ISP portability imposes costs and provides benefits. The cost to LECs derives from the added complexity of networks supporting ISP portability.[17] Consumers face a more complex shopping decision since some ISPs will be connected to the LEC DSL network while others will not be. Configuring software for Internet connectivity can be complex. Without a doubt, the overall software complexity is greater for LEC DSL networks than for the other two system designs.

ISP portability provides ISPs with access to the LEC DSL service – a valuable complement to their existing networks. Of course, ISPs have to invest time and effort in working with the new interface requirements imposed by the new technology.

Providing ISP portability imposes significant complexity on the LEC's network and thereby raises costs. ISP portability provides the consumer with choice of ISPs but also raises the specter of finger pointing between the LEC and the ISP when a problem occurs. Many consumers will find it hard to diagnose problems and may complain to the LEC regarding ISP problems and vice versa.

The cable industry is following quite a different business and technical model. The typical cable system approach to providing high-speed modems bundles service from the cable system's ISP with high-speed digital access service. Doing so simplifies the problems of management of Internet addresses (lowering costs) and simplifies the customer's transaction with his or her service supplier. Offering such an integrated service removes many of the opportunities for conflict when service faults occur. This arrangement also limits competition between the cable system and other ISPs. A consumer who wishes to use AOL or Erol's Internet service over a cable modem must first pay for the Internet service from the cable company. The cable company connection can act as the gateway to Yahoo or the FCC web page. In this circumstance, AOL's added value is now restricted to AOL's own content and information services. The consumer's

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[17] The problem of ISP portability is also made more complex by the FCC's policy (part of the Computer II Rules) that LECs not engage in any net protocol conversion.

incentive to purchase from any ISP other than the cable company is substantially reduced in such an environment.

c. The Market Niche Served by LEC Digital Subscriber Line Services

DSL services appear to be a transition technology that will provide significant value before the next generation of terrestrial networks (with fiber running much closer to the subscriber premises) come into being.

DSL appears best suited to provide service to residential consumers and small businesses. Large organizations (e.g., the FCC or Brookings) already have DS-1 or faster connections. Many large office buildings already have access to high-speed capabilities – with fiber running to the basement of the building. High-speed Internet access can be provided in an office building by installing a router in the basement and connecting several tenants to a single high-speed transmission link.

In contrast, residential consumers and small businesses not located in major office buildings rarely have access to such alternatives.[18] For these consumers, DSL technologies offer the promise of substantial value.

d. Competing Technologies

As we discussed above, competing technologies are evolving rapidly. We do not yet know how consumers value the mix of portability, speed, and cost. Wireless suppliers are working hard to develop technologies supporting effective Internet access. Hughes is selling satellite-delivered Internet service to consumers. Cable companies are rolling out cable modems. Such rapid innovation and turbulent competition promises benefits for consumers but increases the risks for service vendors who must invest significant capital in a specific technology.

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[18] Residential consumers in large multiple dwelling units may also have access to shared fiber.

e. Cost Structure for DSL Providers

A LEC must make several different types of investments in order to provide DSL services to consumers. Some of these investments are in training, some in information systems, some in support technologies, and some are directly in DSL hardware. Some costs are incurred on a firmwide or regionwide basis. These costs include (1) putting in place information systems for order taking, inventory, and customer support; (2) staff training; (3) development of marketing plans and promotional materials; and (4) planning.

Other costs are incurred as each central office or wire center is made DSL ready. Although, in the long run, the cost of serving many customers from a central office will be proportional to the number of customers served, there are fixed costs (both capital and administrative) associated with making a central office capable of supporting its first DSL customer. These costs include space planning, installing DSL modems and multiplexers at the central office, and installing necessary connections to the data backhaul network and OAM systems.

DSL costs are also incurred on a per-loop or per-customer basis. The per-customer costs include marketing costs, administration of the customer records, customer support (potentially an expensive task if software problems occur), installation costs, loop qualification and upgrading costs, and the costs of a DSL modem dedicated to the customer. The higher per-customer costs appear to be marketing, customer support, installation, and the cost of the DSL modem. Upgrading the loop could also be quite expensive – however, in most of our analysis we assume that the short-run approach to DSL will be to provide service to those locations that can be served using the existing loop plant.

There are also some costs that are incurred in proportion to the number of ISPs connected to the network. These costs are relatively small relative to the other categories of cost and are not considered in the current version of our cost model.

f. Conclusions

There are many alternative approaches to providing high-speed access to the Internet and developing technologies promise more. Each of these technologies has its own advantages and disadvantages. LEC provided DSL services are only one of many competitive alternatives that customers will choose from.

It appears clear that there is substantial demand for such high-speed Internet access. Residences and smaller organizations, such as schools and libraries, will benefit from having the high-speed Internet access now available to larger organizations.

Just as the demand for broadband entertainment and telecommuting has driven the need for broadband access to the residence, the demand for high-performance connectivity for new services and applications is driving the need for broadband access to the business environment. Video conferencing, collaborative work applications, business Internet access, and virtual enterprise networks, which use the public broadband network to connect all points of an enterprise, reflect the need to connect an increasingly dispersed work force.

Frank M. Fenton and James D. Sipes, Bell Labs

3. Trends in the Use of Digital Access Services

In the past few years, the demand for high speed services has increased rapidly. Much of this increase derives from carriers' and other business firms' use of DS-1 and DS-3 lines for special access to the telecommunications network, but there has also been substantial growth in end-users' demand for ISDN lines and frame-relay services.

