

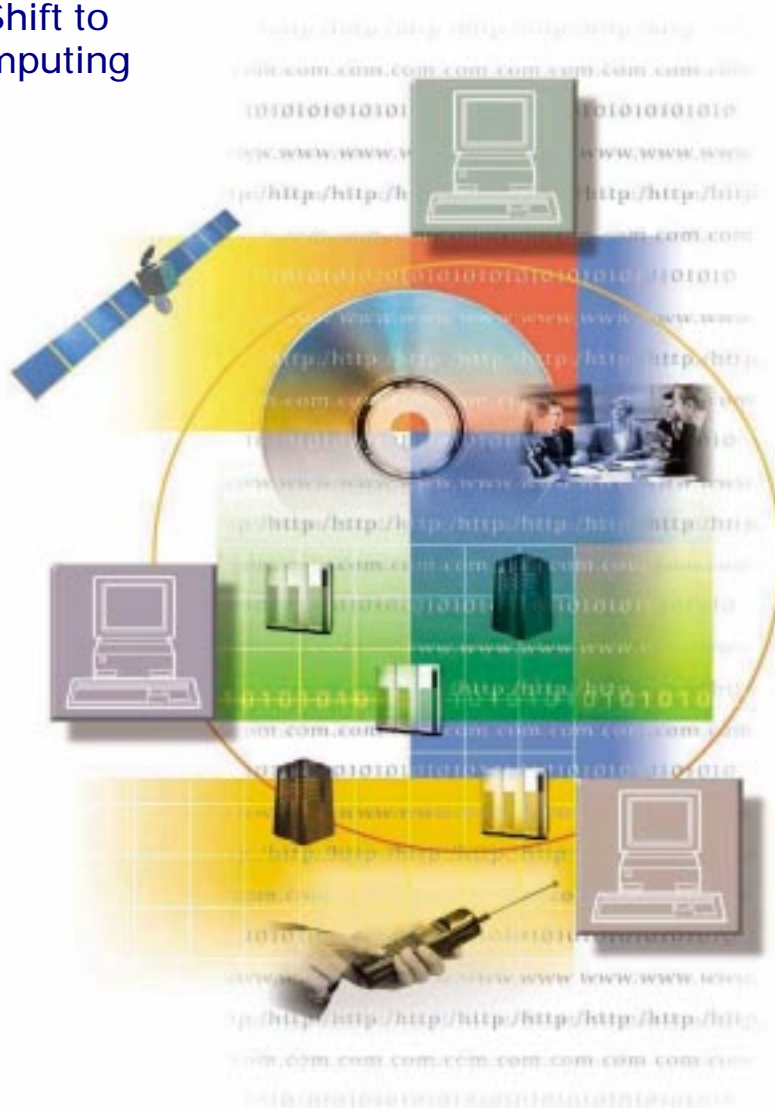
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Building the “Info Utility” Industry

Internet Infrastructure:
Winners in the Shift to
Web-centric Computing



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- Just as, in the early 20th century, electric utilities permitted firms and households to “outsource” the age-old function of power generation, so is the Internet making it possible to outsource another age-old function: information management.
- Instead of running Web sites on their own computers, companies are outsourcing this function to data centers run by other companies. As corporate operations shift to the Web, other data-processing functions should be outsourced to info utilities. So the emergence of this industry is part and parcel of the shift to Web-centric computing.
- Seven forces driving the emergence of info utilities:
 - ◆ The collapsing cost of bandwidth makes it feasible to store data in offsite computers and to access it as needed.
 - ◆ Information management is becoming more mission-critical and complex, and therefore best left in the hands of sophisticated specialists.
 - ◆ Info utilities’ costs are low because they possess economies of scale—an important consideration for customers as managing information becomes a larger share of their total costs.
 - ◆ Info utilities achieve “economies of skill” as well as “economies of scale”—customers can tap expertise they cannot hire in a tight high-tech labor market.
 - ◆ The virus factor: info utilities are expert at guarding against viruses and hackers.
 - ◆ Minimizing “total cost of ownership” of computers: It is cheaper to maintain and upgrade systems if they are centralized in a data center, rather than dispersed among many local area networks.
 - ◆ Digital democratization: info utilities enable small and mid-sized businesses, which could not install the most sophisticated software packages in-house, to use such software.
- Building the Info Utility industry will include:
 - ◆ Companies that build a corporate presence on the Web
 - Advisors (Electronic Data Systems, Proxicom, Scient)
 - Operators of Server Farms (Verio, Digex, Exodus)
 - Bandwidth Providers (MCI WorldCom, Qwest Communications)
 - Software (Oracle, Infospace.com, Microsoft, Citrix)
 - Hardware—*Enterprise Hardware* (Sun Microsystems, IBM, Intel); *Printers* (Hewlett-Packard); *Telecom Equipment* (Cisco, Lucent, Nortel Networks)
 - Domain Names (Network Solutions)
 - ◆ Companies that connect consumers to the Web
 - Personal Computers (Gateway)
 - Internet Service Providers (America Online)
 - Electronic connections to the Web—*Cable* (AT&T, Comcast); *Satellite* (Hughes Electronics); *Retailers* (Tandy)

Building the “Info Utility” Industry

Everyone knows that the Internet is transforming the global economy by digitally linking everything to everything else, but in some respects the change is even more fundamental than that. We are witnessing the rise of a new industry—the *info utility industry*—which feeds data to the rest of the economy, much as the electric utility industry provides energy. Whether it was people power, animal power, wind power, waterpower, or (beginning in the late 18th century) steam power, businesses and households have always used energy. But for many centuries they produced and managed *their own* energy generated by their own power plant, whether it was a wooden wheel driven by a waterfall or a coal-powered steam engine in the basement of a factory.

The Electric Utility . . .

This arrangement began to change in the 1880s and 1890s with the development of electricity, which was at first used primarily for lighting. Though consumers quickly agreed that electric light was brighter, cleaner and safer than gaslight, this realization did not automatically launch the electric *utility* industry. At first, many factories and office buildings simply *used their own existing power plant*—be it a coal-burning furnace, a steam engine, or a waterworks—to generate enough electricity to illuminate the building. It took years of innovation, persuasion and shrewd marketing stratagems (such as offering to wire six lighting outlets for free and subsidizing the purchase of electric irons manufactured by GE) before electric utility entrepreneurs convinced people to abandon their “self-contained plants” and instead rely on energy supplied by a “central station”—what we now refer to as an “electric utility plant.” The leader of this effort was Samuel Insull, an aide to Thomas Edison who became CEO of Commonwealth Edison in Chicago. Insull’s strategies are detailed in Harold L. Platt’s excellent book, *The Electric City*.

A major challenge for electric utility executives was to expand the uses of electricity beyond lighting (which was mainly used at night) to other tasks that would balance the load across a full 24-hour day (Figure 1). Using the plant’s capacity more fully and evenly would reduce unit costs and permit lower prices. Electric trolley cars were part of the answer. Another victory in this lengthy campaign to “diversify” electricity demand was convincing the owners of office buildings that it was cheaper to power their elevators with electricity purchased from a central station than with power produced in-house. Because an individual building needed to invest in powerful generating capacity that was (literally) used for heavy lifting only sporadically—i.e., when the elevator was actually moving—it was cheaper for buildings to use power generated by a central station. Gradually, Samuel Insull and his colleagues won the argument, attracting customers to their central stations, which in turn balanced the power load across the day and the week; created economies of scale; and permitted lower rates, which in turn led to increased electricity sales, bigger and more efficient plants, and still lower rates (Charts 1, 2). By the 1920s giant new factories—including auto assembly plants—were being powered by the electricity supplied by Commonwealth Edison and its peers. These electric utilities were among the glamour stocks of the 1920s. (See “The Information Revolution Wars,” May 9, 1999).

We are witnessing the rise of a new industry—the info utility industry—which feeds data to the rest of the economy, much as the electric utility industry provides energy.

Figure 1: Promoting Electricity Consumption

To increase electricity consumption, utilities promoted "table cookery."



Electric Cooking Appliances

TABLE cookery was rapidly introduced and accepted. Manufacturers of electric cooking appliances accurately sensed the needs of the modern home and developed products that combined convenience with utility. That immediate popularity should have resulted for the toaster, chafing dish, grill, waffle iron, percolator and the many other table conveniences, is not surprising.

