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The Rise and Demise of Lucent Technologies

William Lazonick and Edward March

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. 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. On December 1, 2006, the merger that created Alcatel-Lucent took place, making Lucent a wholly owned subsidiary of Alcatel. 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 2006 merger with Alcatel. Our analysis of the case of Lucent shows the ways in which strategy,

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organization, and finance interacted to enable both Lucent's rapid growth in the late 1990s and its loss of competitive capabilities in the first half of the 2000s.

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.

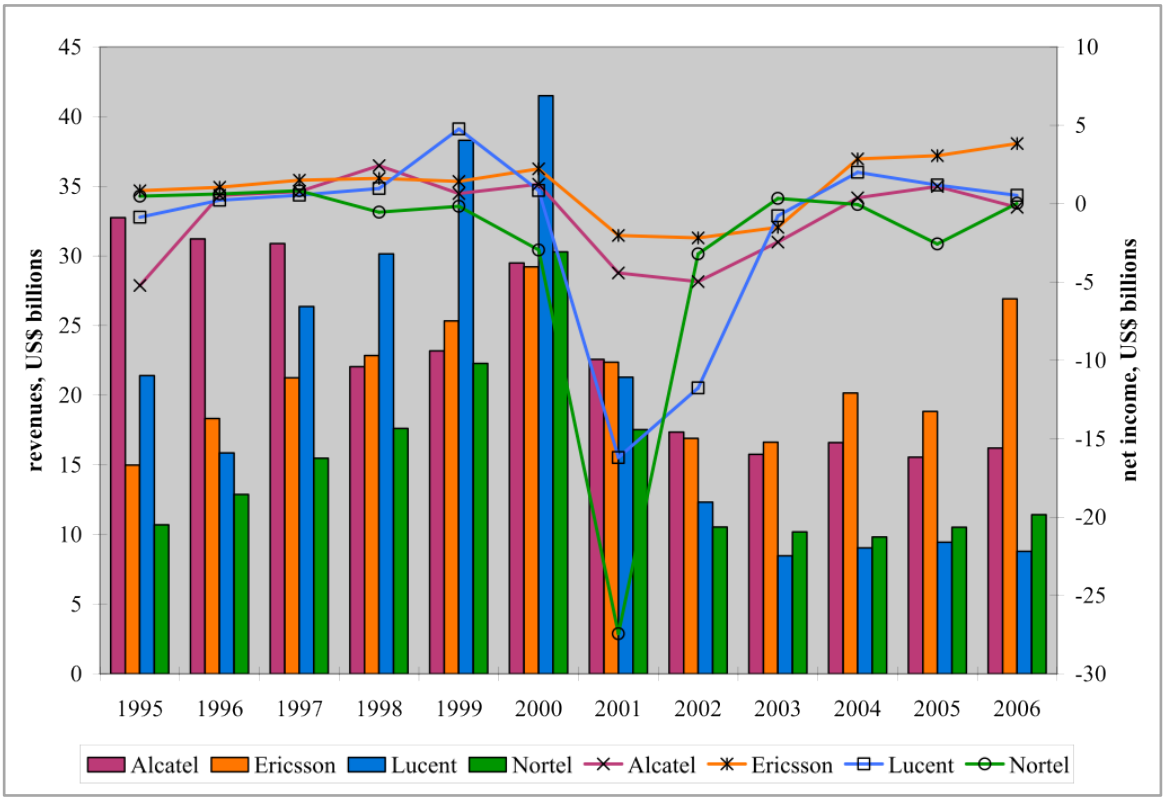
Like Lucent, both Nortel and Alcatel struggled to return to profitability after the depths of the downturn in 2002-2003. But on December 1, 2006, when the merger that created Alcatel-Lucent took place, Alcatel was almost twice the size of Lucent in terms of revenues and employees. Lucent became a wholly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

There were very few, if any, companies that had the financial and technical resources of Lucent at its founding in 1996. With those resources, transferred from the AT&T parent organization, Lucent executives moved forward with confidence to create a company expected to be one of the dominant competitors in the rapidly changing information and communication technology (ICT) equipment sector. The company would not face barriers to entry involving R&D investment, manufacturing capability, or global deployment of a marketing and sales force. The major challenges that Lucent faced were organizational: it had to change its bureaucratic culture and reinvent its business practices for quicker response to the deregulated, fast-paced competitive environment into which it was released.

The Lucent case is unique. This study explores the ability of a company initially formed decades earlier within a regulated industry to

[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, remained larger than its rivals; but it divested its enterprise division Avaya on the very last day of the fiscal year, and thus recorded revenues of $33.8 billion and employment of 126,000. In this essay, we correct for this accounting obfuscation.

Figure 1
Revenues and Net Income, Alcatel, Ericsson, Lucent, Nortel, 1995-2006
(US$ billions)