To develop a better picture of these growth trends, we asked a group of large LECs to provide us with information on the number of lines of each of a number of high-speed services that they had in use at the end of each year, 1992-1996. Detailed responses were provided by a large sample of these carriers for four services: ISDN-BRI, ISDN-PRI, DS-1 and DS-3. The latter two services are offered in both the intrastate and interstate jurisdictions; therefore we report the total lines across the two jurisdictions in the figures that follow.

We have data on ISDN-BRI lines for 31 states and on ISDN-PRI for 27 states. To show the differential growth in these lines and ordinary switched access lines, we have plotted the growth of each of these high-speed services against the FCC's year-end tabulation of access lines in these same states for 1992-96. As one can see in **Figures 3-1** and **3-2,** the growth in ISDN lines has far outstripped the growth in ordinary telephone access lines. Indeed, the basic-rate (128 kbs) service grew at a rate of 70% per year while the faster (1.544 mbs) service grew at a rate of 47% per year over this period. By comparison, the growth in switched access lines was about 4.5% per year.

Figure 3-1
Total ISDN-BRI and Switched Access

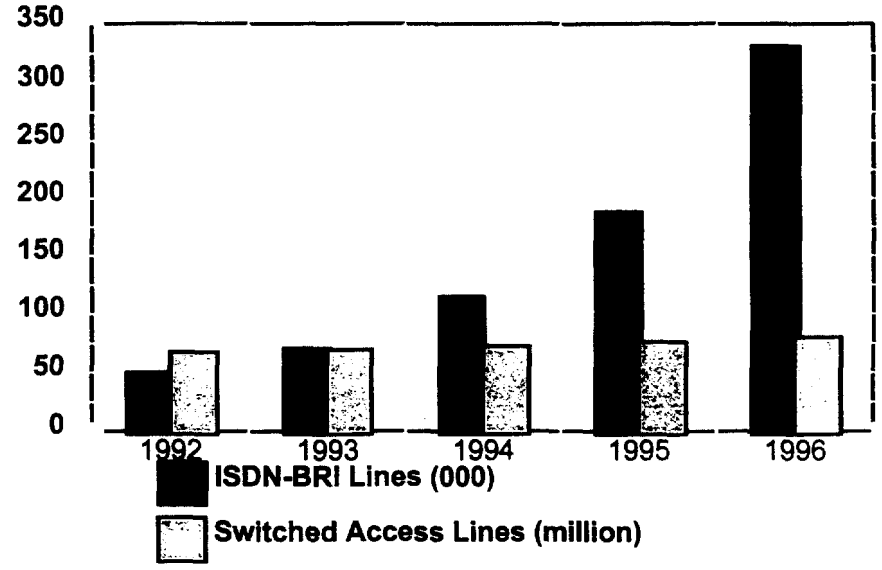
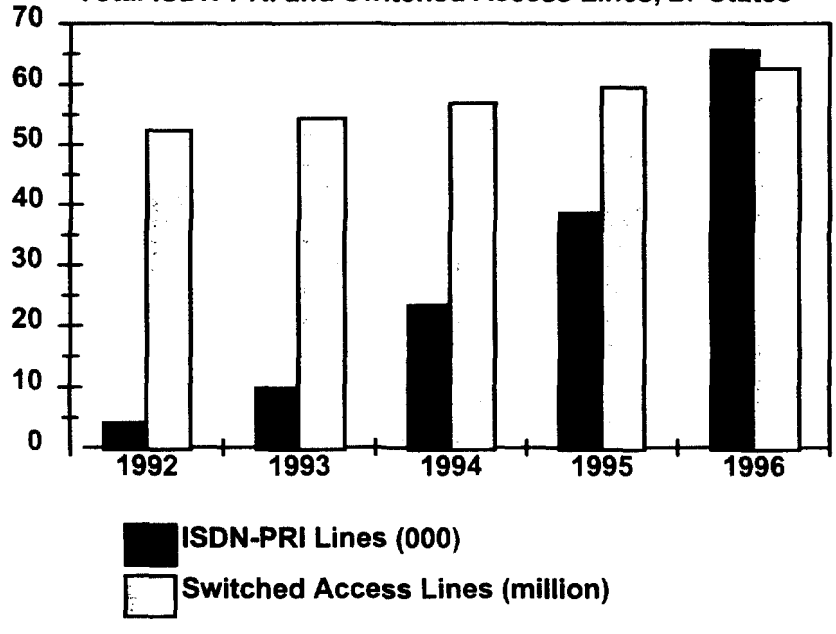


Figure 3-2
Total ISDN-PRI and Switched Access Lines, 27 States



A similar story may be told about DS-1 and DS-3 lines. As **Figures 3-3** and **3-4** show, the growth in these services was slightly lower than those recorded by ISDN services. Nevertheless, DS-1 lines grew at an average annual rate of 24% while DS-3 lines grew at an annual rate of 47%.

