat database; Avaya 10-K filing, 2000, 49.

Figure 2: Employees, Alcatel, Ericsson, Lucent, Nortel, end of fiscal year, 1995-2006



Notes: Alcatel employment of 59,509 for 2006 does not include 29,861 employees who joined Alcatel-Lucent from Lucent on December 1, 2006.

Lucent 2000 employment includes 31,000 employees of the Enterprise Networks division that was spun off as Avaya on September 30, 2000.

Source: Standard and Poor's Compustat database; Avaya 10-K filing, 2000, 21.

In the next section of the paper, we show that the main source of Lucent's growth in the period 1995-1999 was its "incumbent's advantage". During these boom years, Lucent was able to sell more of its legacy telecommunications equipment to its legacy customers as households subscribed to additional "twisted-pair" copper telephone lines dedicated to "dialup" Internet. Then toward the end of the Internet boom, the focus of the telecommunications industry shifted toward the installation of optical networking equipment and, relatedly, the provision of broadband access to households. Lucent stepped up its sales of this equipment to "next-generation" service providers, using ample, and risky, vendor financing to secure the contracts. The company also did a large number of acquisitions, typically using its stock as payment, of young technology companies, many of which did not have a commercial product. In addition, in 2000 at the peak of the boom, eager to support its stock-price performance, Lucent engaged in some dubious accounting practices designed to inflate its reported sales.

We then turn to Lucent's financial turmoil in the collapse of demand for telecommunications equipment in the crash of 2001-2003. As can be seen in Figure 2 above, Lucent was compelled to slash its payroll in order to stay afloat. In the process, the company disposed of business units that would be needed when the demand for communications equipment would improve. The company also laid off thousands of skilled and experienced employees who would later be difficult to replace in a more propitious economic climate. Along with this massive downsizing, and burdened with a junk bond rating, Lucent averted bankruptcy in 2001 and 2002 by selling its stock at one or two percent of the price that it had commanded in the speculative boom.

As a result of its financial excesses in the Internet boom and its desperate downsizing in the subsequent crash, Lucent was in a weakened position for reestablishing itself as a leading communications technology company when, from 2003, the industry recovered. The industry's key growth businesses were now enterprise networking and wireless. But as a result of the spinoff of its enterprise networks division in late 2000, Lucent no longer possessed the capability to serve this market. In wireless, Lucent needed to generate products for both the CDMA2000 and UMTS standards. It did not, however, possess the financial resources to make serious progress in next-generation UMTS, which was as it turned out the most rapidly growing global wireless standard. In December 2006, with its revenues down to \$8.8 billion, its net income at \$527 million, and its employment cut to less than 30,000, Lucent became part of Alcatel.

2. A "127-year-old startup"

A brief pre-history of Lucent Technologies

Lucent can date its origins back to Cleveland, Ohio in 1869 when Elisha Gray and Enos Barton launched a company that manufactured telegraph equipment for Western Union. In 1872 the firm was reorganized as Western Electric Manufacturing Company, with its headquarters in Chicago. In 1881 American Telephone & Telegraph acquired a controlling interest in Western Electric. Subsequently, as AT&T's wholly-owned subsidiary, Western Electric became its exclusive manufacturer of telecommunications

equipment. In 1913 AT&T became a regulated monopoly for the provision of telephone service in the United States, thus making Western Electric in effect a monopolist in the provision of telephone equipment and infrastructures. In 1970 Western Electric had a peak employment of over 215,000 people, making the company the 7th largest employer among the Fortune 500.²

In 1907 AT&T and Western Electric combined their engineering departments, and in 1925 turned this organization into the jointly-owned Bell Laboratories. The result was the world's premier corporate research lab of the 20th century. With its invention of the transistor in 1947, Bell Labs was in the forefront of the microelectronics revolution of the last half of the 20th century. Subsequently Bell Labs was a pioneer in, among other things, digital, optical, and wireless technologies (see Baker et al. 2000).

In 1949 the US Department of Justice launched an antitrust suit against AT&T that sought to sever the exclusive access of AT&T to Western Electric's manufacturing capabilities. The result was a 1956 consent decree that allowed AT&T to maintain control over its manufacturing arm but barred the company from competing in industries other than telecommunications. In addition, AT&T and Western Electric were required to license their patents to other companies at reasonable fees (Lewis 1956). As a result Bell Labs' R&D supported the development of the information and communication technology industries, while AT&T remained the ubiquitous telephone services company.

Beginning in the late 1960s AT&T was challenged by new entrants into the long-distance business (in particular MCI) who demanded access to the AT&T transmission infrastructure. In 1974 the US Department of Justice launched an antitrust suit against AT&T that on January 1, 1984 resulted in the breakup of the Bell System. The breakup created seven regional Bell operating companies, or RBOCs, out of AT&T, leaving AT&T Corp. as a competitive long-distance service company that also included Western Electric and Bell Labs as the AT&T Technologies division. AT&T now was excluded from entering local telephone markets, where the RBOCs were allowed to operate as regulated monopolies. Despite this limitation, AT&T was confident it could sustain profitable growth by capitalizing on Bell Labs technology and Western Electric manufacturing and product management expertise that it strategically retained.

The 1982 modification of the 1956 consent decree that underlay the breakup of the Bell System left AT&T free to enter the computer industry. Toward that end, during 1991 AT&T acquired NCR in a \$7.4 billion hostile takeover. Originally known as National Cash Register, NCR was a company that itself dated back to 1884. AT&T supplemented its internally developed computer products with NCR products to create a portfolio that made use of NCR marketing expertise and sales channels in the commercial computer market.

² In 1970 AT&T itself employed 773,000 people, but, as a service company, was not included in the Fortune 500 list of the largest industrial companies based in the United States. In 1996 Fortune changed its classification system to include service companies in the Fortune 500.

Then in September 1995 AT&T announced that it would spin off Lucent and NCR in what became known as the “trivestiture”. The direct impetus for the trivestiture was the pending passage of the Telecommunications Act of 1996 which would open up competition across all lines of business within the telecommunications industry. Restrictions to entering long distance and local service markets would be lifted, making it possible for AT&T and the RBOCs to become direct competitors. As a result, AT&T’s most important customers, the RBOCs, became reluctant to place orders with AT&T Technologies, given that equipment orders would provide sensitive market strategy and capacity information to AT&T, their emerging competitor. Likewise, AT&T would now have a strong incentive to procure telecommunications equipment from suppliers other than its own manufacturing division to reach cost-performance parity with its RBOC competitors. Since both competitive forces would result in a decline in AT&T Technologies revenue, divestiture became inevitable.

Meanwhile AT&T had failed to integrate NCR (which as an AT&T division became known as Global Information Solutions, or GIS) into its operations. Given that AT&T would now be a focused telecommunications service provider, it made sense to expand the divestiture of AT&T Technologies into a “trivestiture” that spun off GIS, now renamed NCR, along with Lucent Technologies.

A “start-up” with 11 “hot businesses”

Lucent’s IPO in April 1996 was the largest in US history up to that time. Lucent executives were fond of saying that their company was a “127-year-old startup that had well over \$20 billion in annual sales”. Figure 3 shows the organization chart of Lucent as a “start-up”. Running the company was Henry Schacht, an AT&T board member since 1981 who in 1995, at the age of 60, had retired as chairman of Cummins Engine (Endlich 2004, ch. 3). Below Schacht, as Lucent’s president and COO, was 46-year-old Rich McGinn, a veteran of two decades in the Bell System who, despite having only an undergraduate degree as a history major from Grinnell College in Iowa, had risen to be head of AT&T’s Network Systems group. It was generally recognized that McGinn was Schacht’s heir apparent (Endlich 2004. 32), and indeed in October 1997, McGinn took over from Schacht as CEO (see Figure 4).

When McGinn became CEO, a press release quoted him as saying that he viewed “Lucent as a group of hot businesses, tightly focused on its customers, markets and competitors” (Business Wire 1997b). Effective November 1, 1997, the company was reorganized around 11 “hot businesses” so that it could, in McGinn’s words, “provide more focus to the business internally, while giving a single face to our customers externally. We are organizing for growth.” While over time, some of these units were sold or spun off, and while, especially in the period 1998-2000, acquisitions augmented the capabilities that many of these units possessed, these 11 businesses encompassed the revenue-generating activities that would define Lucent over the decade of its existence.

Figure 3: Lucent Technologies Organization Chart, September 1996

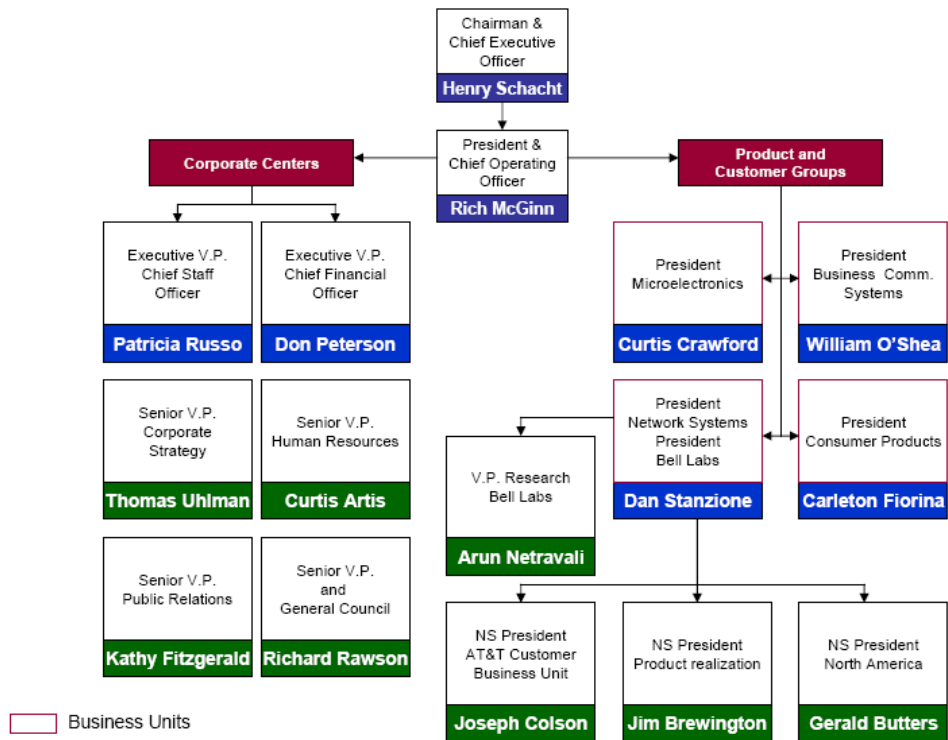
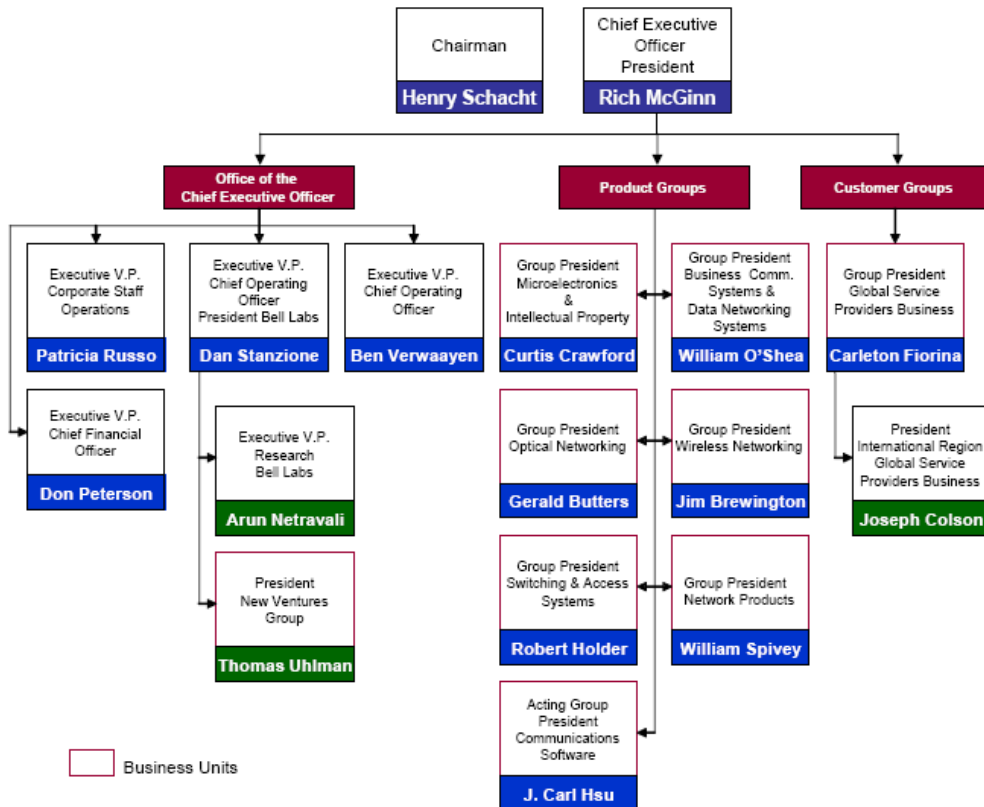


Figure 4: Lucent Technologies Organization Chart, November 1997



These 11 businesses can be grouped into four broader product categories:

- **Core network products:**

Switching and Access. The dominant product was the 5ESS switch that Lucent would attempt to retain as the centerpiece of its network strategy even as circuit switching migrated over to packet switch data networks. Switching and Access was the largest revenue business unit within Lucent in the late 1990s, but with changes in network technology, this “giant” would, as “Converged Core Solutions”, represent less than seven percent of Lucent’s revenues in its last year of existence. During the last half of the 1990s, however, sales of the 5ESS and related hardware and software were central to Lucent’s growth.

Optical Networking. This business unit was the former transmission systems unit, offering products that supported point-to-point transmission, network traffic routing, and traffic consolidation or multiplexing equipment. During its lifespan, Lucent continued to offer products connected to copper cables, predominately for local-loop networks. The Optical Networking unit was, however, rapidly introducing new optical-based products to support service provider initiatives to create new networks that could take advantage of the increased speed and capacity provided by optical fiber transmission. By the 2000s this unit would become a victim of the very technological advances to which it, with the help of Bell Labs, contributed. The massive build-out of high-speed, high-capacity optical networks resulted in a glut of digital communications transmission capacity.

Wireless Networking. By forming a separate wireless unit from the outset, Lucent acknowledged the growth potential in this area. The unit focused on developing wireless network equipment, in direct competition with Ericsson. Initially Lucent offered products compatible with the most widely used wireless transmission standards: AMPS, CDMA, TDMA, and GSM. In 1996 Lucent secured a contract with Sprint PCS to build 60 percent of its 2G wireless infrastructure (Wall Street Journal 1996), thus enabling the company to obtain significant US business outside the old Bell System. As wireless communications expanded from simple voice to the “triple play” of voice, data, and video – that is from 2G to 3G – it was necessary for Lucent to select the standards in which it would invest. Lucent chose CDMA2000 and UMTS, thus positioning it to compete in North America, Europe, and Asia. In the 2000s, however, virtually all of Lucent’s 3G revenues would come from CDMA2000. Its failure to commercialize UMTS products ultimately cost it markets in Europe and Asia.

- **Support Businesses:**

Microelectronics. Initially this unit designed and manufactured advanced integrated circuits, optical devices, and power supplies. Eventually, power supplies would reach commodity status, and were transferred to the Network Products Unit. The supplier relationship between Microelectronics and Lucent product units became similar to that which developed between AT&T Technologies and the RBOCs. There was intense pressure for price reduction and additional supplier concessions. Microelectronics sought

to satisfy these demands for its internal customers while expanding its customer base to external telecommunications equipment companies. Lucent increased its external sales of microelectronics products from \$2,214 million in 1997 to \$3,726 million in 2000, in part through a number of acquisitions. The Lucent product units treated the Microelectronics unit like any other supplier. Without a collaborative business relationship, Lucent derived no competitive advantage from having an internal components supplier. In July 2000 Lucent made the decision to spin off Microelectronics in order to position it better to compete for external customers (Ladendorf 2000). In April 2001 Microelectronics was spun off in an IPO to form Agere (the same spelling but different pronunciation of a startup that Lucent had acquired a year earlier), with Lucent giving up control of the spinoff in June 2002 through a tax-free distribution to Lucent shareholders of the Agere shares that it held.