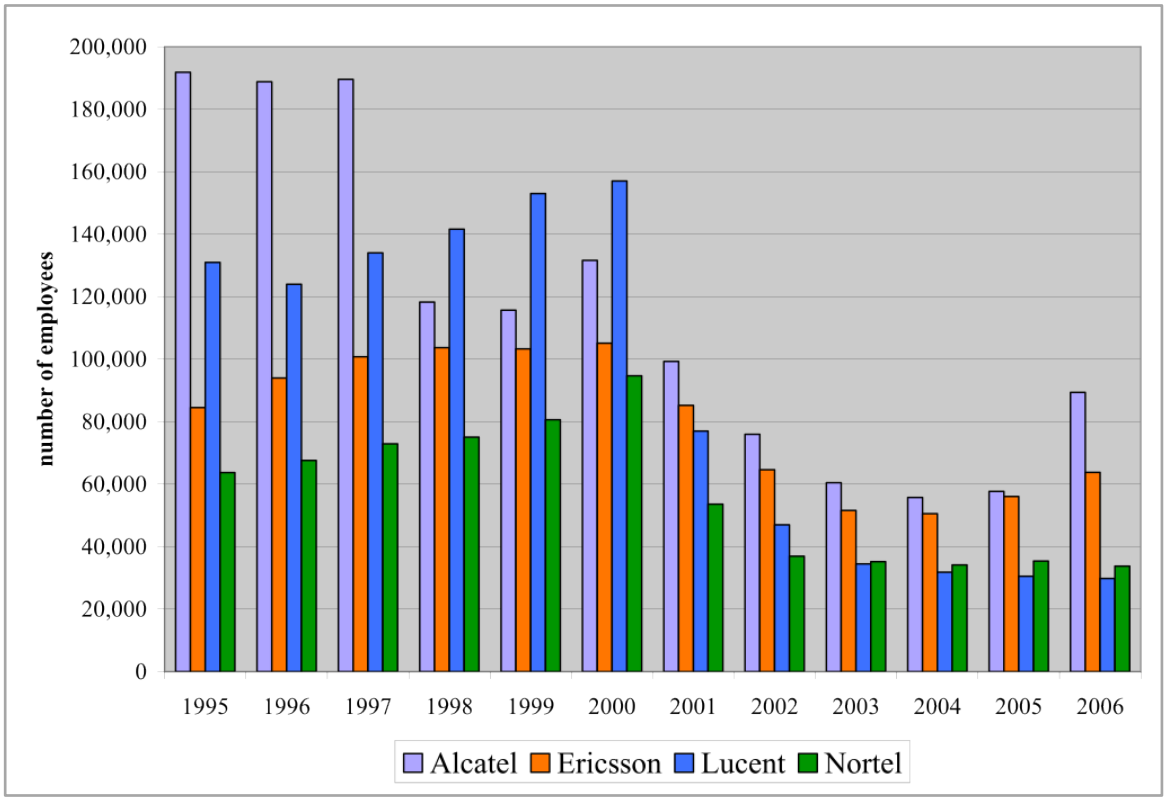


Notes: Fiscal years ending September 30 for Lucent and December 31 for Alcatel, Ericsson, and Nortel.
Lucent's 1995 revenues reflect sales of AT&T activities spun off as Lucent in the IPO on April 10, 1996.
Lucent's net income for 1995 is an estimate of the net income of the AT&T activities spun off 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.
Sources: Standard and Poor's Compustat database; Avaya 10-K filing, 2000, p. 49.

transform itself into a more nimble, globally competitive company where massive technology changes occur in years rather than decades.[2] The

[2] The co-authors came to know one another in 1999 when Edward March, who had worked at AT&T and Bell Labs for two decades, was director of engineering at Lucent Technologies Merrimack Valley Works in North Andover, Massachusetts, and William Lazonick was professor and director of the Center of

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

fundamental question that this study poses is: Can an "old economy" company comprising predominantly employees and executive managers

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Industrial Competitiveness at University of Massachusetts Lowell. Lazonick and March were cooperating in a study, funded by the Russell Sage Foundation, of the challenge of developing a skilled workforce in the rapidly changing ICT industry. See William Lazonick, Michael Fiddy, and Steven Quimby, " 'Grow Your Own' in the New Economy? Skill-Formation Challenges in the New England Optical Networking Industry," in *Globalization, Universities, and Sustainable Human Development*, ed. Robert Forrant and Jean L. Pyle (Cheltenham, Eng., 2002), 233-59; and William Lazonick and Steven Quimby, "Transitions of a Displaced High-Tech Labor Force," in *The Future of Work in Massachusetts*, ed. Tom Juravich (Amherst, Mass., 2007), 111-34.

whose careers developed within a regulated business framework make the necessary changes for success when facing global competitors in a deregulated environment? Incremental change would not be sufficient; more significant change was necessary to benefit from opportunities in the growing global telecommunications equipment market. Lucent's established customer base composed of communications service providers in the United States would provide most of the revenue earned during this transition. Bell Labs would be the source of technical innovation needed for responding to, or driving, change in the evolving ICT industry.

In this essay, 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 questions we examine are:

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? We show that, in a booming market for telecommunications equipment, Lucent relied heavily on its "incumbent advantage," selling predominantly to the regional Bell operating companies that had emerged from 1984 out of the breakup of the old Bell System and benefiting from the rapid but short-lived expansion of demand for extra telephone lines for dial-up Internet.

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 Lucent was on the brink of bankruptcy? We argue that at the peak of the boom, Lucent's top management made a number of decisions concerning acquisitions, divestitures, loans to customers, and accounting for revenues that were designed to impress financial markets but that in the subsequent deep decline of the industry wreaked havoc with Lucent's financial position and depleted the company's productive capabilities.

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? We explain how the damage that was done to Lucent's financial position and productive capabilities in the Internet decline of 2001-2003 left the company without the financial and productive resources necessary to compete in global markets, especially in the burgeoning wireless segment of the telecommunications industry.

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 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 seventh largest employer among the Fortune 500.[3]

As a regulated monopoly the company was focused on providing reliable telecommunication service; cost and product features were not as important as designing networks and manufacturing equipment that did not fail. The public telecommunications network was considered a "public safety asset." Regulators measured failure in terms of "minutes of downtime per year"; redundancy in network design and use of more costly materials or components in equipment would ensure that this metric remained within acceptable limits. Sustaining the "good will" of state and federal regulators was imperative to increase the probability of winning favorable rulings in rate increase requests. With superior network performance, those increases would offset the costs incurred to maintain a highly reliable public network.

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 twentieth 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 twentieth century. Subsequently Bell Labs was a pioneer in, among other things, digital, optical, and wireless technologies.[4]

In 1949 the U.S. 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.[5] 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.

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[3] 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.

[4] William O. Baker, Ian M. Ross, John Mayo, and Daniel Stanzione "Bell Labs Innovation in Recent Decades" *Bell Labs Technical Journal* 5 (Jan.-March 2000): 3-16.

[5] Anthony Lewis, "AT&T Settles Antitrust Case; Shares Patents," *New York Times*, 25 Jan. 1956, pp. 1, 16.

Bell Labs was important as a source of innovation and as an institution that could "promote good will" among the regulators. Some considered the "pure research" work in Bell Labs as an AT&T investment made from the income earned as a public utility for the advancement of science in the "public good." Patents were always a priority for the company; they supported the marketing image of AT&T as a technically advanced company and minimized the risk of AT&T's needing to pay licensing fees to other companies for use of key technologies. Because of the requirement to license AT&T patents at reasonable fees, Bell Labs technology was made public at technical conferences and through professional publications. Given its status as a regulated monopoly, the company did not find the control of proprietary information a critical issue.

Beginning in the late 1960s, AT&T was challenged by new entrants into the long-distance business (in particular MCI) who demanded that AT&T provide them with access to its transmission infrastructure. In 1974 the U.S. 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 combined Western Electric and Bell Labs into 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 the Western Electric manufacturing and product management expertise that it strategically retained.

This breakup of AT&T introduced the equipment manufacturing unit to a competitive environment and gave an indication into how Lucent would adapt in the future. Although the unit was trying to attract new customers, the AT&T services unit and the RBOCs continued to be the dominant customers. The RBOCs began looking at price-competitive products from other equipment suppliers, but the long lead time required to certify this equipment for use in the existing public network gave AT&T a sales advantage for several years.

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 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.

This acquisition was both a strategic and a defensive move. It stemmed from the recognition that mainframe computers controlled AT&T central office digital switches and, as a result, the company had an established competency in data processing equipment. Entering the

computer business was an attempt to leverage this competency to grow revenue in a non-traditional market for AT&T. In addition, there was speculation that IBM was considering entering the telecommunications equipment market based on its competency in mainframe computers. AT&T was one of only a few companies with sufficient resources to counter this competitive threat. Defensively, AT&T sought to establish itself as a formidable competitor in IBM's traditional market.