Figure 3-3

Total DS-3 and Switched Access Lines, 23 Stat

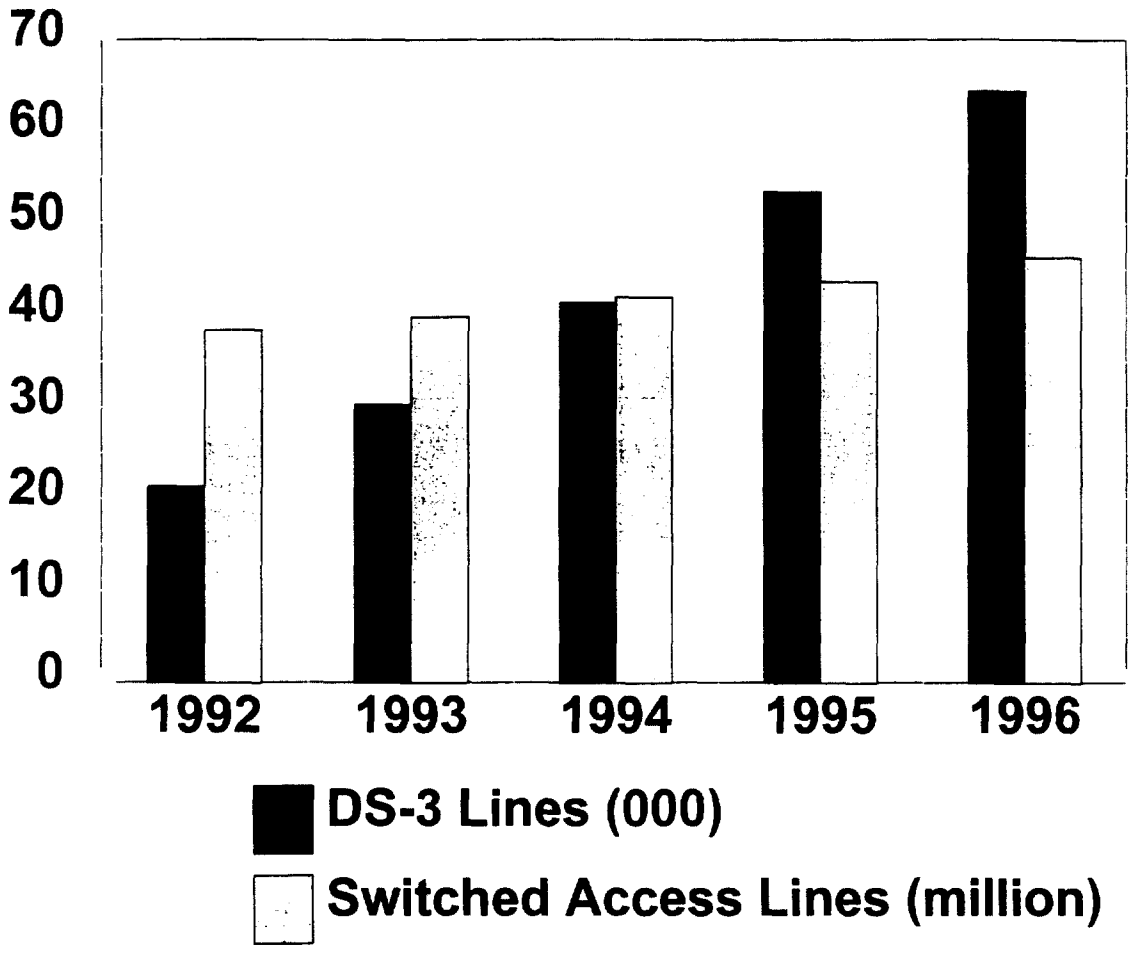
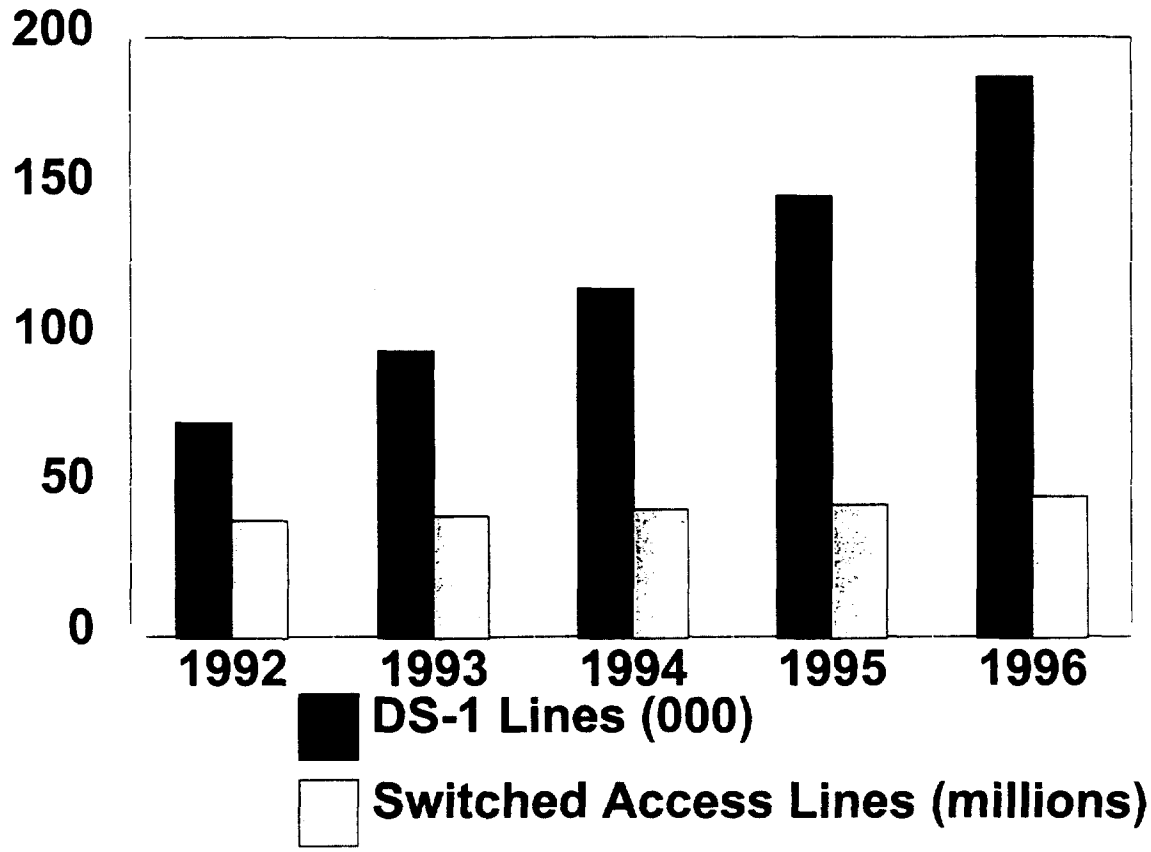


