

# **THE FIRST 100 FEET FOR HOUSEHOLDS: CONSUMER ADOPTION PATTERNS**

John Carey

Two important questions that must be addressed in building an advanced information infrastructure are: Do people want it and will they pay to use it? Many analysts assume that new telecommunication technologies will succeed or fail in a marketplace context that is different from the markets for earlier technologies. However, a review of the history of technology introductions reveals that many common factors affected the outcomes for those technologies. An understanding of these factors may inform the assessment of consumer responses to new technologies and services, such as interactive television, broadband Internet access, and advanced telephone services. Further, many historical lessons may be extracted from earlier marketplace experiences and applied to future technologies. This chapter reviews several common patterns associated with the adoption of earlier technologies and suggests ways in which these patterns may be used to support public policy planning for the National Information Infrastructure (NII) as well as private sector technology and service development.

## **Pricing**

The price of consumer electronic products has played an important role in their rate of adoption by the public and in determining the overall market size for these products. Historically, products have been introduced at a high price in order to recover some of the research and development costs of the product. Also, early manufacturing of the product is generally

expensive, since it cannot realize the economies of scale that are possible in mass production. Typically, the price drops sharply over time, spurring adoption by the mass public. Dozens of products have followed this pattern, including radios, black and white TVs, color TVs, and VCRs (see Table 1).

**Table 1 Average Price of Selected Electronic Products (Current Dollars)**

Year	Radio Set	B&W TV	Color TV	VCR
1925	\$ 83			
1930	78			
1935	55			
1940	38			
1945	40			
1947		\$ 279		
1950		190		
1955		138	\$ 500	
1960		132	392	
1965			356	
1970			317	
1975			341	\$ 1,140
1980				1,122
1983				572
1985				494
1987				414
1989				382

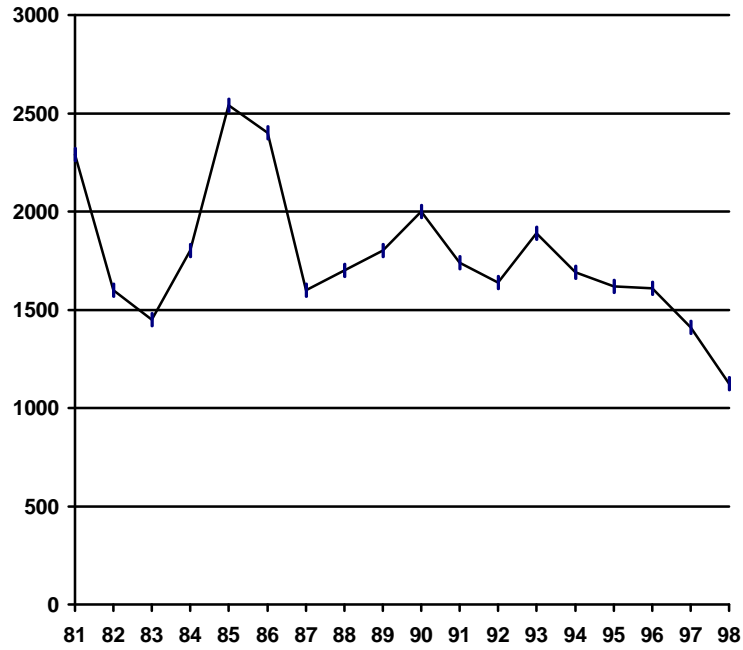
Sources: Electronic Industry Association; Sterling and Haight; U.S. Department of Commerce

The same pattern has occurred with many telecommunication services. In 1910, the fee for basic telephone service in New York City was \$20 per month<sup>1</sup> and the cost of a three-minute call between New York and Chicago in 1900 was over five dollars<sup>2</sup>. In 1997, the cost of basic telephone service in New York was \$15 and the cost of a three-minute call between New York and Chicago was 45 cents.

