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Between Markets and Mandates:

Approaches to Promoting Broadband Access for Persons with Disabilities

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Foreword

By Fernando R. Laguarda, Time Warner Cable

For a person with a disability, the impact of broadband can be truly life-altering. It can empower social networking, mentoring, and connecting with the broader world. It expands access to information, resources, and tools to meet complex needs in emergencies and disasters. It may even provide an opportunity for employment. All of which makes this report. *Between Markets and Mandates: Approaches to Promoting Broadband Access for Persons with Disabilities,* by Krishna Jayakar of the Pennsylvania State University, so timely and valuable.

We are living through the dawning of the next age in digital communications: the age of broadband. Fueled by nearly $1 trillion in private sector investment since 1996, broadband has been deployed to reach more than 90 percent of the U.S. population and offers a platform that fuels an entire ecosystem of services and applications. Subscribers benefit from constantly improving speeds, access to always-on availability of educational, cultural, and entertainment programming, tele-health and tele-medicine, e-commerce and e-government applications, and advanced communication services for people with disabilities. Finding the cable industry at the center of these developments is no surprise. Cable has historically been about expanding opportunities, whether providing more video choices than broadcast channels ever could, introducing the first residential high-speed broadband Internet services, or providing facilities-based competition in the telephone marketplace.

Yet despite all of this, some people are still not benefiting from broadband as much as they could.. Nearly 12 percent of the U.S. population reports having a disability. Just 43 percent of the 36 million Americans with disabilities subscribe to broadband services, compared with nearly 70 percent for the general population. Age and income play a significant role in this adoption gap. But in addition, the accessibility of devices (personal computers, tablets, etc.), their cost, and the accessibility of online content all play a role as well. Thus, despite the tremendous potential benefits of broadband in general, and to people with disabilities in particular, there remains a significant gap in broadband adoption for that group compared with the general population. Policy-makers are aware of that gap, but plans to address it continue to move slowly at this point in time.

This report examines access to broadband by individuals with disabilities in order to identify programs and policies that promote broadband adoption. It begins by identifying significant barriers that prevent persons with disabilities from accessing broadband, including availability in their locations of residence, affordability, and device and content accessibility. It then presents case studies of programs and policies aiming to improve access to technology by people with disabilities, ranging from technological innovations and market-driven initiatives to public-private partnerships and regulatory mandates. The report comparatively evaluates the efficacy of these approaches in improving disability access and concludes by discussing success factors and challenges for these efforts, recommending potential solutions to each.

When we launched the Time Warner Cable Research Program on Digital Communications, we hoped to fund reports that would highlight and promote practical solutions to important challenges facing industry and government. This report could not be more timely or necessary.

As always, we look forward to your comments and feedback.

Section One: Introduction

The U.S. Census Bureau (2010), in its most recently available American Community Survey, reports that 36.4 million Americans, or an estimated 11.9% of the civilian non-institutionalized population of the United States, experience some form of diagnosed disability including difficulties related to vision, hearing, mobility, self-care, or cognition. Individuals are affected not only by congenital disabilities, but also by those that emerge over the course of a lifetime due to accident, illness, and the normal course of aging. Indeed, age-related disability is a fate awaiting many, with more than one-third (36.7%) of Americans above the age of 65 reporting some form of disability.

Information and Communication Technologies (ICTs) and broadband Internet access in particular have often been put forward as a means of mitigating the many disadvantages associated with disability (Litan, 2005; Lyle, 2010; Vicente and Lopez, 2010). Broadband technologies have a recognized potential to help individuals with disabilities lead more productive lives, increase their labor force participation, encourage political engagement and integrate better into their local communities. Broadband enables people with disabilities to live independent lives and permits "telerehabilitation" (Lyle, 2010). Indeed, Litan (2005) argues that increasing broadband access to the elderly and persons with disabilities is not only beneficial to the targeted population, but confers economic benefits on the nation by lowering healthcare costs and enabling workforce participation.

Yet, despite these well-documented advantages, recent reports jointly prepared by the Economics and Statistics Administration (ESA) and the National Telecommunications and Information Administration (NTIA) (U.S. Department of Commerce, 2011) have found that the rate of broadband adoption among people with disabilities (43%) was lower than that in the overall population (73%). Nearly half of all households headed by a person with disabilities (46%) reported not owning a computer, while the comparable percentage for persons without disabilities was 20%. Though the report found that similar gaps exist for rural residents, the less educated, urban minorities and the poor, access for people with disabilities presents a more complex challenge: in addition to the barriers of cost and availability common to all these groups, people with disabilities also confront problems emerging from the limitations of the technologies and interfaces themselves. Universal broadband access for people with disabilities is thus a bigger challenge.

Though it affects a significant minority of Americans, broadband access for people with disabilities has not attracted a lot of policy analysis (for a brief survey, see Sawhney and Jayakar, 2007). The majority of scholarly analyses in this area are produced by think tanks and government agencies (Lyle, 2010). With a few exceptions, such as Vicente and Lopez (2010) and Robare (2011), academic research is published mostly in journals specializing in disability studies such as *Disability and Society*, the *Disability Studies Quarterly*, and the *Hearing Journal* (Endres, 2009; Gregg, 2006; Simpson, 2009). Downey (2008) has published an excellent book on closed captioning for broadcast programming. The Twenty-First Century Communications and Video

Note: The views expressed are those of the authors and not necessarily those of Time Warner Cable or the Time Warner Cable Research Program on Digital Communications.

Accessibility Act, passed in 2010 to update a number of legal provisions related to disability access to ICTs, has attracted extensive coverage in the trade press (to cite only a representative few, Eggerton, 2011; McAdams, 2011; Tremaine, Sloan and Hurd, 2011), and at academic conferences (Jayakar, 2011). This literature is reviewed in greater detail for the analysis presented here.

This report is intended to fill this gap in the academic literature. Based on the significant factors that prevent persons with disabilities from accessing broadband, as identified in the literature, the report inventories and evaluates the programs and policies aimed at improving broadband access to people with disabilities, ranging from technological innovations and market-driven initiatives to public-private partnerships and regulatory mandates. The objective is to identify success factors and challenges for these efforts and recommend potential solutions. Specifically, the report addresses the following research questions.