Business Communications Systems. Initially this unit offered Private Business Exchange (PBX) systems, communications terminals and switching systems for enterprises. Through acquisitions, it expanded its capability in data networks and network software applications, both of which would eventually become key business areas for Lucent. In 2000 this unit was spun off as Avaya as part of Lucent's strategy of ridding itself of "slower-growing" business units (Fisher 2000). After the telecommunications decline of the early 2000s, Lucent realized that enterprise and other private networks presented key opportunities for growth. It could not capitalize on these opportunities, however, without first rebuilding capabilities that it had lost with the Business Communications spin-off. With the limited resources available to it at that time, however, Lucent was unable to make the necessary investments.

Network Products. This unit produced fiber optic cable, and eventually would design and manufacture fiber-based optical subassemblies. It would produce power units, a business transferred from Microelectronics that would be sold to Tyco International in December 2000. When service providers were rapidly replacing copper cable with fiber, this unit provided Lucent with a competitive advantage, producing advanced fiber optic cable with superior signal transport capabilities. When communications networks became saturated with optical fiber, this unit became a liability and was sold to Furukawa Electric in November 2001.

All three Support Businesses enabled Lucent to be a full-line supplier of network solutions to customers. This ability was a carryover from the AT&T days when Lucent's predecessors were part of a vertically integrated enterprise. But when, in the New Economy, these businesses could no longer support levels of revenue and profit that were demanded for the company's growth targets, they became viewed as "non-core" units that could be divested from the company.

- **New Opportunity Businesses**

The reorganization that went into effect on November 1, 1997 aligned Lucent resources with key growth areas in the telecommunications market. Through this structure Lucent

would attempt not only to capitalize on the products and services it had traditionally offered, but also to profit from Lucent's intellectual property.

Intellectual Property Group. Along with issuing licenses for use of Lucent patents, this group aggressively pursued patent infringements to generate "revenue". As a regulated monopoly, the Bell System had viewed its inventions as public property that should be diffused to other companies and industries. This perspective was clearly articulated in the 1956 consent decree. As a competitive company, Lucent believed that a significant amount of income could be obtained from the licensing of intellectual property and the aggressive pursuit of infringement. Yet, in the years 2003-2005, Lucent generated a total of only \$387 million, or 1.4 percent of its revenues, from patent licensing.

New Ventures Group. Following a trend at the time, Lucent also formed new businesses based on innovative product or service ideas generated internally. The New Ventures Group was directly linked to Bell Labs. During its time with Lucent, the Group distributed at least \$250 million to 32 new ventures (Tenorio 2002a). In January 2002, however, with Lucent facing financial collapse, 80 percent of the Group was sold to Collier Capital, a London-based equity management company, for \$100 million (Tenorio 2002a and 2002b).

Data Networking Systems. Just as with the Wireless Group, in forming this business unit Lucent acknowledged that data networking was a business that required additional investment. Lucent had very limited expertise in data networking; therefore, most of the new product developments in this area came from acquisitions. Between May 1998 and July 2000, Lucent did 11 data networking acquisitions for \$25.7 billion; although just one of these acquisitions, Ascend, cost Lucent \$21.4 billion, paid in stock. There was a hope within Lucent that this unit would become a formidable competitor to Cisco Systems. Throughout Lucent's lifespan, however, Data Networking struggled to establish itself in the marketplace.

- **Software and Services:**

This category represented businesses that were projected to take Lucent to higher levels of profitability. There was a belief among key Lucent executives that the company was too "hardware centric". While hardware sales generated high revenues, the margins were generally low. A shift to software and services was expected to increase profit because of the higher margins that could be attained.

It was believed that these higher margins would, in turn, help drive continuous stock-price appreciation. Yet in its 127-year "prehistory", Lucent had been totally in the hardware business. As it turned out, with the telecommunications industry in decline after 2000 (and Lucent's stock price in the tank as well), it became essential for Lucent to expand in Software and Services. Given its dire financial condition, these businesses were the only *low-overhead options* that the company had left to pursue. Services came to generate a growing proportion of Lucent's revenues, exceeding 20 percent from 2001 and peaking at over 26 percent in 2006. Unfortunately, however, with Lucent's total

revenues in 2006 only 41 percent of the 2001 level, Lucent's Services sales of \$2.3 billion in 2006 were \$1.9 billion less than five years earlier.

Communications Software. The idea of selling software as an end product entailed a major cultural shift for Lucent. The company had always viewed software as an integral part of hardware that was necessary to make the equipment work. It took some time before people at Lucent became comfortable with the business of selling software as a revenue generating product on its own. Yet as telecommunications equipment became increasingly software-based, the sale of generic software upgrades for systems operation and applications represented an increasingly important high-margin revenue stream.

Global Service Provider Business. This business unit was created in an attempt to provide a single Lucent interface to customers. Marketing and sales from the various product units were centralized, and the newly formed business unit was assigned profit and loss responsibility. The formation of the Global Service Provider Business was Lucent's way of signaling to customers that it was selling complete network solutions, not just "boxes". Lucent product units would no longer compete against each other for sales of products with overlapping capabilities to the same customer. In addition to selling systems, this unit would sell software and services to communications services companies. At times, products from other companies would be sold to fulfill the requirements of a contract.

In November 1997 Carly Fiorina, who less than two years later would leave Lucent to become the CEO of Hewlett-Packard, became the first President of this group. In October 1999, shortly after her departure, Lucent announced another reorganization. The existing product and service units were reconfigured into four core business units: Service Provider Networks, Enterprise Networks, NetCare Professional Services, and Microelectronics & Communications Technologies. The Global Service Provider Business was disbanded; marketing and sales was redistributed back into the four core business units.

Lucent's expansion in the Internet boom

The new competitive environment required a cultural change at Bell Labs. Decisions to invest in new technology had to be based on anticipated market demand and networking trends, rather than on "protecting" existing technologies or platforms by extending their useful lives through customization and adding exotic features. In making these decisions, Lucent executives had to adopt a business mindset rather than a science mindset. Bell Labs needed to create a portfolio of advanced technology products without investing in "too much technology" to avoid putting timely product introduction at risk.

To mobilize employees for facing the challenge of creating a competitive, fast-paced technology-driven company out of a 127-year-old startup, a company-wide initiative was launched known as "Lucent GROWS", with each letter in the acronym representing a critical behavior or goal.

- **Global Growth Mindset:** Increase revenue to the extent that Lucent is taking market share away from competitors worldwide.
- **Results Focused:** Drive to achieve measurable results and meet pre-established goals in all tasks or activities.
- **Obsessed With Customers and About Competitors:** Develop the kind of relationship with new global customers that had already been established with AT&T and the RBOCs, but do so in a few years rather than 100 years.
- **Workplace that is Open, Supportive, and Diverse:** A recognition that an open and supportive environment is necessary to nurture risk-taking, not punish failure, and encourage honest, non-threatening communications among employees at all levels. Diversity was a priority not only for demonstrating a commitment to equal opportunity, but also as a way to attract high-quality people to Lucent who ultimately would become the “change agents” of the company.
- **Speed:** Hitting market windows on time is important; exceeding customer service expectations is important. All employees must act in a timely and responsive manner.

Lucent GROWS was an effective initiative in aligning employees with the new “mode of operation” that was required for the company to compete successfully in the new business environment. It was an effective motivational campaign for the first two years of the company as revenues continued to increase, the value of employee stock options escalated, and Lucent was the market leader in several sectors.

As a newly independent supplier of communications equipment in the new world of deregulated telecommunications markets, Lucent faced three immediate challenges.

1. The company had to restructure itself from a vertically integrated, full-line supplier of telecommunications equipment into a highly competitive, more agile company focused on the most profitable segments of the rapidly evolving ICT industry – a company that could not only compete on the quality of its technology and service but also on price and time-to-market.
2. Lucent had to diversify its customer base both domestically and internationally, so that it was less dependent on revenues from sales to its established customers, AT&T and the RBOCs.
3. Lucent had to utilize the R&D capabilities of Bell Labs to create the technologies and products necessary for next-generation telecommunications networks, or, alternatively, gain access to those technologies and products through acquisitions.

In the Internet boom Lucent was moderately successful in meeting these challenges; it grew rapidly as revenues increased at a compound rate of over 17 percent per year from 1995 through 1999, when it reached sales of \$38.3 billion. As can be seen in Table 1, the core of Lucent’s business as it began as an independent company was Systems for Networks Operators, which grew from \$10.6 billion in revenues in 1995, when the company was still part of AT&T, to \$23.6 billion just four years later.

Lucent had inherited the four segments shown in Table 1 from AT&T. Some of these technologies and products were, however, approaching “commodity status”, and were no longer competitive, especially if premium pricing was necessary for profitability within the Lucent structure. In October 1997 Lucent spun off its Consumer Products business, which mainly manufactured wireline and wireless telephones, by setting up a joint venture with Philips in which Lucent had a 40 percent share (Lucent Technologies 10-K, 1998, 2). A year later, the joint venture was disbanded, and Lucent sold off its consumer product assets, thus turning itself exclusively into a business-to-business company.

Table 2 shows the distribution of Lucent’s product and services revenues according to a breakdown it adopted in 2000 (Lucent Technologies 10-K 2000, 73). In the boom years of 1998-2000, wireless products, which were emerging as growth opportunities, represented 15 percent of the company’s revenues by 2000. In its 2000 10-K filing, Lucent did not include the revenues for its Enterprise Networks division because it was spun off as Avaya on September 30, 2000, the last day of fiscal year 2000. Obviously, however, these Enterprise Networks revenues, net income, and employees were part of Lucent’s operations for fiscal 2000, and we have therefore included these Enterprise Networks data in Figures 1 and 2 above as well as in Table 2 below.

Table 1: Lucent revenues by reportable segments, 1995-1999

	<u>1995</u>	<u>1996</u>	<u>1997</u>	<u>1998</u>	<u>1999</u>
Total revenues, \$m	20,258	23,286	26,360	30,147	38,303
<i>Percent of total</i>					
Systems for Network Operators	52.3	56.7	59.2	62.2	61.5
Business Communications Systems	25.2	23.7	24.3	26.8	22.3
Microelectronics Products	9.0	9.9	10.5	10.0	14.2
Consumer Products	9.1	6.1	3.8	0.0	0.0
Other Systems and Products	4.5	3.6	2.2	0.9	2.0

Notes: In 1999 Systems for Network Operators was renamed Service Provider Networks, Business Communications Systems was renamed Enterprise Networks, and Microelectronics Products became Microelectronics and Communications Products.

In 1999 Lucent restated its 1997 and 1998 revenues and costs to take into account “pooling-of-interests” mergers with Ascend and Kenan Systems. Restated revenues were \$27.611 billion in 1997 and \$31.806 billion in 1998.

In 1995-1997 Other Systems and Products included custom designed defense systems for the US government.

Source: Lucent Technologies 10-K filings, 1996-1998.

Table 2. Lucent's revenues by major product groups, 1998-2000

	<u>1998</u>	<u>1999</u>	<u>2000</u>
Total revenues, \$m	32,121	38,885	41,493
<i>Percent of total</i>			
Core Networking Systems	46.6	47.1	45.8
Wireless Products	13.9	14.2	15.0
Enterprise Networks	24.1	21.3	18.5
Microelectronics	7.5	7.2	9.0
NetCare Professional Services	2.0	2.8	3.0
Other	5.9	7.4	8.7

Note: "Other" principally includes optical fiber, power systems, and consumer products

Source: Lucent Technologies 10-K filing, 2000 ; Avaya 10-K filing, 2000.

In producing these goods and services, Lucent had to diversify its customer base. Even after the breakup of the Bell System in January 1984, AT&T and the RBOCs had remained the primary customers of AT&T Technologies. Throughout its existence Lucent also relied heavily on these customers for revenues. For example, from 1996 to 1999 the installed base of local access lines that connected to Lucent equipment increased from 110 million to 150 million in 1999, primarily through sales to RBOCs. Helping to drive the demand for more local access lines in this period was the practice in households and businesses of having a second telephone line dedicated to Internet access.

In their financial statements, companies must report the names of companies that make up 10 percent or more of their revenues. From 1996 through 1999, AT&T was the only company so reported, accounting for a peak of over 14 percent of Lucent's revenues in 1997. In 2000, when AT&T represented 10 percent of Lucent's revenues, Verizon (formed when the RBOC Bell Atlantic merged with GTE) had surpassed it, accounting for 13 percent. The importance of Verizon as a Lucent customer increased in the 2000s, reaching 27 percent of total revenues in 2004 and 28 percent in both 2005 and 2006.

In the new competitive environment of the last half of the 1990s AT&T and the RBOCs were themselves seeking to identify alternative suppliers so that they would not be solely dependent on a "single source" and so that they could use price competition to boost margins and profits. The ability of these customers to choose among suppliers was enhanced by the emergence of industry standards, such as the SONET and SDH digital transmission standards, as well as by the rapid rate of technological change. At first Lucent had an "incumbent" advantage because of the existence of a huge embedded base of its equipment, but the emergence of innovative competitors using new lightwave technology to build "carrier grade" optical networking equipment during the last half of the 1990s caused Lucent's incumbent advantage to erode.

In response, Lucent itself aggressively sought new customers, focusing on service providers planning new optical networks and wireless infrastructure installations or "next-generation" service providers, such as Sprint PCS, Winstar, and Global Crossing among many others, that were planning new types of service offerings. Some of these

companies (such as Winstar and Global Crossing) went bankrupt at the end of the boom. Others such as Sprint PCS, however, remained important Lucent customers. Sprint represented 15 percent of Lucent revenues in 2003, 11 percent in 2004, and 12 percent in 2005.

At the same time, Lucent made a push into non-US markets that increased non-US sales from \$6.7 billion in 1997 to \$12.2 billion in 1999. As a result, non-US sales as a proportion of total company sales rose from 26 percent to 32 percent (see Table 3). When non-US sales declined to \$11.2 billion in 2000, US sales declined even more, so that non-US sales rose to almost 34 percent of the total. As can be seen in Table 3, the most significant expansion of non-US sales from 1997 to 1999 was to EMEA, although sales to this region declined in 2000 while sales to other non-US regions were stable or rose. Table 4 shows that most of the increase in non-US revenues from 1997 to 1999/2000 was in Service Provider Networks, although the Enterprise Networks group (which would be spun off as Avaya in 2000) and MCT (which would be spun off as Agere in 2001) also generated substantial increases in non-US sales during the Internet boom.

Table 3. Lucent Technologies' non-US sales, 1997-2000

	CAN \$m	CLA \$m	EMEA \$m	AP \$m	non-US sales as % of Lucent sales	% of non-US sales in CAN	% of non-US sales in CLA	% of non-US sales in EMEA	% of non-US sales in AP
1997	100	700	3,000	2,800	25.6	1.5	10.6	45.5	42.4
1998	500	900	3,900	3,000	27.5	6.0	10.8	47.0	36.1
1999	400	1,500	6,800	3,500	31.8	3.3	12.3	55.7	28.7
2000	400	1,700	5,300	4,000	33.9	3.5	14.9	46.5	35.1

CAN=Canada; CLA=Caribbean/Latin America; EMEA=Europe/Middle East/Africa; AP=Asia Pacific

Note: Data for 2000 do not include sales by Enterprise Networks, spun off as Avaya on September 30, 2000.