The NCR acquisition enabled AT&T to broaden the range of computer products offered by extending its portfolio into the mini-computer and personal computer market. This acquisition would give AT&T the opportunity to learn how to sell to small businesses and consumers, an environment much different from selling to the large regulated service companies that were AT&T's traditional customers. The company already had opened AT&T Phone Center stores nationwide to sell telephone handsets to consumers, but this was a struggling venture.

With telecommunications equipment, AT&T service teams would install and test systems purchased by the telecommunications service provider companies. These knowledgeable teams would remain on site until the installed equipment functioned correctly and the network was fully operational after installation. A mini-computer or personal computer purchase did not come with an installation team. The products had to work out of the box or be able to be made operational easily by the customer. Buyers of AT&T's computer products, however, experienced a high initial failure rate. The damaged to the company's reputation severely limited opportunities for success in the computer market.

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.

The failed AT&T computer venture was an indicator of what needed to be fixed within Lucent immediately after the "trivestiture." Speed in decision-making and execution of plans was an imperative, and risk taking needed to be tolerated and rewarded. A greater effort in understanding customer needs and expectations for future product development was required. An intense concentration on quality was also required, because in the new environment Lucent equipment would not necessarily be installed by a Lucent service team. Contracts for equipment installation were awarded through a competitive bidding process. At its founding, Lucent attempted to correct mistakes made during the computer venture and to establish a culture in which these mistakes would not be repeated.

A "start-up" with 11 "hot businesses"

Lucent's IPO in April 1996 was the largest in U.S. 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.[6] 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, and indeed in October 1997, McGinn took over from Schacht as CEO (see Figure 4).[7]

Prior to the spin-off of Lucent as an independent company, the units forming Lucent operated within a competitive environment from the time of the AT&T breakup in 1984 until the "trivestiture" in 1995. These units had minimal success attracting new customers in the global telecommunications equipment market; revenue was still dominated by sales to the AT&T services unit and the RBOCs. A bold new venture into the computer market failed. To accelerate the change that would enable Lucent to compete globally, a drastically different approach was needed to align the resources of the company and to mobilize employees to take advantage of emerging opportunities.

Rather than carry over the functional organization structure that allocated resources according to the types of network operations that service providers performed, Lucent would begin as an entrepreneurial company, dissecting the previous organization into highly focused, semi-autonomous business units with a flattened organization structure to drive decision making downward. Cross-functional resources were aligned with a specific family of products addressing a particular market need.

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[6] Lisa Endlich, *Optical Illusions: Lucent and the Crash of Telecom* (New York, 2004), chap. 3.

[7] Ibid., 32.

Figure 3
Lucent Technologies Organization Chart, September 1996

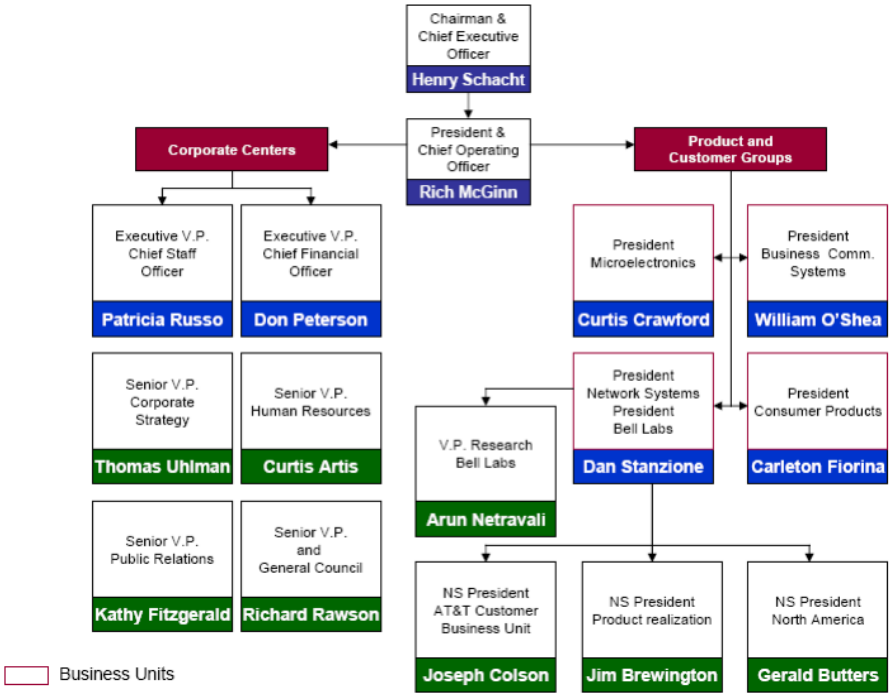
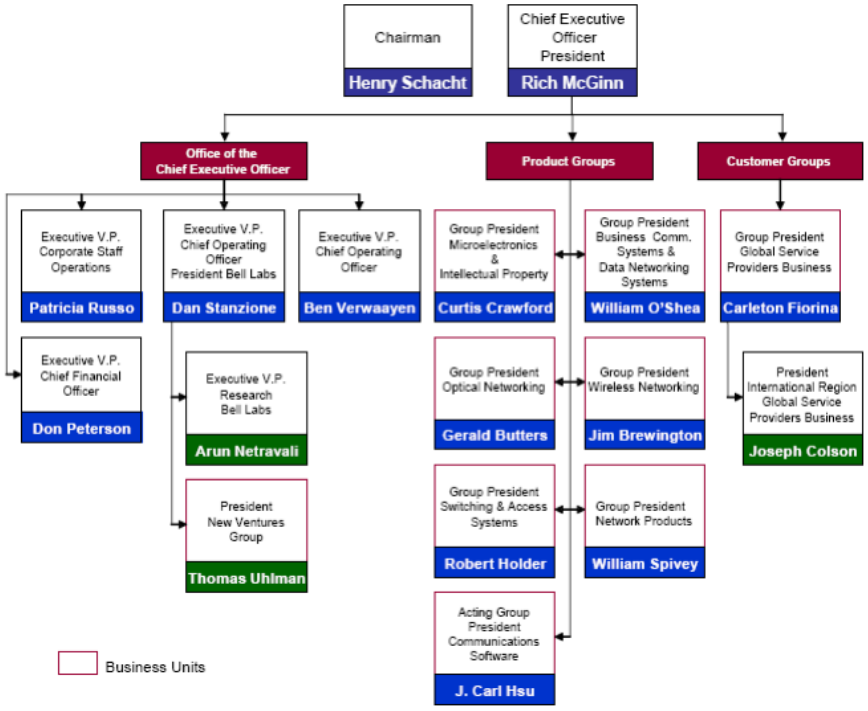


Figure 4
Lucent Technologies Organization Chart, November 1997



The creation of smaller business units gave greater visibility to key business performance metrics than in the past. Employees would be aware of who their customers were, the status of revenue, profit, back schedule, and inventory levels. To stimulate interest in business performance, all employees were awarded "Founders Grant Share Options," a hundred shares of Lucent common stock. The company's stock price was posted daily so that, as the stock appreciated, employees could see the increased value of their holdings.