Research Question One: What are the main barriers to access preventing persons with disabilities from accessing broadband? These include:

- inaccessible content (e.g., lack of closed captioning on television)
- hardware and software issues (e.g., incompatibility with assistive technologies or over-complexity of software)
- inadequacy or unavailability of alternative technology platforms, and their lack of interoperability with mainstream products (e.g., video relay services)

Research Question Two: What programs and policies, such as market-driven initiatives, public-private partnerships, regulatory mandates, or others, have been implemented to overcome the disability barriers identified in Research Question One? To answer this question, this report presents seven case studies of policies and programs indicative of different approaches to promoting disability access, and analyzes them in terms of participants, financing, consumer benefit and other operational details. It also notes whether specific approaches have been favored for overcoming particular barriers to access.

Research Question Three: What lessons can be learned from evaluating the success of programs and policies for promoting broadband access for persons with disabilities? Based on this analysis, which approach, if any, has the greatest relative advantage? There are many metrics to measure program success: consumer benefit, penetration or consumer uptake, cost efficiency, sustainability (without cross-subsidies), etc. Which criteria would be appropriate for analyzing the success factors and challenges faced by programs and policies?

Section Two explores the concept of disability. This is necessary because sound policy requires an understanding of the problem to be tackled: it is particularly important in this case because disability has been a contested concept whose definition has evolved over time. Demographic information on the prevalence of disability is also discussed in this section. Section Three is a discussion of the research literature on the benefits of broadband access, both for the general population and for persons with disabilities. This section is intended to highlight the urgency of the problem and to illustrate the benefits to be realized through the equitable provision of broadband resources. Section Four presents available survey research on the "disability divide" in broadband access, and explores other causal variables such as income, education and place of residence. Section Five addresses the reasons why people don't subscribe to broadband, even in areas where the service is available. It also explores factors particular to persons with a disability in deciding whether or not to subscribe to broadband.

Section Six presents seven case studies of programs and policies aiming to deploy technologies, products and services to improve broadband access for persons with disabilities: specifically, the government mandate for video description, the public-private partnership that resulted in the DeafBlind Communicator, the government program on assistive technology, the universal design movement, digital literacy programs, the World Wide Web Consortium's Web Accessibility Initiative and the computer refurbishing movement. These programs and policies are discussed in terms of their participants, financing, and intended consumer benefit. Section Seven turns to a comparative evaluation of the successes and challenges facing disability access programs. This section aims to identify lessons for program implementation based on the experiences recorded in the case studies. Section Eight presents conclusions and suggestions for future research.

Section Two: Understanding the Concept of Disability

For decades, the prevailing approach to disability was based on what was called the "medical model of disability" (Borsay, 2006; Hughes and Patterson, 2006; Oliver, 2006). The medical model viewed disability primarily at an individual level, as an unfortunate "personal tragedy" (Oliver, 2006, p. 8), implying that persons with disabilities cannot or do not participate fully in society mainly because of their own physical and psychological limitations. Disability was therefore based on the diagnosis of a medical practitioner or other expert. The solution to disability was expected to come from the individual through personal effort aided by expert advice or through reconciliation with an unchangeable fate.

More recently, a purely medical definition of disability is in retreat, with most experts advocating the role of the physical and social environment in creating the conditions for disability (Borsay, 2006; Oliver, 2006). Advocates of this "social model of disability" argue that disability is "socially produced" (Hughes and Patterson, 2006, p. 91). According to this view, physical differences become disabilities because society fails to make the modifications necessary to enable full participation by all individuals.

Others seek a compromise definition based on the "bio-psycho-social model" (World Health Organization [WHO], 2011, p. 4). According to this view, "Disability is the umbrella term for impairments, activity limitations and participation restrictions, referring to the negative aspects of the interaction between an individual (with a health condition) and that individual's contextual factors (environmental and personal factors)" (WHO, 2011, p. 4). In other words, individuals with a physical impairment become subject to disability if their living context does not permit the full range of daily activities due to that impairment. Disability is not therefore an unalterable attribute of the individual, but emerges in the interaction between that person and his or her environment.

Current definitions of disability have come to reflect this changed approach. According to the Americans with Disabilities Act (ADA1990, as amended in 2008), the term disability means,

> "with respect to an individual (A) a physical or mental impairment that substantially limits one or more major life activities of such individual; (B) a record of such an impairment; or (C) being regarded as having such an impairment."

Whereas part (A) of this definition acknowledges the medical model of disability through its reference to physical and mental impairments, parts (B) and (C) recognize that disability can also arise from the prejudices of others about the consequences of physical differences (whether such differences limit daily life activities or not) and the resulting discrimination. Having a documented record of disability and/or being regarded as having an impairment thus fall under the definition of disability.

The U.S. Census Bureau periodically collects information on the population of persons with disabilities in the United States. Its definition of disability is derivative of the ADA definition, but is operationalized by including a number of specific enumerating categories. The Census Bureau's American Community Survey (ACS) reports demographic and economic information, including

data on disability, estimated through annual sample surveys. On disability, information is collected on six categories:

- *hearing difficulty* (whether respondents were deaf or had serious difficulty hearing)
- *vision difficulty* (whether respondents were blind or had serious difficulty seeing even with eyeglasses)
- *cognitive difficulty* (whether respondents had serious difficulty concentrating, remembering, or making decisions due to physical, mental, or emotional conditions)
- *ambulatory difficulty* (whether respondents had serious difficulty walking or climbing stairs)
- *self-care difficulty* (whether respondents had difficulty performing Activities of Daily Living [ADLs] such as dressing or bathing)
- *independent living difficulty* (whether respondents had difficulty performing Instrumental Activities of Daily Living [IADL] such as doing errands alone, shopping or visiting a doctor's office) (U.S. Census Bureau, 2010, see documentation).