A new technology must attract some early users who are able and willing to pay a high price for it in order to achieve the economies of scale in manufacturing that reduce the price for the general public. Who purchases new products and services when they are expensive? The answer varies somewhat by product, but early purchasers are usually wealthy, have an insatiable desire for the product, or love electronic gadgets and are willing to pay a high price in order to be one of the first to own a new electronic device. Also, many early purchasers are businesses or schools that need the product.

The personal computer, which is a core component of household access to advanced information services, has followed a different pricing pattern (see Figure 1). Rather than reduce the price of personal computers (PCs), manufacturers have increased the capabilities of PCs each year. This was an appropriate response to the early market for PCs by business users and working professionals who dominated household usage. Consumers have received the benefits of technological advances in the form of more speed and power, rather than a decline in price. It is unclear whether this strategy missed a significant share of the potential household market. In the past few years, this pricing policy has changed and adoption of PCs increased sharply as the average price approached \$1,000.

**Figure 1 Average Price of Home Personal Computers, 1981 - 1998**



Sources: Dataquest; Statistical Abstract of The U.S.

It is also useful to note the cost of these technologies at the point when they had entered half of U.S. households. These price points tell us when a median household decided that a new technology was affordable. Radio achieved a 50 percent penetration of U.S. homes in 1931, nine years after it was introduced. Black and white TV achieved a 50 percent penetration in 1955, eight years after it became readily available to the public<sup>3</sup>. Color Television reached this level of penetration in 1972 and videocassette recorders (VCRs) at the end of 1987.

**Table 2 Number of Years to Reach a 50 Percent Penetration of U.S. Households**

Technology/Medium	Years
Newspapers	100+
Telephone	70
Phonograph	55
Cable Television	39
Personal Computer	17
Color Television	17
VCR	10
Radio	9
Black & White Television	8

Source: Electronic Industry Association; U.S. Dept of Commerce

In late 1997, personal computers had not yet entered half of U.S. households and some research indicated that the growth rate for PCs was slowing down<sup>4</sup>. This apparent slowdown may have been related to price. For radio sets, black and white TV, and color TV, the technology cost approximately 1.8 or 1.9 weeks of household income when it reached a 50 percent penetration. The price of VCRs dropped to approximately one week's household income just before it had entered half of U.S. homes. Applying the patterns for radio or TV, personal computers should achieve a 50 percent penetration at a price of \$1,000 to \$1,200, as happened in early 1999. If the VCR price and purchase pattern is applicable, personal computers may have to decline to less than \$750 dollars in order to break the 50 percent penetration level and reach 60 or 70 percent.

## **Killer Applications vs. a Confluence of Factors**

Those who develop and market new telecommunication technologies often herald "killer applications" and "magic bullets" that will lead to a decisive "home run" for a new technology or service. Indeed, there are examples of very popular applications that helped technologies to gain quick acceptance in millions of American homes. For example, a few very popular radio programs such as Amos n Andy drove the sale of radio sets.

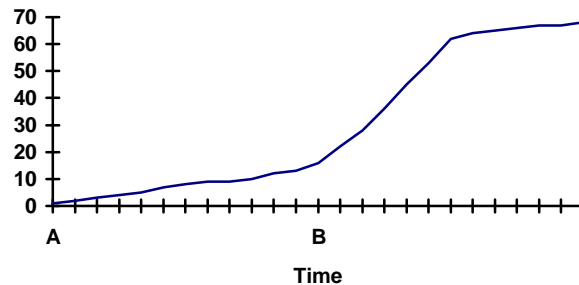
More commonly, however, a confluence of several factors is required in order for a new communication technology to take off and gain widespread acceptance. Cable television and FM radio illustrate this pattern. They were in the marketplace for many years before experiencing a period of rapid marketplace growth.