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."[8] Effective November 1, 1997, the company was reorganized around eleven "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."

Of the eleven "hot businesses," ten concentrated on products or services and the eleventh was formed to sell integrated solutions to meet customer needs. Lucent desired to position itself as a full-stream network supplier, not a seller of "boxes." The eleventh business unit was created to interface with customers as the "single face of Lucent." It would sell both Lucent products and those from other companies if necessary to meet the complete range of a customer's needs.

Over time some of these units were sold or spun off, and, especially in the period 1998-2000, acquisitions augmented the capabilities that many of these units possessed; nevertheless, these eleven businesses encompassed the revenue-generating activities that would define Lucent over the decade of its existence.

The eleven 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 7 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

[8] "Lucent Technologies Appoints Chief Operating Officers, Organizes Business around Fastest Growth Opportunities," *Business Wire*, 23 Oct. 1997.

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, thus enabling Lucent to obtain significant U.S. business outside the old Bell System.[9] 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 little 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

[9] "Manufacturers Strike It Rich in American PCS Market, Report Says," *Mobile Communications*, 16 April 1996.

compete for external customers.[10] 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 spin-off 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.[11] 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.

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[10] Kirk Ladendorf, "Lucent Plans Spinoff of $4 Billion Unit," *Austin American-Statesman*, 21 July 2000.

[11] Lawrence Fisher, "Lucent To Spin Off Slower-Growing Units," *New York Times*, 2 March 2000.

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.[12] In January 2002, however, with Lucent facing financial collapse, 80 percent of the Group was sold to Coller Capital, a London-based equity management company, for $100 million.[13]

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 made eleven data networking acquisitions for $25.7 billion, although just one of those acquisitions, Ascend, cost Lucent $21.4 billion, paid in stock. There was a hope within Lucent that this unit would become a formable 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." Though 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

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[12] Vyvyan Tenorio, "New Details of Lucent VC Sale," *The Daily Deal*, 11 Jan. 2002.

[13] "Ibid., and Vyvyan Tenorio, "Lucent Unloads Majority of Startup Portfolio to Coller," *The Daily Deal*, 4 Jan. 2002.

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.

This business unit came into immediate conflict with the desire for autonomy by the ten other business units. It was seen as a constraint on their business strategies and their sales. At times, products from different business units could be used to address a customer need, but in different ways. The Global Service Provider business unit would select which product would be used. Thus, from the very beginning, the desire for a confederation of autonomous business units operating as entrepreneurial organizations was in jeopardy.

In addition, the possibility of duplicate functional coverage in product offerings indicated an inefficient use of technical resources and unhealthy competition within the company rather than an intense focus on external competitors. The problem was long-lasting at Lucent. An effective way to drive down product cost was the consolidation of system functions using custom-integrated circuits or software. Decision-making regarding which business unit products would have these features or functions could not be managed within the "hot business" structure. Ultimately product offerings from acquired companies faced the same problem. 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 the Global Service Provider 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 were redistributed back into the four core business units.

Lucent's expansion in the Internet boom

An organizational structure is effective only if the employees within it are committed to achieving company objectives; they perform their roles and responsibilities knowledgably and creatively when necessary. Lucent needed to re-develop all of its employees to compete in the new environment, without the security of working according to bureaucratic procedures and with personal responsibility and "ownership of problems" of critical importance to performance.

The cultural change required to create an entrepreneurial spirit throughout the company began with executives relinquishing some of their responsibility to drive decision making downward through the organization. The purpose was to enable faster and better decisions and more competitive responses to market conditions and customer desires. It extended to Bell Labs, where technology decisions now had to be based on anticipated market demand and networking trends, rather than on "protecting" existing technology platforms by extending their useful lives through customization and adding updated features. 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. The operational units needed to become more customer-oriented, responding in timeframes dictated by customers and not by standard order delivery intervals.

Overall, both management and the employees needed to adopt a competitive business mindset, attuned to the changing strategies and priorities of the company. The bureaucratic, "science first," regulated monopoly mindset of the past had to abandoned. 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.

> ***G****lobal Growth Mindset*: Increase revenue to the extent that Lucent is taking market share away from competitors worldwide.
> ***R****esults Focused*: Drive to achieve measurable results and meet pre-established goals in all tasks or activities.
> ***O****bsessed 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 a hundred years.
>
> ***W****orkplace 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.
>
> ***S****peed*: 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.

The Lucent GROWS campaign prepared employees for the immediate challenges the company faced. As a newly independent supplier of communications equipment in the new world of deregulated telecommunications markets, Lucent needed to accomplish three tasks:

First, 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 compete not only on the quality of its technology and service but also on price and time-to-market. The framework for accomplishing this task was the organization structure composed of eleven "hot businesses" and the GROWS initiative that informed employees of the attitudes and behaviors needed for the competitive environment.

Second, 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. To attract and retain new customers Lucent needed to compete on price. The inability to drastically reduce its cost structure would result in lower profit margins on Lucent products relative to other ICT suppliers like Cisco. Vendor financing would also become a tool to win new customers who had limited revenue or credit. Lucent needed to be willing to accept greater financial risk in an attempt to attract newly formed service provider customers. But without the correct controls, this practice could significantly weaken Lucent's financial position. In addition, to retain new customers Lucent needed to overcome the perception that it was giving priority to its traditional long-time customers during periods of material shortages and rationing of equipment. Balanced treatment of various types of customers

would become a particular problem during the boom years when Lucent received short interval orders for large amounts of equipment.

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. This task was complicated by the need to "bet" on the correct network protocol for transmitting information. The digital communications network made possible what the industry called "triple play" services: the transmission of voice, data, and video signals over a single network. The circuit-switched network was the default public network prior to the founding of Lucent, and the company planned to offer "triple play" capabilities by offering equipment that was compatible with this network. Cisco Systems was the dominant data transmission equipment company using Internet Protocol (IP) for the transmission of data across packet networks. Lucent would eventually lose valuable time and waste resources attempting to create alternative approaches to packet transmission without using the IP advocated by Cisco. Both Lucent and Cisco attempted to compete in each other's primary markets, telecommunication and data networks, respectively; both companies failed.

Lucent revenue growth during the formative years

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. With the new organizational structure and empowered employees, an immediate task was for each business unit to prune its product portfolio for profitable growth. Some of the technologies and products were approaching "commodity status" or becoming obsolete 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.[14] 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.[15] Internally Lucent would report financial results for each of the eleven "hot businesses."

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[14] Lucent Technologies 10-K (1998), 2.

[15] Lucent Technologies 10-K (2000), 73.