According to data from the American Community Survey (Table 1), approximately 12% of Americans (36.3 million) out of a total civilian non-institutionalized population of 304 million were estimated to experience some form of disability. However, data on disability are often affected by inconsistencies in definitions, the specific methodology used in surveys and even the ways in which questions might be worded. These lead to vastly different estimates of the incidence of disability between different surveys. For example, an assessment by the U.S. Department of Health and Human Services (n. d.) states that nearly 54 million Americans, or 18–19% of the population, have an activity limitation or disability due to long-term physical, sensory or cognitive conditions.

Table 1: Disability Statistics for the United States, 2010

Percentage of the Population With:	Population under 5 years	Population 5 to 17 years	Population 18 to 64 years	Population 65 years and over	Overall population
Hearing difficulty	0.5	0.6	2.1	15.1	3.4
Vision difficulty	0.4	0.7	1.7	6.9	2.1
Cognitive difficulty	n.a	3.9	4.2	9.5	4.6
Ambulatory difficulty	n.a	0.6	5.2	23.8	6.4
Self-care difficulty	n.a.	0.9	1.8	8.8	2.4
Independent living difficulty	n.a	n.a	3.5	16.2	4.3
Any disability	0.8	5.2	10.0	36.7	11.9
Total population in age category	20.13 million	53.89 million	191.14 million	39.13 million	304.29 million

Source: American Community Survey (U.S. Census Bureau, 2010)

International data reported by the World Bank (Mont, 2007) also show a wide range of estimates, from a low of 2% in Bangladesh to a high of 20% for New Zealand; in general, developed nations tend to report higher prevalence rates for disability due perhaps to better reporting standards and greater awareness about disability. In view of these findings, the 12% rate in the ACS report is an undercount since it does not include institutionalized populations or high-functioning individuals with certain mental conditions such as autism and bipolar disorder. This caveat applies when interpreting the data provided below.

Data from the ACS on disability by age category are reported in Table 1. The percentage of the population with disability increases with age, with more than one-third of all people above the age of 65 experiencing disability, especially related to movement (walking, climbing stairs) and independent living. It is also notable that many persons experience disabilities in multiple categories—this is expected, since cognitive difficulties, for example, are often associated with an inability to perform daily activities and chores. In their analysis of 2000 census data, Waldrop and Stern (2003) also found that almost half of all persons with disabilities reported having more than one. The ACS also reports data on the incidence of disability by gender (men and women are subject to disability in roughly the same proportions, 11.7% and 12.2%, respectively), and by race: whereas the percentage of people with disabilities among Caucasians (12.4%) and African Americans (13.5%) is roughly comparable to the national average, the incidence of disability is higher among American Indians and Alaska Natives (15.8%) and lower among Asians (6.2%) and Hispanic Americans (8.1%).

The data in Table 1 also show that although people with disabilities cumulatively account for a substantial share of the population (almost one in eight), the share of the population with each type of disability tends to be low. For example, the most prevalent disability category (ambulatory difficulties) accounted for only 6.4% of the overall population. This may explain why accessibility products and services do not command a viable market, despite the protestations of many disability rights advocates. As Riley (2005) has argued, a "consumerist approach" may not sufficiently advance the goals of accessibility because the disability market is fragmented, and activist groups centered on particular disability categories are rarely able to speak in one voice on any issue. We will return to this data when discussing barriers to access.

Also of relevance to the later discussion on barriers to access are other demographic variables related to disability, such as education, employment status and location of residence. The ACS data (U.S. Census Bureau, 2010) showed dramatic differences in educational attainment between people with and without disabilities: significantly more individuals with disabilities reported less than a high school education than those without disability did (26.6% versus 11.2%), while the proportions were reversed for bachelor's degrees or higher (13.5% for people with disabilities, versus 31.4% for those without disabilities). Employment status too was dramatically different: for the population above the age of 16, only 21.8% of people with disabilities reported being employed, while the comparable number for persons without disabilities was 64.2%. Employed persons with disabilities earned lower wages than workers without disabilities, with median earnings of $19,500 and $29,997, respectively. As a result, significantly more persons with disabilities lived below the poverty level (21%) than those without disabilities (12.3%). And 14.4% of people with disabilities fell between 100 to 149 percent of the poverty level, while only 8.1% of those without disabilities were placed in that earnings band. As a result, more than one-third of individuals with disabilities (35.4%) were living in households at or marginally above poverty status.

Next, we turn to data on the location of residence. The ACS does not report data on the residential status of persons with disabilities, but the information is available from a U.S. Census Bureau brief based on the decennial census carried out in 2000 (Waldrop and Stern, 2003). Though the precise numbers might be outdated, the census brief presents patterns that may reasonably be assumed to persist. In 2000, the states recording the five highest disability rates were all in the rural South: West Virginia, Kentucky, Arkansas, Mississippi and Alabama, in that order. Overall, the disability rate among regions was also the highest in the South, and the lowest in the Northeast. County level data also show a correlation between rural location, poverty and disability. As Waldrop and Stern (2003) report, "counties with very high disability rates were clustered in the coal mining areas of Kentucky, West Virginia, and Virginia."

These statistics indicate some of the problems policy makers and disability rights advocates are likely to encounter when attempting to increase broadband penetration among persons with disabilities. Individuals with disabilities are in general older, less educated, less likely to be employed, more likely to live in poverty and in a poor and/or rural area. However, broadband technologies promise to assist people with disabilities to work, learn, communicate and engage with the local community, mitigating many of their socioeconomic problems.

Section Three: The Promise of Broadband for Persons with Disabilities

In the United States, broadband is defined as wired or wireless connections that "enable the end user to receive information from and/or send information to the Internet at information transfer rates exceeding 200 kbps in at least one direction." (Federal Communications Commission [FCC], 2009). Though these speeds are low by international comparisons, broadband access even at available speeds has been recognized as having tremendous potential to impact on consumer welfare, firm productivity and overall economic growth. Czernich, Falck, Kretschmer and Woessmann (2009) catalog some of the ways in which broadband deployment leads to economic growth. On the demand side, broadband permits access to a much wider range of applications and services, increasing consumer choice and usage and consequently welfare. On the supply side, broadband augments production efficiencies, since network goods are both complements and substitutes to other production inputs, such as transportation and labor. But broadband also allows new markets to be developed and extends the reach of existing markets through the innovation of new network-based products and services. Because of this, broadband is often referred to as a General Purpose Technology (GPT) (Majumdar, Carare, and Chang, 2009).