Cable television provides a useful illustration of the confluence process. In 22 years, from 1950 to 1972, cable television grew from zero penetration of U.S. households to 10 percent penetration. From 1972 to 1990, cable penetration jumped from 10 percent to just under 60 percent<sup>5</sup>. Why did penetration grow so rapidly in the 1970s and 1980s? In the 1950s and 1960s, cable television represented a way to improve television reception for communities with poor reception, generally small towns and suburban areas 50 or more miles from a broadcast transmitter. Cable offered very few extra channels or services, so it had little appeal in areas where there was good reception. In the 1970s, a confluence of several new elements acted as a starter motor for a large growth engine to kick-in. First, Teleprompter Cable in New York City became profitable and this signaled industry investors that large city cable systems were viable. At the same time, the Federal Communications Commission (FCC) lifted a freeze on franchise awards in major markets. In addition, satellite transmission made the distribution of national cable

programs easier and less costly, which gave rise to the launch of many basic and pay channels, notably HBO and WTBS. Then, in the late 1970s, Warner Amex and Cox Cable became interested in interactive cable services. This encouraged much experimentation with program formats as well as investment in cable as the technology of the future<sup>6</sup>. The experimentation led to the development of several new channels with specialized programming, while the investment brought cable infrastructure to many communities that previously had no access to cable.

Cable television and other technologies slowly reached a threshold and then grew rapidly. This trajectory is often characterized as an S-curve pattern of growth, as shown in Figure 2. The elements required to reach the threshold will not be the same for all technologies and the timetable

**Figure 2. S Curve  
Pattern Of Adoption**



for reaching the threshold may vary by many years. Indeed, the crucial question associated with S-curves is the time required to move from launch of a new technology (Point A in Figure 2) to the threshold (Point B), where rapid growth begins. This period may vary from a few years to a

few decades. Further, many technologies never reach the point at which rapid growth becomes possible or they simply fail to gain marketplace acceptance.

### **(1)Early and Later Users And Uses**

The early uses and the early users for a technology may differ from later uses and later users. That is, the market for a new telecommunication technology or service changes over time. A technology must attract a first group of users if it is to survive long enough to attract a second group. Those who are introducing the technology should try to anticipate the mix of users and uses over time, but since this is very difficult, they must be prepared to shift strategies based upon feedback from the marketplace.

VCRs illustrate this process. When VCRs were first introduced in the United States, they were quite expensive - approximately \$1500. Businesses and schools that used the technology for training and education were early users along with high income households, especially those with an interest in the latest electronic gadget. Household use included taping television programs to view later (time shift viewing) and watching pornography; a majority of videocassettes sold and rented in the late 1970s was pornography<sup>7</sup>. These uses made it possible for VCR prices to decline. The second wave of users tended to rent movies on videocassette and, later, to buy them.

This example suggests that there may be some services that might appeal to a mass market but never reach the mass market because no early group of users is prepared to pay the higher price or because of some other early barrier. In the case of VCRs, the unexpected emergence of "mom



and pop" video rental shops was critical for mass adoption of VCRs. The growth of a technology is often a fragile, changing process.

### **(1)Replacement Cycles And Pace Of Change**

The growth of some technologies is linked to the purchase of other technologies. For example, while few people in the 1980s bought a TV set or VCR just to obtain a remote control device or stereo sound, many consumers chose these features as options when they purchased a new VCR or replaced their old TV set. Thus, replacement cycles for existing technologies may provide an important opportunity to introduce new technologies. In U.S. households, color TVs are replaced after an average of eight years, telephone answering machines after five years, and personal computers after six years (see Table 3).

**Table 3. Replacement Cycles For Electronic Products**

Product	Average Life
Cordless Telephone	10 Years
Color TV	8
Camcorder	7
CD Player	7
VCR	6
Personal Computer	6
Telephone Answering Machine	5
Fax	4

Sources: Gannett News Service; Appliance

New models of an existing technology are purchased for at least four reasons: to replace an existing model that no longer works; to obtain an additional unit of the technology; to upgrade an existing model that works but does not have a desired feature or is of lower quality than the upgrade model; or, as a byproduct of another purchase. For example, a person may purchase a new personal computer that happens to come with a modem.

Upgrade purchases have been very important for technologies where the pace of technological change has been rapid, such as television and personal computers. For example, the percentage of households with a personal computer that also had a modem grew from less than 10 percent in 1988 to more than 60 percent in early 1997<sup>8,9</sup>. The inclusion of modems in nearly all personal

computers sold since 1994 helped this key peripheral device to cycle through the population of PC owners.