Figure 3-4
Total DS-1 and Switched Access Lines, 23 States



A major reason for the sharp rise in the number of these high-speed lines has been the steady decline in the real price of these services. We do not have data on actual transactions prices for these services, but the Bureau of Labor Statistics has been tracking "special access" rates since June 1995. For the period June 1995 through April 1998, intrastate special access services have declined at a nominal annual rate of 8.2% per year for outbound service and 10.5% for inbound service. Given an inflation rate of about 2% over this period, this suggests double-digit declines in the inflation-adjusted (real) rates for both.

Internet users are starving for more bandwidth, and it's important that we begin working on the next Internet connectivity breakthrough even as K56flex modems are establishing their place in the market.

Raouf Halim, Rockwell – Network Access Division

4. Residential Demand for High-Speed Connections – An Economic Approach

This section reviews consumer use of the Internet and personal computers and uses this information to derive a function describing residential demand for DSL services (and their substitutes such as cable modems). A more complete development of this material is presented in Appendix D.

a. The Growth of the Internet

Because Internet hosts must be registered, there are very good data on the growth of Internet hosts. The Internet began its remarkable growth in the late 1980s. In early 1989, there were only about 100,000 hosts. By January 1998, there were more than 29 million hosts.[19] The growth has not been diminishing; the Internet continues to grow at an annual rate of about 60% per year. The growth in Internet hosts or domains clearly reflects growth in the potential usefulness or attractiveness of the Internet to businesses and consumers alike, but it does not provide a measure of the extent or intensity of consumer interest in the Internet, nor does it suggest anything about the value of greater speed in accessing the Internet.

b. Consumer Ownership of Personal Computers

Access to the Internet or other on-line services currently requires the use of a computer. Recent surveys suggest that between 1993 and 1996, household computer penetration almost doubled. Not surprisingly, the share of homes with a PC rises sharply with household income. Also,

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[19] Network Wizards reports that of these 29 million hosts, only about 5 million would respond to inquiries by the ping utility. Obviously, some are behind firewalls, offline, or otherwise unreachable.

access to a computer – whether at work, at home, or at school – has increased rapidly for all ages and demographic groups.

To use the Internet, home computers must generally be equipped with a modem that translates the analog telephone signal into a digital signal that computers can read and vice versa. According to the March 1997 Nielsen survey, 29% of households had computers with a modem. More important, the share of home computers equipped with a modem increased from 59.9% in July-August 1995 to 71.4% March 1997, a period of 19.5 months.

c. Patterns of Household Computer Use

The availability of a home computer and the propensity to use it is related to both to age and to educational attainment. Income is a more powerful determinant of both computer ownership and use. Persons with a college education are far more likely to own a computer and to use it than are noncollege graduates.

Computer use has been growing most rapidly in homes. Between 1984 and 1993, the number of persons age 18 or over with access to a computer grew by 220%, but the number using a computer at *home* grew even more rapidly, by 289%. Home computer penetration has now risen to more than 40% of U.S. households, suggesting a continuing growth of home-computer penetration of nearly 15% per year. Obviously, computer penetration cannot continue to grow at this rate for very long because complete saturation would be reached in less than six years at this growth rate.

d. Internet Subscription and Usage

As recently as 1993, most home use of a computer was for tasks other than email or access to the Internet. Current evidence suggests that about one-sixth of Americans use the Internet. This estimate is largely confirmed by recent data on the number of subscribers for the leading Internet Service Providers (ISPs). These data are consistent with a total residential penetration of 16%.

Home Internet subscription is directly related to household income in part because computer ownership is related to income. Internet penetration also rises with population density, perhaps because of differences in tastes between urban and rural residents. Lower rural penetration could also reflect the fact that Internet connections require a long-distance charge for many rural households.

e. Price Sensitivity of Demand for Internet Access and Usage

The decision to subscribe to the Internet requires only that the value of having it, regardless of the intensity with which it is used, exceeds its cost. Indeed, one might subscribe, but rarely log in to one's Internet service. As long as the "option" value of the service exceeds its monthly cost, a household will subscribe.

The only econometric study of the demand for Internet connections is a recent one by Rappoport, Taylor, and Kridel[20]. They found the price elasticity of demand for access to be -0.18 at a price of $9.95 per month, -0.28 at a price of $14.95 per month, and -0.38 at a price of $19.95 per month. Rappoport *et al.* also estimated the price sensitivity of demand for *additional telephone lines* by using Request III survey data for 1996. They found that the arc price elasticity of demand was -0.44 between monthly prices of $20 and $25, prices that are substantially above the current average of Internet service alone. This elasticity rose to -1.0 between monthly flat rates of $25 and $30.