We often wonder how many cups of coffee, how many crisp pieces of toast, how many waffles, chops and other delicious menu items are prepared with the Electric Service we supply to Manhattan's households. We hope they exceed our calculations, for we know of no simpler and tastier method of preparing food.

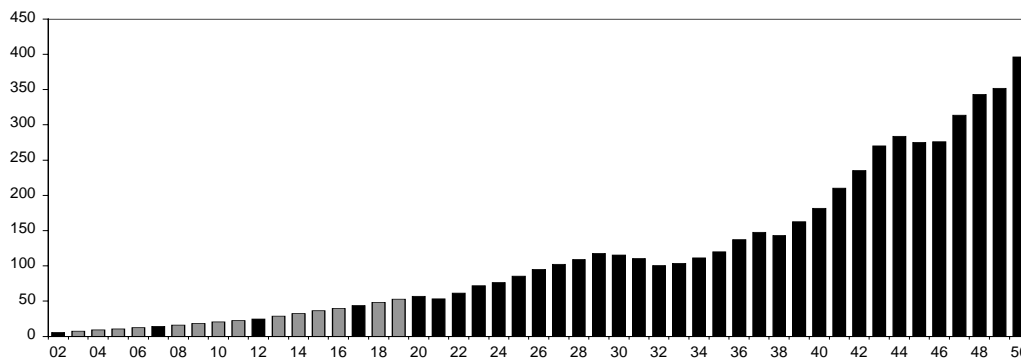
**The United Electric
Light and Power Co.**
130 East 15th St., New York.

Source: *New York Times*, March 9, 1921.

Of course, the development of electricity enriched many companies besides utilities. Such firms as General Electric and Westinghouse prospered by manufacturing a wide range of appliances, as well as equipment for generating and distributing power. Demand for copper surged, benefiting mining companies in the West. The proliferation of suburban trolley lines created a new source of demand for railway equipment companies just as the national railway network was being completed. And even after electricity had become a ubiquitous feature of middle-class life, it spawned a second generation of great growth industries. The viability of the film industry was established in 1915 by the success of *Birth of a Nation*, and Hollywood flourished in the 1920s. In that decade as well, a craze for radio swept the land; sales of radios and accessories rose from \$60 million in 1922 to \$843 million in 1929—a 46% compound annual growth rate. RCA—"Radio" to Wall Street traders—was one of the hottest stocks of the great bull market.

Chart 1: Total Electricity Used, 1902-1950

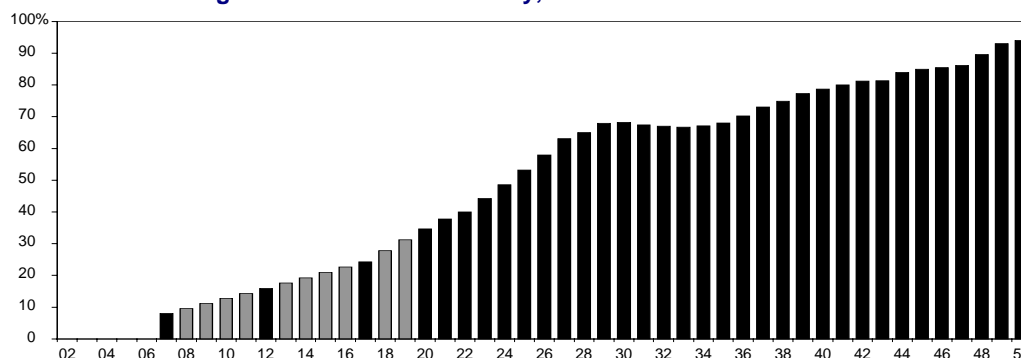
Billions of kilowatt-hours



* shaded bars are estimates

Source: *Historical Statistics of the United States, Volume II, p. 828.*

Chart 2: Percentage of Homes with Electricity, 1902-1950



* shaded bars are estimates

Source: *Historical Statistics of the United States, Volume II, p. 827.*

... and the Info Utility

Over the next couple of decades in-house information systems are likely to become anachronistic, as old-fashioned as the apartment building that generates its own electricity to power the elevator.

Although the analogy is not exact, something similar is occurring today in the realm of information management. For centuries companies have been managing their information “in house,” whether via giant ledgers painstakingly inscribed by clerks wielding quill pens; or typewriters and filing cabinets; or giant card-sorting machines (the main product of the pre-electronic IBM); or mainframe computers; or networks of servers and personal computers. But over the next couple of decades, these in-house information systems are likely to become anachronistic, as old-fashioned as the apartment building that generates its own electricity to power the elevator. Just as energy production was outsourced to electric utility plants, information management is increasingly being outsourced to “server farms”—giant warehouses where hundreds of computers operate Web sites and run other applications for corporate customers.

Operated by such companies as Exodus, MCI WorldCom and Qwest Communications, these server farms have high-bandwidth connections to the Internet, tight physical security, and large staffs of engineers providing a variety of sophisticated services. Although now used primarily for Web hosting and e-commerce, the role of

server farms should expand rapidly over the next few years to include storing electronic data and hosting “application service providers”—firms that rent software to customers. The rise of the info utility industry, which is still in its infancy, is being driven by several powerful forces:

- As the cost of bandwidth collapses, it is economically feasible to store data in off-site computers and access it as needed.
- The rise of the Internet and e-commerce mean that information management is simultaneously becoming more mission-critical and more complex. Firms are therefore more willing to leave the work to specialists employed by server farms.
- Managing information is becoming a larger percentage of a company’s total cost, which makes it a competitive necessity to do so as cheaply as possible. Off-site data centers enjoy economies of scale that dramatically reduce unit costs.
- Info utilities achieve “economies of skill” as well as “economies of scale.” The labor shortage in high technology is acute and virtually certain to intensify further. In comparison to specialized high-technology firms that can offer challenging, cutting-edge assignments, your run-of-the-mill widget manufacturer has a hard time attracting high-tech talent. Information utilities are able to leverage the talent of the staff across their entire customer base.
- The virus factor: Though no defense against hackers and viruses is perfect, a sophisticated data center employing top-flight specialists has the best chance of success. Many companies, ranging from tiny home businesses to middle-market corporations, will deem it prudent to store critical files in an off-site server farm. Although in some ways it is psychologically difficult to let an outsider control your most valuable records, it is also safer. Outsiders already handle many other mission-critical functions, such as electricity and phone service.
- Minimizing total cost of ownership of information systems. As product cycles get shorter and systems become more complex, companies are realizing that—even though hardware is getting dramatically cheaper—the “all in” cost of buying hardware and software *and* employing a staff to install, upgrade and support systems is high and rising. Renting software from an ASP (application service provider) may prove cheaper and easier.
- Digital democratization. As the entire economy goes digital, all companies have no choice but to follow suit. Certainly large, established companies—such as the big brick-and-mortar retailers—must engage in e-commerce. But mid-sized companies that historically could not afford the cost or complexity of implementing the most sophisticated software solutions, such as Oracle databases, are interested in renting this software for a fixed monthly fee from applications service providers.

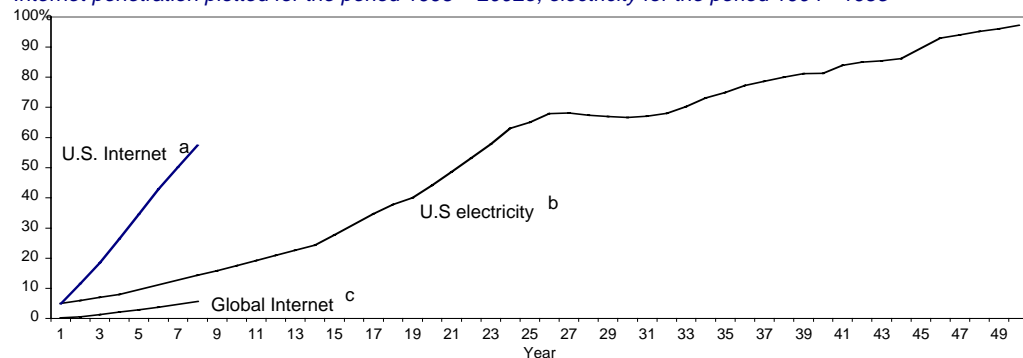
The Internet has spread considerably faster than electricity; one reason for this is that the key infrastructure components—personal computers and phone lines—were already in place, whereas the entire electricity infrastructure had to be built out.