Table 1
Lucent Revenues by Reportable Segments, 1995-1999

	1995	1996	1997	1998	1999
Total revenues, $m	20,258	23,286	26,360	30,147	38,303
Percent of total					
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 U.S. government.
Source: Lucent Technologies 10-K filings, 1996-1998.

Table 2
Lucent's Revenues by Major Product Groups, 1998-2000

	1998	1999	2000
Total revenues, $m	32,121	38,885	41,493
Percent of total			
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.

These business unit performance metrics supported the GROWS initiative, boosting morale when goals were exceeded and serving as a "call for action" when results failed to meet expectations. Educational programs

and “all employee meetings” became routine. Management explained the significance of the metrics and framed quarterly results in a way that would align employee decisions and priorities with the short-term goals of their business unit. Externally, business unit results were clustered according to functional area, insolating competitors from sensitive data for specific markets or product lines.

In the boom years of 1998-2000, wireless products emerged as growth opportunities, and they 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 the Enterprise Networks data in Figures 1 and 2 as well as in Table 2.

The steady revenue growth gave Lucent the financial means to invest in advanced technology and develop new products for the core and wireless networks. To sustain this growth trajectory, however, 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, 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 in the network. But with the emergence of innovative competitors using newly introduced lightwave technology to build “carrier grade” optical networking equip-

ment, Lucent's incumbent advantage began to erode during the last half of the 1990s.

The GROWS initiative emphasized the need to take market share away from global competitors. When the company was founded, Lucent executives realized that newly established industry standards would create open architecture networks in which the sale of proprietary equipment no longer guaranteed follow-on sales into the future. Equipment manufacturers would need to compete on price and features, and Lucent would need to rapidly adjust to this new reality as the "incumbent" advantage evaporated.

As the RBOCs began purchasing equipment from Lucent's competitors the company's share of the "incumbent" market began to drop. In response, Lucent aggressively sought new customers, focusing on service providers planning new optical networks and wireless infrastructure installations. These "next-generation" service providers, such as Sprint PCS, Winstar, and Global Crossing among many others, were planning advanced networks that would enable them to offer new types of service. 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 global markets that increased non-U.S. sales from $6.7 billion in 1997 to $12.2 billion in 1999. As a result, non-U.S. sales as a proportion of total company sales rose from 26 percent to 32 percent (see Table 3). When non-U.S. sales declined to $11.2 billion in 2000, U.S. sales declined even more, so that non-U.S. sales rose to almost 34 percent of the total. As can be seen in Table 3, the most significant expansion of non-U.S. sales from 1997 to 1999 occurred within EMEA, although sales to this region declined in 2000 while sales to other non-U.S. regions were stable or increased. Table 4 shows that most of the increase in non-U.S. 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-U.S. sales during the Internet boom.

Ongoing development of Lucent's technological foundation

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 windows of opportunity on time with advanced technology products. Under the system inherited from AT&T, competing on quality and reliability 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.

Table 3
Lucent Technologies' Non-U.S. Sales, by Geographic Area, 1997-2000

	Non-U.S. 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

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-U.S. Sales, by Reportable Segments, 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

SPN=Service Provider Networks; EN=Enterprise Networks; MCT=Micro-electronics 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

From the start, Lucent Technologies emphasized the role that Bell Labs could play in its efforts to compete as an independent company.[16]

[16] Baker et al.,"Bell Labs Innovation in Recent Decades."

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 ninth (in 1985) to nineteenth (in 1989) among the U.S. patent leaders. In each of the two years prior to the Lucent spin-off, AT&T ranked thirteenth. As an independent company, Lucent moved up the ranking from twelfth in 1996 to fifth in 2000, at which time only IBM, NEC, Canon, and Samsung surpassed it.

Table 5
Lucent Technologies, U.S. Patents, U.S. Rank, and R&D Expenditures, 1996-2006

	U.S. Patents	U.S. 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: http://www.ipo.com.

As an independent company Lucent strived to control proprietary information and instill within employees an understanding of the competitive disadvantage that occurs if technical breakthroughs are disclosed. Lucent was no longer subject to the condition imposed upon AT&T by the 1956 consent decree requiring that it license all its patents. As in the past, the generation of patents was a priority and highly encouraged, but for different reasons. Now, this strategy would protect intellectual property embedded in new product designs, "lock-up" technology from use by competitors, and serve as a new source of revenue for the company through licensing fees when advantageous. Eventually a Lucent organization was put in place to obtain income from patent licensing and infringement cases.

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 fifth in 2000 to forty-second in 2005. During these years, by comparison, IBM maintained its position as the number one patent producer in the United States.

Even though Bell Labs remained a separate entity within Lucent, each product development group was aligned with the appropriate business unit. These assignments were based on the expertise within the group and portfolio of products each group had previously developed or for which it had technical support responsibility. A majority of Bell Labs resources were assigned to legacy network units such as switching and transmission.[17] Several of the newer business units serving emerging fields, such as Data Networking and Business Communications Systems (eventually becoming Enterprise Networks), were starved of resources desperately needed to create product offerings that would enable them to be recognized new entrants in their markets. The exception was Wireless Networks, which received a fair share of development resources. But wireless was a high priority area of importance toward the end of the AT&T days, and the increase in resource support continued with Lucent.

The Bell Labs designers needed to address three major technology trends impacting the core public network: packet switching, optical transmission, and wireless communication. Their response to these trends would prove to be a test of business unit structure effectiveness and ability of the empowered workforce to meet customer expectations and take market share away from competitors. Overall, the Switching, Optical and Wireless business units responded adequately to these challenges, but the timeliness of the responses has been questioned.

In Switching Systems, efforts concentrated on software upgrades to the 5ESS central office digital switch. Lucent's "incumbent" advantage

[17] Ibid.

depended critically on sales of these upgrades for the switches installed 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 it through hardware paths. As a result, this business unit, which 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 as 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 U.S. 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.[18] 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.[19]

Lucent's shortfall in optical networking revenues was an indication that the company continued to have difficulty directing R&D investments toward technologies or products more immediately marketable. Even though some of these developments would be licensed through the Intellectual Property Business Unit or to a lesser extent formed into a new business through the New Ventures Group, neither business unit contributed significant revenue to compensate for declining hardware and software sales.

Despite the effort to "drive decision making downward" to improve the speed and quality of decisions, technical resources were wasted on projects with no market value, exacerbating Lucent's continuing cost problem and slowing down its response to market dynamics. The entrepreneurial environment that Lucent was trying to create did not result in R&D

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[18] "Patent Full-Text and Full-Page Image Databases," 2009 United States Patent and Trademark Office. URL: http://patft.uspto.gov/.

[19] Dan Egbert, "Lucent Preparing Battleground for Optical Business Fight," *Associated Press Newswires*, 24 May 2000.

investments being correctly focused on customers, competitors and changing market conditions to the extent originally planned. The inability to improve the quality of decisions, setting of priorities, and contingency planning would hurt Lucent's performance, especially in the declining years of the telecommunications market when resources were very limited.