Of greater interest for our purposes is Rappoport *et al.*'s analysis of the responses to questions involving willingness to pay for Internet service at speeds four times faster than "normal" speed, which is likely to be in the 14.4 to 28.8 kbps range. They found that demand for this higher speed service was inelastic (elasticity = -0.51) in the range of $40 to $50 per month but rather price elastic (elasticity = -1.23) in the range of $50 to $60 per month.

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[20] Paul N. Rappoport, Lester D. Taylor, and Donald J. Kridel, "An Econometric Study of the Demand for Access to the Internet," unpublished ms., November 1997.

f. Projecting Household Demand for Internet Access and High-Speed Connections

No one can know the prospective residential demand for high-speed online or Internet services. So few households now have access to such services that actual data on subscriptions are difficult to obtain and of limited value. Moreover, the very nature of these online and Internet services will surely change as high-speed circuits become widely available. Nevertheless, given the limited data on household computer penetration and the spread of residential subscriptions to online services and two recent unpublished studies of Internet demand, we can proffer estimates of the likely demand for high-speed residential connections. We conclude that about 5% of households offered the service would subscribe by the end of 1998 if the service were rolled out in 1997 at a price of $40 per month. By year-end 2001, this would increase to between 10 and 11% of households, depending on the real rate of decline in the $40 price. Were the service priced at $60 per month at initial 1997 rollout, only 3 to 3.5% of households would subscribe by the end of 1998 and 8 to 9% by year-end 2001. Because we assumed that computer penetration, online service subscriptions, and high-speed access penetration approach equilibrium very slowly, we view these estimates as extremely conservative.

Powerful desktop computers become even more powerful when they can exchange files with other computers.
Paul Horowitz and Winfield Hill, *The Art of Electronics*

5. Technologists' Views of Needs for Digital Access

This section contains excerpts from a study prepared by SRI International for this project. The entire study is attached as Appendix A.

a. Internet Growth

Figure 5-1 plots this worldwide Internet growth over the past 18 years for three established network metrics: hosts, domains, and websites[21]. Because these are logarithmic plots, the linear segments shown indicate exponential growth. Since the inception of the Web in 1993, the number of Websites has been growing much faster than the other two measures and has already overtaken the number of domains. By mid-1997, there were slightly more than 1 million websites and domains and 19.5 million hosts.

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[21] http://www.nw.com/zone/WWW/top.html, see also URL group 3