In addition to its impact on macroeconomic growth, broadband has also been found to have individual and community-level effects. Some recent studies have found evidence for the influence of broadband deployment on employment (Champion, Kosec and Stanton, 2012; Singer and West, 2010). Using panel data for 1998–2010 from the Current Population Survey's Internet and Computer Use supplement, Champion et al. (2012) found that individuals with Internet access at home are more likely to work, to work longer hours and to do a larger amount and share of work from home than are similar individuals who do not have home Internet access (p. 28). Singer and West (2010), commissioned by the industry group Fiber-To-The-Home North America, found that if current-generation broadband access[1] were made available to all households in the United States by 2015 under a national broadband plan, it would create almost 40,000 jobs per year. If instead, next-generation broadband networks[2] were deployed to 80 percent of homes by 2015, the total incremental gains would be more than 250,000 jobs per year. Crandall, Lehr and Litan (2005) found that a one-percent increase in broadband penetration will increase private, non-farm employment by 293,200 jobs annually. Singer and West's (2010) mostly optimistic findings are not uniformly supported by other studies. Some (e.g., Fornefeld, Delaunay, and Elixmann, 2008) argue that ICT-enabled productivity gains may actually lead to job losses in the short term as "the company is able to produce more with the same personnel or produce the same with fewer personnel" (p. 96). Similarly, Shideler, Badasyan and Taylor (2007) found that broadband deployment results in overall employment growth, but the impact on specific industrial sectors varies. Overall, the consensus is in favor of a generally positive impact of broadband deployment on employment growth—though particular firms and industrial sectors might be impacted negatively in the short run. The implications for individuals with disabilities, confronted by high rates of unemployment as documented in the previous section, appears to be positive.

In addition to creating jobs, broadband is particularly beneficial to individuals confronted by visual, hearing and ambulatory difficulties. It makes a variety of information, communication and entertainment options available at the user's location, and provides opportunities for social interaction for individuals who often lead isolated lives due to lack of mobility and the inaccessibility

of peer networks. "Accessible technologies can have a remarkable effect on empowering persons who have functional limits, and the Internet holds a great promise for connections to a range of people regardless of location" (Baker, Hanson, and Myhill, 2009, p. 48). It also improves educational opportunity for persons with disabilities through online education (Ellis, 2011) and enables new means of workforce participation possible through telecommuting and telework (Fuhr and Pociask, 2011). While all workers save money and stress and gain greater flexibility to structure their daily life through telecommuting, it is much more consequential for individuals with ambulatory difficulties, for whom it might mean the difference between working and not working at all.

Experts have also pointed to the benefits of broadband for healthcare delivery for the elderly and other persons with disabilities (Litan, 2005; Slater, Lindstrom and Astbrink, 2010). Since broadband services are available around the clock, they provide a platform for monitoring and other support services. Emergency systems can also use broadband to receive and appropriately route calls to the nearest emergency service centers. Since these services can be provided remotely, service providers also realize economies of scale through coverage of a larger customer base and territory. Broadband deployment to people with disabilities thus confers benefits on the recipients of healthcare services, as well as on the service providers and society at large.

Litan (2005) quantified the healthcare cost and added earnings benefits of deploying broadband to the elderly and people with disabilities. Healthcare savings result from the lower medical management costs due to the greater efficiency of broadband for communication and monitoring, and the avoided or deferred costs of institutional care since the elderly and persons with disabilities can stay in their homes longer with better monitoring. Additional earnings arise through enabling seniors and persons with disabilities to continue working if they choose to do so through telecommuting. Litan calculated total benefits under two scenarios; under the first, broadband continues to diffuse at rates commensurate with its past pattern of growth (the base scenario); and under the second, the government adopts a set of comprehensive and proactive policies to encourage broadband adoption (the policy scenario). Litan estimated (writing in 2005) that cumulative savings by 2010 from healthcare costs and additional earnings would be $89 to $150 billion in the base scenario, and $163 to $277 billion in the policy scenario (both in constant 2005 dollars). Cumulative savings by 2030 were expected to be $927 to $1,338 billion in the base case, and $1,459 to $2,185 billion in the policy scenario (also in 2005 dollars). To put these numbers in perspective, Litan (2005) stated that the "potential cumulative economic benefit of policies designed to accelerate broadband use for seniors and individuals with disabilities is comparable to what the federal government is likely to spend on homeland security measures during the next 25 years" (p. 3).

Given these well-documented benefits, it is surprising that people with disabilities continue to access and use information and communication technologies at rates well below those of the rest of the population. In the next section, we present data on the "disability divide" and summarize survey research exploring reasons for the lower subscription rate to ICTs and broadband among people with disabilities.

Section Four: The Disability Divide

Data on ICTs and broadband penetration in the United States are available from the U.S. Census Bureau's *Current Population Survey* (CPS), periodically produced jointly by the ESA and the NTIA (U.S. Department of Commerce, 2010; 2011), the NTIA's (2011) *Digital Nation* report, and data from the FCC's 2009 *Broadband Service Capability Survey* (Horrigan, 2010) and from surveys conducted by non-government organizations such as the Pew Research Center (Fox, 2011) and Connected Nation (2008; 2011).