These potent forces are driving a shift to “Web-centric computing.” As IBM CEO Louis V. Gerstner, Jr. pointed out in his firm’s annual report, this is not a future trend but an established fact. Every time you buy a stock online, calculations are performed on the Web, using data stored on the Web. You can go to the Web site of any large real estate broker and calculate, free of charge, what your monthly payment would be based on various assumptions about the principal amount, interest rate, and length of the loan. Using such a calculator is a lot cheaper and easier than installing on your own PC software that will perform the same calculations—just as it is easier to let the electric utility produce your electricity, rather than doing it yourself. In the U.S. the Internet has spread considerably faster than electricity (Chart 3); one reason for this is that the key infrastructure components—personal computers and phone lines—were already in place, whereas the entire electricity infrastructure had to be built out.

The analogy between utilities and Web-based computing is made by software company Citrix Systems. It likens server-based computing to the telephone system, where new services, such as call forwarding or voice mail, are simply turned on by calling a central location. “Think of how frustrating it would be if requesting a simple new device, such as call waiting, required the phone company to send a technician to your home to install new software on all your phones. Some of your phones might require more memory and others might have to be replaced with the newest version phone. The technician would need to spend countless additional hours reconfiguring each phone to ensure optimum performance, only to finish and inform you that you really need to upgrade all the wiring for the system to work properly. It sounds ridiculous. Yet thousands of companies go through this exact process every day when trying to install and manage business-critical applications.” Server-based computing, Citrix claims, makes it much easier to install, upgrade and use software.

Chart 3: Penetration of Electricity and the Internet

Internet penetration plotted for the period 1995 – 2002e, electricity for the period 1904 - 1953



- a – Percent of U.S. households with Internet access through PC or non-PC devices
- b – Percent of U.S. households with electricity
- c – Percent of global population using the internet

Source: *Historical Statistics of the United States*, Volume II, p. 827, IDC and PaineWebber.

Growth of the Info Utility Industry Should Be Explosive

We have seen that:

- There is a strong and increasing need for corporations and individuals to patronize info utilities;
- Though in its infancy, the industry is already a well-established part of the economy.

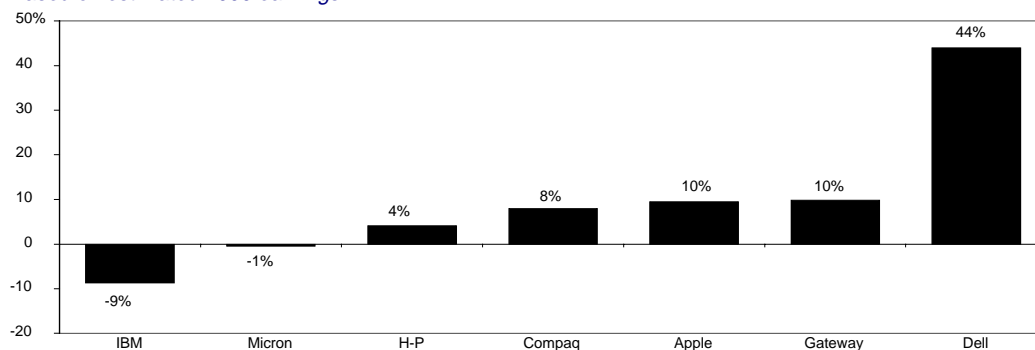
Nevertheless, it would certainly be possible for the info utility industry to be impeded by a variety of roadblocks. This occurred, for example, to railroads in 19th-century America. Because of a financial panic in 1837 and a lengthy depression in the 1840s, which scared away British investors, railroads linking New York City and Chicago were started in the 1830s but not completed until the 1850s. However, such misfortunes are not likely to sidetrack the info utility industry, which is being moved forward by these powerful forces:

- The industry will take a “Great Leap Forward” when corporate gorillas such as Wal-Mart, General Motors, General Electric, Procter & Gamble and Johnson & Johnson shift their basic, nuts-and-bolts operations to the Web—i.e., not just selling on the Web, but *buying* on the Web.
- Competitive forces will prompt them to make this move soon; GE’s Jack Welch has already made the move to the Web his top priority. He and others see how Dell leapfrogged competitors by moving to the Web; in 1999, Dell earned about 44% of the total profits earned by major U.S. PC manufacturers (Chart 4). When giant firms move to the Web, they will bring along thousands of suppliers who represent a sizeable chunk of global GDP. Corporate gorillas have plenty of money, and the capital requirements are not huge, so this Great Leap Forward would occur even if a recession were to chill the financial markets—something we do not expect.

Because the Internet is an “open platform” based on the Internet Protocol standard, thousands of entrepreneurs are free to feverishly construct the info utility industry without risk of building a business on the wrong technical standard, such as faced pioneers in electricity.

Chart 4: Major U.S. Manufacturers’ Share of PC Industry Profits

Based on estimated 1999 earnings

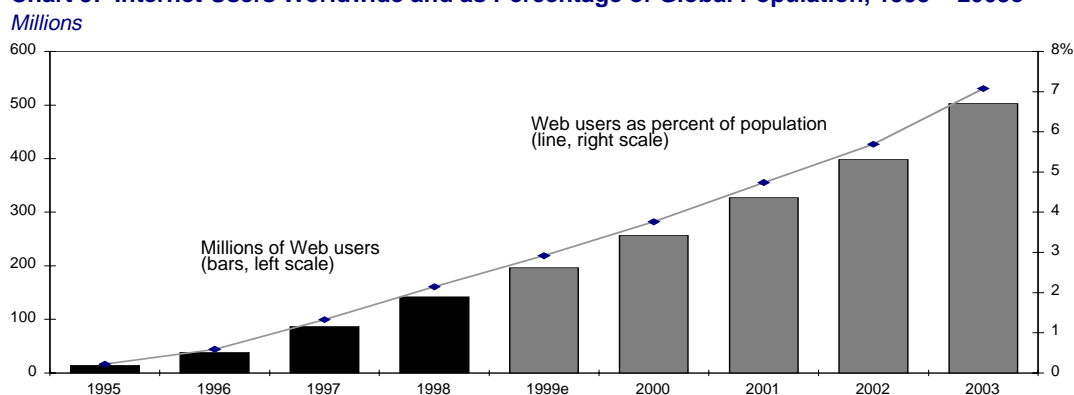


Note: Small manufacturers and foreign competition account for the remaining 34% share of profits.

Source: PaineWebber.

- Because the Internet is an “open platform” based on the IP (Internet Protocol) standard, thousands of entrepreneurs are free to feverishly construct the info utility industry without risk of building a business on the wrong technical standard, such as faced pioneers in electricity (AC or DC?), autos (gasoline, steam, or electric?) and personal computing (MS-DOS or Mac OS 0.7?). Furthermore, no corporation or cartel or government can control the pace of the Web build-out the way, for example, IBM set the pace of mainframe computing; Intel and Microsoft influenced the evolution of the PC; or the RBOCs have controlled local telephony for the last decade and a half.
- Web connectivity is proliferating. Today, PCs are the dominant device for connecting to the Web, but wireline phones, wireless phones, satellite-PCs, palm pilots and other devices are crowding into the market. Again, competition should propel innovation and rapid growth (Chart 5).