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 has been based on 3G (third generation) technology. These networks provide remote access to "Internet-like" service such as voice, data, and video.

As a regulated monopoly in the United States, Lucent's predecessor was not concerned with network standards. Being the primary equipment supplier, it had dominant control, essentially dictating what the industry standards would be. This position was retained during the earlier Lucent years. Sales of wireless equipment to the RBOCs created a large imbedded base of installed Code Division Multiplex Access (CDMA) equipment, making this technology the "unofficial standard" for North America.

In the global wireless market, Global System for Mobile Communications (GSM), a 2G system, was dominant throughout the European Union and Asia. Rather than invest in GSM technology in an attempt to catch up with global competitors, Lucent decided to risk investment in Universal Mobile Telecommunications Systems (UMTS) to leapfrog competitors and be first to market with next generation 3G wireless network products. Lucent anticipated that UMTS or a derivative, W-CDMA (Wideband Code Division Multiplex Access), would be the technology adopted for 3G capabilities.

The wireless market was Lucent's best opportunity to increase global sales dramatically. But with limited Bell Labs resources, Lucent needed to take a risk and focus development on only one global wireless standard. Developing products for multiple standards, even though reducing this risk, would appreciably delay product introductions and enable competitors to retain their lead over Lucent. In addition, a significant time interval was needed to design the portfolio of wireless network products. Lucent would be required to anticipate market demand at the end of that interval, increasing the risk associated with being more aggressive in the global wireless market. As we shall see, 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

With the growth of optical and wireless, the convergence of voice, data, and video, and the emergence of packet networks as a viable alternative to the imbedded circuit switched public network, the major telecommunications equipment companies looked to acquisitions to fill critical gaps in their product portfolios during the last half of the 1990s. These acquisitions would also 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. To protect or grow their market positions, these companies believed that they needed to adopt the Cisco business model.

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 made 41 acquisitions for $26.7 billion, over 99 percent paid with its high-flying stock.[20]

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.[21] 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.

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

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[20] Marie Carpenter, William Lazonick, and Mary O'Sullivan, "The Stock Market and Innovative Capability in the New Economy: The Optical Networking Industry" *Industrial and Corporate Change* 12 (Oct. 2003): 963–1034.

[21] Endlich, *Optical Illusions*.

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 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: Marie Carpenter, William Lazonick, and Mary O'Sullivan, "The Stock Market and Innovative Capability in the New Economy: The Optical Networking Industry." *Industrial and Corporate Change* 12 (Oct. 2003): 963-1034. Compiled from company annual reports and press releases. Wherever possible, the value of the deal at closing rather than at announcement has been used.

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

Many of the products from Lucent acquisitions were still in the development phase. Lucent did these acquisitions to obtain technical expertise not resident within Bell Labs and products that it did not have in data networking and enterprise networks. Bell Labs had expertise in core network technologies but not in these emerging fields. The telecommunication and information technology industries were merging into what would become the Information and Communication Technology (ICT) sector. To compete in this very rapidly evolving sector, in which many more formidable competitors emerged, Lucent needed to integrate not only products from acquisitions into its portfolio but also expertise from the acquisitions into Bell Labs' product development teams. In integrating acquisitions, a key issue was whether the entrepreneurial culture Lucent was attempting to create could accommodate and retain technical employees from acquired companies, most of whom were accustomed to operating within an entrepreneurial business.

Data Networking

Lucent's Data Networking acquisitions took place primarily between 1998 and 2000, with one in 2004 and another in 2006. These moves were targeted at packet switch technology that could be used with Local Area Networks (LANs) or Wide Area Networks (WANs).[22] Initially Lucent invested in companies utilizing Asynchronous Transfer Mode (ATM) technology, which was viewed as a competitor to Internet Protocol, the technology championed by Cisco for packet transport.

[22] 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**
3/11/98	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; the costliest deals are highlighted.
Sources: Company filings and press releases, and assorted news sources.

By focusing on ATM, Lucent risked investing resources into an alternative protocol with a limited market presence. IP was extensively deployed in enterprise networks and LANs; Cisco was a strong advocate of this protocol within the ICT sector. Lucent had difficulty accepting the fact that it was not a dominant player in the data networking field; it did not have the clout to dictate network standards as when it was a unit of AT&T. Rather than resist, the company needed to accommodate IP, the unofficial standard for data transmission. Lucent's failure to establish ATM protocol as an accepted alternative for data transmission wasted development resources and caused the company to fall further behind in the data networking market.

Failure did follow. 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 using ATM-based products as an alternative for IP packet transport. ATM products had been developed in both the switching and transmission portfolios with very little success. Now these products needed to be re-engineered to accommodate IP-based signals, or in some cases completely discarded.

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 technologies and products that Lucent pursued within this business unit were a preview of what Lucent would attempt to develop as a company in

the future, but with far fewer resources. 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.

Enterprise Networks gave an indication of the type of company Lucent needed to become to adapt successfully to the changing needs of the ICT market. It needed to focus on interfacing with networks installed at customer sites, accommodating those protocols rather than attempting to migrate customers to the alternative Lucent preferred. It needed to organize its installation and repair resources into a business, offering those services along with network design and operation services to take advantage of opportunities being created in the accelerating ICT sector. Enterprise Networks provided goods and services that interfaced with the core public network; Lucent needed to move away from core network development and toward this interface to achieve future growth. But de-emphasizing the core network would be a drastic change in company strategy; it essentially would be abandoning what the company considered to be its core competency.

During the severe downturn in the telecommunications industry in 2001-2003, Lucent realized the need 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 those 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 switches, wireless systems, and optical networks. 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 television networks for both Internet and telephone services.

Microelectronics was making investments that extended its portfolio to technologies used by designers worldwide. It was attempting to position itself for growth, and to reduce its dependence on Lucent as the primary customer by expanding its device portfolio for designers not in Bell Labs. The entrepreneurial business units were formed to instill this type of action within the company. Both Microelectronics and Enterprise Networks were successful in changing their businesses to attract a more diversified customer base, thus making it possible for each of them to function as a stand-alone business unit.

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 any Bell Labs device research investments that it had previously 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. As a result, these units pursued very little acquisition activity. The acquisitions that were made, however, helped to address serious competitive challenges that each business unit faced. Nevertheless, these acquisitions were reactions to a changing competitive environment rather than part of a long-term competitive strategy.

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 enhanced with a software-dominated “soft switch.” The only acquisition for this business unit, Excel Switching Corporation, brought programmable switching expertise into Lucent so that equipment could be developed that bridged circuit and packet networks using IP.