The most recent data (U.S. Department of Commerce, 2011) show that in October 2010, 68% of American homes had broadband Internet access service, up from 64% the previous year. More than three-fourths (77%) of homes had computers or handheld devices enabling access to the Internet, a significant increase over the 62% computer penetration reported in 2003.[3] However, there were significant disparities in availability, access and usage across a number of demographic and economic categories. For example, 57% of households with annual income less than $25,000 had no computer, whereas only 3% of households with annual income above $100,000 were without computers in the home. Similarly, broadband penetration went up from 43% for households with annual income less than $25,000, to 93% for households with annual income above $100,000. Asian households had much higher broadband connectivity (81%) compared to African-American (55%) and Hispanic (57%) households, with white, non-Hispanic households falling in between (72%). Other factors affecting computer and broadband penetration included the head of household's age, education and place of residence (rural versus urban), as well as disability status. Table 2 presents data from the U.S. Department of Commerce (2011) (calculated from data in Figure 10, p. 16, and Table B2, p. 45)

Table 2 strikingly demonstrates what has been called the "disability divide" in broadband and Internet penetration in U.S. households. In 2010, 16.38 million households were estimated to have at least one individual with a disability, out of a total of 119.13 million households. Of these, an estimated 7.6 million households, or 46.4% of those households including persons with disabilities, did not have a computer or other access device. The comparable figure for households without persons with disabilities was 20.2 million, or 19.7% of such households. In other words, nearly half of all households where an individual with a disability lived had no computer, whereas only one-fifth of other households were without computers. Similarly, even among households with computers, higher percentages of households including an individual with a disability had no Internet connectivity or only low-quality dial-up connections, as compared with other households. Thus, only about 80% of computer-using households that included a person with a disability had broadband, compared to nearly 90% of households where no individuals with disabilities lived.

Further analysis reported by the U.S. Department of Commerce (2011) has shown than not all of the disparity in access rates between households with and without people with disabilities may be attributed to disability itself. The householder's age, household income, educational level, and place of residence (rural versus urban) are also correlated with computer and broadband penetration. Regression analyses were conducted to calculate the marginal effect of disability status, holding other variables constant—the "disability gap," originally 29% (72% broadband penetration in households without people with disabilities versus 43% for households including individuals

Table 2: Comparison of Computer and Broadband Penetration in Households, 2010

	Households with Disabled Resident [A]		Households with No Disabled Resident [B]		Total households [A+B]	
	(millions)	(%)	(millions)	(%)	(millions)	(%)
Number of households	16.38	100.0	102.75	100.0	119.13	100.0
Households with no computer	7.60	46.4	20.24	19.7	27.84	23.4
Households with computer but no Internet	1.24	7.6	5.55	5.4	6.79	5.7
Households with computer and dialup Internet	0.54	3.3	2.77	2.7	3.31	2.8
Households with computer and broadband	7.06	43.1	74.19	72.2	81.25	68.2
Percent broadband in households with computers	–	80.4	–	89.9	–	89.0

Source: Calculated from U.S. Department of Commerce (2011), Figure 10, p. 16, and Table B2, p. 45.

with disabilities), falls to 6% after controlling for other factors. Among computer-owning households, the original 10% gap (90% versus 80%) falls to only 3% after controlling for other variables. The report concludes that "differences in demographic and socio-economic attributes and geography explain a substantial portion of the disability-related broadband gap, even among computer owners" (U.S. Department of Commerce, 2011, p. 32).

However, this conclusion may be questioned on the argument that income and educational level are not truly independent of disability status; as the census data (U.S. Census Bureau, 2010) cited in Section Two show, educational attainment was lower for people with disabilities than for the general population, with more than a quarter of persons with disabilities reporting less than a high-school education. Similarly, only 21.8% of people with disabilities reported that they were employed, while the comparable number for others was 64.2%. The median earnings for people with disabilities were consequently 50% lower than those for others. The data in Table 1 also showed that age and disability were correlated, with the elderly showing higher incidence of disability. The marginal effects reported by the U.S. Department of Commerce (2011) from regression analyses are therefore likely to underestimate the effects of disability, since part of the variance attributed to income and education may be traced back to disability. But to be fair, age will claim some of the effect attributed to disability as well. The description of the report's methodology in Appendix A is insufficiently detailed to make a judgment in this regard.

To independently verify the effect of income, age and disability on Internet use and desktop computer ownership, data from the Pew Internet and American Life Project were analyzed via regression analysis. The data, collected in a September 2010 national telephone sample survey, contain information for around 3,000 adults on information technology use patterns, health status and demographics such as age, gender, household income and place of residence. Disability data on six categories (hearing, vision, cognitive impairments, mobility, personal care activities and daily chores) were also provided. In the area of information technology use, the dataset included statistics on Internet access and ownership of desktops.

Binary logistic regressions were carried out for dichotomously defined technology use variables as dependent variables, and age, household income and disability status as predictors. An illustrative

example is provided below for desktop ownership as a DV, with age, income and hearing disability as predictors (Table 3). Age was defined as a continuous variable, and household income as a scalar, interval variable (1–10). The total number of observations was around 3,000, reduced to 2,428 due to missing values, mainly for household income. It was observed that disability status was a strong negative predictor of technology use when used singly (Model 1), but became insignificant when combined with age and income (Model 2), as indicated by the Wald statistic and the significance level. The pattern for other technology use variables (ownership of laptops, cell phones, e-readers, tablets) is very similar—strongly negative when used singly; turning insignificant, but still weakly negative once age and income are added to the model as predictors. The full set of results for all technology use variables and different types of disabilities is not reported due to space, but is available from the author.

Table 3: Binary Logistic Regression of Desktop Ownership

DV = Desktop Ownership		Constant	Hearing	Age	Income	N
Model 1	coeff.	0.473	-0.399			2428
	Wald stat.	117.23	7.79			
	sig.	0.000	0.005			
Model 2	coeff.	-0.447	-0.063	-0.012	0.349	2428
	Wald stat.	9.000	0.158	24.20	297.26	
	sig.	0.003	0.691	0.000	0.000	

Analysis of data from the Pew Internet and American Life Project showed clear evidence of a "disability divide" with persons with disabilities owning computers and subscribing to broadband at lower rates. This finding was consistent across multiple surveys, as well as over time, even though the non-adoption rate has tended to come down for both users with and without disabilities over time. However, the reasons for this are difficult to attribute: since income and education, often mentioned as independent factors behind non-adoption, are also correlated with disability. Independent analyses carried out by the author show that once the effects of age and income are controlled for, the impact of disability itself on Internet use and desktop computer ownership become insignificant. This suggests that persons with disabilities are not uninterested in information technology use because of their disabilities *per se*, but because of the negative effects of disability on income and education.