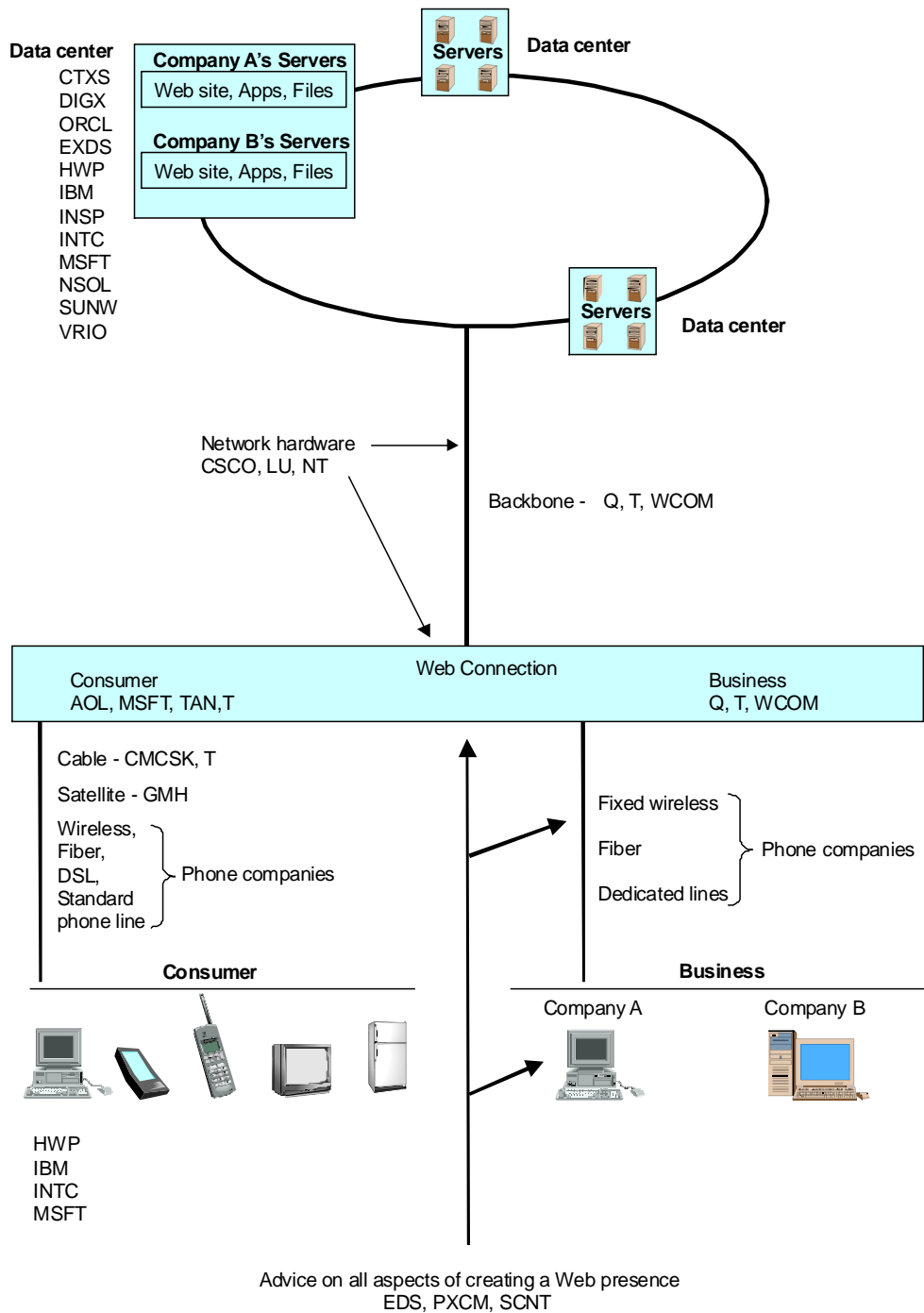
Chart 5: Internet Users Worldwide and as Percentage of Global Population, 1995 – 2003e



Source: IDC, June 1999.

- The Web is instantly international; a Web surfer traveling on business in Bangkok can shop for a Gameboy on eBay and, if she puts in the winning bid, have the seller (who lives in London) ship it to her house in Chicago. So the build-out of the info utility will not spread slowly across the globe. Europe and Japan (which are ahead of the U.S. in some areas such as wireless) are developing their own info utility industry, with considerable involvement from U.S. firms.
- Capital is not a serious constraint because much of the physical infrastructure—an installed base of networked PCs and servers, a national grid of telephone and cable wires, wireless and satellite systems—is already built (Chart 6). To be sure, as we saw in the autumn of 1998, a bear market *would* deprive some young companies of financing in the equity and junk bond market for a few precious months. But, driven by the cash flow of well-established companies, the info utility industry would continue to develop rapidly.

Chart 6: The Info Utility Industry



Source: PaineWebber.

As was true of electricity, it will take a long time for info utilities to become a dominant feature of the economy. Thomas Edison invented the light bulb in 1878, and Samuel Insull was peddling electricity to Chicago office buildings at the turn of the century, but it was not until the 1920s that many all-electric factories were built. One reason for the measured pace of change was that a huge “installed base” of coal-fired steam engines already existed. Similarly with information, companies will migrate to info utilities over a long period of time. When companies first establish a presence on the Internet, many will prefer initially to operate their own servers. Later, as their Internet operations become more complex—shifting, for example, from “brochure ware” to e-commerce—they are likely to outsource some activity to server farms. Later still, after they have become comfortable with outsourcing, some internal software applications—such as inventory management or human resources software—may also be shifted to the Web.

Info Utilities are a 21st century application of an idea articulated in 1776 by Adam Smith's The Wealth of Nations—boosting efficiency by replacing customized, built-to-order, one-of-a-kind products with standardized items. Standardization and specialization slashed the cost of making shoes and textiles in the first industrial revolution and is doing the same in the information revolution today.

Probably the first companies to totally outsource their operations to info utilities will be new companies that do not have a legacy of in-house information technology in which they have invested millions of dollars and thousands of hours. For example, Corio Inc. is an ASP (application service provider) that specializes in offering a full suite of business software to high-growth businesses. Corio Intelligent Enterprise provides, over a secure network, software solutions from PeopleSoft (for human resources and financial management), Siebel (for customer relationship management), CommerceOne (procurement), Cognos (business intelligence, i.e., data mining), and BroadVision (e-business). By renting this suite of software, Corio claims, small companies can “obtain immediate ‘out of the box’ access to world-class e-business capability for a monthly fee—without the costs and challenges they would experience acquiring, integrating, managing and supporting the applications themselves.”

Corio's strategy illustrates a key factor behind the rise of info utilities. With the world moving at “Internet speed,” companies are rushing to build Web-based business models, lest they be bypassed by competitors. So instead of laboriously building customized in-house IT systems they are using the “Lego Block” approach of assembling an information system from prefabricated elements. Then, the system is managed by specialized workers operating out of a server farm, which enjoys economies of scale. This is a 21st century application of an idea articulated in 1776 by Adam Smith's *The Wealth of Nations*—boosting efficiency by replacing customized, built-to-order, one-of-a-kind products with standardized items. Standardization and specialization slashed the cost of making shoes and textiles in the first industrial revolution and is doing the same in the information revolution today.

If we are correct that it will take a long time for the economy to substantially switch to info utilities, does that mean that that we take a pessimistic view of the industry's prospects? Not at all. Because the market in question is so huge (literally any information in the world that can be digitized, from accounting information to movies to 3-D models of manufactured products) and is growing so fast, it is possible for the info utility industry to grow very rapidly, from a small base, and for it to still take a long time before a majority of companies and households have shifted their information off-site.

Leaders in the Info Utility Revolution

To identify the best ways to participate in the build-out of the info utility industry, we asked PaineWebber analysts for their recommendations. The 26 companies in Table 1 all sell goods and services that will help businesses and individuals connect to, or establish a presence on, the Internet. These infrastructure companies are conceptually distinct from companies, such as Amazon.com or eBay, that are themselves operating a business on the Web. The names in Table 1 vary widely, from corporate consultants to telecom equipment companies to cable companies. A quick survey of these firms provides an informative snapshot of the emergence of the info utility industry, which is shaping up as one of the most fascinating and momentous chapters in American economic history.