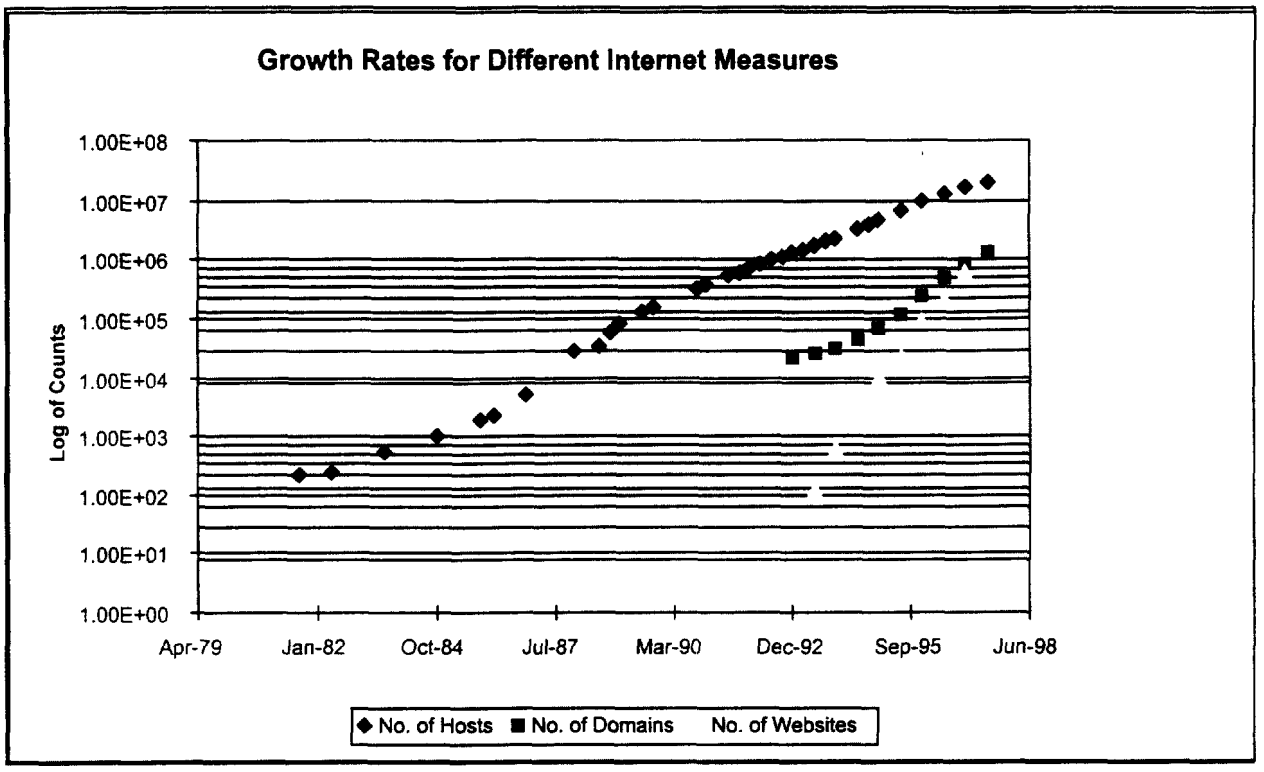

Figure 5-1 Three Measures of Internet Growth

b. A Taxonomy of the Home Internet Access Market

i. Current Outlook

SRI International's proprietary Values and Lifestyles (VALS ™) consumer segmentation focuses on adult consumers' motivations for buying products, the media they use, and the activities they engage in. On the basis of consumers' fundamental attitude and lifestyle orientations, VALS divides the adult U.S. population into eight psychographic segments of roughly similar size. We used these categories to analyze consumer acceptance of the Internet.

In brief, research conducted by SRI's VALS program indicates that 65% of active home Internet users can be classified into the following three categories: (1) actualizers, who are classic early adopters inclined to incorporate new technologies into their busy lifestyles; (2) achievers, who have the second largest presence on the Internet but are the least intensive users, averaging three

or fewer visits per week; and (3) fulfills, who act on the need to know and for whom the information-intensive Internet is seductive.

The middle two segments use the Internet in the same proportion (23%) as their percentage of the total population (25.4%): (1) expedience, who are often early adopters of technology but gravitate to it for stimulation and thrills; and (2) strivers, who have little discretionary income but are image conscious, so they follow the trends.

Other groups are either absent from the Internet or their representation is not in proportion to their share of the population (12% vs. 38.4%): (1) believers, who balk at the PC interface and therefore are largely absent from the Internet; (2) makers, who do not find that the Internet provides enough practical value or the type of personal leisure activities they desire; and (3) strugglers, who have minimal resources and can't justify the cost.

ii. Future Growth Factors

We predict that each market segment will grow somewhat in size (population growth) and that home use will increase still further, as a proportion of home/work/school use. Market penetration will increase for each segment: there will be more computer awareness in schools and businesses, and novices and lower income consumers will begin finding affordable computers. Website hardware will get cheaper and smaller. Thus, more home users may be setting up their own web servers. These will require 24-hour "up all the time" symmetric access.

c. Emerging Internet and Computer Technologies

i. Different Types of Internet Access Traffic

Internet traffic has increased and changed in character over the past ten years, transitioning from FTP (file transfer) and telnet (remote logins) traffic to email and chatrooms (interactive bidirectional text streams) and finally to web browsing. The result is that many different traffic types need to be supported over a packet-switching network. Many studies have shown that throughput is optimized for such networks when packet sizes and traffic offering rates are very

similar. Even though this is not the case, the transport and application level protocols (e.g., TCP/IP and telnet) have been modified and refined to closely approximate optimal performance for the primary traffic types listed below:

- Bursty two-way (email)
- Continuous in bursts one-way (FTP, netnews, web access, streaming)
- Low-volume commands one way and large bursts in the other (Web browsing, remote X-servers, telnet)
- Low-volume two-way (text) traffic (chat rooms, text conferencing)

Voice and data traffic places new demands on the Internet — and that network is still adjusting to these new demands.

Two types of trends in increased Internet traffic are of interest. First are the relatively predictable trends—e.g., the desire of current active modem users to want higher bandwidths for the current mix of email, web browsing, and interactive text. This trend will be modulated by the emergence of smaller and cheaper websites at small businesses and households, leading to more outgoing traffic (and thus more symmetry re outgoing/incoming) and longer Internet session times at household sites. Second are the relatively unpredictable trends such as the low-latency interactive traffic discussed above.

Of the unpredictable trends, two appear to be critical determinants of long-term Internet evolution, namely, dynamic software downloading and its stimulation of still more downstream, and interactivity and its requirement for low latency.

ii. Network Computing

Network Computers (NCs) are being touted as the next killer product that will bring all hold-outs into the computer-literate and Internet-conversant fold. The concept is simple; make a very inexpensive end-user device that relies on network servers for most of the processing and storage. For the expected NC user application— a web browser—this model of thin clients and

thick servers is appropriate. As a result, considerably more network bandwidth will be needed, depending on the level of processing shift. If the NCs have full browsers, the traffic between client and server (user and ISP) would be the same as for current web browsing. However, as web browsers acquire more features that require more local memory, the complexity of the required end-device increases. The alternative is that most of the browser processing is done on the server and the end-device is a very simple I/O processor. Screen updates will likely generate network traffic in this case which will increase and change the nature of bandwidth requirements. In current browsers, accessing web pages is bursty with some (reading) time between accesses. With the I/O-only NC, reading can also generate network traffic, which could create almost continuous downstream traffic.

It is likely that some NCs will have Java interpreters, and thus, a compromise situation will exist between the two extremes described above. In this case, a low-cost NC might have a Java runtime chip and some local cache memory. So, only the portions of a web browser currently needed can be downloaded. Network traffic would be like current web browsing plus some additional software downloading.