Section Five: Why Persons with Disabilities Don't Subscribe to Broadband

Given the widespread benefits attributed to ICT and broadband adoption as reported in Section Three, it is surprising that persons with disabilities do not adopt computers and broadband more enthusiastically. Several surveys have sought to find answers to this paradox (Connected Nation, 2008, 2011; Fox, 2011; NTIA, 2011; U.S. Department of Commerce, 2010; 2011). In Table 4, the main reason households provided for not subscribing to broadband is reproduced from NTIA (2011). Note that the percentages represent all non-subscribing households (with and without individuals with disabilities).

Table 4: Reasons for Non-Subscription to Home Broadband, 2009–2010

	October 2009 (%)	October 2010 (%)
Don't need/not interested	37.8	45.9
Too expensive	26.3	25.3
No computer/inadequate computer	18.3	14.2
Service not available	3.6	3.1
Can use elsewhere	4.4	4.9
Other	9.6	6.9

Source: NTIA (2011), Figure 14, p. 20

As shown in Table 4, the principal reason for non-subscription is that households remain unconvinced about the benefits of broadband; the percentage went up in 2010 relative to 2009 because households that put forward other reasons for not subscribing to broadband in 2009 (and would presumably have subscribed had it not been for these reasons) were able to overcome the problem and subscribe by 2010. In both years, affordability was put forward as a reason by roughly one-fourth of non-subscribing households, and the lack of access devices by a smaller percentage. The NTIA (2011) states that this rank-ordering has remained the same every year, with one exception, since the Census Bureau began collecting the data in 1997 for Internet access, and later for broadband.

Other surveys have found similar though not identical results. Connected Nation, a public-private partnership, conducts annual telephone surveys to collect information on computer ownership and broadband connectivity. In 2010, Connected Nation carried out random-digit-dialed telephone surveys of nearly 16,000 adults spread across 12 states and Puerto Rico to assess technology adoption and usage and barriers to adoption. Paralleling the NTIA (2011) report, Connected Nation (2011) also found that the main barrier to adoption of computers and broadband is lack of conviction about the need for these technologies: more than half of computer non-adopters (52%) and nearly a third of broadband non-adopters (32%) said they did not need these technologies. However, expense was cited as a reason by a sizeable number of respondents (29% and 20% for computers and broadband, respectively), and so was the lack of a computer (29%).

These reports seek to determine the reasons for non-adoption in the general population, and are not specifically targeted to persons with disabilities. Data on non-adoption specifically for persons

with disabilities are relatively rare, though some recent reports do provide information relevant to disability access (Connected Nation, 2008; Fox, 2011, Horrigan, 2010). The Connected Nation (2008) report provides one reference point, separately reporting reasons for non-adoption for the overall population and for different demographic segments, including people with disabilities. Data compiled from the report are presented in summary form in Table 5.

Table 5: Comparison of Reasons for Non-Adoption of Computers and Broadband, 2008

Barriers to Computer Ownership			Barriers to Broadband Adoption		
	Persons w/ disabilities	Overall		Persons w/ disabilities	Overall
I don't need a computer	56	62	I don't need broadband	41	44
Too expensive	41	24	I don't have a computer	44	32
I use a computer someplace else	4	10	Too expensive	29	23
Other	5	10	Broadband is not available in my area	12	14
			I can access broadband someplace else	7	8

Source: Connected Nation (2008), compiled from Figure 4: Barriers to Computer Ownership; Figure 5, Barriers to Broadband Adoption,; Figure 10: Barriers to Computer Ownership among People with Disabilities; and Figure 11: Barriers to Broadband Adoption among People with Disabilities,.

It is evident from the data in Table 5 that persons with disabilities are marginally more aware of the benefits of computers and broadband, with a smaller percentage of people with disabilities denying that they need these technologies (56% of people with disabilities were non-adopters versus 62% overall for computer ownership, and 41% versus 44% for broadband). But it is still significant that sizeable numbers of non-adopters were not aware of the need for computers and broadband among both populations, those with and without disabilities. However, a substantially higher percentage of people with disabilities cited expense as a factor in not adopting computers (41% versus 24% overall), and lack of a computer was cited by 44% of people with disabilities (versus 32% overall) for not subscribing to broadband. The percentage of people with disabilities who have access to computers elsewhere (at work, school or a local community center) was also lower—which is understandable, given the lower participation rate of people with disabilities in education and the workforce, and the ambulatory difficulties of a substantial number. Significantly, the percentage of individuals with and without disabilities who cite unavailability of broadband in their area as a reason for non-subscription has come down substantially between 2008 and 2010 (comparing Tables 4 and 5).

The Pew Research Center's Internet and American Life Project produced a report on the technology profile of persons with disabilities, based on telephone interviews of about 3,000 adults (Fox, 2011). Among other questions, respondents were asked about disability status (using the same six categories as the ACS) and their ICT usage. The survey confirmed previous reports' findings that people with disabilities subscribed to broadband at lower rates and at slower connection speeds than others did. The key result was that though disability was negatively associated with broadband subscription, its effect is reduced (though still negative) once other variables such as education, employment and household income are accounted for.

Fox's (2011) survey results found that only 2% of respondents answered yes to the question "Do you have any disability or illness that makes it harder or impossible for you to use the Internet,

or not?" However, this might underestimate the negative impact of disability because the base for the 2% calculation was *all* respondents in the survey. Since the Pew Research Center makes all its databases available for download, it was possible for this author to independently analyze and verify this result. Of the 3001 respondents in the database, 906 (30.2%) reported that they had difficulty in one or more of the six disability categories; and of these, 75 reported that their disability made it harder for them to access the Internet. These 75 cases translate into 2.5% of the entire sample (the number reported by Fox), but 8.3% of the 906 respondents with disabilities. Thus one in 12 individuals with disabilities find it harder to access the Internet due to their disability—hardly a trivial result. In addition, the telephone survey methodology used by Pew might have reached fewer deaf and hard-of-hearing individuals who use relay services for telephone access.