Table 1: Beneficiaries of the Rise of the Info Utility Industry

Ticker	Name	Price (2/10/99)	PW Rating	1999 EPS	2000 EPS Estimate	Market Cap (\$ billions)	1999 sales (\$ millions)	Proj. EPS Growth Rate
AOL	America Online	58 7/16	Buy	\$ 0.17	0.35	132.2	4,777.0	50%
T	AT&T	49 1/8	Buy	2.20	2.15	157.0	62,391.0	10
CSCO	Cisco Systems	135 15/16	Buy	0.75	1.02	448.7	12,154.0	35
CTXS	Citrix Systems*	181 15/64	n/a	1.35	1.69	16.0	403.3	40
CMCSK	Comcast Corp	50	Buy	0.11	0.26	37.8	6,378.0	14
DIGX	Digex	90 13/16	Buy	-1.25	-1.95	5.2	59.8	50
EDS	Electronic Data Systems	73 3/4	Buy	1.92	2.27	36.5	18,634.2	16
EXDS	Exodus Communications	120 3/8	Buy	-0.78	-0.92	20.2	241.6	60
GTW	Gateway	58 1/4	Buy	1.36	1.85	18.3	8,645.5	25
GMH	Hughes Electronics	105 7/8	Buy	-0.84	-0.35	45.5	6,916.3	10
HWP	Hewlett-Packard	125 7/8	Attractive	2.99	3.43	126.5	42,370.0	15
INSP	Infospace.com	191 1/2	Buy	0.07	-0.41	18.5	36.3	50
INTC	Intel	107 5/8	Buy	2.32	3.05	359.0	29,389.0	20
IBM	Intl Business Machines	119 1/8	Buy	3.63	4.30	213.6	87,548.0	15
LU	Lucent Technologies	53	Buy	1.22	1.33	161.2	38,303.0	20
WCOM	MCI WorldCom	49 13/16	Buy	1.33	1.90	140.0	33,365.0	20
MSFT	Microsoft	106	Buy	1.39	1.65	543.7	19,747.0	30
NSOL	Network Solutions	292 5/16	Buy	0.77	1.10	9.7	209.2	50
NT	Nortel Networks	122 5/8	Buy	1.02	1.29	168.2	22,217.0	16
ORCL	Oracle	62 5/16	Attractive	0.43	0.56	178.1	8,827.3	25
PXCM	Proxicom	110	Attractive	0.15	0.30	2.9	82.7	50
Q	Qwest Communications Intl	45 5/8	Buy	0.09	0.15	34.0	3,927.6	15
SCNT	Scient	89 1/2	Buy	-0.06	-0.06	5.2	20.7	60
SUNW	Sun Microsystems	94 5/8	Attractive	0.69	0.91	147.0	11,726.3	30
TAN	Tandy	42 1/4	Buy	1.48	1.73	8.2	4,093.4	18
VRIO	Verio	68 1/8	Attractive	-2.62	-2.89	5.2	257.6	57

* First Call consensus EPS, all others are PaineWebber estimates.

Source: FactSet and PaineWebber.

Table 2: Building The Info Utility Industry

- ◆ **Building a corporate presence on the Web**
 - **Advisors**
 - Electronic Data Systems, Proxicom, Scient
 - **Operators of Server Farms**
 - Verio, Digex, Exodus
 - **Bandwidth Providers**
 - MCI WorldCom, Qwest Communications
 - **Software**
 - Oracle, Infospace.com, Microsoft, Citrix
 - **Hardware**
 - ❖ **Enterprise Hardware**
 - Sun Microsystems, IBM, Intel
 - ❖ **Printers**
 - Hewlett-Packard
 - ❖ **Telecom equipment**
 - Cisco, Lucent, Nortel Networks
 - **Domain names**
 - Network Solutions
- ◆ **Connecting consumers to the Web**
 - **Personal Computers**
 - Gateway
 - **Internet Service Providers (ISPs)**
 - America Online
 - **Electronic connections to the Web**
 - ❖ **Cable**
 - AT&T, Comcast
 - ❖ **Satellite**
 - Hughes Electronics
 - ❖ **Retailers**
 - Tandy

(For a detailed discussion of the "nuts and bolts" of Internet infrastructure, see the informative report by PaineWebber analyst John C. Hodulik, "E-nabling a Net-centric World," December 8, 1999.)

Building a Corporate Presence on the Web

Advisors

Compelled to quickly build a presence on the Web, companies of all types need two things: a good strategic plan for getting on the Web, and the hands-on technical skills to get it done. So demand is strong for information technology service firms that can design Web sites, install e-commerce software (such as Open Market, Inc. or BroadVision), build Internet systems architectures (such as Oracle), and provide management consulting related to Internet strategies. It is estimated that fewer than 5% of *Fortune* 500 companies have invested beyond the marketing and branding of front-end sites to integrate their systems enterprisewide, which would increase operating efficiencies and improve customer service. Now that the Y2K preoccupation is over, firms can concentrate on this mission. PaineWebber analyst Andrew Burns believes that the three best-positioned firms are Electronic Data Systems, Proxicom and Scient.

It is estimated that fewer than 5% of Fortune 500 companies have invested beyond the marketing and branding of front-end sites to integrate their systems enterprisewide.

New management installed at **Electronic Data Systems** in 1999 raised the firm's e-business profile by reorganizing the e-business unit, recruiting new management and advertising more aggressively. E-business is only 5-10% of revenue today, but comprises 15-20% of new business bookings and pipeline. The increasing complexity and scale of Internet consulting and systems integration projects—a trend reflected in the rise in average project size from \$500,000 two years ago to \$2-4 million today—plays into the hands of larger firms such as EDS and IBM Global Services.

Proxicom, by virtue of its comprehensive e-services offerings, vertical alignment, leading partnerships, growing international presence and strong management team, is also well positioned in the e-services arena. Unlike most of the competition, which remains regionally and nationally focused, Proxicom is rapidly gaining strong mindshare and critical mass internationally. The company is also establishing its leadership in developing Web applications for wireless applications, the next huge growth driver in the e-services market.

Scient is one of only a handful of companies that have focused exclusively on e-services since inception, enabling clients to leverage the reach and efficiency of the Internet to radically create or transform their business models. Known as the "Green Berets" of Internet consulting, Scient has strong management, critical mass and integrated expertise in creative Web design, strategic consulting and complex back-end technology integration. Scient's clients are both established *Fortune* 1000 companies and higher-growth "dot coms." The company recently launched Scient Capital, enabling it to take an equity stake in the start-ups that it helps to build.

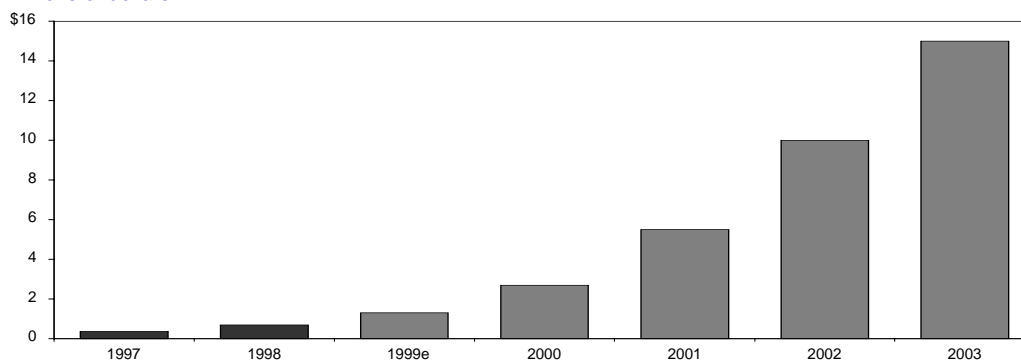
A key driver of demand for IT services is that, in comparison to their customers, service firms are better able to hire skilled technology workers, who would prefer to work for a high-octane tech company handling a variety of interesting projects. But the high-tech labor shortage also poses a risk to IT service firms, because their business is not very scaleable—i.e., to grow, they need more people. To acquire employees in a tight labor market, some firms may make acquisitions, which can be risky.

Operators of Server Farms

After developing a Web strategy, many firms will establish a Web site in a data center, also known as a “server farm,” operated by an Internet infrastructure company. In the newly emerging info utility industry, this is where outsourcing actually takes place; instead of operating their own data centers, firms are—to one degree or another—leaving the task of Web hosting to other firms that have special expertise and economies of scale. Between 1999 and 2003, revenues from Web hosting are forecast to grow 84% annually to \$15 billion (Chart 7).

Chart 7: Web Hosting Revenues, 1997-2003e

Billions of dollars



Source: IDC.

Shared Hosting

PaineWebber analyst John Hodulik notes that there are three flavors of Web hosting—shared, dedicated and colocation—each with its own economics and target customers. Shared hosting, so named because many customers share the same server, is the low-end market segment, serving smaller companies with relatively small Web sites (up to 500 megabytes of data, or roughly 10,000 pages). As many as 3,000 corporate and personal Web sites are hosted on a single server owned by the hosting provider and housed in a data center. Sharing facilities helps to lower the cost of service; Web sites requiring less than 50 Megabytes of storage space generally cost \$15-25 per month. Sales of shared hosting services often occur over the Internet with little interaction between customer and provider. Secondary channels such as telecommunications carriers are important in this model.