Source: Lucent Technologies 10-K filings, 1997-2000

Table 4: Lucent's non-US sales, by reportable segments, 1997-2000

	Non-US Sales, \$m				Non-US sales as percent of			
	Lucent	SPN	EN	MCT	Lucent sales ¹	SPN sales	EN sales	MCT sales
1997	6,747	4,044	995	1,708	25.8	25.8	15.9	40.3
1998	8,291	4,892	1,511	1,888	26.2	25.6	19.0	40.8
1999	12,186	8,058	1,763	2,365	32.5	34.2	20.6	43.6
2000	13,097	8,642	1,625	2,830	31.6	32.6	21.2	40.7

SPN=Service Provider Networks; EN=Enterprise Networks; MCT=Microelectronics and Communications Technologies

Note: We treat Avaya revenues for 2000 as Lucent revenues, using the data on US and foreign revenues in Avaya 10-K filing, 2000, 75.

¹ Includes sales of SPN, EN, and MCT; excludes "other". Sales for 1997 and 1998 are restated from 1999, and therefore the percentage in this column differ what from the analogous percentages in Table 3.

Source: Lucent Technologies 10-K filings, 1997-2000

Development of Lucent's technological capabilities

In the highly competitive environment in which Lucent found itself, it was necessary not only to deliver products to the marketplace with superior quality and price performance but also to hit market widows-of-opportunity on time with technical innovations. Under the system inherited from AT&T, competing on quality was Lucent's strength, but cost and time-to-market were its weaknesses. The possession of Bell Labs contributed to Lucent's quality advantage, but, given the rapidity of technological change from the mid-1990s, if advanced products were not available on time, the introduction of higher quality products through "Bell Labs Innovation" would not generate anticipated revenues or profits.

From the start, Lucent Technologies emphasized the role that Bell Labs could play in its efforts to compete as an independent company (see Baker et al. 2000). Indeed, as shown in Figure 5, "Bell Labs Innovation" was part of the company's logo.

Figure 5. Lucent Technologies logo

As a distinguished corporate research organization in the United States, Bell Labs positioned Lucent high up among the list of leading patent-generating companies in the nation (see Table 5). After the breakup of the Bell System, patents generated at Bell Labs placed AT&T anywhere from 9th (in 1985) to 19th (in 1989) among the US patent leaders. In each of the two years prior to the Lucent spinoff, AT&T ranked 13th. As an independent company, Lucent moved up the ranking from 12th in 1996 to 5th in 2000, at which time only IBM, NEC, Canon, and Samsung surpassed it.

Table 5. Lucent Technologies, US patents, US rank, and R&D expenditures, 1996-2006

	US patents	US rank	R&D expenses, \$m	R&D as % of sales
1996	799	12	2,551	11.0
1997	768	11	4,047	15.4
1998	928	13	5,094	16.9
1999	1,152	9	4,792	12.5
2000	1,411	5	5,023	14.9
2001	1,109	12	3,520	16.5
2002	662	24	2,310	18.7
2003	621	27	1,488	17.6
2004	534	35	1,284	14.2

2005	405	42	1,177	12.5
2006	552	37	1,189	13.5

Source: Intellectual Property Owners website: www.ipo.com

From 1996 to 1998, Lucent doubled its R&D expenditures to \$5.1 billion, and raised R&D as a percent of sales from 11.0 to 16.9. This level of R&D expenditure was more or less sustained over the next two years, but, with declining revenues was cut back drastically from 2001 to 2003. With these cuts in R&D, Lucent's patent output also declined; its rank among patent producers in the United States plunged from 5th in 2000 to 42nd in 2005. During these years, by comparison, IBM maintained its position at the number 1 patent producer in the United States.

The products developed internally using Bell Labs resources were typically within the three major business units of the company: Switching Systems, Transmission Systems, and Wireless Networks (see Baker et al. 2000).

In Switching Systems, efforts concentrated on software upgrades to the 5ESS Central Office Digital Switch. Lucent's "incumbent" advantage depended critically on sales of these upgrades for the switches imbedded in the public circuit switch network. As packet switching began to compete with circuit switching, significant development was focused on creating "soft switch", a switching system that provides routing of traffic more through software algorithms than by redirecting through hardware paths. As a result, this business unit, that at one point was a leader in switching hardware technology, became highly dependent upon software creation.

In Transmission Systems, efforts concentrated on products that would create the "all optical network". Optical products were characterized by two properties: the number of channels, or wavelengths, that the system would support through a single optical fiber; and the speed at which signals could be transported over each of these channels. The number of channels that can be carried on a single fiber is increased utilizing Wave Division Multiplex (WDM) technology. Bell Labs developed a progression of optical transport systems that supported 16, 40, and 80 wavelengths per optical fiber. The 40 and 80 wavelength products were designed to use Dense Wavelength Division Multiplex (DWDM) technology.

Bell Labs gave Lucent considerable in-house knowledge of optical networking technology. For the period 1996-2002, 2,372 (35 percent) of Lucent's 6,829 US patents related to optical, compared with 626 (29 percent) of 2,123 for Nortel, 854 (40 percent) of 2,102 for Alcatel, and 160 (25 percent) of 643 for Cisco (United States Patent and Trademark Office 2009). Yet in 1999 Nortel's optical networking revenues were \$4.0 billion compared with Lucent's \$3.6 billion; and in 2000, Nortel's optical networking revenues soared by 133 percent to \$9.2 billion while Lucent's actually fell by 7 percent to \$3.3 billion. John Chambers, CEO of Cisco, said that in optical networking his company's main competitor was Nortel, not Lucent (Egbert 2000).

In Wireless Networks, Bell Labs had much work to do. Wireless transmission was a new technology that was growing, and Lucent did not have an imbedded base of products in this area that it could leverage or modify into “next generation” product offerings. The major product in wireless networks was the base station. These systems were designed for two types of wireless networks. In the earlier days of mobile communications, the network was based on 2G (second generation) technology. These networks provided basic voice communications. In the 2000s the wireless network began migrating toward 3G (third generation) technology. These networks provide remote access to “Internet-like” service such as voice, data, and video.

In designing base stations, decisions needed to be made regarding the transmission standard that would be used. The selection was complicated by the fact that a greater variety of standards had evolved in wireless communications than in wireline communications. No single standard was proving to be dominant; Lucent needed to determine in which of the alternatives it would risk investing. Lucent selected Code Division Multiplex Access (CDMA) and Universal Mobile Telecommunications Systems (UMTS). Lucent did not elect to invest in Global Systems for Mobile Communication (GSM) which was a 2G system used throughout the world. As GSM networks eventually migrated to 3G technology, Lucent anticipated that UMTS or a derivative, W-CDMA (Wideband Code Division Multiplex Access), would be the technology adopted. As we shall see, however, in the first half of the 2000s, notwithstanding its early success in sales of 3G networks based on CDMA2000 technology, Lucent failed in its efforts to commercialize 3G networks based on UMTS.

Lucent’s acquisitions

Given the growth of optical and wireless technologies as well as the convergence of voice, data, and video, during the last half of the 1990s the major telecommunications equipment companies looked to acquisitions to fill critical gaps in their product portfolios as well as to give them instant access to new customers bent on investing in next-generation technologies. Old Economy companies like Lucent, Nortel, Alcatel, and Ericsson watched Cisco Systems use a growth-through-acquisition strategy to dominate the enterprise networking market and make inroads into the carrier markets. Founded in 1984, Cisco went public in 1990 with about \$70 million in sales and 200 employees. It did its first acquisition in 1993, and by the end of 1998 had done 29 more, for which it paid a total of over \$8.4 billion, 94 percent of which took the form of Cisco’s own stock. By that time the upstart had \$8.4 billion in revenues and 15,000 employees. But Cisco was just beginning: in 1999 and 2000, it did 41 acquisitions for \$26.7 billion, over 99 percent paid with its high-flying stock (Carpenter et al. 2003).

The perceived need to compete for acquisitions became a “strategic” justification for keeping stock prices high. This in turn demanded meeting or exceeding quarterly revenue and earnings targets, objectives with which Lucent top executives, led by the hard-driving McGinn, became obsessed (see Endlich 2004). Table 6 shows the value of the acquisitions made by Lucent, Nortel, Alcatel, and Cisco in 1997-2000, and the extent to which they were purchased with stock.

Table 6. Market Value of Acquisitions, Acquisition Share, and Mode of Payment, Nortel, Lucent, Alcatel, and Cisco, 1997-2000

	Nortel (NT)	Lucent (LU)	Alcatel (ALA)	Cisco (CSCO)	NT+LU+ALA +CSCO
Value of acquisitions (\$m)					
1997	430	2,635	0	586	3,651
1998	8,390	2,416	5,000	1,114	16,920
1999	6,452	32,003	4,124	14,435	57,014
2000	14,395	9,996	7,233	12,254	43,878
1997-2000	29,667	47,049	16,357	28,389	121,463
Percent of total acquisitions by value					
1997	11.8	72.2	0.0	16.1	100.0
1998	49.6	14.3	29.6	6.6	100.0
1999	11.3	56.1	7.2	25.3	100.0
2000	32.8	22.8	16.5	27.9	100.0
Percent of value acquired with stock					
1997	63.7	30.7	0.0	70.9	41.1
1998	98.2	38.0	93.7	84.9	87.4
1999	88.0	99.2	43.0	99.8	95.1
2000	99.8	97.6	97.6	98.8	98.7

Notes: a) Under accounting rules governing spinoffs, Lucent was not allowed to use pooling-of-interests accounting until October 1998, which reduced its incentive to use stock as the acquisition currency prior to that time.

b) Lucent's acquisition costs not disclosed (employees in parentheses): 1997, Triple C Call Center (18); 1998, Pario Software (4), TKM Communications (45); 1999, Soundlogic CTI (22), CCOM Information Systems (10). Lucent's 1998 figures include the acquisition of Stratus by Ascend (\$917 million in stock, 65 employees), and 1999 figures include the acquisition of XNT Systems and Quantum Telecom Solutions by Excel Switching.

c) Cisco's acquisition cost of Telesend (10 employees) in 1997 not disclosed

Sources: Carpenter et al. 2003. Compiled from company annual reports and press releases. Wherever possible, the value of the deal at closing rather than at announcement has been used.

Between October 1996 and September 2006, Lucent made 41 acquisitions. Table 7 shows the distribution of acquisitions by year and business area, while Table 8 shows the distribution of acquisitions among the Lucent business areas in terms of the number of acquisitions, the value paid for them, and the number of people employed by the target at the time it was acquired. Of Lucent's 41 acquisitions, 31 were made in 1999-2000 representing 92 percent of the total value paid and 76 percent of the total employees. Ascend was by far the most expensive acquisition, accounting for 46 percent of the value that Lucent paid for 36 acquisitions in 1997-2000. The 371 million Lucent shares expended to acquire Ascend represented 13.5 percent of all Lucent common shares outstanding. Overall Lucent used almost 23 percent of its stock to make acquisitions over the decade of its existence. In terms of cost per employee of the acquired company, the five most expensive acquisitions (highlighted in Table 8) were Chromatis (\$29.7 million), Spring Tide (\$10.1 million), Nexabit (\$7.4 million), Ascend (\$7.1 million), and Ortel (\$5.5 million). The first three companies in this list were founded in either 1997 or 1998. As shown in Table 8, the most active business areas for making acquisitions were Data Networking, Enterprise Networks, and Microelectronics.

Table 7. Lucent Technologies' acquisitions by business area, 1996-2006

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Enterprise Networks	1	3	1	3							
Enterprise Services		1	1								
Microelectronics			2	3	4						
Data Networks			6	3	2				1		1
Global Services			1	1							
Communications Software				1							1
Switching Systems				1							
Optical Systems					2						
New Ventures Group					1	1					
Total	1	4	11	12	9	1	0	0	1	0	2

Data Networking

Lucent's Data Networking acquisitions took place predominantly between 1998 and 2000 (with only two being made outside these years, one in 2004 and the other in 2006). These moves were targeted at packet switch technology that could be used with Local Areas Networks (LANs) or Wide Area Networks (WANs).³ Initially Lucent invested in companies utilizing Asynchronous Transfer Mode (ATM) technology, which was viewed as a competitor to Internet Protocol (IP), the technology championed by Cisco for packet transport.

In 1999 Lucent began to shift its strategy by acquiring companies with IP expertise and products that could offer Voice over Internet Protocol (VoIP) capability. The shift toward IP was an admission by Lucent that it had made a huge error in judgment and investment, by attempting to compete against Cisco by developing ATM products as an alternative to IP packet transport. ATM products had been developed in both the switching and transmission portfolios with very little success. Now these products would need to be re-engineered to accommodate IP-based signals, or in some cases completely discarded.

³ A Local Area Network (LAN) connects devices over a relatively short distance, such as within an office building or between buildings in a small campus. A Wide Area Network (WAN) spans a larger geographic area such as a state or a country; WANS are formed by interconnecting multiple smaller networks, such as a group of LANs or metropolitan areas networks (MANs).

Table 8: Characteristics and costs of Lucent Technologies' acquisitions, 1996-2006

Date acquired	Lucent business unit/ Company acquired	Location	YF	AC \$m	MP	%LU	AE \$m	C/AE
Enterprise Networks, Business Communications								
10/8/96	Agile Networks	Boxborough, MA	1991	100	cash		60	1.67
7/17/97	Octel Communications	Milpitas, CA	1982	1,825	cash		2,900	0.63
10/15/97	Livingston Enterprises	Pleasanton, CA	1986	610	stock	1.20	200	3.05
12/10/97	Prominet	Marlborough, CA	1996	200	stock	0.39	85	2.35
6/8/98	SDX Business Systems	Hertfordshire, UK	1991	207	cash		340	0.61
4/5/99	Mosaix	Redmond, WA	1983	129	stock	0.09	550	0.24
7/1/99	CCOM Information Systems	Iselin, NJ	1989	ND	cash		10	NA
12/15/99	Soundlogic CTI	Vancouver, BC					22	0.00
Enterprise Networks Professional Services								
5/19/97	Triple C Call Center Comm.	Frankfurt, Germany	1994	ND	stock	NA	18	NA
3/1/98	TKM Communications	Toronto, ON	1988	ND	cash		45	NA
Microelectronics								
4/6/98	Chip Express Corp	Santa Clara, CA	1989	10	cash		130	0.08
4/19/98	Optimay	Munich, Germany	1987	64	cash		60	1.07
2/22/99	Sybarus Technologies	Ottawa, ON	1997	41	cash		35	1.17
3/2/99	Enable Ethernet	San Jose, CA	1995	51	cash		40	1.28
7/15/99	SpecTran	Sturbridge, MA	1981	68	cash		500	0.14
1/20/00	Agere	Austin, TX	1998	377	stock	0.25	90	4.19
2/4/00	VTC	Bloomington, MN	1984	104	cash		230	0.45
2/7/00	Ortel	Alhambra, CA	1980	2,998	stock	1.63	550	5.45
6/19/00	Herrmann Technology	Dallas, TX	1994	432	stock	0.22	260	1.66
Data Networking, Internetworking Systems								
4/27/98	Yurie Systems	Landover, MD	1992	1,044	cash		250	4.18
7/9/98	Lannet Data Communications	Tel Aviv, Israel	1985	115	cash		500	0.23
7/28/98	MassMedia Communications	Natick, MA	1995	0	cash		12	0.00
10/6/98	Quadritek Systems	Malvern, PA	1993	50	cash		70	0.71
11/24/98	Pario Software	Redwood City, CA	1997	ND	cash		4	NA
11/25/98	WaveAccess	Ra'anana, Israel	1993	56	cash		65	0.86
1/13/99	Ascend Communications	Alameda, CA	1989	21,423	stock	13.45	3,000	7.14
6/25/99	Nexabit Networks	Malborough, MA	1997	896	stock	0.47	120	7.47
8/13/99	Xedia Corp	Action, MA	1993	246	stock	0.23	90	2.73
3/13/00	DeltaKabel TeleCom	Gouda, Netherlands	1973	52	cash		60	0.87
7/25/00	Spring Tide Networks	Maynard, MA	1998	1,315	stock	0.81	130	10.12
8/20/04	Telica	Marlborough, MA	1998	295	stock	1.83	251	1.18
3/21/06	Riverstone	Santa Clara, CA	1997	207	cash		550	0.38
Communications Software								
1/11/99	Kenan Systems	Cambridge, MA	1982	1,484	stock	0.94	750	1.98
9/12/06	Mobiltec	San Mateo, CA	2000	ND	cash			NA
New Ventures Group								
7/12/00	USA Digital Radio	Columbia, MD	1990				46	NA
6/5/01	MetroCommute.com	New York, NY	1994		cash			NA
Optical Networking								
3/15/00	Ignitus Communications	Acton, MA	1999	106	cash		75	1.41
5/31/00	Chromatis Networks	Hendron, VA	1997	4,756	stock	2.38	160	29.73
Network Switching Systems								
8/18/99	Excel Switching	Hyannis, MA	1988	1,723	stock	0.73	460	3.75
Global Professional Services								
7/20/98	JNA Telecommunications	Sydney, Australia	1960	67	cash		240	0.28
8/10/99	International Network Serv.	Sunnyvale, CA	1991	3,284	stock	1.63	2,200	1.49

Notes: **YF** means year founded; **AC**, acquisition cost; **MP**, mode of payment; **%LU**, % of Lucent outstanding common stock used for acquisition; **AE**, acquisition employees; **C/AE**, cost of the acquisition per acquisition employee.