### **Failures, Fads, And Marketplace Decline**

There are also many lessons to be derived from technologies that failed in the marketplace or lost ground after achieving a significant penetration of U.S. households. A few examples are noted here. First, many technologies have failed because they offered a superficial benefit. For example, quadraphonic sound, or four-channel sound, did not represent an advance in technology for the consumer market. Rather, it represented an application of existing industrial technology (multitrack recording and playback) that provided a genuine industrial benefit (control of editing) into a home market where no benefit could be demonstrated. In addition, little software was developed for the new system, thus further reducing its appeal to consumers. From a consumer's point of view, quadraphonic sound offered no advantage over existing stereophonic sound. The failure of quadraphonic sound was predictable but proponents ignored its weaknesses and instead tried to create advantages that were ephemeral.

Second, some technologies are fads. We are familiar with fads in leisure products such as hula-hoops, yo-yos and pet rocks. However, consumer electronic technologies and services may also be fads or have a fad component. For example, in the early 1970s, citizen's band (CB) radio had a steady population of approximately 200,000 users. As CB became a fad in the mid 1970s, the population of users grew to a peak of 10 million in 1976. It then declined rapidly and leveled off at approximately one million users by the early 1980s<sup>10</sup>. More recently, CB radio has experienced another surge in use by immigrants who are using it as a substitute for long distance

telephone calls. It remains unclear whether this is another fad or if this group of users will adopt CB as a long-term service.

Third, some technologies experience cyclical patterns of strong adoption, decline in usage and periodic returns to popularity and usage. For example, 3-D movies were very popular during the mid-1950s then faded away, experiencing renewed interest in the 1960s and for brief periods in each decade thereafter. Videogame consoles and associated software surged in the early 1980s, collapsed in the mid-1980s, and were resurrected in the late 1980s. In the 1990s, they experienced cyclical growth and decline, although not as extreme as in the 1980s. These peaks and valleys have been associated with the introduction of new generations of equipment, which fade in popularity after a few years. More recently, PC videogames have begun to compete with console videogames, leading to another dip in videogame console hardware and software sales, even though a new generation of technology was introduced in 1996. However, the decline has not been as precipitous as the decline in the mid-1980s.

Sometimes, an apparent failure is merely a false start. For example, television was launched as a commercial service in the late 1930s, but the high price of TV sets (\$600) and the disruption caused by World War II led to a halt in service<sup>11</sup>. The technology was reintroduced after World War II and grew rapidly. Similarly, two home video recording technologies were launched and then withdrawn in the early 1970s (the EVR system by CBS and Avco's Cartrivision system) before the modern VCR finally took hold in the mid-1970s. Fax technology wins the prize for false starts. It was invented in the 1840s and tested in the 1860s with no significant adoption, reintroduced unsuccessfully in the 1930s and the 1950s, achieved widespread adoption in the

business market during the 1970s, and finally entered large numbers of households in the 1990s<sup>12,13</sup>.

### **(1) Enhancements and New Services**

It is useful to distinguish enhancements to existing technologies from the development of entirely new services. Qualitative enhancements to existing technologies often provide a good path for the development of many new telecommunication technologies. Consumers have responded positively to enhancements such as adding color to black and white television, higher fidelity for recordings, stereo sound for television and touchtone telephone service. From a supply-side perspective, consumers were adopting new technologies and services. From a demand-side perspective, consumers were simply upgrading to a better version of a familiar and desirable technology or service.

New services, by contrast, provide a more radical change from earlier services and often include new content. Examples include new cable channels, personal computer software, video games and electronic mail. In addition, new services often add higher costs than enhanced services, especially if they involve the creation of content. New services also require a change in how people use media. For example, a person watching color television uses the same content as someone watching black and white television even though there is a qualitative difference in their experience. However, someone watching basic cable channels for the first time in the 1970s or participating in a telephone conference call in the 1980s was altering his or her behavior. The change is more significant because it requires that people alter existing media habits. Such a change often requires time; indeed, the growth in use of basic cable channels and the rise in use of electronic mail spanned a number of years.