This is a commodity business where economies of scale are important to profitability. The best-positioned firm may be **Verio**, the largest supplier of shared hosting to small and medium-sized businesses. Its national platform enables Verio to supply bundled turnkey packages of Internet access, e-commerce and other complex services to companies that do not have the expertise to do it themselves. It has been acquiring companies in the U.S. and Europe to consolidate the fragmented market.

Dedicated Hosting

This is the middle segment of the market, serving customers with more complex Web sites and Web-based applications looking to outsource all aspects of the delivery platform. Instead of sharing a server, each customer has its own server or servers in one

or more data centers that support sophisticated mission-critical applications such as e-commerce, internal communications, personnel management, and other enterprise resource planning functions. Pricing depends on the number of servers required to support the applications, the amount of bandwidth needed to handle the traffic, and additional services required to manage the site. The monthly cost can range widely, from \$1,000 for a simple site to as much as \$500,000.

Dedicated hosting is offered by a limited number of providers, the largest of which manage as many as 2,000-3,000 servers. Typically each customer chooses a hosting platform based on the UNIX or Windows NT operating platform. The Web-hosting company will supply the hardware required to support the site, depending on the customer's needs. On top of this is built the middleware platform, from providers such as Microsoft, IBM and Netscape. The emerging leader in this space is **Digex**, which has large enterprise customers such as Ford, Nike and United Airlines. Sales growth has been accelerating, and its standardized format allows Digex to minimize costs while focusing on value-added services such as security, applications management and usage reporting.

Colocation

This model appeals to highly sophisticated customers (such as the biggest dot.com players) that have a dedicated IT staff and want hands-on control of their Internet activities. In contrast to hosting, colocation customers choose the platforms and network architecture on which their Web site will be based. Customers generally physically move their existing equipment from internally operated data centers to those operated by third-party providers and augment those platforms as the functionality and traffic load increase. Economies of scale created by large Web-hosting providers can cut the costs of providing complex Web-hosting and colocation services to 10-20% of what it would cost a company to host its own site internally. The provider generally gets revenue from three sources: physical space within the data center, connectivity or bandwidth, and value-added services.

Exodus is the category killer in colocation geared toward large dot.coms and *Fortune* 2000 firms. Its customer list is a Who's Who of the Web, including Yahoo!, Hotbot, Excite, priceline.com, Travelocity, eBay, GeoCities, CBS Sportsline, DoubleClick, Buy.com, Excite, MSN Hotmail and Ask Jeeves. It operates 22 major Internet data centers, with a goal of 34 major sites by the end of this year. To reduce time to market and improve the platform of services, it has made many acquisitions that give it a bundle of services that few, if any, competitors can match.

Bandwidth Providers

Although wireless will become important, the torrent of digital information that flows in and out of server farms is now principally carried over wires. The companies that own those wires have a very valuable asset, because bandwidth demand should soar over the next decade; bandwidth consumed on the Internet doubles roughly every 90-120 days. Best positioned, among the companies we follow, are **MCI WorldCom** and **Qwest Communications**. PaineWebber analyst Eric Strumingher estimates that 35% of WorldCom's consolidated revenue will come from providing data services,

compared to an industry average of 10-15%. The vast majority of this revenue (about 75%) is in complex data services sold to corporations, rather than to other carriers. Moreover, MCI WorldCom is taking share in the data business; its revenues are growing 35%, versus 30% for the industry. UUNet, a WorldCom subsidiary, provides the Internet backbone for AOL, and AOL's merger with Time Warner means that in a couple of years Bugs Bunny cartoons and Warner Brothers movies—which require much more bandwidth than text and still pictures—will be traveling over WorldCom's network. This should accelerate a business that is already very strong.

Qwest Communications is a young company that made a big, bold, winning bet a few years ago that the volume of digital traffic would explode. It has quickly built a 19,000-mile broadband fiber optic network that serves 150 U.S. cities as well as Mexico and Europe. CEO Joseph P. Nacchio writes, “Our network is the first built to the exact specifications of the new era of the Internet. It allows us to give customers the two things they want most in network technology—reliability and the scalability that enables technology to evolve with their needs. The Qwest network is a core advantage that competitors with deeply embedded legacy systems will find very difficult—and very expensive—to match.”

Of course, to get on the Web consumers need an Internet service provider, where the dominant player is **America Online**. The company has roughly 50% of the U.S. market, and just about the best brand on the Web. Its unique mixture of Internet connectivity, community, and content has been vastly strengthened by the acquisition of Time Warner, the ultimate content company.

Software

The rise of info utilities transforms the competitive landscapes of the software industry. For years there has been a spirited argument between Bill Gates of Microsoft on the one hand and Larry Ellison of Oracle and Scott McNealy of Sun Microsystems on the other. Ellison and McNealy have argued that the incumbent “client-server architecture”—e.g., PCs connected to a local area network—would be supplanted by PCs connected to a wide area network, with operating systems, data and application logic residing in a computer center rather than on dispersed PCs and servers. This more centralized arrangement, they claimed, would reduce the “total cost of ownership” because software upgrades could be made more cheaply.

This is one of the few arguments that Bill Gates has lost. As Ellison notes in Oracle's annual report, “Database applications running on corporate Internets combine the best of mainframe and client-server computing: great user interface [a strength of the traditional PC], low-cost PC hardware, efficient wide area networking and centralized data backup and software upgrades.” Oracle is ideally positioned for this arrangement, because its bread-and-butter databases are used to manage vast amounts of data—whether it is an inventory of auto parts or millions of customer accounts. More specifically, Oracle benefits in two ways from the Web: because new databases are being set up on the Web, and because its applications have been rewritten from the client-server model to the Internet model ahead of most of its traditional competitors. The company now has as customers all of the top ten business-to-consumer

e-commerce sites and nine of the top ten business-to-business e-commerce sites. The Internet and e-commerce are driving an acceleration in Oracle's business. Importantly, the Web makes it easier for mid-sized corporations to take advantage of Oracle's software, which is highly complex; this should expand demand further.

Another software infrastructure beneficiary is **Infospace.com**, which provides enabling technologies and Internet services for Web sites and Internet appliances. PaineWebber analyst James Preissler thinks Infospace will become a key constituent of the Web's software infrastructure. The company essentially offers an unbranded "Web portal in a box" including integrated content such as white and yellow pages, maps and directions, weather, real-time stock quotes, community services including address book and calendar, and communication services such as private-label e-mail and instant messaging, which it then licenses and distributes through its branded partners. Its 2,100 affiliates include AOL, Netscape, and Microsoft's MSN. In addition to providing infrastructure services to Web-enabled wireless telephones, Infospace will also do the same for Internet-enabled home appliances, such as notepads that Intel will be selling by the middle of this year.

Where does this leave **Microsoft**? In an environment offering enormous opportunities to grow, but also more competition. The company has many avenues of growth. Its *Windows* operating system dominates the PC market, which will be the primary method of accessing the Web for the next five years at least. Its leading *Office* applications, including the *Exchange/Outlook* messaging application, will likely carry their "off-line" dominance over to the Internet world. Windows NT is one of the two dominant operating systems used by servers in data centers. And Microsoft is forming alliances with all types of broadband vendors to gain leverage for placing Microsoft technology on non-PC devices (e.g., cell phones, palmtops, set tops, etc.).

A likely beneficiary of the rise of the info utility industry is **Citrix**, whose software enables server-based computing. Using Citrix software, servers can provide access to application software (or other digital information, such as movies) to users operating a PC or virtually any other information appliance. Much of the demand comes from corporate Information Technology managers who want to centralize and simplify computing in order to reduce the total cost of ownership. However, an exciting new market for Citrix software is applications service providers (ASPs) who operate data centers and provide software to customers on a "pay-as-you-go" basis.