Sources: Company filings and press releases, and assorted news sources.

Enterprise Networks

When developing equipment for the packet-switched public network, Lucent focused on ATM technology. When developing equipment for LANs used by companies, however, it needed to develop capability in both IP and Ethernet technologies, which were typically used for LANs. Several of the smaller acquisitions helped to reinforce these product areas.

Lucent's first acquisitions were for the company's Business Communications Services group, which later became known as Enterprise Networks. Most acquisitions for this unit occurred between 1996 and 1999. The strategies within this Business Unit were a preview of what Lucent would pursue as a company in the future. Acquisitions were made to support packet switching applications in LANs. Initially ATM technology was pursued, but eventually IP and Ethernet technology became the focus. Software products that would manage multimedia data flow were of interest along with VoIP capabilities over LANs. An integrated product and service offering provided by Lucent was Call Center design and installation. Various software company acquisitions were made to enhance the features and capabilities of this offering. In addition, Lucent's expertise in providing professional network services to businesses was strengthened by several acquisitions. This cluster of business services eventually became known as NetCare Professional Services.

In response to the severe downturn in the telecommunications industry in 2001-2003, Lucent needed to focus on packet-based switching systems, routers, applications software, and professional services. Unfortunately, the Enterprise Networks business unit in which Lucent would have developed these capabilities and products had been spun-off as Avaya in September 2000. With the relevant experience and expertise developed within the Enterprise Networks unit no longer available to Lucent, the company needed to recreate these capabilities in the 2000s. But it lacked the financial resources to make new acquisitions as it had done originally to reinforce the ability of Enterprise Networks to compete in the new telecommunications environment.

Microelectronics

Acquisitions for this unit were all made between May 1998 and June 2000. These acquisitions rounded out the unit's product portfolio and positioned it to better meet designer requirements for the creation of packet switch and wireless systems. This product portfolio included Ethernet and advanced processor chips for routers, and chip-sets to support the Global System for Mobile Communications (GSM), the European 2G standard for wireless communication.

Acquired optical technology capabilities included specialty optical fiber fabrication and advanced optical filters utilized to support deployment of Dense Wavelength Division Multiplexing (DWDM) technology. An important addition that addressed a growth market was Ortel Corporation, which made optical components used to upgrade cable TV networks for Internet and telephone services.

The Microelectronics unit was spun off by Lucent as Agere Systems with an IPO in April 2001. Initially Lucent retained voting control, but in June 2002 Lucent distributed its Agere shares to Lucent shareholders. Henceforth, Lucent would gain access to the Agere technologies obtained from previous microelectronics acquisitions only as a customer of Agere products, just like any other network equipment company. With the conclusion of the Agere spin-off, Lucent lost any strategic advantage that it could obtain from the microelectronics acquisitions and Bell Labs device research investments that it had made.

Other Business Unit Acquisitions

Switching Systems and Optical Networks were two business units that were heavily supported by internal product development through Bell Labs research and design teams residing within the product units. As a result, very little acquisition activity was directed at these units. The acquisitions that were made, however, helped to address serious competitive challenges that each Business Unit faced.

The most important product in Switching Systems was the 5ESS Switch. It was created to support conventional circuit switch digital networks. As demand for packet switching grew, the 5ESS had limited ability to meet these needs. The digital switch needed to be replaced with a software-dominated “soft switch”. The only acquisition for this unit, Excel Switching Corporation, brought programmable switching expertise into Lucent so that equipment that could bridge circuit and packet networks using IP could be developed.

Optical network capacity continued to grow because of the number of deployments and technical advances that increased speed and number of wavelength channels per strand of fiber. A bottleneck existed in getting customer broadband, or packet switch, traffic from business and residences onto the high-speed optical networks to consume this capacity. One approach to the bottleneck problem was the development of optical metropolitan, or network edge, equipment that would consolidate and direct this traffic onto the high-capacity network. To perform this function, the equipment needs to be compatible with the various protocols found in metropolitan networks: SONET, ATM, and IP. Economically, it is best to process all three protocols in one piece of equipment rather than use specialized stand-alone units. The Ignitus and Chromatis acquisitions were intended to satisfy this need, even though products from each company were still under development. As it turned out, Lucent was unable to commercialize any products generated from these acquisitions. Indeed, given the dubious circumstances surrounding the Chromatis acquisition, which we outline below, it may well have been the case that the prime purpose of this \$4.8 billion deal, done at the zenith of the Internet boom, was to hype Lucent’s languishing stock price or prevent a competitor from acquiring the company.

There appears to have been no underlying strategy in the acquisitions for Communications Software, New Ventures, and Global Professional Services. One can conclude that these acquisitions were made as opportunities presented themselves, the

cost of the acquisitions seemed reasonable at the time, and the product or service offerings fit well into the “value propositions” of the business unit.

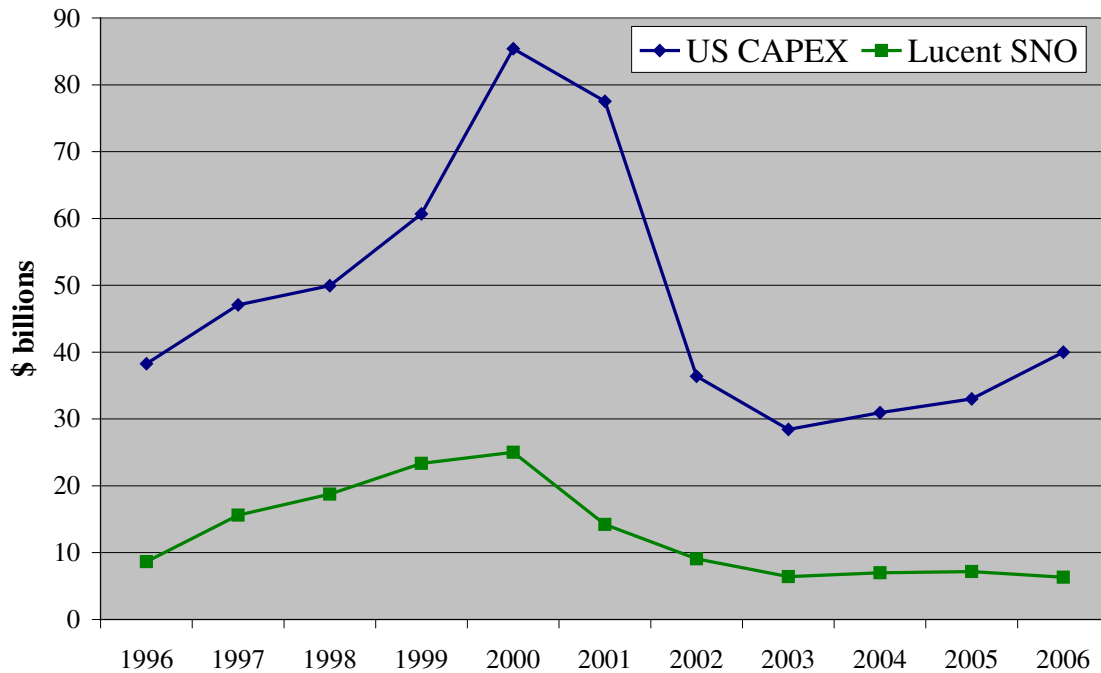
3. From boom to almost bust

Lucent’s revenue slowdown and decline

Since the creation of Lucent in 1996, the company achieved year over year revenue growth on its consolidated operations until 1999. Then revenue declined steadily for the next four years. When revenue stabilized after 2003, it was less than 25 percent of the peak level reached in 1999. The telecommunications equipment industry as a whole went into sharp decline during 2001 and 2002. Growth resumed in the 2004 timeframe but at a significantly slower rate than experienced in the late 1990s. To some extent, therefore, Lucent’s performance in the 2000s can be attributed to an inhospitable economic environment. To what extent was that the case, and to what extent and in what ways was Lucent’s performance the result of strategic missteps or organizational failures?

As we have seen in Figures 1 and 2 at the beginning of this paper, all of the major Old Economy communications equipment companies went through wrenching declines when the New Economy crashed in 2001 and 2002. Underlying their lower revenues, negative incomes, and downsized labor forces was, as shown in Figure 6, a sharp decline in expenditures on capital equipment in the telecommunications industry in the United States (CAPEX). In 1995-2000, CAPEX grew at annual compounded rate of 23 percent; in 2000-2003 it declined at a rate of 28 percent. In Figure 6 we see from the data on Lucent’s revenues from Systems for Network Operators (SNO), on which changes in CAPEX had a direct impact, Lucent failed to capture fully the growth of CAPEX in 1999 and 2000, was adversely affected by the decline in CAPEX in 2001 through 2003, and then was unable to participate in the growth of CAPEX from 2004 through 2006. SNO revenues reached \$26.5 billion in 2000 but declined to \$6.3 billion in 2006. Moreover, during its decade as an independent company, Lucent became increasingly more dependent on SNO sales with the spinoffs of the Consumer Product unit in 1997, the Enterprise Networks unit in 2000, and the Microelectronics unit in 2001. SNO revenues as a percent of total revenues rose from 56.7 percent in 1996 to a peak of 77.3 percent in 2004, before declining to 75.9 percent in 2005 and 71.9 percent in 2006.

Figure 6. Capital expenditures on telecommunications equipment in the United States (US CAPEX) and Lucent Technologies revenues from Systems for Network Operators (Lucent SNO)



Sources: US Census Bureau, 1996-2006; Lucent Technologies 10-K filings, 1996-2006

Lucent’s problem in 2000 was that it failed to take advantage of the huge surge in capital spending on optical network equipment that marked the last stage of the Internet boom. Nortel was able to take advantage of the mammoth optical networking build-out that occurred in 2000. Nortel optical revenues increased by 133 percent from 1999 to 2000, while during the same period Lucent’s optical revenue declined by 7 percent. Nortel’s \$9.2 billion in revenues from optical systems in 2000 were \$5.9 billion greater than Lucent’s \$3.3 billion

In early January 2000, Lucent announced that revenues in the first quarter of fiscal 2000 had been flat at about \$9.8 or \$9.9 billion, while its earnings per share had fallen from 48 cents to 36-39 cents, compared with the first quarter of fiscal 1999 which ended December 31, 1999. In its press release, the company attributed the lower than expected revenue and earnings for the first quarter of fiscal 2000 to:

- Faster than anticipated shifts in customers’ purchases to Lucent's newest 80-channel DWDM optical product line and greater than expected demand for OC-192 capability on the 80-channel systems, which resulted in near-term manufacturing capacity and deployment constraints

- Changes in implementation plans by a number of customers inside and outside the United States, which led to delays in network deployments by enterprises and service providers;
- Lower software revenues, reflecting acceleration in the continuing trend by service providers to acquire software more evenly throughout the year. In the past, these purchases occurred primarily in the quarter ending December 31;
- Lower than anticipated gross margins resulting from ramp-up costs associated with introducing and deploying new products along with lower software revenues.

By October 2000, when it was clear that Lucent had failed to take advantage of the optical networking boom, CEO McGinn and Executive VP of Corporate Strategy and Business Development William O'Shea identified the problem as a missed product cycle with OC-192 optical transport equipment (see Arnst 2000; Barbash 2000; Schiesel 2000). This explanation was somewhat misleading. Sales of OC-192 equipment only began to take off in 2000. AT&T and the RBOCs, which were Lucent's major customers, were not in the forefront of investing in OC-192 optical networking systems in 2000. Lucent executives, therefore, failed to provide an adequate explanation for Nortel's substantial increase in optical networking market share.⁴

In failing to take advantage of the optical networking boom of 2000, Lucent achieved only modest growth that year. Many of the problems that Lucent experienced in the downturn were of its own creation. They were the result of the obsession by Lucent's top executives with recording high rates of growth, quarter after quarter. In early 2001 Lucent was investigated by the SEC for "channel stuffing": the booking of sales on products shipped that were preceded by private agreements with distributors assuring them that they did not have to pay for goods that were not subsequently sold. In November 2000, after CEO McGinn was ousted, Lucent revealed that it had improperly booked \$679 million in revenue during the 2000 fiscal year (Jander 2000a, 2001a). While the SEC took no action on this particular admission, in October 2002 it served notice on Lucent of a possible civil lawsuit over improper accounting to inflate its sales figures in 1999 and 2000 (Loomis 2003). In November 2000, the company was the target of two class action lawsuits from shareholders for the misreporting of 2000 revenues and earnings (Johnson 2000b). With Lucent's stock price in a free fall – in October 2002 Lucent's stock price was just 1.5 percent of the value at its peak in December 1999 – the number of lawsuits mounted, and in March 2003, the company agreed to an omnibus settlement of 54 separate lawsuits for a total of \$420 million (PR Newswire 2003).

Another problem that Lucent created for itself in the boom period was excessive vendor financing. It is a common practice in the telecommunications equipment industry for a vendor to secure business by offering to finance some of the purchase price. This practice involves risk to the vendor if the loan goes bad. In the Internet boom, with its young

⁴ It is beyond the scope of this paper to provide a complete explanation of the differences between Lucent and Nortel in sales of optical networking equipment in the boom. We intend to address this question in a future paper.

firms and unproven technologies, vendor financing could become very risky indeed. In one well-known case Lucent provided vendor financing to WinStar Wireless for purchase of Lucent 5ESS switches and related gear to be used in a fixed wireless installation (Business Wire 1997a). Given the uncertainties that surrounded the success of WinStar's service – creating a local access network using fixed wireless technology dependent upon line-of-sight transmission across roof tops – Lucent was in effect acting as a venture capitalist to secure the sale. In the end, Lucent had agreements to provide WinStar with up to \$2 billion in vendor financing. In 2001 Lucent pulled the financial plug on WinStar by refusing to extend a loan of \$90 million. After WinStar was forced into bankruptcy, Lucent had to write off \$700 million in bad debts. At the end of fiscal 2000, Lucent had entered into agreements with customers to provide up to \$8.1 billion in credit or loan guarantees, of which almost \$2.1 billion was outstanding. Lucent made provisions of bad debts to customers of \$2.2 billion in 2001 and \$1.3 billion in 2002.