A related issue is the demand for new or enhanced services. Many analysts have noted that new technologies are often created by engineers who have little knowledge about whether there is a demand for the technology<sup>14</sup>. In this sense, new services often result from "technology push" rather than "user demand." This practice has been cited as a reason why many technologies fail. However, most communication technologies in this century -- e.g., motion pictures, radio, phonographs, and television -- entered the marketplace in a context of uncertain demand. Technologies do not falter simply because they represent technology push; they fail because they cannot meet the challenge of finding or creating applications that people want.

Who controls content creation for a new technology? Sometimes a new group of entrepreneurs leads content development, as with early personal computer software and much of the early content on the World Wide Web. In other instances, existing players control content for the new technology, as with compact discs (CDs), which were produced by the same industry that created record albums and audiocassettes. Entrepreneurs are more likely to bring creativity to the process and to generate new ideas; existing players are more likely to bring financial resources, organizational relationships, and to help ensure that the technology gets a reasonable opportunity in the marketplace.

### **Applying Historical Lessons to the Adoption of Advanced Telecommunication Technology**

The preceding review of consumer adoption patterns for earlier telecommunication technologies and services suggests several lessons that may help us to understand how consumers are likely to respond to advanced data, video and telephony services. The first lesson is general: the technology used in delivering a service is far less important to an ordinary consumer than the service itself. Therefore, it is important to place an emphasis upon the services that will be

delivered by an advanced telecommunications infrastructure rather than the way they will be delivered. Similarly, consumers may not distinguish services in terms of the bandwidth required to deliver a service. Consumers are certainly able to distinguish a dial-up sports score service over the telephone from a video sports segment on a PC or TV. They are more likely to think, however, about advantages such as convenient access, timeliness of information, and fun in watching video clips of games, rather than the bandwidth of the distribution channel. More generally, it is important to think in simple terms about end users' motivations and desires. Many discussions of broadband networks focus upon comparative engineering benefits or economic advantages for suppliers of services. End users, such as residential customers, are often taken for granted in the planning of advanced networks. Instead, the focus should be upon end users -- consumers who are able to take the initiative and adopt new technology -- and how to present new services in an appealing way.

## (2) Positive Indicators

There are many positive indicators of consumer interest in services that will utilize an advanced telecommunication infrastructure. The first of these is spending patterns. After decades of relatively constant spending on media and information as a share of household income<sup>15</sup>, consumers increased their spending steadily throughout the 1980s and 1990s. Table 4 shows the growth in total consumer electronics spending between 1992 and 1997. Further, early adopters in the 1990s have spent heavily on a range of telecommunication and entertainment services, as shown in Table 5.

**Table 4. Consumer Spending on Electronic Media, 1992-1997**

Year	Total Spending (Billions of Dollars)
1992	47
1993	52
1994	58
1995	63
1996	66
1997	70

Source: Consumer Electronics Manufacturers Association



**Table 5. Spending on Information and Entertainment By Early Adopters, 1996**

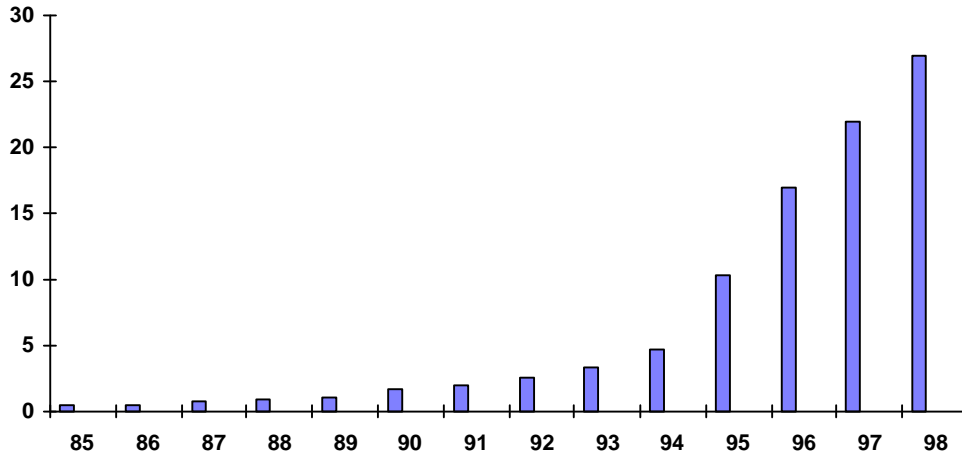
Technology Or Service	Range In Spending Per Year
Cellular	\$ 625-675
Local Phone Service	475-525
Long Distance	375-425
Cable TV/Satellite	350-400
Newspapers/Magazines	300-350
Paging	225-275
Online/Internet	175-200
Information Hardware	200-250
Entertainment Hardware	375-425
Videocassette Rentals/Purchases	200-300
<b>TOTAL SPENDING</b>	<b>\$ 3,000 - 3,500</b>