Major vendors (Sun, Oracle, Intel, Microsoft, Apple) are coming out with NC products and related services. The uncertainty here is whether this will be another bust like the personal digital assistant (PDA) market has been to date or whether it really will capture the consumers' imagination. These (primarily) low-cost hardware solutions do not address many of the reasons people have for not getting on the Internet (or even using stand-alone computers). However, the NC, much like higher bandwidth access (clearly needed for the NC), could be a strong catalyst to solving these more systemic issues.

iii. Software Components, Plugins

Current software application products like Microsoft Office are being driven by market pressures to increase the number of features with every new release. Although this may provide the right incentives for consumers to want to upgrade to the latest version, the downside is that application

memory requirements are growing almost as fast as new hardware technologies bring the price of memory down. The end result is that consumers are becoming disenchanted with the rapid obsolescence of computer hardware and software.

Another technical approach is emerging that has implications for network traffic—software components and plugins. Applications are composed of a number of components, and so the user needs only to load those components needed for the immediate task. Plugins allow the user to download special processing (e.g., format conversions, decompressors) as needed from network servers. Browsers are the primary applications using plugins today, but the concept can be applied to any network-oriented application. Although stand-alone users can benefit from the use of components, they become especially attractive for network computers with limited local storage. The increased network bandwidth demands caused by this approach while unpredictable are clearly sizable (depending on how the applications are partitioned, how predictable the set of capabilities the user needs are, and many other factors).

iv. Videoconferencing

One of the new technologies that has been long promised is video telephones or video teleconferencing (VTC)—first introduced at the World's Fair of 1939 and subsequently marketed by AT&T as Picturephone in the mid-1960s. The hope of reducing travel and other expenses associated with international corporations and business associations has not overcome the technical, economic, and social hurdles — other than in a few specialized applications such as education. There has been a recent surge in videoconferencing products because of lower end-user equipment and higher bandwidth long-distance lines, but many barriers still exist.
The primary barrier to the adoption of VTC is that our acceptance level for video imagery is very high, conditioned by television that has not only high-quality images but significant real-time editing and production.

VTC over the Internet suffers additional bandwidth and latency problems that currently limit widespread acceptability, especially for two-way real-time applications. The inflexibility (or

difficulty) in controlling the camera's pan and zoom often reduce VTCs to looking at talking heads—a very wasteful use of bandwidth. The power of video will not be realized over the Internet until it can be transmitted at much higher quality, with multi-camera real-time switching capability. Thus, we do not expect VTC to be a widely accepted, heavily used Internet application within the timeframe of this study—i.e., up to the year 2004.

v. Internet Telephony

Transmitting voice conversations over packet networks has received much attention lately as this option has moved from technological toy to commercial offerings. The first demonstrations of voice over IP was made in the late 70s, but the best efforts delivery philosophy of IP routing led to less than toll quality. In the past, its limited quality kept it out of the main stream.

Recent developments have changed this picture. First, long-haul networks—including overseas links based on fiber—now cost less and no longer drop or delay packets so much that even voice communications are unacceptable. Second, the exponential growth in ISPs and their larger role in the Internet architecture has created new incentives. The ESP (Enhanced Service Provider) exclusion that reduces the amount ISPs pay to LECs creates a favorable environment for investing in new IP voice solutions. There has been a groundswell of activity to develop Internet telephony (Itel) products that concentrate on user equipment and local access. Forecasts vary widely: Internet voice services are predicted by some to grow from a $1 billion market today to a $60 billion market by 2002, with up to 35% of all calls traveling over IP networks by that date.[22] Although SRI does not necessarily agree with these rather bold predictions, they do indicate that the impact of Internet telephony could be significant.

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[22] Because Internet telephony does not use the standard 64 Kbps PCM voice encoding, it requires only about one-fifth as much transmission capacity to carry a call. Thus, in a future where the volume of data traffic equaled the volume of voice traffic, switching 35% of the voice traffic to the data networks would expand data traffic by only 7%.

In summary, technology advances make Internet telephony an attractive and growing market segment, initially for large businesses, but spreading into the ISP/home user market. The actual penetration is uncertain because of the many factors surrounding pricing (and costs) of this service and the downward price pressure on voice service.

vi. Internet Radio

One traffic type that can be easily supported by the current Internet structure is taking broadcast radio from one locality and providing it to another locality. Persons on travel who want to listen to the home-town sports broadcasts or to the BBC are examples. This service has the potential of greatly increasing (outbound to the users) traffic with little user action required. The Internet seems a good match for relocating local radio broadcasts. The growth of this service depends on who provides the Internet radio content, how the service is paid for, whether or not ISP servers are overwhelmed and whether there is enough interest in this service. This is another service in the category of uncertain penetration in the next five to seven years.

vii. Real-Time Games

Computer games are getting more sophisticated, as new hardware (e.g., Intel's MMX Pentium chips) arrives in the marketplace, and are eating into the stand-alone video game market. Graphics, animation and, real video clips are becoming part of the genre. As the appetite for more varied content increases, fueled by the number of kids who are computer literate, network-based games are a natural next step. However, the low-latency, high-bandwidth interactions that games will demand will stress all parts of the current Internet—servers as well as access lines. But, somebody will try it, and—as noted earlier—interactivity is a big draw. The real appeal of network-based games, however, is multiple players and if that can be supported, the response could be large.

viii. Multiuser Interaction

Network games are an obvious application that could use a highly interactive, multiple-user synchronous network transport service. There are also many business applications for this

synchronous collaboration service, especially with the growing number of telecommuters. Synchronous collaboration is not video (or audio) conferencing alone, but multiple users simultaneously interacting through an application. Whiteboards, multiuser spreadsheets, CAD design, or distance learning are only a few of the possibilities. The network infrastructure support again needs low latency and, in some cases, high reliability. Much like the Internet telephony example, these are quality-of-service characteristics that the standard Internet will have difficulty providing, even with high-bandwidth access lines.