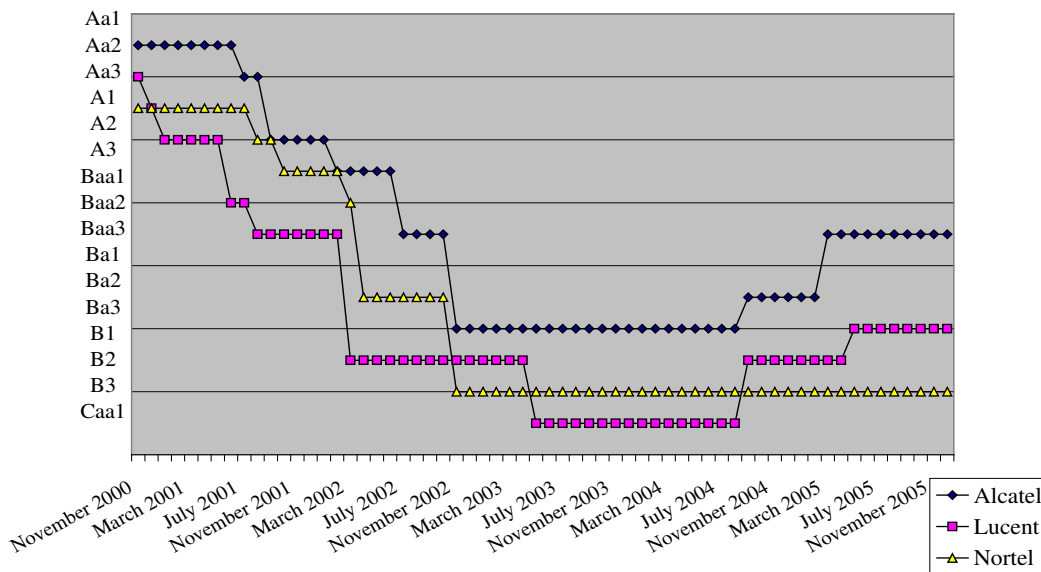
At the same time, some of Lucent's most expensive acquisitions made in 1999 and 2000 turned out to be virtually worthless. Key personnel left the acquisitions; their products were not successfully developed or integrated into the Lucent portfolio; in some cases product offerings overlapped; and all were eventually shut down. In the boom, it appeared that the more Lucent paid for an acquisition on a per employee basis, the more likely it was that key personnel, enriched by the acquisition and often eager to join another startup, would walk out the door. Such was the case at Lucent's most expensive acquisition, Ascend (Endlich 2004, 115-118). Such was not, however, apparently the case with another expensive acquisition, Kenan Systems, which cost Lucent almost \$1.5 billion in stock. Kenan Systems had 750 employees, but not one of them held stock. The only stockholder was the CEO, Kenan Sahin, who had founded the company in 1982. In January 2002, Kenan Systems was sold for \$300 million in cash.

When Lucent acquired Chromatis Systems for almost \$4.8 billion in May 2000, it estimated that the optical switch for metropolitan area networking which the startup was planning to produce would generate revenues of \$375 million in 2001 and \$1 billion in 2002, with revenues peaking in 2005. Just prior to the Chromatis acquisition, Lucent had completed the purchase of Ignitus for a total of \$106 million in cash. Ignitus was a startup in which Lucent had previously invested, and was developing technology similar to that of Chromatis. With Chromatis in hand, Lucent cancelled further development of the Ignitus product. In August 2001 Lucent shuttered the Chromatis operations, which had failed to produce a commercial product, and took a \$3.7 billion write-off of goodwill (Jander 2000b, 2000c, 2001b). The Spring Tide acquisition made in September 2000 for \$1.3 billion in stock, as part of Lucent's effort to build capabilities in IP networking equipment, did deliver a product. But Spring Tide was shut down in November 2000, leaving Lucent's books with an impairment charge of \$837 million.

In 1999 Lucent's acquisition of Kenan Systems, Ascend, Mosaix, Nexabit, International Network Services, Xedia, and Excel, absorbed 18.0 percent of Lucent's stock valued at \$29.2 billion. These acquisitions did not entail subsequent write-downs because they were done as "pooling-of-interest" mergers, a much-abused practice that the Financial Accounting Standards Board would outlaw in July 2001.

Nevertheless, even in 2000, the dilution of shareholdings caused by these expenditures of stock was putting downward pressure on earnings per share, and with the downturn in 2001, things only got worse. As Lucent’s revenues plunged, and its losses mounted, the bond-rating agencies lowered its credit-rating. As shown in Figure 7, the downgrades began in December 2000; by August 2001 Lucent’s credit rating was “junk”. Six additional downgrades through November 2002 left Lucent with a Moody’s rating of Caa1; Moody's gives a Caa rating to “bonds...of poor standing [that] may be in default or [for which] there may be present elements of danger with respect to principal or interest” (see www.moody.com).

Figure 7. Moody’s bond ratings of Alcatel, Lucent and Nortel, Nov. 2000-Dec. 2005



Note: Obligations rated ‘A’ are to be considered as upper-medium-grade, a ‘Baa’ rating indicates a medium-grade investment with certain speculative characteristics, ‘Ba’-rated obligations are viewed as more speculative again and bonds and preferred stock which are rated ‘B’ generally lack characteristics of the desirable investment. Obligations rated ‘Ba3’ and below are considered to have junk bond status. The numbers ‘1, 2 and 3’ are modifiers within these categories.

Sources: www.moody's.com; Carpenter and Lazonick 2007.

In the decline of 2001-2002, as its financial shortfalls mounted, the stock market became an important source of finance to Lucent, mainly because its downgraded bond rating made it impossible to issue long-term debt. In August 2001 Lucent did a preferred stock issue that netted \$1.83 billion, and in March 2002, when its bond rating had been cut for the fifth time in 16 months, it did a more complicated deal in which it set up a trust to issue preferred securities and then had the trust buy 7.75% convertible subordinated debentures from Lucent for a net cash inflow of \$1.75 billion.

The irony for a company like Lucent – and it applies to many other US companies that experienced financial difficulties in the Internet bust – is that it could have used the

speculative stock market of the Internet boom to *sell* stock on the market to pay off debt or augment the corporate treasury (see Carpenter et al. 2003). After all, US corporations had behaved this way in the speculative boom of the late 1920s (O’Sullivan 2004), and, in more recent history, major Japanese corporations had sold massive amounts of stock in Japan’s “bubble economy” of the late 1980s (see Ide 1998, 83-4; more generally, Lazonick 1999). Had it not been for this financial behavior, the adverse impacts on these corporations of the subsequent downturns – in the United States in the early 1930s and Japan in the early 1990s – would have been far more severe.

Lucent’s decline 2001-2003

In the Internet bust of 2001-2002 all telecommunications equipment companies experienced sharp revenue declines, and they all responded by slashing employment (see Figure 1 and Figure 2). From 2001 to 2002 Alcatel’s revenues declined by 41 percent, Ericsson’s by 42 percent, Nortel’s by 65 percent, and Lucent’s by 70 percent. Clearly, the two North American companies, Nortel and Lucent, were much harder hit than the two European companies, Alcatel and Ericsson.⁵ Yet in 2002, Lucent’s revenues were still 17 percent greater than Nortel’s. In 2003, however, Lucent’s revenues declined another 31 percent, compared with 9 percent for Alcatel, 2 percent for Ericsson, and 3 percent for Nortel. In 2006 Lucent’s sales were only 77 percent of Nortel’s, 54 percent of Alcatel’s, and 36 percent of Ericsson’s.

As for employment, Lucent reduced its headcount in every year of the 2000s. When it merged with Alcatel in December 2006, Lucent had fewer than 30,000 employees, roughly 20 percent of the 153,000 people it had at the peak in 1999. Lucent had 100 percent more employees in 1999 than Nortel, 32 percent more than Alcatel, and 48 percent more than Ericsson. In 2006 Lucent had 12 percent less employees than Nortel, 50 percent less than Alcatel, and 53 percent less than Ericsson.

Lucent’s revenues fell from \$41.5 billion in 2000 to \$8.5 billion in 2003. As it booked losses totaling \$26.8 billion for this three-year period, the company shed assets and employees to stay afloat. After 2000 Lucent’s revenues went into sharp decline, with the wireline business being much harder hit than the wireless business, as is evident in Table 9.⁶ Mobility Access & Applications Solutions (MAAS) revenues declined 21 percent from \$6.8 billion in 2000 to \$5.4 billion in 2002, while Integrated Network Solutions (INS) plummeted 66 percent from \$18.7 billion to \$6.4 billion.⁷

⁵ Contributing to the extraordinary losses in 2001 of Lucent (\$14.2 billion) and Nortel (\$24.5 billion) were write-downs of high-priced acquisitions that the companies had made in 1998-2000. One reason why Nortel’s reported loss was so much greater than Lucent’s was because, as a company based in Canada, it had not been able to account for its stock-based acquisitions as “pooling-of-interests”, as Lucent did for \$29.8 billion in stock-based acquisitions that it made in 1999.

⁶ In its 2001 financial statements, with total revenues not including Agere at \$21.2 billion, Lucent simply listed its segments as Products (79.1 percent) and Services (19.5 percent), with Other making up the remainder.

⁷ From 2000 to 2002, “switching and access” revenues declined from \$10.8 billion to \$3.2 billion, “optical networking products” from \$3.3 billion to \$1.4 billion, and “wireless products” from 6.4 billion to \$4.5 billion (Lucent 2002 10-K, 42.).

Table 9. Lucent's reportable segments, 2000-2002¹

	2000²	2001	2002
Total revenues (without optical fiber), \$m	27,062	19,271	12,207
<i>Percent of total</i>			
Mobility Access & Application Solutions	25.3	33.1	44.1
Integrated Network Solutions	68.9	62.8	52.6
Other (including intellectual property)	5.8	4.1	3.4

¹ The spinoff of Enterprise Networks as Avaya was completed on September 30, 2000, and Avaya revenues were not included in Lucent 2000 reported revenues. In Table 2, which compares revenues in 1998, 1999, and 2000, we added Enterprise Networks revenues to the 2000 total. In this table, which looks back from 2002, we have omitted Enterprise Networks data from the 2000 total.

² Restated to reflect sale of Power Systems business and Agere spinoff in 2001.

The first major disposal of assets came at the end of fiscal 2000 when Lucent spun off its Enterprise Networks division as Avaya. In its 2000 *Annual Report* (p. 4), Lucent stated that the purpose of the Avaya spinoff as well as that of the prospective spinoff of its microelectronics division as Agere was “to strengthen our focus on the service provider market.” Avaya had 2000 revenues of \$7.7 billion and 31000 employees worldwide. Restating 1999 revenues to reflect the Avaya spinoff, Lucent’s revenues in the year ending September 30, 2000 were, at \$33,557 million, \$3,667 million more than the previous year. But, based on the restated figures, gross margins, which had been rising steadily from 1996 through 1999, fell from 49.5 percent in 1999 to 42.2 percent in 2000. Service Provider Networks accounted for almost 79 percent of revenues in 2000, with Microelectronics and Communications Technology (MCT) representing almost 21 percent.

In December 2000 Lucent sold its Power Systems business to Tyco International for \$2.5 billion in cash. In April 2001 much of MCT was spun off as Agere, which had 2000 revenues of about \$3.1 billion, excluding internal sales to Lucent, and 16,500 employees worldwide.⁸ The IPO netted \$3.3 billion for Agere, while the disposal left Lucent with a loss of \$3.0 billion. In the first quarter of 2002, Lucent sold its Optical Fiber Solutions business to Furukawa Electric for \$2.3 billion, of which about \$2.1 billion was in cash.

In 2001, with revenues declining sharply from their 1999 peak, Lucent commenced a major restructuring program. By September 2002 Lucent had reduced its employment by 79,000 people, or 63 percent of its labor force two years before. The divestitures of the power business, fiber optic cable business, and microelectronics removed almost 28,000 people from the company. Most of the remaining headcount reduction of 51,000 came through voluntary and involuntary terminations, including an early retirement program offered to 8,500 management personnel. In addition, continuing an outsourcing strategy initiated during the boom, but accelerated during the decline, Lucent sold or leased

⁸ Lucent still held 57.4 percent of Agere’s shares, which were distributed to shareholder on a tax-free basis on June 1, 2002.

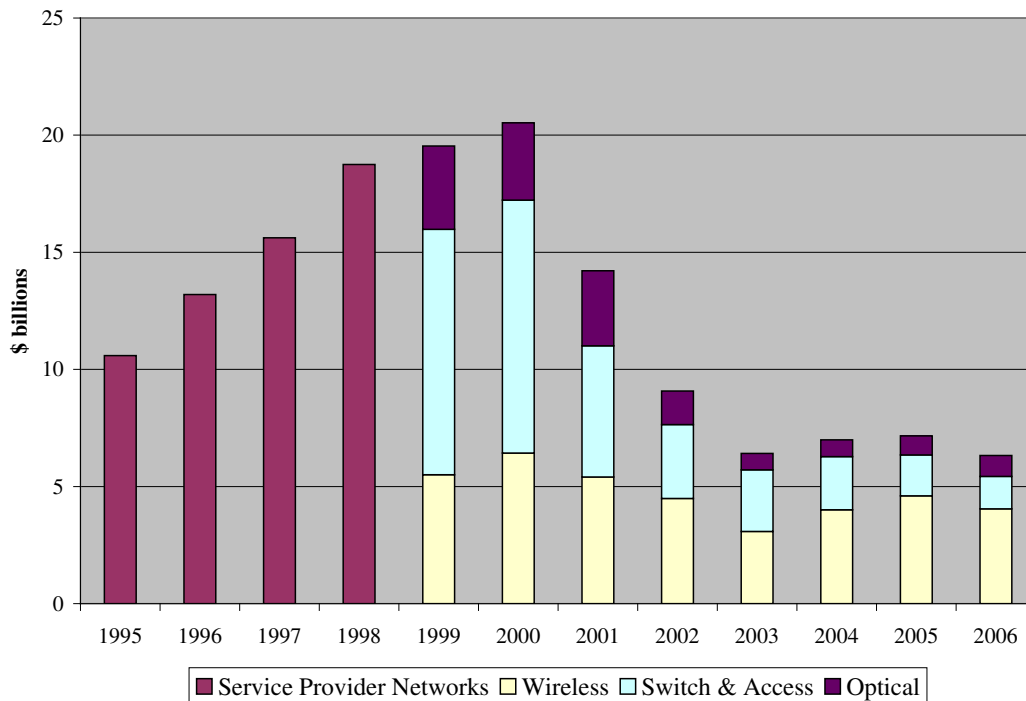
several of its major manufacturing plants to contract manufacturers such as Solectron and Celestica (see Lazonick et al. 2002; Lazonick and Quimby 2007).

In the process, what had been a highly unionized labor force was decimated. In September 1999 Lucent had 46,818 US union employees representing 40 percent of its US labor force. In September 2006, Lucent had 2,800 US union members, while its two major spinoffs, Avaya and Agere, had 2,800 and 26 respectively. As a result, only 15 percent of the 38,199 US employees of these three companies were union members.⁹

The decline of Lucent’s switching and access business

Figure 8 shows the extent to which Lucent’s switching and access business declined both absolutely and relatively from 2001. Lucent was an important supplier of access and switching equipment needed to add new residential or business telephone lines to the network. Growth in these product lines could be forecasted by tracking the number of housing starts in a region. However, the Internet changed this dynamic. As the number of Internet “dial-up users” increased, a significant number of residences added second telephone lines as dedicated Internet connections. Digital Subscriber Loop (DSL) technology would eliminate this problem, but this technology was not extensively available or reliable in the 2000 time-frame.

Figure 8: Lucent Technologies sales distribution within the “Service Provider Networks” category, 1995-2006

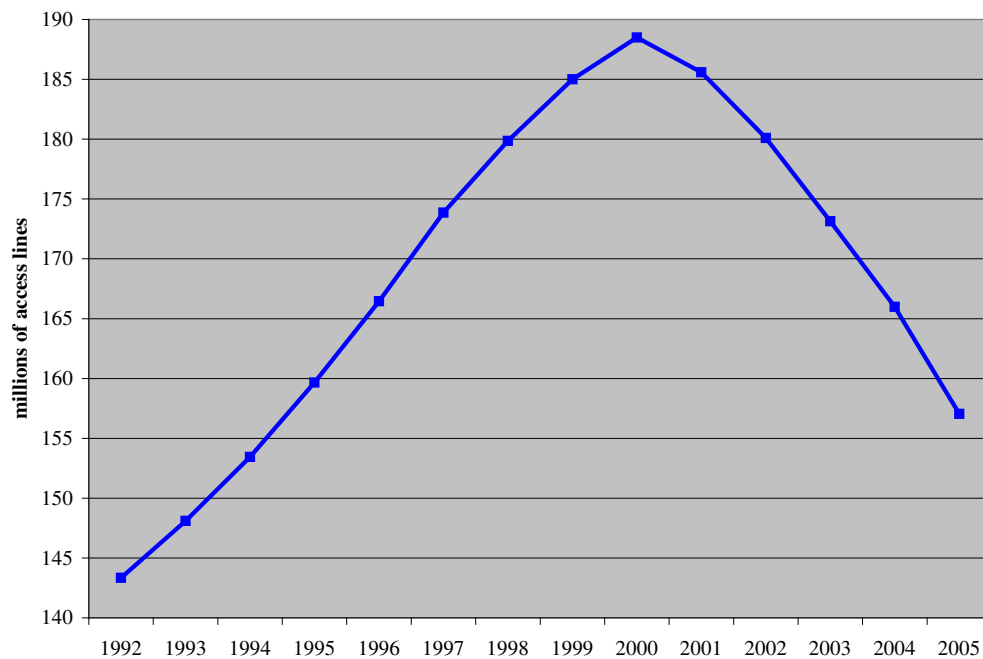


Source: Lucent Technologies 10-K filings

⁹ In addition, Avaya added 2,970 union members outside of the United States as a result of its November 2004 acquisition of Tenovis Germany GmbH.