Horrigan (2010) analyzed data from the FCC's Broadband Service Capability Survey that conducted telephone interviews with a national sample of about 5000 adults living in the United States in October and November, 2009. The survey collected demographic information (including disability status) and asked respondents about broadband adoption and online behavior. On disability, Horrigan found that persons with disabilities constituted 39% of non-adopters and 15% of adopters—for comparison, 23% of all respondents in the FCC survey claimed a disability. Horrigan also found that persons with disabilities used a smaller number of online services than other users did: on average, users with disabilities participated in 12% fewer online activities. Persons with disabilities were somewhat more likely to claim cost as one of the reasons for not subscribing to broadband (37% of non-adopters with disabilities versus 35% of non-adopters without disabilities), as well as digital literacy (25% versus 19%). Fewer non-adopters with disabilities were likely to claim relevance of online content as a factor than non-adopters without disabilities were (17% versus 19%). On age, Horrigan reported that adoption rates fell with age for both persons with and without disabilities but faster in the case of those with disabilities, with the result that the disability divide was the greatest for older Americans.[4]

Horrigan's (2010) finding about the lack of relevance of online content as a barrier to access was corroborated by Lyle (2010), who identified inaccessible web pages, new media applications and video programming on the web a barrier to access. New media applications present difficulties because they often lack alternative text or visuals, and are not easily amenable to text-to-speech conversion software. Video programming on the Web is often not captioned, and also lacks alternative text. Lack of accessibility also applies to the design of electronic devices and platforms. Lyle (2010) comments that designers of electronic equipment and device manufacturers do not consider accessibility, usability and compatibility when designing their products, with the result that they lack built-in accessibility features and are often not compatible with the assistive technologies used by persons with disabilities. For example, cell phones have keypads that are not easily manipulated by persons with mobility impairments, and have menu displays that could be challenging for persons with visual disabilities. Thus, persons with disabilities aiming to use these access technologies face significant frustration and may decide not to own a computer or subscribe to broadband as a consequence.

The survey research cited in this section shows that non-adopters, with and without disabilities, tend to give similar reasons for not adopting computers or broadband. The three principal reasons for not adopting computers or broadband are:

- the perception that they do not need computers/broadband
- the lack of an adequate access device
- the expense factor

However, users with disabilities are somewhat less likely to state that they do not need computers or broadband (in other words, they are more aware of the benefits of ICTs), but more likely to state expense as a factor behind non-adoption. Accessibility of both content and devices were also problems especially relevant for persons with disabilities. To summarize, the research cited in this section identified the following as principal barriers to broadband access by persons with disabilities:

- **Accessibility of devices**: problems with the accessibility and usability of commonly used electronic devices, and their lack of compatibility with assistive technologies needed by persons with disabilities
- **Cost of devices:** expenses associated with the purchase and use of ICTs and broadband technologies such as computers and mobile devices
- **Accessibility of content:** Inaccessible web pages, complexity of new media applications, lack of alternative text and captioning
- **User demand:** discomfort with technology, lack of awareness of the benefits of ICTs and broadband

Though the survey research is fairly consistent in its identification of these problems, it is possible that these sources do not adequately address all possible problems faced by persons with disabilities in accessing ICTs and broadband. Anecdotal evidence suggests that effort, time and expense associated with the maintenance and upkeep of services could also be a barrier to access (J. Simpson, personal communication). Upgrading technology, mailing back a piece of faulty equipment, contacting service personnel, or accessing online help manuals can be a daunting challenge to persons with hearing or vision disabilities, or an elderly person with mobility impairments. Transportation itself may pose a hidden barrier to many systems and services in the disability community. While the survey research helps identify the four problems most often mentioned by the disability community as barriers to ICT and broadband access, they should not be interpreted as the *only* barriers to access. In the next section, we consider the different programs and policies that have been implemented to increase broadband adoption by persons with disabilities, in light of these findings.

Section Six: Case Studies of Improving Access for Persons with Disabilities

A number of efforts have been undertaken to improve access to broadband technologies, devices and services for the disability community, running the gamut from market-driven initiatives to public-private partnerships and regulatory mandates. Market-driven efforts are based on the recognition by businesses that assistive technologies and services can find viable markets in the disabled community, and potentially make the platform more attractive to users without disabilities as well. Many new devices have incorporated assistive technologies such as text-to-speech software to enable access by people with disabilities. Second, public-private partnerships involving cooperation between advocacy groups or government agencies and industry have sought to improve broadband access for people with disabilities. A third approach relies on legislation or regulation to mandate certain disability-related modifications to content or technology.

The choice between these alternative approaches is not clear-cut, since they all have advantages and disadvantages. Disability advocates have argued that profit-oriented firms are unlikely to make accommodations for disabilities, unless there is a proven market potential for such products and services. Public-private partnerships may offer a better model, but they too are subject to the same economic forces as purely market-driven actions. Regulation offers the promise of a universal and immediate solution, but it may freeze access standards at the minimum required by law, and reduce incentives for innovation. Since there is *prima facie* no approach that dominates others in all respects, the objective here is to present case studies of different programs drawn from all categories—technological innovations, market-driven initiatives, public-private partnerships and regulatory mandates, and comparatively evaluate their efficacy in improving disability access.

Based on the review of Lyle (2010) and other sources, these are possible approaches to the disability divide:

- **Regulatory mandates:** Formal legal requirements to provide a product or service, created through legislation or regulatory rule-making; government does not directly administer the program but requires industry or other private parties to do so
- **Government programs:** These involve direct funding and administration of a program by government at federal, state or local levels, or spanning two or more levels
- **Public-private partnership**: Government and private agencies, sometimes with the involvement of consumer groups, partner to create or distribute new products or services
- **Market initiatives:** Private parties or industry consortia develop and distribute products motivated by their market potential
- **Consumer initiatives:** Consumer groups or advocacy organizations create cooperative arrangements to distribute products or services, usually on a not-for-profit basis

The methodology used is as follows. Case selection and analysis are, in general, based on the method described in Yin (2008). Cases are chosen to be representative of a particular approach to improving ICT or broadband penetration among people with disabilities, as well as the specific barrier that is addressed (as identified in Section Five), such that there is at least one representative of each goal and each approach in the matrix (Table 6). All the chosen cases deal with some aspect of disability. Not all cases deal specifically with broadband, because cases fitting all goal-approach combinations could not be found. For example, a case promoting device access through

a public-private partnership could not be found within the broadband space. However, a close approximation is the case of the DeafBlind Communicator. The device does not strictly require broadband, though it can be used for mobile telephony and web browsing. Cases were selected such that their analysis could prove instructive for the promotion of ICT and broadband access for persons with disabilities, even though the cases themselves may not deal with broadband. Case selection was done in a manner that would ensure that every case could be compared to another along the vertical or horizontal dimension (possible comparisons are indicated with double-headed arrows). This helps answer questions about the comparative efficacy of a method for different issue areas (for example, do public-private partnerships work better for innovating new access devices or for creating new content accessibility standards?) or the effectiveness of different methods in the same issue area (are device costs better controlled through government programs or cooperative efforts?).