Hardware: the Arms Merchants

Just as General Electric and Westinghouse became major companies by equipping a fast-growing electric utility industry, makers of high-tech equipment are benefiting from the creation of info utilities. These are the "arms merchants" that make servers, switches, routers, cables and software for telecom providers, operators of server farms, etc. They serve a global market and therefore are benefiting not only from the spread of the Web and the emergence of info utilities in the U.S., but also from telecom deregulation and the creation of telecom systems in emerging markets. One thing seems certain: demand growth should be enormous over the next five years. International Data Corporation (IDC) estimates that there were 0.5 billion Web pages

of content at the end of 1998 and the number should increase to 4.4 billion pages by year-end 2002. The number of domain name registrations grew 130% annually from 1996 through 1999 and should grow 52% this year. The reason why this rapid growth can continue, even as comparisons get more difficult, is that growth is coming from three directions:

- More users—rapid growth is possible for many years because most of the world still is not online.
- Users spending more time online—as functionality improves, users are able to connect with wireless devices as well as PCs.
- More bandwidth is used per minute—it will be much more when users are viewing movies rather than receiving e-mails.

Importantly, these three variables *compound* each other, so if each one increases by a factor of X, bandwidth consumption should increase by a factor of X³. As a hypothetical illustration, if each of these three parameters were to double, total bandwidth consumption would increase by a factor of eight.

Enterprise Hardware

Server manufacturers are obvious beneficiaries of the growth of the info utility industry, because they make the boxes that host Web sites and run enterprise software applications. With 25% of the enterprise server market, **Sun Microsystems** is the largest and best-positioned competitor in this market. Sun was early in recognizing the lucrative potential of application and Web outsourcing and has emerged as one of the big winners in this nascent market. Sun’s sales growth has been very strong for the past year. With companies like Exodus looking to increase the size of their server farms rapidly in 2000, Sun should continue to benefit from strong demand in this emerging channel. **IBM** is another significant player in the server arena. With 20% of the market, Big Blue is smaller in this segment than Sun, but it has bigger complementary businesses in software and services. These businesses offer some support to the hardware business, while providing protection against the cyclicity of hardware spending. Leveraging its brand name, its global reach and its “soup-to-nuts” menu of software and hardware offerings, Big Blue is positioning itself as the all-purpose company for e-business.

Although **Intel** does not manufacture servers, it is a major supplier of microprocessors and other chips to the industry and benefits from the same trends as the manufacturers. With sales to almost all of the major server vendors, Intel’s microprocessors can be found in over 70% of all enterprise servers sold. This high-end business is very profitable and growing rapidly, accounting for about 20% of revenues in 1999 and an expected 25% in 2000. Besides benefiting indirectly as a supplier to the info utility industry, Intel recently announced plans to become more directly involved as an application service provider. Over the next two to three years, Intel plans to invest \$1 billion in 12 service centers where it will own and service all the hardware and software necessary for providing application services.

Printers

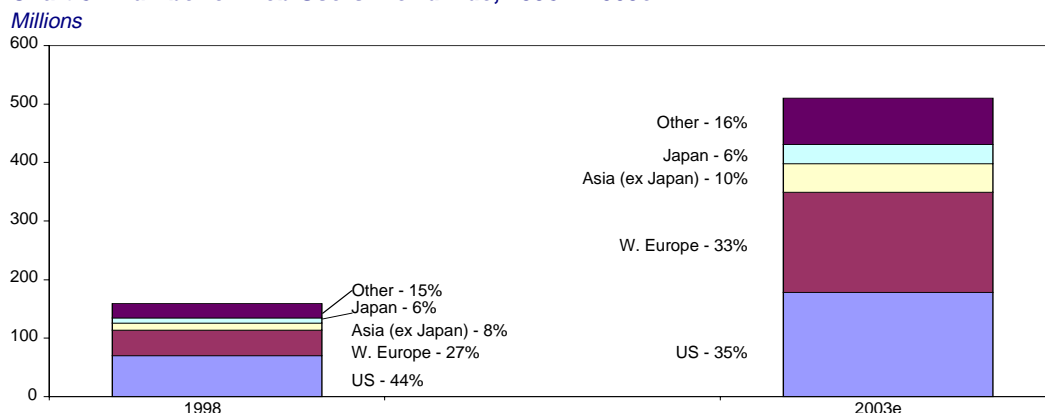
The info utility industry will make it possible for *all* data (including photographs, blueprints, etc.) to be stored in electronic form and downloaded into a variety of devices—PCs, laptops, palmtops, etc. But if people need to read more than a few paragraphs, or they wish to annotate it, they will print it out. (For a more detailed explanation of why the paperless office is a mirage, see "The Information Revolution Wars," May 9, 1999.) This is bullish for makers of printers such as **Hewlett-Packard**, the dominant player in the U.S. market with a share of 50% or more in virtually all major categories. Not only will there will be a printer in every office, but it will be heavily used and therefore will consume lots of paper and ink cartridges, which are highly profitable. HP is also a leading manufacturer of personal computers, whose sales are growing rapidly. A new CEO has credible plans to turn around the server business; she has also identified \$1 billion of annual cost savings in HP's cost structure, which should be realized over two to three years. Most of these savings would be reinvested in the business to accelerate the corporate growth rate.

Telecom Equipment

These companies make the switches and cables that direct data and voice over the Internet and telecommunications infrastructure, ensuring that the right data gets to the right place as quickly and cheaply as possible. The ascendancy of the Internet and deregulation of the telecommunications industry have driven enormous domestic growth; the market potential is even greater overseas, where telecom deregulation and the spread of the Web are less well advanced. IDC points out that at the end of 1998 about 70 million Americans were logging onto the Internet, or about 44% of the worldwide total. By 2003 the number of American surfers is expected to rise to 179 million, but its worldwide share is expected to *decrease* to 35% (Chart 8) as the number of foreign Web surfers grows from 89 million in 1998 to 332 million in 2003. Another driver of foreign demand for telecom equipment is deregulation; in the last couple of years, large state-controlled telecom companies in both Europe and South America have been privatized. China stated it would allow foreign companies to own up to 49% of telecommunications ventures within its borders. China's entry into the World Trade Organization should also open that market to western firms.

In data networking, **Cisco Systems** is the gorilla with an eye-popping 90% of all Internet traffic passing through its products. Cisco's highly regarded management has proven itself adept at making smart acquisitions that complement its in-house R&D efforts. The company has further distinguished itself by recognizing and adapting to changes in the business, such as data's growing importance relative to voice on telecommunications networks and the growing use of data networks to transmit voice communications. Cisco has also effectively used the Web to cut costs and accelerate response times in its own business; 83% of CSCO orders are through the Web. The company's critical challenge is to increase its presence in the "provider market" (i.e., telecom firms such as AT&T, Qwest) as opposed to the "enterprise market" (corporations such as GE, GM). Precisely because enterprises are outsourcing their information needs to telecom companies that operate server farms, the "provider market" is growing much faster.

Chart 8: Number of Web Users Worldwide, 1998 – 2003e



Source: IDC.

With sales of \$38 billion in 1999, **Lucent** is also a market leader, but in the telecommunications equipment sector. Before being spun off, it was the equipment manufacturing arm of AT&T, and it has very strong ties with AT&T (which accounts for about 10% of sales) and the Regional Bell Operating Companies. The operators are racing to build out their networks to accommodate increasing Internet traffic and the demand for higher-speed access to the Internet. Lucent is a leading manufacturer of wireless infrastructure, which is another key driver of growth. With less than 8% of the world's population using cell phones, the opportunity here is substantial, particularly because some developing nations are likely to use wireless as their primary service, rather than digging up the streets to install wireline systems. Though smaller than Lucent (1999 revenue of \$22 billion versus \$38 billion), **Nortel Networks** is another beneficiary of the boom in demand for telecommunications equipment. The company has thrived as telecom operators such as Qwest and VoiceStream, among others, have consistently raised their capital spending plans. Nortel expects demand for network capacity to grow 100x-200x over the next two years, driving the need for further capital spending.