Figure 9 shows the sharp rise in the number of installed access lines in the United States that began in the 1990s, and the sharp decline that began in 2001. The rise and then fall of Lucent Switching & Access revenues tracked these changes in the number of installed access lines.

Figure 9: U.S. wireline telephone lines supplied by Incumbent Local Exchange Carriers within the local loop



Source: US Federal Communications Commission 2007.

The demand for local loop access lines did not decline until 2001. However, the tendency of Lucent to use discounting to pull orders forward to meet end-of-quarter revenue targets, and the willingness of the service providers to place orders in anticipation of future needs to obtain these discounts, meant that Lucent began to lose its incumbent advantage in 2000. In 2001, as service providers found that they had purchased an excessive amount of equipment, they scaled back orders of Lucent wireline products to a much greater extent than for Lucent's competitors. As a result, in 2001 and 2002, Lucent experienced a steeper drop-off of orders compared with the other carriers.

The main reason for the decline in demand for access lines was the growing availability of cable connections to deliver broadband Internet. In the 1980s and early 1990s, cable companies such as Cablevision, Comcast, and Cox Communications invested heavily to upgrade their networks. They installed optical fiber and high-speed equipment in an effort to offer enhanced services such as interactive cable TV to differentiate themselves from satellite companies that were emerging as serious competitors (Young and Grant 2003). As cable TV companies completed the upgrade of their networks, they realized that they were well positioned to offer customers high-speed broadband services that were far superior to dial-up. Many Internet users cancelled their second telephone lines,

and began to use cable for their Internet services. By 2003 cable TV companies had captured 70 percent of the high-speed broadband market (Vascellaro 2007). Lucent was not successful in selling equipment to the cable providers. Rather it sold Internet access equipment using DSL technology to the traditional regional telephone companies.

Long-haul, metropolitan, and local network expansions were driven by the belief that Internet traffic would create an ever increasing demand for high-capacity transport. As Lucent and other major equipment suppliers were investing heavily in developing next-generation equipment for the core network, they were ignoring a fundamental part of the network that would eventually become the “broadband bottleneck”. This part of the network is known as the “last mile”, the connection between the local access network and a residence or small business. The gating item in the “last mile” is the copper wire, known as the “twisted pair”, leading from the residence or business to the local access network. These copper wires do not have sufficient capacity to carry the broadband signals needed for multimedia applications.

This “last mile” bottleneck placed the local telecommunications service providers at a disadvantage when competing against the cable companies in the broadband market. Cable TV companies, which owned the coaxial cable leading into the home, had an advantage because coaxial cable has the necessary capacity to transport high-speed broadband signals. In 1999, of the 2,754,000 high-speed access lines installed in the United States, 51 percent were coaxial cable and 22 percent were wireline access provided by the telecommunications companies (US Federal Communications Commission 2000, 2-3).

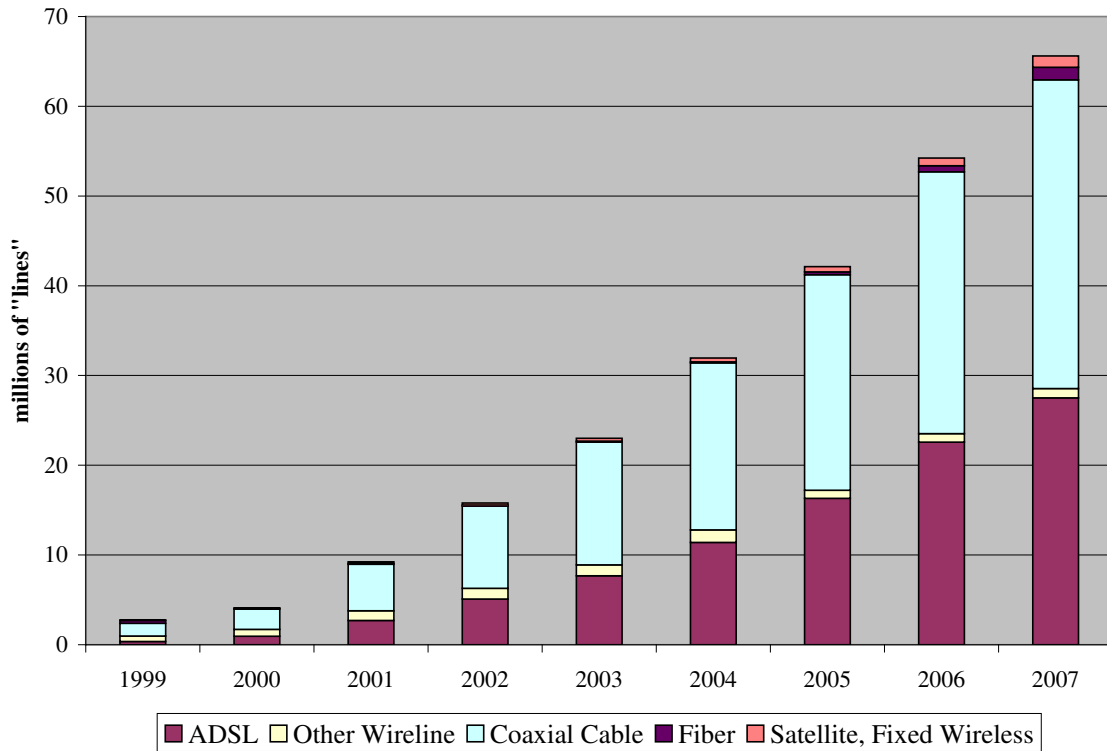
It was critical that the local service providers find a solution to the “last mile” bottleneck to slow down the erosion occurring in the local access market and to capture a share of the rapidly growing broadband market, which offered the possibility of new revenue sources from “value-added” services. The counter to the competition from the cable TV companies in these markets was Digital Subscriber Line (DSL) technology, which could be deployed using the “twisted pair” already installed in the “local loop”.

DSL technology was developed in the late 1980s at Bellcore, an R&D consortium created by the RBOCs after the breakup of the Bell System. The initial DSL installations were ADSL, characterized by a much higher download speed than upload speed over the “twisted pair”. This “asynchronous” performance was acceptable for most residential and small business users because they did not need to transmit large amounts of data out over the Internet.

Throughout the 1990s and in the 2000s, Lucent along with other technology developers, equipment manufactures, and international standards bodies worked to create DSL systems that were cost and performance compatible with high-speed coaxial cable Internet access. These efforts enabled local telecommunications service providers to continue earning revenue on their investments in the local loop network, and gave equipment manufacturers a new market opportunity to address.

The focus on DSL technology was highly successful in closing the gap with cable TV companies. As graphed in Figure 10, between 1999 and 2007, the average broadband growth rate for coaxial cable access was 51 percent. The ADSL growth rate for the same period was 79 percent. Through 2007 coaxial cable remained the leading access technology with 52 percent of the installed high-speed lines. However, ADSL had grown in application to 42 percent of these lines, a significant accomplishment given the barriers that needed to be overcome to “force” high-speed broadband signals through the “twisted copper pair”.

Figure 10: Number of high -speed telecommunications “lines” in the United States



Source: US Federal Communications Commission

Lucent took a significant step in the DSL market in September 1999 with the introduction of the “Stinger Access Concentrator”, a product platform capable of serving large corporations, small businesses, and residential customers. Previously the company had been addressing this need by distributing DSL products made by Copper Mountain Networks of Palo Alto (Wall Street Journal 1999). The Stinger Access Concentrator is a network element initially designed for the central telephone office. It can simultaneously provide high-speed data transmission and voice communication over the same copper line. Multiple customers are connected through the element using multiplexing techniques (Lucent Technologies 1999).

As Lucent entered the DSL market, it found itself in an unusual position; it was not the incumbent supplier. Following the breakup of the Bell System, four of the RBOCs,

Ameritech, BellSouth, Pacific Telesis, and SBC Communications, formed the Joint Procurement Consortium to reduce equipment purchase prices by buying as a group, thus recapturing some of the volume purchasing price advantage they had as members of the former Bell System. In October 1996 the consortium made the decision to standardize on the Alcatel ADSL system for broadband applications in the local loop (Snyder 1996).

This decision made Alcatel the incumbent supplier to the RBOCs, and launched the company into global leadership in the DSL market, a position that it retained throughout the ten-year history of Lucent. In 2001 Alcatel had 41 percent of the DSL market, followed by Siemens with 13 percent and Lucent with 10 percent (Fiber Optic News 2002). Even though Alcatel retained this leadership position, its market share declined to 31 percent of the global DSL port market in 2006. As the DSL market grew rapidly in Asia, Huawei Technologies, a Chinese telecommunications equipment company, attained a market share of 17 percent, making it the second largest DSL port supplier globally. By 2006 Lucent's market share had eroded to 7 percent (Wilson 2005).

The Lucent Stinger platform, applicable to both the ADSL and SDSL (symmetric digital subscriber line) systems, helped position Lucent to compete in international markets. The initial design was based on development work conducted by Ascend Corporation which Lucent acquired in January 1999 (Cambridge Telecom Report 1999). Because of the continuous change in the DSL market, the Stinger product platform required regular updates. In 2001, the Stinger interface was upgraded to support IP, another indication of the decline of ATM as a packet transport protocol.

Lucent was investing in DSL technology at a time when its revenue was rapidly shrinking, share price was collapsing, and it had no ability to fund large R&D projects as it had done earlier during its history. Stinger served as a good investment because it required only incremental changes to accommodate new DSL standards and network protocols. It was a product that was sold to incumbent regional telephone companies, a customer base that Lucent had historically dominated. Despite the ongoing investments in Stinger, Alcatel remained the market share leader. Lucent's local access market revenue increased but not to the level where it offset the lost revenue from the decline of the circuit switch business.

4. Stagnation

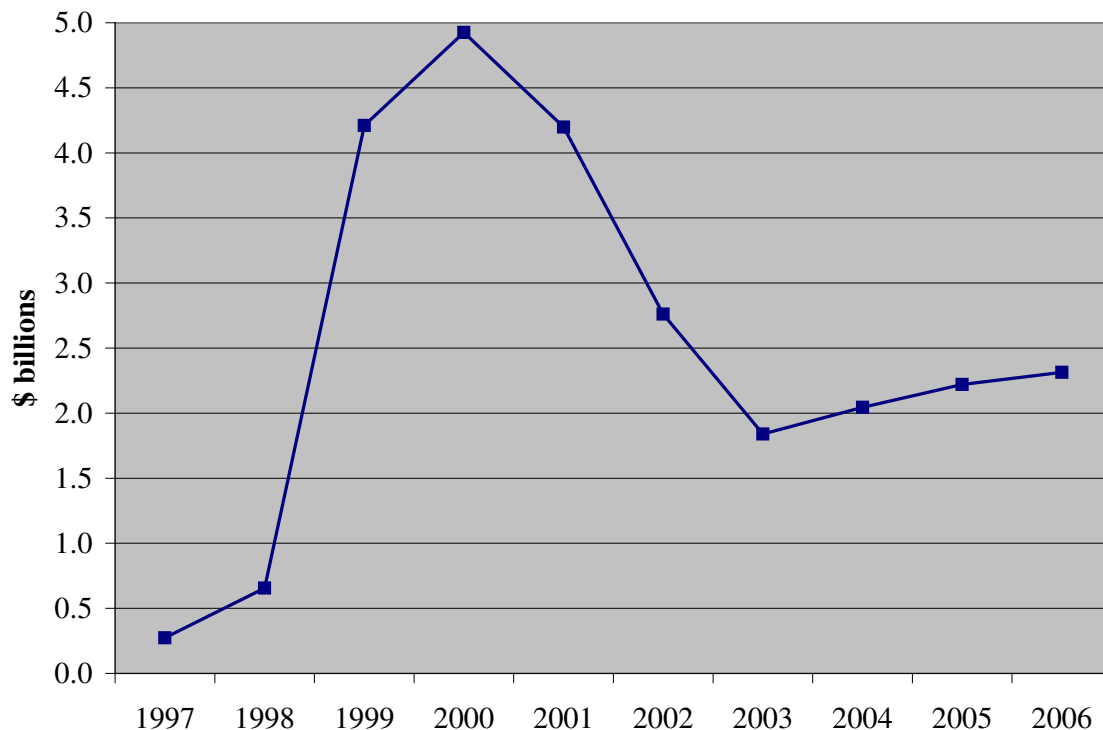
Services

Throughout its existence, Lucent frequently changed its financial reportable segments. These modifications usually reflected the dynamics of the telecommunications industry, new strategies, or changes in the composition of the company because of spinoffs or acquisitions. In 2004 Lucent established a new segment, Lucent Worldwide Services, signaling the company's shift from its traditional hardware orientation toward an emphasis on professional services. This shift sought to capitalize on Lucent's longstanding expertise in network planning, design, and construction, initially established during the Bell System era and then continually refined as a supplier to AT&T and the

RBOCs. Through Lucent Worldwide Services, the company now attempted to expand its addressable market by offering total network support to telecommunications service providers, including those operating multi-vendor networks. The Services segment was viewed as an important growth engine for Lucent; a business that could increase profitability without requiring large investments in R&D that were typically needed for new hardware products. At a time of declining revenue and lower profit margins, the Services segment provided a path to increased earnings within an industry environment of collapsing hardware sales.

Along with issuing financial results by reportable segments, Lucent also issued results by product or services group. The performance of the “Services Group”, not to be confused with Lucent Worldwide Services, was initially reported in 1997. Figure 11 shows the annual revenues attributed to the “Services Group” from 1997 through 2006. Note, however, that the composition of the group changed frequently over this period.

Figure 11. Lucent Technologies “Services Group” revenue, 1997-2006



Source: Lucent Technologies 10-K filings, 1997-2006

Prior to 1998, the “Services Group” revenue was generated by the NetCare Professional Services business unit, which designed and installed broadband networks supporting convergence of voice, data, and video communication. The unit was strengthened in 1999 with the acquisition of Ascend Communications and International Network Services. Between 1999 and 2002 Lucent classified revenue from professional services generated

from sales within the wireline and wireless business units as “Services Group” revenue. This classification caused the revenue “bubble” seen in Figure 11. In 2002 this practice was stopped, and professional services revenue was solely associated with contracts awarded to this business unit. In 2006, however, the Network Operations Software revenues previously reported within wireline businesses were moved into Services, reflecting the synergy between the requirements for effective management of multi-vendor networks and development of advanced software control systems to maintain efficient network operation.

During the “stagnation years”, 2004-2006, the “Services Group” revenues increased steadily. While the 7.6 percent average annual growth rate achieved was insufficient to offset the significant revenue decline experienced in core network equipment sales, Services helped to stabilize Lucent total revenue as the company emerged from the collapse of the telecommunications equipment industry of the early 2000s.

In 2004 Lucent’s reportable segments included Services along with Integrated Network Solutions (INS) and Mobility Solutions (Mobility), both of which were retained from prior years. INS included software and wireline equipment for voice networking, data and network management, and optical networking. Mobility included software and equipment supporting core wireless access networks.