Sources: American Demographics; Anderson Consulting; Wall Street Journal

In addition, there has been a sharp increase in the number of households subscribing to online and Internet services, as shown in Figure 3. It appears that the use of these services may have reached a critical threshold. It is unclear how high penetration will rise or when growth will begin to level off.

**Figure 3. Number of U.S. Households Subscribing to an Online or Internet Service Provider, 1985 -1998**

(Millions Of Households)



Sources: Veronis & Suhler; Jupiter Communication

The growth in online subscriptions has been accompanied by a growth in second telephone lines within households and a general trend of multiple units for technologies, such as televisions, radios, telephones and personal computers<sup>16</sup>. This indicates an increased demand for existing services as well as more personalized use of technologies, e.g., a teenager talking on one phone line while a parent talks on another. In turn, it suggests that consumer demand for an advanced telecommunication infrastructure may be linked to an aggregation of existing and new services, such as a package of multiple telephone lines and a high-speed data line.

## (2) Target Early Adopters

A review of adoption trends for earlier technologies suggests that there are three important groups of early adopters. The first is technophiles who feel compelled to have the latest electronic gadgets and “hot rod” delivery systems; this group is largely male and has higher income. A second group consists of households with home offices. This includes people who operate businesses from their homes, telecommuters who work part-time at home and part-time at a regular office, and workers such as teachers or lawyers who maintain an office at home to complement their regular place of work. The number of home offices has grown sharply, from about 20 million in 1988 to more than 33 million in 1997<sup>17</sup>. Households with home offices typically adopt telecommunication technologies earlier than other households. For example, in 1996, 42 percent of telecommuters had two or more telephone lines, compared to 17 percent of all households; 37 percent had a fax machine compared to 11 percent of all households<sup>18</sup>. Curiously, there has been relatively little marketing of advanced telecommunications services or even added capacity to consumers with home offices. Advertising for high-speed digital phone lines (ISDN) or even second telephone lines has been sparse.

A third group of early adopters consists of households with moderate or high income and children. More than 60 percent of households with a computer also have children under 18 present. Many parents believe that their investment in information technology and services will help to prepare their children to do better at school and to find better jobs in the future. Children also have shown a strong interest in computers, although this may be as much for entertainment as education. Personal computers are the second most requested item by children for Christmas<sup>19</sup>.

Business and education are important target groups that may lead to consumer adoption of

advanced telecommunications services. In the past, many technologies entered businesses and schools first, creating habits and appetites that people eventually brought home. For example, the telephone was predominantly a business service in the late nineteenth century, and then entered households of business people who wanted the same service at home. Similarly, many people developed an appetite for the personal computer in business or education settings, then brought it into their homes.

## (2) Motivations & Desires

Why do consumers adopt new technologies and services? A good starting point is consumers themselves and their behavior. One useful historical example of what not to do is provided by the early Bell System. For decades, the Bell System marketed telephones to consumers as serious business tools in the home and actually discouraged uses of the telephone for fun, social chatting, or casual conversations among family members. It was well into the twentieth century before marketing efforts recognized and reflected how people were actually using the telephone<sup>20</sup>.