Master of the Domains

Network Solutions contributes the most basic element of Internet infrastructure, the domain name. Up until mid-1999, NSOL distributed virtually all global top level domain names; any Internet address ending with .com, .org or .net was registered through Network Solutions. Each registration costs \$35 per year and lasts one to ten years, after which time it must be renewed. Because the registration fee is paid up front but booked over the length of the registration period, at any given time the company has much of its forward 12-month revenue already in the bank, and now with extended prepayment, up to ten years. Furthermore, the cash can be used to fund substantial business expansion, new initiatives, or invest in strategically related companies. Besides being highly visible, a large portion of the revenue is recurring by nature due to the renewal requirement. In calendar Q3 1999 the company began facing competition and fared well by managing to grab 87% of the 1.49 million new registrations. Though its market share is likely to diminish somewhat over time, its size and reselling partnerships with ISPs should afford it substantial protection.

Connecting Consumers to the Web

Personal Computers

While corporations are beginning to shift operations to info utilities, consumers also have to get connected, or better-connected, to the Web. Although wireless phones, TVs, and other devices will increasingly be linked to the Web, there is general agreement that, for at least the next five years, PCs will remain the primary way that consumers interface with the Internet. A very attractive consumer PC stock is **Gateway**, whose franchise is enhanced by its successful Country Stores and an alliance with the premier Internet service provider, AOL. As PC prices plummet, “beyond the box” revenues—from financing, warranties, providing Internet service, etc.—are becoming much more important. Gateway’s alliance with AOL includes an \$800 million investment from AOL, revenue sharing of AOL subscriptions signed up through GTW, access to AOL proprietary content (which is much expanded by the TimeWarner merger), a featured spot on AOL’s properties to promote GTW’s products as well as the inherent AOL endorsement of the Gateway franchise. Gateway began to reap the benefits of its recent partnership with AOL during the most recent quarter, when it added 400,000 ISP subscribers.

Now that PCs have virtually become commodities—albeit “branded commodities” dominated by a few major brands (much as Alcoa dominates aluminum foil)—the most pressing issue for consumers is not which box to buy, but how to connect that box to the Web. Pent-up demand for a fast, convenient Internet connection is enormous. The five firms best positioned to benefit from this are:

Internet Service Providers

America Online, which, after its announced merger with Time Warner, is the leader in the convergence of:

- Connecting consumers to the Web;
- Providing interactive services;
- Creating and distributing content.

By giving AOL cable access to 13 million homes, the deal would eliminate the major strategic weakness that AOL has—its dependence on slow “dial-up” services, which make it vulnerable to being out-flanked by cable firms that have a “fat pipe” into American homes.

Electronic Connections to the Web

Cable

AT&T, by virtue of its acquisition of Tele-Communications Inc. (the largest cable operator in the U.S.) and its pending acquisition of MediaOne, should have cable access to 24 million homes. The company should be able to offer consumers a compelling and convenient bundle of services—long distance, cable, local telephone

service, wireless telephony and high-speed Internet. The company’s strong brand name and reputation for high-quality service should make it a very formidable competitor.

Comcast, a major cable company serving 12.2 million households, is aggressively installing high-speed Internet. By the end of this year about 35% of its customers will have Internet access; by year-end 2001, the figure should be 50%. Comcast is competing against DSL (digital subscriber lines) offered by local telephone companies. However, Comcast does *not* need a high market share for this initiative to be profitable, because it generates *incremental* revenue for a plant that is already largely in place. PaineWebber analyst Thomas Eagan estimates that the company only needs to garner a 13% market share to generate a 45% internal rate of return. One factor slowing the rollout of high-speed Internet has been a shortage of workers to install modems. This bottleneck is being alleviated by selling modems at stores and having consumers do part of the job of installing them.

Satellite

Whereas the cable properties of AOL-Time Warner, AT&T and Comcast have to be upgraded to provide broadband access, **Hughes Electronics’** satellite Internet infrastructure is already built out—it is in the sky. GMH’s main consumer business is DirecTV, which offers consumers a basic package of 95 channels for \$29 per month. DirecPC uses a satellite dish to provide Internet access that in many cases is faster than cable. This satellite infrastructure was validated by AOL’s decision to form an alliance with GMH and invest \$1.5 billion in the company. Of this, \$500 million will be invested in DirecPC, partly to subsidize the sale of dishes so that the company can hit “critical mass” and advertise nationally. GMH upgraded its strategic position by selling its satellite manufacturing business, Satellite Systems, to Boeing for \$3.75 billion in cash. This deal raised the company’s top-line growth rate, reduced technological risk from satellite malfunction, and generated cash to invest in higher-growth businesses.

Retail

At various times in the past, **Tandy’s** ubiquitous Radio Shack stores have sold CB radios and personal computers. Now their featured product is Internet connectivity. No matter which way access develops—wireless, DSL, satellite or cable—Radio Shack will sell it. Ironically, this brick-and-mortar retailer is more leveraged to the growth of the Internet than most dot.com retailers; their growth will be limited by growth in their category, whether it is books, music, drugs or pet food, but Radio Shack sells devices and services for getting connected to the Web, including wireless phones, cable modems, satellite dishes, handheld devices and—thanks to a five-year agreement with Microsoft—MSN broadband and dial-up Web access. As noted, a shortage of technicians is prompting such companies as Comcast to encourage their customers to buy modems in stores and do part of the installation themselves. This is clearly bullish for Tandy.

Additional information available upon request.

Prices of companies mentioned as of February 10, 2000

3Com Corporation	2	COMS	\$65.06	MCI WorldCom Inc.	2	WCOM	\$49.81
ASK Jeeves		ASKJ	\$82.00	MediaOne Group Inc	3	UMG	\$78.13
AT&T Corp	3	T	\$49.13	Microsoft Corp	2	MSFT	\$106.00
Amazon.com, Inc.	2	AMZN	\$76.19	Network Solutions	2,3	NSOL	\$292.31
America Online		AOL	\$58.50	Nike Inc -Cl B		NKE	\$33.69
Boeing Co	3	BA	\$39.75	Nokia Corp		NOK	\$201.25
Broad Vision		BVSN	\$176.63	Nortel Networks		NT	\$122.75
Cisco Systems	2	CSCO	\$135.94	Open Market Inc	2,15	OMKT	\$53.50
Citrix Systems	2	CTXS	\$181.23	Oracle Systems Corp	2	ORCL	\$62.31
Cognos		COGN	\$68.31	Peoplesoft Inc	2	PSFT	\$24.00
Comcast Cl A Spl	2	CMCSK	\$50.00	priceline.com Inc.	2	PCLN	\$56.25
Commerce One		CMRC	\$157.06	Procter & Gamble	3	PG	\$91.44
Dell Computer Corp	2	DELL	\$38.80	Proxicom Inc.	2	PXCM	\$110.00
Digex	2,3	DIGX	\$90.81	Qwest Communications		Q	\$45.63
Doubleclick		DCLK	\$118.50	Schwab (Charles) Corp		SCH	\$38.50
Electronic Data Systems.		EDS	\$74.38	Scient Corp	2	SCNT	\$89.50
Ericsson	2	ERICY	\$90.81	Siebel Systems		SEBL	\$101.88
Exodus Communications	2	EXDS	\$120.38	SportsLine USA	2,3	SPLN	\$44.94
Ford Motor	3	F	\$47.00	Sun Microsystems	2	SUNW	\$94.63
Gateway Inc	3	GTW	\$58.25	Tandy Corp		TAN	\$42.25
General Electric Co	3,6	GE	\$135.44	Time Warner	3	TWX	\$85.19
General Motors		GM	\$76.88	UAL Corp	3	UAL	\$51.31
Hewlett-Packard		HWP	\$125.88	Unicom Corp	3	UCM	\$38.50
Hughes Electronics		GMH	\$105.88	Verio	2	VRIO	\$68.13
IBM	3	IBM	\$119.13	VoiceStream Wireless	2	VSTR	\$149.63
Infospace.com	2	INSP	\$191.50	Wal-Mart Stores		WMT	\$57.94
Intel Corp	2	INTC	\$107.63	Yahoo Inc		YHOO	\$365.00
Johnson & Johnson		JNJ	\$78.00	eBay Inc.	2	EBAY	\$162.38
Lucent Technologies		LU	\$53.00				

2. PaineWebber Incorporated makes a market in this security.

3. PaineWebber Incorporated has acted in an investment banking capacity for this company.

6. General Electric owns over 20% of the outstanding stock of PaineWebber Group and has a representative on the board. General Electric has agreed to certain voting limitations. PaineWebber Group is the parent of PaineWebber Incorporated.

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