In 2006 INS and Mobility were restructured into three reporting segments: Mobility Access & Applications Solutions (MAAS), Multimedia Network Solutions (MNS), and Converged Core Solutions (CCS). This restructuring demonstrated Lucent’s intent to be recognized in the market as a systems-integration, service-oriented company focused on multimedia applications in both wireline and wireless networks. Also, by separating out CCS as a standalone segment, Lucent prevented the declining financial performance of this segment from tarnishing results in MNS, a segment that was expected to show considerably higher growth potential. Mobility Solutions became MAAS, a segment focused on 3G wireless networks based on CDMA2000, UMTS/HSPA (high-speed packet access), and spread spectrum technologies for mobile voice and data services.

Revenue for the Lucent reporting segments defined in 2006, with results restated back to 2002, is shown in Table 10. These results show the serious decline in the CCS business, which a decade earlier had been the backbone of Lucent’s business. The MNS results highlight the outcomes of Lucent’s response to the challenges of both optical networking and convergence of voice, data, and video in core and metropolitan transmission networks. Revenues from Mobility Solutions declined to 2003, before experiencing a partial recovery in 2004-2006. These results considerably lagged, however, the growth in wireless subscribers worldwide.

Table 10. Lucent's reportable segments, 2002-2006

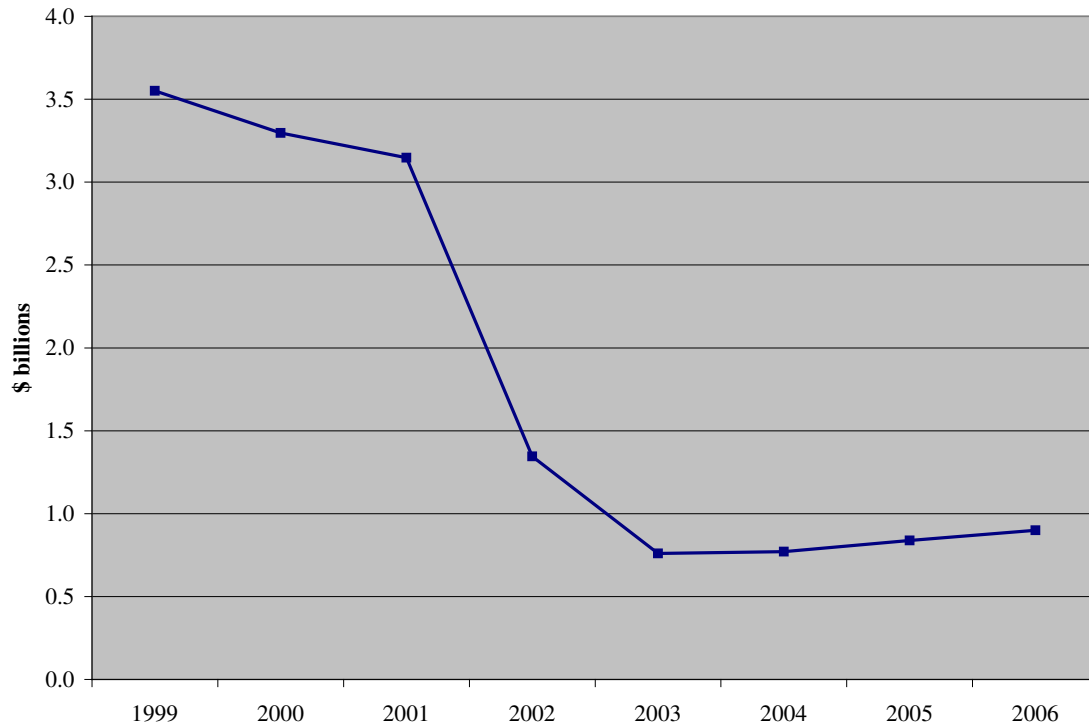
	2002	2003	2004	2005	2006
Total revenues, \$m	12,321	8,470	9,045	9,441	8,796
Mobility Access & Application Solutions	3,578	3,147	4,166	4,600	4,051
Integrated Network Solutions	4,599	3,233	2,713	2,413	2,277
Multimedia Network Solutions			1,498	1,563	1,677
Converged Core Solutions			1,215	850	600
Services	2,761	1,840	2,044	2,220	2,313
Other (including intellectual property)	517	250	122	148	155
Percent of total revenues					
Mobility Access & Application Solutions	29.0	37.2	46.1	49.4	46.1
Integrated Network Solutions	37.3	38.2	30.0	25.6	25.9
Multimedia Network Solutions			16.6	16.6	19.1
Converged Core Solutions			13.4	9.0	6.8
Services	22.4	21.7	22.6	23.5	26.3
Other (including intellectual property)	4.2	3.0	1.3	1.6	1.8

Optical Networking

Optical products were an important offering in the MNS portfolio that experienced a modest market recovery during the “stagnation years”. After the collapse of the optical equipment market in 2002, Lucent achieved an optical growth rate of 5.6 percent between 2003 and 2006. As shown in Figure 12, annual optical equipment revenue during this timeframe increased from \$760 million to \$900 million, approximately one-fourth of the level generated during the industry peak.

The collapse of Lucent optical group revenue was directly related to the tremendous overcapacity of installed fiber optic networks worldwide. This situation can be attributed to the building of excessive core network capacity in the Internet boom in anticipation of broadband traffic that did not materialize. The number of independent global telecommunications companies that were installing new networks exacerbated the problem. Between 1998 and 2001 approximately 39 million miles of fiber optic cable were installed within the United States, at a cost of \$90 billion. At the time, Merrill Lynch estimated that only 2.6 percent of this fiber capacity was actually in use, and predicted that most of the cable would remain dark forever (Wall Street Journal 2001).

The huge investment in optical communications networks was primarily driven by the belief that Internet traffic would double every 100 days with no end seen to this trend (Wall Street Journal 2005). When this growth path was not sustained, telecommunications service providers drastically cut back their purchases of optical transport and switching equipment. Investments in technologies such as OC-192 and the “all optical switch” did not produce the expected revenue growth and profits.

Figure 12. Lucent Technologies “Optical Group” revenue, 1999-2006

Source: Lucent Technologies 10-K filings, 1997-2006

Overcapacity in the optical network adversely affected sales of long-haul, high-capacity optical products after 2001, but the optical market was changing. Increasing broadband demand at the regional level required capacity upgrades of the metropolitan network that served urban areas, industrial campuses, and business locations. Now required were optical systems designed for metropolitan applications that could perform similar functions to long-haul network systems. These units would be smaller, of lower capacity, and at lower prices.

Lucent addressed this market with new products like Lambda Unite that served as a bridge to interconnect the regional networks and the high capacity optical core networks. The Metropolis product portfolio enabled incumbent service providers to use their imbedded base of SONET/SDH equipment for both voice and high-speed data traffic in the upgrade of their regional networks.

In 2001 Lucent began a shift in strategy, focusing product development, service offerings, and marketing and sales efforts on the needs of the largest global service providers. This strategy was based on the realization that 70 percent of telecommunications equipment spending was concentrated among the world's 50 largest service providers and that 90 percent of all equipment spending was made in 20 countries (Lucent 2001 10-K, 1; Lucent 2002 10-K, 1). Utilizing the new strategy in the marketing of its portfolio of metropolitan optical network products, Lucent announced three major sales agreements in 2002-2003. Verizon awarded Lucent a three-year contract in April

2000 that made Lucent its exclusive provider of DWDM equipment to expand regional interoffice core networking throughout the United States. In June 2003 Lucent announced that Bell South had selected the Metropolis product family for deployment in its nine-state area to increase the optical processing capability of its regional networks. Finally, in September 2003 Lucent announced a multi-year agreement with AT&T to supply Metropolis DMX Access Multiplexers to increase network capacity and enable new revenue generating services in AT&T metropolitan networks.

Thus, it appeared that Lucent was again benefiting from its “incumbent advantage” as former Bell Systems companies awarded it major contracts. However, several new competitors appeared, including Fujitsu, Huawei Technologies, UT Starcom, and ZTE Corporation, forcing Lucent to aggressively compete on price, along with features and function, to win these contracts. Ultimately, Fujitsu became the market leader with Nortel, Alcatel, and Lucent following behind. Even though revenue growth in the optical market was achieved during the “stagnation years”, the amount of revenue earned was a small fraction of the optical sales obtained during the boom years.

Wireless capability peters out

During the late 1990s Lucent’s wireless sales increased steadily as its North American customers installed the necessary infrastructure to support the booming demand for mobile voice communications services (see Figure 13).¹⁰ Lucent sold wireless systems, comprised of base stations and other ancillary equipment linking these stations to the core wireline network. Most of these sales were for CDMA technology, even though Lucent was able to support TDMA and a small level of GSM, the other dominant digital wireless technologies at the time. The wireless networks installed were typically 2G networks providing mobile voice communication service to subscribers.

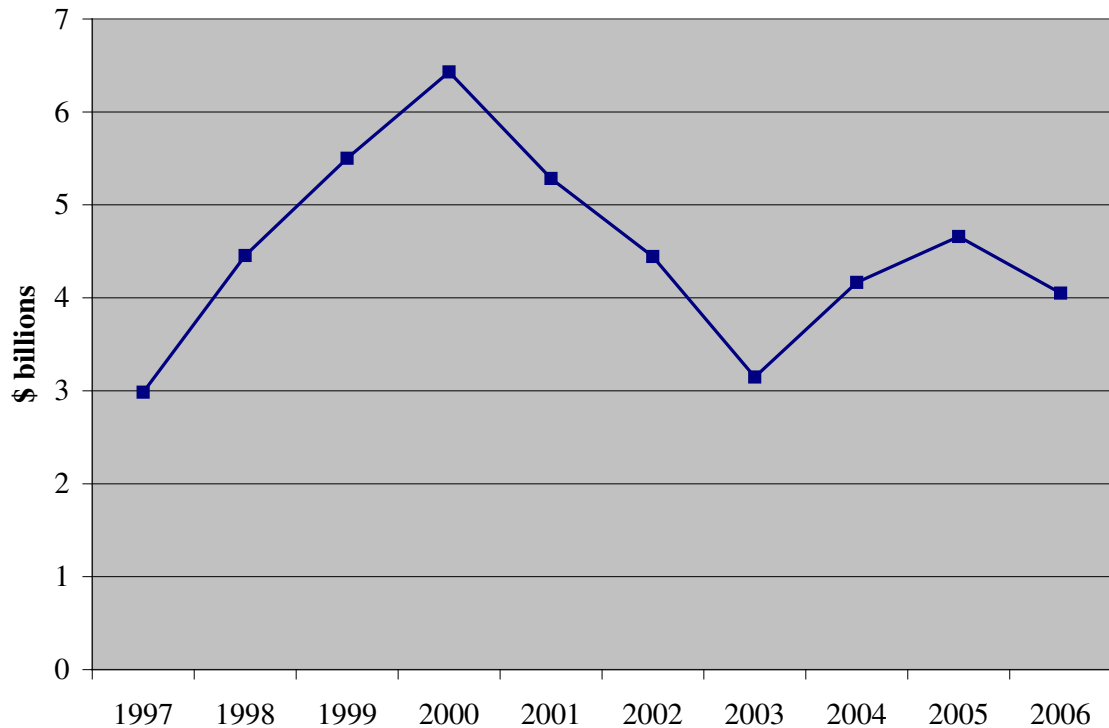
The Lucent wireless business was very dependent upon a small number of customers. In 2002 the five largest customers accounted for 75 percent of the wireless revenue, and by 2005 had increased to 80 percent. Verizon Wireless and Sprint together accounted for 63 percent of this revenue (Lucent 2002 Annual Report, 14; Lucent 2005 Annual Report, F-23). From 2002 through 2005 the number of Lucent installed base stations grew from 70,000 to 140,000 units. This growth was driven by a transition from 2G, basic mobile voice service, to 3G networks, enabling mobile high speed data access along with voice communications.

This dependence on a small number of wireless service providers made Lucent vulnerable to the capital spending patterns of these companies. As seen in Figure 13, after 2000 the company’s wireless revenue decreased steadily until 2004. In the 2002 Annual Report (p. 14), this decline was attributed to “a decline in capital spending by certain U.S. service providers” and completion of various projects. Even more significantly, in the 2003 Annual Report (p. F-20), Lucent acknowledged that two of its customers, AT&T and Cingular, had selected an alternative technology to its TDMA product for

¹⁰ On the growth in demand in the last half of the 1990s through 2007, see data in FCC Information Center 2007.

deployment in their 3G wireless networks. These two companies elected to deploy GSM, a technology in which Lucent had made a minimal investment but one that was dominant throughout the world. To compete for 3G deployments, Lucent offered service providers CDMA2000, a derivative technology of GSM or UMTS.

Figure 13. Lucent Technologies “Wireless Group” revenue, 1997-2006



Source: Lucent Technologies 10-K Filings 1997-2006

To increase wireless revenue, Lucent needed to compete for international customers. However, CDMA2000 systems had limited application internationally. It was necessary for Lucent to develop new 3G equipment more compatible with the installed base of globally deployed GSM systems. Lucent decided to invest in the development of UMTS equipment, a technology that was recognized by many as “next-generation GSM”. In its 2001 10-K filing (p. 9), Lucent proclaimed: “We have already brought to market spread spectrum CDMA-2000-networks in North America and expect to supply UMTS networks in Europe and Korea in the near future.” The following year Lucent claimed: “We have built more CDMA networks than anyone else, and we are leveraging that expertise to establish a strong position in the very early stages of UMTS deployment.” The Lucent strategy was to leap-frog competitors who were supplying equipment for the gradual migration of 2nd generation GSM networks to 3G capability by offering UMTS products that would enable a “flash cut” to the next-generation GSM technology.

In 2003 Lucent announced that it had “built 27 3G networks in 14 countries, or 43 percent of the 63 commercial 3G networks deployed” (Lucent 2003 10-K, 9) In 2004 Lucent reported “33 3G networks in 17 countries, or 29 percent of the 114 commercial

3G networks deployed” (Lucent 2004 10-K, 9) In 2005 the 10-K filing (p. 8) simply stated that Lucent had “deployed these networks with more than 35 customers on the continents of North and South America, Asia, Europe and in the Australia, New Zealand region”. Lucent did not report on the total number of base stations installed as it had done since 2002. In 2006 the company decided to omit any comment on the subject.

In the 2005 Annual Report (p. F-23), Lucent acknowledged: “Substantially all of Mobility revenues are currently generated from CDMA technology. UMTS revenues to date have been limited to the sale of data cards and revenue related to a UMTS contract with Cingular that was not significant during fiscal 2005. We are conducting third-generation W-CDMA/UMTS trials in China and Japan.” In 2006 the company announced an expansion of the supply agreement with Cingular to provide UMTS equipment supporting Cingular’s 3G network in the United States. Despite this, in the 2006 Annual Report (p. F-21), Lucent acknowledged lower UMTS data card sales internationally as being partially responsible for the decline in total wireless revenues that year. The company was also still awaiting results from UMTS product trials in China.

Clearly, Lucent’s competitive advantage in supplying 3G networks, based on CDMA2000, had eroded over these years. A major reason for this loss of competitive advantage was the failure of Bell Labs innovation to leverage the company’s expertise in CDMA technology “to establish a strong position” in UMTS networks, as had been the expectation in 2002. When Lucent decided to forgo investment in GSM, the most widely deployed wireless technology, it gambled that it would be able to establish CDMA globally as a strong alternative that would serve as an engine for growth in the wireless market. Lucent would then seek to supplement its presence in CDMA with UMTS technology to compete for international wireless sales. This strategy failed. Lucent’s attempts to develop UMTS capability took place at a time when the company was financially constrained. In the period 2003-2006, the company’s R&D spending, on an annual basis, was only 27 percent of its level in 1997-2000 and only 41 percent of its level in 2001-2002. As the communications technology industry recovered with the wireless boom, Lucent had very limited resources available to develop new capabilities and create new products.