Give the lady what she wants.

Motto of Marshall Field's

6. Study of Users of High-Speed Modems

In this section, we describe recent research conducted on the preferences and behavior of consumers who have used a high-speed Internet connection for a sufficiently long period of time to become experienced. Appendix B contains a more complete description of Dr. Hoag's research. This formal study was undertaken because so little is known about these questions. To date, only a handful of researchers have offered insights, and these are based on unscientific, though useful data (such as the focus group results of Deutsche Morgan Grenfell, 1997). The cable companies that are currently marketing modems have reported favorable outcomes, but of course these reports are for the consumption of investors and market analysts. The problem is mostly in the dearth of detail on adoption patterns, satisfaction, and usage. This is the primary focus of the present study and the original research it was drawn from.

a. Electronic Focus-Group Results

Before conducting a larger survey, thirty-five cable modem users were recruited to participate in an electronically mediated focus group. A website was established where participants could describe why they subscribed to the cable modem service, how it changed their use of and satisfaction with the Internet, and how their perceptions of the Internet changed after they obtained their cable modems. As with most focus groups, this was not a random sample; the sample consisted of those individuals who responded to a letter sent to 120 residential cable modem subscribers in a single market.

In general, the feedback was very positive. Without exception, focus group respondents praised the service and declared the Internet to be vastly more useful, less frustrating, and more flexible with a cable modem. Despite the expectation that users would express frustration with the cable company, almost no one offered such comments. Three respondents complained that the price was too high (between $45 and $70 per month, depending on speed), and another two or three

cited reliability problems but tempered their complaints with overall positive comments. Still others admitted to being pleasantly surprised by the value they got for their subscription fees.

The following comments illustrate the group's enthusiasm, "I have been evangelizing the cable modem from day one"; "worth its weight in gold"; "Everyone I tell about my Internet access through cable is incredibly jealous"; "I give the modem a 10."

As to how the cable modem changed their Internet usage, 100% claimed that it had a profound effect on usage. The common view was that data-intense applications, such as FTP, web services and videoconferencing, were feasible with a cable modem but not with a dial-up modem. The consensus among respondents was that they spent more time on line and/or had started to use the Internet for new applications and to accomplish tasks previously handled by other means.

Many respondents implied that their home usage of cable modems was work related, but most also mentioned entertainment and personal research-related uses. Other comments implied that because of the cable modem, home Internet use changed from entertainment-only to a balance of personal and work/telecommuting applications.

In sum, all focus group participants were very happy with their cable modems, some near to the point of rapture.

b. Model of Influence and Large-Sample Survey Results

Following the focus group, a telephone survey of a random sample of 256 cable modem users and dial-up access Internet users was conducted. The response rate was very high, 78%, and all respondents shared the same cable provider in the same market allowing for comparison of the two groups.

On the basis on previous theoretical and empirical research and the findings of the focus group, Dr. Hoag constructed a model to explain modem adoption and Internet and other media use. This model was devised to guide the development of the survey.

In summary, Dr. Hoag found that a number of factors are likely to lead to an Internet user's adoption of a cable modem, but his or her occupation - any job (no matter the level) in an information field - was the strongest predictor. The second most influential factor was the data intensiveness of Internet use. Those who just used email would not be likely to get a cable modem. But those who needed bandwidth for the web or videoconferencing would be more likely to have one. The relationship among likelihood of getting a cable modem, Internet perceptions, demographic factors, the manner in which the user uses the Internet, and what other technologies the user already has adopted is very revealing. The study of cable modem users suggests that old, established patterns are shifting — no longer is age, being male or having a high income and education a simple indicator of Internet use. That so many cable modem subscribers also owned a near arsenal of cutting edge technologies is suggestive of an early adopter mentality. Although the study market was specifically chosen because it was the most mature cable modem market anywhere, and therefore presumably should have passed through the early adopter phase, the product is still apparently very young in terms of its life cycle.

c. Satisfaction and Consumption Factors

Cable modem users were more satisfied than dial-up users on fifteen of the eighteen measured facets of satisfaction (twelve of them at statistically reliable levels) though the mean differences between the two groups was not very great. Still and all, because a 5-point scale was used to measure all satisfaction items except "overall satisfaction" (which used 10 points), the difference between an average score of 4.25 and 3.92 (as in the case of the web) may be meaningful.

In only one area, cost of service, were the dial-up users more satisfied, hardly a surprise because typically, they spend less than half of what the cable modem users spend. However, at higher speeds, users were more satisfied with asynchronous uses of the Internet (email, Web, and FTP).

For several other measures of satisfaction, cable modem users were more satisfied with the Internet. High-speed access subscribers were more satisfied with the Internet as a general way to communicate, to learn new things, to be more efficient, to get information, to shop, and to work from home. They were more satisfied with on-line speed and customer service as well. Slow-modem users were more satisfied with the Internet as a way to socialize and with cost of service. Results for several items were inconclusive: satisfaction with Usenet, IRC/MUD, as a way to be entertained, and reliability were not statistically reliable.

In general, it seems clear that cable modem users were more satisfied with the Internet than those with a slow dial-up modem. The mean differences in satisfaction were not very great but the narrow measurement scale could mask meaningful differences. Therefore, it is fairly safe to say that access speed is related to satisfaction with the Internet.