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

From Boom to Almost Bust

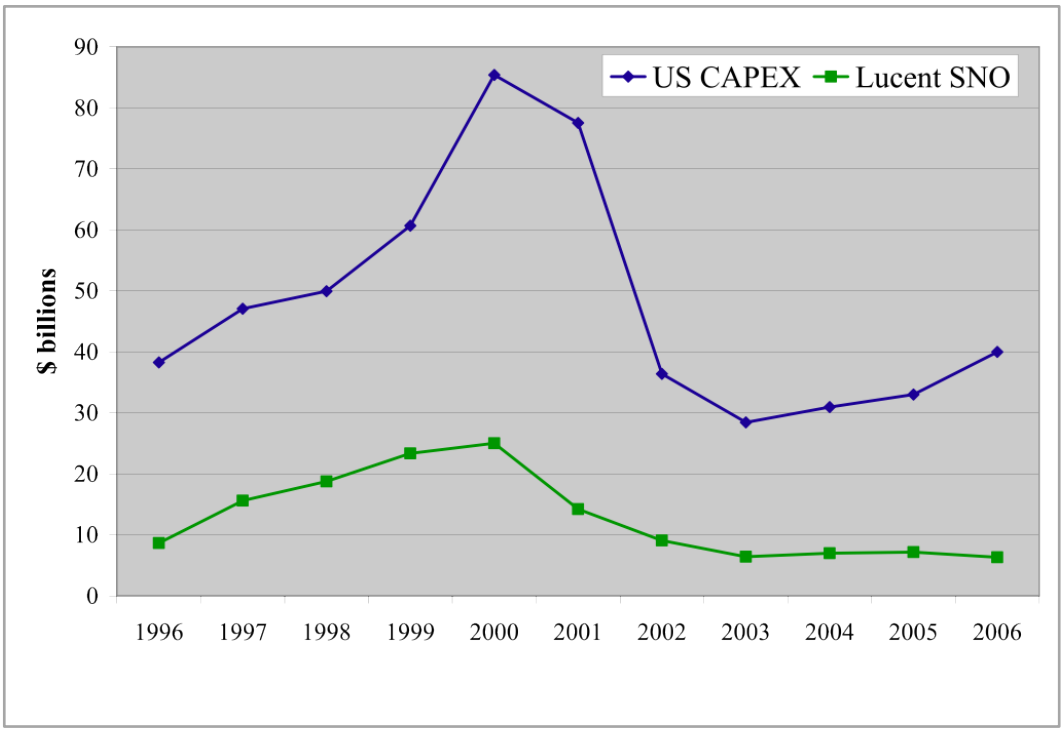
Lucent's revenue slowdown and decline

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 essay, 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 an 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 spin-offs 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.

Enterprise Networks and Microelectronics were two of the "hot businesses" at Lucent's formation. They were two avenues for achieving revenue growth from technological changes occurring in the telecommunications industry. When they were no longer part of Lucent, the company began to drift back toward a preoccupation with core network equipment, making the company more dependent upon CAPEX spending.

The Enterprise Networks unit would have enabled Lucent to participate more fully in the local area networks market, where demand for interconnecting businesses, industrial parks, and campuses showed continued growth despite the overall downturn in the industry. Microelectronics would have given Lucent the opportunity to earn from

investments in Bell Labs research in the area of advanced optical devices, wireless signal processing, and application specific integrated circuits (ASICS). These device markets were highly competitive but they provided opportunities for Lucent to supplement revenue from core network products with sales of advanced technology components.

One of Lucent's problems in 2000 was that it failed to take greater 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.

Prior to 2000 service providers were engaged in major network build-out programs to install capacity to support the anticipated accelerated growth of Internet traffic. These build-outs were extensive projects requiring a large number of optical systems. When it became obvious in 2000 that the growth rate would not be sustained, network installation projects in progress were completed but future projects were cancelled. Hence the modest decline in CAPEX between 2000 and 2001 and the dramatic drop after 2001. Demand for long-haul optical systems would never again reach the peak of 2000. To capitalize on its optical investments, Lucent needed to become more aggressive in the metropolitan and enterprise optical network markets, both of which had many more competitors and a very price-conscious customer base.

The decline in the optical transmission market had longer lasting financial consequences beyond a loss of revenue potential. Because of production capacity limitations, optical systems were built in advance of anticipated demand to ensure that they would be shipped on time when scheduled for installation. Order cancellations caused optical equipment manufacturers to incur a large increase in finished systems inventory. To clear this inventory, price reductions were offered, resulting in an erosion of margins immediately after the collapse of the optical systems market.

Entering 2000 Lucent had problems beyond optical system sales that contributed to declining financial performance. Sales practices that had worked well in previous years to sustain revenue growth and margin increases were no longer effective.

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 ending 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, McGinn and William O'Shea, executive vice-president of corporate strategy and business development, identified the problem as a missed product cycle with OC-192 optical transport equipment.[23] 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.[24]

The OC-192 paradox

During the telecommunications "boom years," network traffic was dramatically increasing as a result of data and multimedia signals transmitted by the Internet and enterprise networks. To support this growth, established service providers initiated major network expansion projects to install sufficient capacity for anticipated increases in traffic into the future. Seeking to capitalize on this unprecedented industry growth, newer local telephone companies, known as the Competitive Local Exchange Carriers (CLECs), and emerging long-distance carriers were building entirely new networks.

The telecommunications service providers looked to optical technology to meet network capacity demand. Two approaches were used. Time Division Multiplexing (TDM), which is included in the SONET/SDH standards, dissects signals into uniform time slots that are transmitted along an optical fiber path. A faster transmission rate increases the system capacity, because a greater number of signal segments are transported per

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[23] Catherine Arnst, "Lucent: Clean Break, Clean Slate?" *Business Week* (6 Nov. 2000); Fred Barbash, "When Firms Can't Keep Up with Change," *Washington Post*, 15 Oct. 2000; Seth Schiesel, "How Lucent Stumbled: Research Surpasses Marketing," *New York Times*, 20 Oct. 2000.

[24] 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.

unit of time. Wave Division Multiplexing (WDM) transmits different wavelengths, or colors, of light on a single fiber. As the number of wavelengths increases, the volume of signal bits transmitted on a single fiber also increases. To prevent excessive signal distortion over long distances when operating at the OC-192 speed (10 Gbps), optical fiber with special properties must be used. WDM requires advanced optical systems that supply the additional wavelength sources and processing devices needed, but optical fiber used to interconnect these systems does not require special properties.

When making the decision regarding investment in OC-192 technology, several of the GROWS behaviors emphasized at the formation of Lucent came into conflict. The "global growth mindset" required Lucent to look for opportunities to broaden its customer base. "Obsession with customers" and "results oriented" required the company to fully understand the future needs of customers and develop new products that allowed those customers to increase profitability within the constraints of their operations or markets. However, these technology decisions had to be made with consideration of how Lucent could earn the largest return on each R&D investment.

The networks constructed by CLECs and emerging long-distance carriers used optical fiber suitable for OC-192 transmission. These customers could meet capacity needs using higher transmission rates and were interested in investing in OC-192 technology. However, the revenue potential from this set of customers was not as great as from the more established service providers.