5. Explaining Lucent’s rise and demise

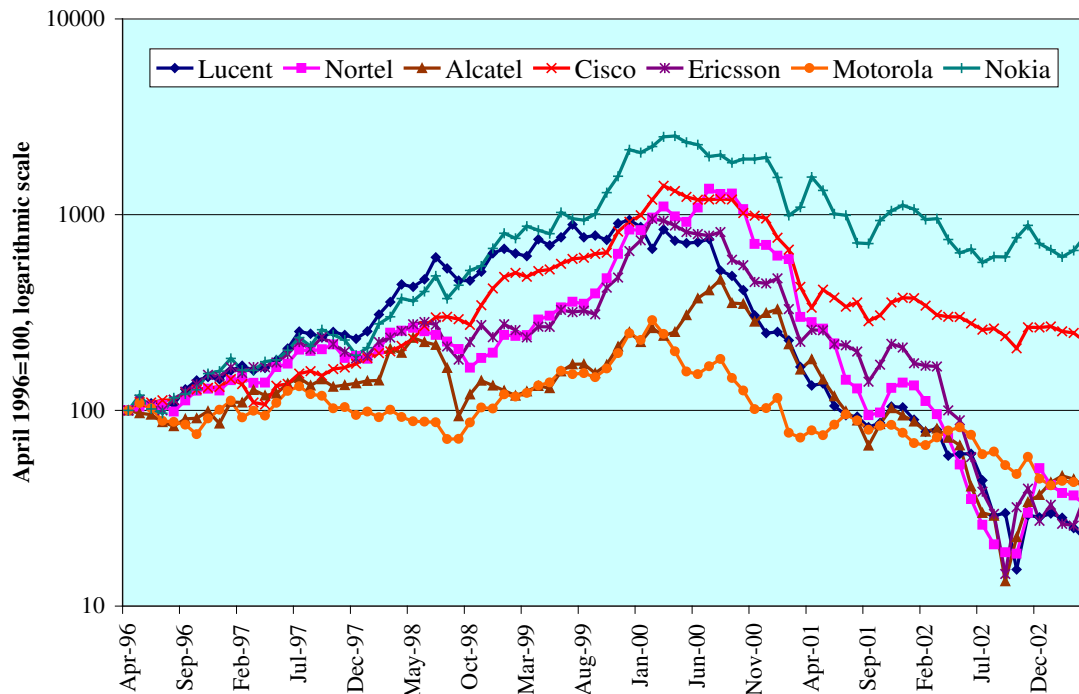
As a “127-year-old startup”, Lucent Technologies came into the world in 1996 endowed with a deep heritage of technological capabilities and established market channels on which it could build. At the same time, the *raison d’être* of the Lucent spin-off was to position the company for benefitting from the new technologies and capturing the new markets offered by the Internet revolution. As that revolution unfolded, Lucent combined both the old and the new as it leveraged its “incumbent advantage” to sell legacy equipment to its traditional customers to address the accelerated demand for second telephone lines used for dialup Internet access. In addition, Lucent engaged the new world of broadband as it manufactured optical networking equipment not only for AT&T and the RBOCs but also for some of the “next-generation” service providers that the Internet boom had brought into existence.

By 2000, as the Internet revolution approached its pinnacle, Lucent had reached the limits of its incumbent advantage, as alternatives to dialup Internet became more readily available. At the same time Lucent found itself lagging competitors in optical networking, most significantly by Nortel. At this point Lucent's top executives became concerned with the sustainability of an increase in the price of the company's stock, in part because their own remuneration depended on its performance. It was not lost on Lucent's executives that when Henry Schacht stepped down as chairman of the company in February 1998, he cashed in his stock options for a gain of \$65.0 million, after less than two years on the job. In that fiscal year, Rich McGinn, the new chairman as well as CEO, generated \$3.6 million from exercising stock options as part of his total remuneration of \$25.3 million, which included a restricted stock grant of \$8.6 million and a bonus of \$11.9 million. In 1998 five other executives named by Lucent in its proxy statement averaged total compensation of \$8.2 million, including averages of \$1.9 million from exercising stock options and \$3.8 million from restricted stock grants. Given the pervasive roles that the stock market had come to play in US corporations in the Internet boom, these executives could also claim that Lucent needed to sustain the increase in its stock price to attract and retain key employees as well as to compete for New Economy acquisitions (see Carpenter et al. 2003).

In this world of stock-based compensation as well as stock-based combination (M&A activity), during 1999 and 2000 – the peak years of the Internet boom – Lucent found itself at a disadvantage compared with the other major communications technology companies, and especially Nortel and Cisco. As shown in Figure 14, between April 1996 and December 1999, Lucent's stock price increased by over nine times, a greater increase over this time period than that for any of its main rivals except Nokia.¹¹ As can also be seen in Figure 14, however, by the last half of 1999 the rate of increase of Lucent's stock price (shown on a logarithmic scale) was slower than that of all its major competitors. Indeed, Lucent's stock price reached an all-time high in December 1999, whereas the stock prices of the other companies continued to rise for several months thereafter. Cisco's stock price increased by 53 percent from December 1999 to March 2000 – at which time the company could boast the highest market capitalization of any company in the world – and as late as December 2000 its stock price was still higher than it had been a year earlier. Nortel's stock price peaked in July 2000, at which time it was 62 percent higher than in December 1999, and in October 2000 was still higher than it had been in December 1999.

¹¹ From April 1996 to December 1999, Lucent's stock price increased 9.4 times compared with 8.4 times for Nortel, 2.5 times for Alcatel, 9.2 times for Cisco, 6.5 times for Ericsson, 2.5 times for Motorola, and 1.4 times for Nokia.

Figure 14. Stock-price movements of shares of Lucent and its major competitors, 1996-2003



Source: Yahoo! Finance

In its efforts to pad revenues and earnings to give its stock price a boost, Lucent engaged in creative accounting such as channel stuffing and excessive vendor financing of next-generation service providers. In 1999 and the first half of 2000, as we have seen, the company also made a number of expensive, but unwise, technology acquisitions, using its stock as the combination currency. All of these decisions, which came from Lucent's top management, created turmoil in the company. The more immediate result was the ouster of CEO Rich McGinn in October 2000 (just a year after the Lucent board of directors had awarded him a \$5.1 million bonus for 1999). The longer term consequence was a weakening of the financial condition of the company even before the Internet bust of 2001 and 2002.

In the downturn, Lucent was compelled to engage in a massive downsizing to avert bankruptcy. Its layoff decisions reflected a desperate attempt to stay afloat rather than a strategic restructuring plan. When 8,500 managers and engineers accepted Lucent's early retirement offer in July 2001, the company lost tens of thousands of years of irreplaceable experience. By 2003 many of Lucent's key manufacturing plants had been shut down. Among them was the Merrimack Valley Works in North Andover, Massachusetts; just three years before, in June 2000, with a workforce of 5,600, this plant had been declared Lucent's worldwide center of excellence for optical networking production (see Lazonick and Quimby 2007).

As we have also seen, when the communications technology industry began to recover from 2003, the divestitures of the enterprise networks division as Avaya in 2000 and the microelectronics division as Agere in 2001 left Lucent lacking in critical capabilities for growth.¹² The decision to divest the enterprise networks division had been announced in March 2000 as Lucent tried to improve its financial performance by ridding itself of “slower-growing” businesses. When Lucent had disappointed Wall Street with its first quarter 2000 earnings announcement in early January 2000, its stock price had plummeted by 20 percent, and through the end of February 2000 was down some 30 percent from its peak levels in December 1999. The announcement of the intent to spin off this division on March 1, 2000 sent Lucent’s stock up over 14 percent in one day. Analyst Paul Sagawa of Sanford Bernstein & Co. stated that the enterprise networks division had been “something of a drag on Lucent’s overall results,” and that the spinoff would turn Lucent into “an extremely vibrant growth engine” (Tampa Tribune 2000).¹³

The decision to divest Agere was first announced on July 20, 2000 at the same time as Lucent revealed that it had lost \$301 million in the third quarter of 2000 because of charges for acquisitions and discontinued operations. The company also warned that earnings results for the next two quarters would fall substantially short of analysts’ expectations (Johnson 2000a). In simultaneously announcing the divestment of the microelectronics division, Lucent was clearly hoping to offset the adverse market reaction to its earnings report.

At the time more than 75 percent of the sales of the microelectronics division came from Lucent’s competitors. In providing the rationale for the spinoff, CEO McGinn argued:

This new company will be able to accelerate its growth now that it’s free from this strategic conflict. This move will also unleash the shareholder value of our microelectronics business, whose success will now be more fully recognized outside of Lucent’s larger communications networking systems business. At the same time, Lucent will now be able to completely focus on the largest network build-out in world history, a more than \$225 billion global opportunity in broadband and mobile Internet infrastructure that is expected to double in five years. We will concentrate our investments, resources and management attention on a triple-play of optical, data and wireless solutions with the network design, consulting and integration services to support them. The communications infrastructure and semiconductor markets have become so big, so fast-moving and so competitive that it is time to divide in order to accelerate growth. (Quoted in Levine 2000)

¹² For an in-depth case study of the importance of maintaining control over chip design for a major communications technology company, see the study of Ericsson by Glimstedt et al. (2010).

¹³ As an independent company, Avaya saw its revenues decline from \$6.8 billion in 2001 to \$4.1 billion in 2004, and incurred losses that totaled \$1.1 billion in 2001-2003 before becoming profitable in 2004-2006, generating a total of \$1.4 billion in net income. The 31,000 employees at Avaya when it was created on September 30, 2000 were reduced to 18,500 by September 30, 2006. In November 2007 Avaya was taken private, and in December 2009 it acquired Nortel’s enterprise network business for \$900 million, bringing Avaya’s payroll to 21,000 employees (Wallis-Jones 2009).

In sharp contrast to the stock market's reaction to the announcement of the spinoff of the enterprise networks division the previous March, the market was not convinced by these arguments – or at least was not willing to pay a high price for Lucent's stock for prospective gains that would take some time to appear. Lucent's stock price fell almost 16 percent on the day of the announcement. Indeed Lucent's stock prices in the days prior to the news of the microelectronics spinoff were the highest that the company had recorded since the price boost from the news of the enterprise networks spinoff in early March.¹⁴ As it turned out, Lucent's stock price never recovered from its sharp fall on July 20, 2000 (see Figure 14). A year later it was at about 14 percent of its level of July 21, 2000, and thereafter fell to as low (in October 2002) as 1 percent and moved back up (in January 2004) to no more than 9 percent of that level.

This is not to say that Lucent's competitors were immune from significant damage in the Internet bust of 2001 and 2002.¹⁵ Nortel's success in selling optical networking equipment in 2000 did not save it from suffering a destructive collapse that ultimately, a decade later, left the company bankrupt and selling itself off in pieces. A study of the demise of Nortel Networks, comparable to our study of Lucent, could add significantly to our understanding of the destructive influence of financialized decision-making in a high-technology industry. So too would a study of Alcatel, which, for example, as Carpenter et al. (2003) have shown, was much more prudent than either Lucent or Nortel in its technology acquisition strategy in the Internet boom. As for Cisco Systems, the company that perfected the stock-financed, growth-through-acquisition strategy which Lucent and Nortel sought to emulate, it failed in its attempt to build on its optical networking acquisitions of the late 1990s to become a major competitor within the communications infrastructure market but has continued to dominate the markets for enterprise networks and, increasingly, home networking equipment.

In the first decade of the 21st century, wireless communications offered the fastest-growing market opportunities for companies such as Lucent, Nortel, and Alcatel. Here the dominant companies are Nokia (including Nokia Siemens Networks), Motorola and Ericsson, with the Chinese company, Huawei Technologies quickly gaining ground. Nokia has been a juggernaut, hitting its peak revenues of \$74.6 billion in 2007. Nokia's revenues, which had grown by 3.3 times from 1996 to 2000, declined by only 3 percent in 2001 before doubling to \$54.6 billion in 2006 – compared with Lucent's final year revenues of \$8.8 billion. Motorola revenues declined by 29 percent in 2001-2002 from \$37.6 billion in 2000, but then bounced back to \$42.9 billion in 2006 before spiraling down to only \$22.0 billion in 2009. From 2000 to 2003 Ericsson's revenues fell 43 percent before recovering to a peak of \$29.3 billion in 2007. To get back on track,

¹⁴ Agere was eventually spun off in June 2002, after Lucent recorded losses for the division of \$4.6 billion on revenues of \$4.1 billion in fiscal 2001. As an independent company from 2002 to 2006, Agere generated total revenues of \$9.2 billion and incurred losses that totaled \$2.2 billion. In April 2007 Agere was acquired for \$4.0 billion by LSI Corporation (Taylor 2007). At the end of fiscal 2002 Agere had 10,700 employees, down from the 17,400 employees in Lucent's microelectronics division two years earlier. By the end of 2006, Agere's headcount was down to 5,100.

¹⁵ We are currently engaged in a project to write parallel cases on major competitors in the communications technology industry, including Alcatel-Lucent. As this project progresses, the research outputs will be posted on the website of the AIRnet (www.theAIRnet.org)

Ericsson had to cut employment from 105,000 in 2000 to less than 51,000 in 2004. But, as Glimstedt et al. (2006) have shown, Ericsson downsized in a deliberate way that left its organizational capabilities intact. With 2009 revenues of \$24.0 billion, Ericsson remains on an even keel, and for the first time surpassed the faltering Motorola in total sales. Meanwhile since 2004 Huawei Technologies' revenues have increased eight-fold from \$3.8 billion to \$30.2 billion.

In the first half of the 2000s, the accelerated growth in wireless networks worldwide provided Lucent with an excellent opportunity to globalize its business and diversify its customer base. During the late 1990s Lucent had focused on TDMA and CDMA wireless technologies, the dominant network standards in North America. This decision positioned Lucent poorly for taking advantage of the largest opportunity for growth, the global wireless subscriber market where GSM technology, emanating from Europe, dominated networks. In the 2000s Lucent not only had to make investments for the transition from 2G to 3G networks, but also had to create successor products to GSM technology based on W-CDMA and UMTS. Lucent had to make large R&D investments to catch up with well-positioned competitors. In the boom years of 1998-2000, Lucent's R&D spending averaged \$5.0 billion per year, representing 13.6 percent of sales. In the bust years of 2001-2003, R&D spending averaged only \$2.4 billion, but was 17.4 percent of sales. In the critical stagnation years of 2004-2006, the company's R&D spending dropped to only \$1.2 billion per year, about the same percentage of sales as in 1998-2000, but in nominal dollars less than one-quarter of the absolute amount. Lucent's failure to increase its share in the global wireless market in the 2000s is evident in the geographic distribution of its annual revenues. From 2003 Lucent's revenues from outside the United States were approximately the same as when Lucent was initially formed in 1996 as an independent company.

By the mid-2000s it became evident that Lucent had the choice of becoming merely a "niche" player in the communications technology industry or finding a partner to supplement its resources so that it could compete once again as a "full line" supplier. In May 2001 Alcatel and Lucent had held initial merger talks with a view to creating a \$50 billion global firm. A year earlier Lucent would have dominated such a combination. By May 2001, however, Lucent had already been severely damaged by the downturn in the telecommunications industry. In contrast, Alcatel sales and profits remained strong at the time of the merger talks. If the merger had gone through Alcatel shareholders would have owned 58 percent of the combined company, even though it had been agreed that the new headquarters would be in Murray Hill, New Jersey, with Alcatel Chairman Serge Tchuruk running the company. In the end, the 2001 merger failed when Alcatel insisted that, given its stronger position, it would select 8 of the 14 board members, while Lucent Chairman Henry Schacht insisted that his company send two more members for an even split (Sorkin and Romero 2001).

Subsequently, Alcatel also succumbed to the Internet bust that during the last half of 2001 spread to Europe. After drastic restructuring, both companies recorded profits in 2004. But in 2006 Alcatel had revenues that were 84 percent greater than Lucent's. Moreover, after 2004 Alcatel's employment began to increase, reaching almost 60,000

people in 2006, whereas Lucent's employment continued to decline, falling below 30,000 on September 30, 2006. On December 1, 2006 the French company absorbed the American company into Alcatel-Lucent.

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