Among the more important motivations to adopt new technology and services is a strong need: a consumer has an existing unmet need in his or her life; a new service meets the need at an acceptable cost; the consumer adopts it. There are many examples of new technology adoption based upon need. For example, when home satellite dishes cost \$2,000 to \$3,000 dollars in the 1980s, they were adopted by 20-25 percent of households in western states such as Montana and Idaho where there were few local broadcast signals or cable systems. In the current context, candidate unmet needs include services that support work at home and multimedia education services for children and adults, such as re-certification courses for harried professionals.

A second motivator is an insatiable appetite for some content or service. For example, gadget lovers will pay just about any price for the latest technology and many people can't get enough of some content such as movies, soap operas, or pornography. Often, consumers with insatiable appetites add the new technology or service to the old rather than substitute the new for the old. In the current context, candidate "insatiabiles" are much the same as they have been in the past.

Inconvenience is a notable third motivation for adoption and change. Many models of change are based upon positive motivations, but painful experience with an existing service can provide an incentive to adopt new services. In planning advanced telecommunication services, it may be useful to ask: where are consumers experiencing inconvenience or bad service delivery that might be relieved by a high-capacity telecommunication infrastructure? Possible answers include slow Internet access, low stocks of popular movies in video rental shops, and poor customer service by existing broadband service providers.

Supplier pressure can lead to adoption and change, but it can also backfire. That is, suppliers of services may have sufficient control over a market to force consumers to change behavior. For example, a bank that dominates a local market might increase the price of all services provided by tellers and thereby motivate consumers to make greater use of automated teller machines (ATMs). However, in a competitive telecommunications environment, it is not clear if such a strategy would work.

The marketplace for advanced multimedia services is changing rapidly. The motivations and wants of Internet users are also changing as a mass market is emerging. While the early users of the Internet included mostly well-educated information seekers, the Internet is now attracting a

mass market with mixed education backgrounds, younger and older users, and more people who are looking for entertainment. However, communication remains the anchor for Internet use<sup>21,22</sup>. It is important for planners to think about what the Internet is becoming rather than what it has been.

### **(1) Discussion**

What does this review of historical trends imply for telecommunications policy and the planning of the National Information Infrastructure (NII) as well as private sector technology and service development? For policy makers, history suggests that it is very difficult to know with precision what applications and services will emerge successfully after the NII is put in place. The development of the telephone network, assignment of spectrum for radio and television, franchising of cable systems and development of the backbone for the Internet were all undertaken with only a weak understanding of what services would emerge successfully.

Telecommunications policy should support the development of an advanced information infrastructure as an investment in the future, not as a blueprint for how the future will unfold.

Since the future is unpredictable, telecommunications policy must also support flexibility for service providers as they develop applications, discover that they are off course, and seek to adjust service offerings or create new ones. When teleports were first designed, the thinking was that the core of the business would be city-to-city transportation of data and other services via satellite. In order to reach the satellite uplinks, fiber optic rings were built around business districts. Through serendipity, the fiber optic rings became the core of the business for teleports, moving data and other services at high speeds within cities. Many services for consumers that

utilize the NII may also miss the mark initially and should be allowed the flexibility to change.

Telecommunications policy should also support broad consumer access to services delivered via the NII. Ideally, all homes will have access to advanced telecommunications services via the NII within a short time frame. However, a review of historical patterns indicates that this has rarely been achieved. Many technologies have been used by businesses first, then by consumers, and by wealthy households followed by the mass public. A more realistic policy may be to support broad public access to NII services but to ensure access through public location terminals, as occurred with public telephone booths in the first quarter of the twentieth century and, more recently, through computers in public schools and Internet access terminals in public libraries.

For private sector developers, there is ample evidence of strong consumer demand for services delivered via the NII. Consumers will invest in the first 100 feet if services meet existing needs or create a demand for exciting new products. Communication and entertainment are likely to be the anchors that drive demand; information and transactions need to be targeted to groups with specific needs and wants such as harried working professionals, people who work at home and parents with school-age children.

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