The more established service providers, which comprised the vast majority of Lucent's customer base, had initiated very few "green field" network build-outs in which new fiber optic cable was being installed. These companies achieved capacity increases using the optical fiber already embedded in the network. Generally, this fiber was not capable of transmitting OC-192 signals over long distances, even though this high-speed technology was suitable in their shorter span metropolitan networks. Recognizing this constraint, Lucent developed high-capacity DWDM systems enabling them to achieve transport capacities comparable to OC-192 systems by multiplexing slower speed OC-48 signals (2.4 Gbps) that would not become degraded in older fiber optic installations. The DWDM capacity solution had much greater potential for revenue generation from Lucent's core customer base. It was also a suitable alternative for the newer service providers wanting to increase capacity without taking the risk associated with deploying newly developed OC-192 technology. Eventually, Lucent would need to address OC-192 capability for metropolitan and enterprise networks, as those would be the growth markets for optical technology during the post-decline years.

Thus, delaying development of OC-192 systems was a deliberate decision aimed at helping service providers increase capacity in an efficient, cost-effective manner. It was considered a viable alternative to

the Nortel approach of increasing capacity through ever increasing transmission rates.

Increasing financial and revenue recognition problems

In failing to take full advantage of the optical networking boom of 2000, Lucent achieved only modest revenue growth in fiscal 2000. 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, to create the image of a high-flying "new economy" company. When revenue growth could no longer be sustained because of decreasing demand, "creative approaches" were pursued to bridge the gap until the telecommunications equipment market recovered. From past experience, Lucent executives realized that the telecom equipment industry is cyclical; demand swings were experienced throughout the AT&T years. Therefore, they moved forward with these stopgap measures confident that the company's financials would be sound in the long term.

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 McGinn was ousted, Lucent revealed that it had improperly booked $679 million in revenue during the 2000 fiscal year.[25] 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.[26] In November 2000, the company was the target of two class action lawsuits from shareholders for the misreporting of 2000 revenues and earnings.[27] 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 fifty-four separate lawsuits for a total of $420 million.[28]

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 firms and

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[25] Mary Jander, "Lucent Shares Hammered by $125M Goof," *Light Reading*, 21 Nov. 2000, and "Lucent, Chromatis, and Ignitus: A True Tale?" *Light Reading*, (22 Nov. 2000).

[26] Carol J. Loomis, "The Whistleblower and the CEO," *Fortune* (7 July 2003).

[27] Tom Johnson, "Lucent Target of Lawsuits over 4th-Quarter Earnings," *Star-Ledger*, 29 Nov. 2000.

[28] "Lucent Technologies Reaches Agreement to Settle Shareowner Class Action," *PR Newswire*, 28 March 2003.

unproven technologies, vendor financing became 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.[29] 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 for bad debts to customers of $2.2 billion in 2001 and $1.3 billion in 2002.

At the same time as Lucent's financial performance was weakening, some of its most expensive acquisitions made in 1999 and 2000 to strengthen the company's new product portfolio 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.[30] 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

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[29] "WinStar–'The New Phone Company'–Debuts in Chicago," *Business Wire* (3 April 1997).

[30] Endlich, *Optical Illusions*, 115-18.

goodwill.[31] 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 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."[32]

In the decline of 2001-2002, as Lucent's financial shortfalls mounted, the stock market became an important source of finance for the company, 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 sixteen 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 percent 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 U.S. 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.[33] After all, U.S. corporations had behaved this way in the speculative boom of the late 1920s, and, in more recent history, major Japanese corporations had sold massive amounts of stock in Japan's "bubble economy" of the late 1980s.[34] Had it not been for this financial

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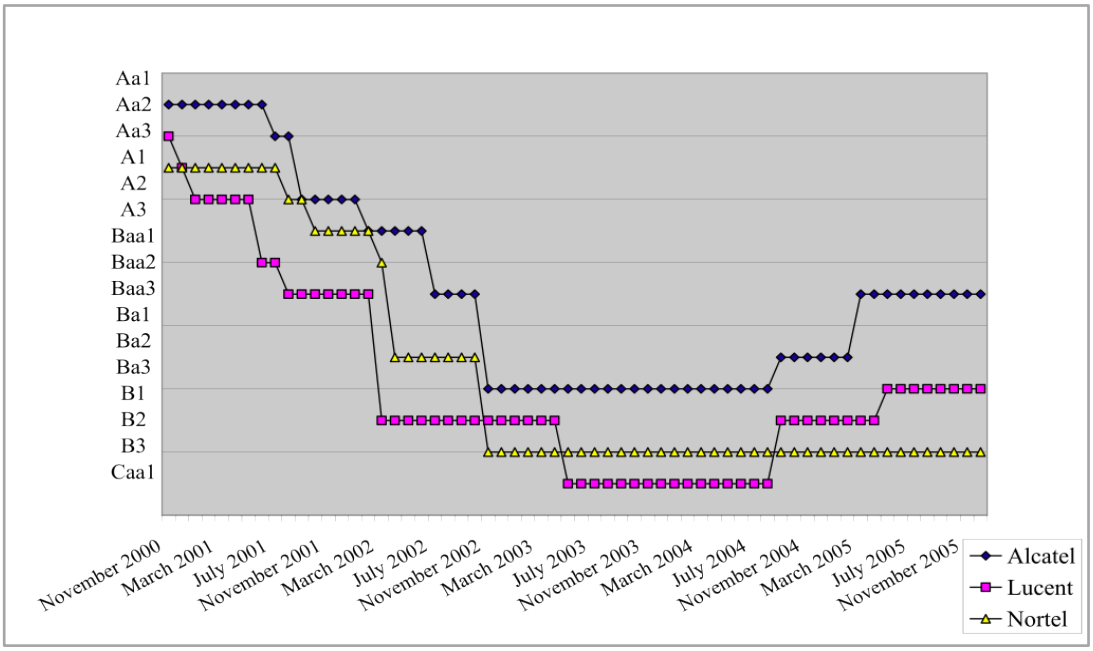
[31] Jander, "Lucent, Chromatis, and Ignitus," and Mary Jander, "Lucent Ditches Chromatis," *Light Reading*, 28 Aug. 2001.

[32] URL: http://www.moodys.com.

[33] Carpenter et al., "The Stock Market and Innovative Capability in the New Economy."

[34] Mary O'Sullivan "What Drove the U.S. Stock Market in the Last Century?" INSEAD Working Paper (2000); M. Ide, *Japanese Corporate Finance and*

Figure 7
Moody's Bond Ratings of Alcatel, Lucent, and Nortel,
November 2000–December 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 a 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.
Source: http://www.moody's.com.

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 2000 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

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International Competition (London, 1998); William Lazonick "The Japanese Economy and Corporate Reform: What Path to Sustainable Prosperity?" *Industrial and Corporate Change* 8 (Dec. 1999): 607-33.