Table 6: Case Selection

	Regulatory Mandate	Government Program	Public-Private Partnership	Market Initiative	Consumer Initiative
Device Access			Case 2: DeafBlind Communicator	Case 4: Universal Design	
Device Cost		Case 3: Assistive Technology			Case 7: Computer Reuse
Content Access	Case 1: Video Description		Case 6: Web Accessibility Initiative		
User Demand					Case 5: Digital Literacy

In each case, the available information is scanned for program objectives, stakeholders involved, services offered, operational details, beneficiaries or target markets, financing including revenue sources and expenditures, and outcomes if available. The objective is to obtain as comprehensive a picture of the operations of each program or policy as possible, given the available information. To do so, a wide variety of information is consulted, including news reports, trade press articles, scholarly research, public databases, analysis from advocacy groups and foundations and regulatory reports from agencies such as the NTIA and the FCC. In each case, the section heading identifies the primary barrier to access addressed in the case, the type of intervention, and the name of the program.

Case Study One: Video Description (Content Access/Regulatory Mandate)

This case is about the FCC's first attempt to mandate video description, a technology to make audiovisual content delivered over broadband networks accessible to persons with visual disabilities. Initiated in 1995, the attempt ended in failure after the Court of Appeals for the D.C. Circuit rejected the measure in *MPAA v. FCC* (2002). Video description has since been mandated by the Twenty-First Century Communications and Video Accessibility Act of 2010, and is now in the process of implementation. This case however, focuses only on the FCC's initial attempt to mandate it, spanning the period 1995–2002.

Name:	Video Description
Barrier:	Content Access
Means:	Government Mandate
Objective:	Provide video description on all broadcast content
Outcome:	Withdrawn after MPAA v. FCC; laid groundwork for successful reintroduction of video description provisions in CVAA (2010)

Video description, also called audio description, narrative description or descriptive video, is a service that "provides narrated descriptions of the key visual elements of visual media without interfering with the audio or dialogue of a program or movie" (Goldberg, 2001, pp. 67–68). Video description needs distinct modifications to be made to all stages of the chain of production of audiovisual content. A separate script is prepared describing onscreen action, costume, location and body language, and carried on the Second Audio Program (SAP) channel separate from the main mono or stereo soundtrack of the program. A digital encryption system is needed at the production end to encode the SAP into the signal uplinked to satellite. Once received, the television station decrypts the signal and then encodes the SAP into its broadcast transmission using a SAP generator. The cost estimates for the local station to install the downlink and SAP generator were at that time estimated to range from $30,000 to $1 million (FCC, 1996). Cable systems may need to install a separate SAP generator for each cable channel over which narrated video would be distributed. Finally, to access video description, consumers needed a stereo-equipped television set or cable box. Consumers using digital-to-analog converter boxes to view digital broadcasts on analog television sets had to ensure that their converter boxes were equipped to handle associated audio channels (FCC, 2010b).

Video description is a relatively new technology whose beginnings can be traced to 1984, when Dr. Barry Cronin, an expert in television captioning for deaf/hard-of-hearing individuals, initiated a program at WGBH Boston to add an audio commentary to television programs that would be carried over the SAP channel (Watkins and Charlson, 2002). By the mid-1990s, it was estimated that video description was available for a number of PBS programs, including those with strong educational or cultural value such as *Nature*, *The American Experience*, *National Geographic* specials, and some episodes of *Mister Rogers' Neighborhood* (FCC, 1995). Nearly 100 noncommercial television stations covering 64 percent of U.S. television households carried these programs. In addition, video-described movies from the NTN cable network reached an estimated 25 million households. Watkins and Charlson (2002) argue that not only people with visual disabilities, but also the elderly, children, individuals with learning disabilities, and even the non-disabled population can benefit from narrative-enhanced programming.

In view of these perceived public benefits, the FCC in 1995 launched an inquiry to assess whether Commission action was appropriate to promote these services (FCC, 1995). The timing of this Notice of Inquiry was opportune since the 1996 Telecommunications Act, being debated in Congress at that time, had language addressing the accessibility of video programming. The Act's Section 713(f) required the FCC to initiate a video description inquiry, but stopped short of specifically authorizing it. Following this Congressional directive, as well as its own 1995 Notice of Inquiry, the FCC released a report summarizing the comments it had received on video accessibility (FCC, 1996). The report identified problems including the cost of preparing the narrative and the technical modifications to systems, copyright complications related to the creation of a new script for narration, and potential conflicting uses of the auxiliary SAP channel, e.g., for Spanish-English bilingual audio service. In summary, the report concluded that "at this time, the best course is for the Commission to continue to monitor the deployment of video description" (FCC, 1996, Section II(B)(2)(24)) and not to mandate it immediately. The FCC continued to collect data through its annual video competition reports (FCC, 1998).

In 1999, the FCC reversed its position previously outlined in its own documents (FCC, 1996, 1998) and released a Notice of Proposed Rule Making (NPRM) putting forward "limited rules to phase 'closed' video description into the marketplace." (FCC, 1999, Section III (19)). It required affiliates of the four major broadcast networks in the top 25 Nielsen markets, and the larger multichannel video programming distributor (MVPDs), to provide a minimum of 50 hours per quarter of video-described prime time and/or children's programming. Larger MVPDs (with more than 50,000 subscribers) would be required to carry the described programming of the major network affiliates, and of non-broadcast networks that reach 50% or more of MVPD households. The deadline to begin providing the required described programming was set at no later than 18 months after the rules were brought into effect. In July 2000, the FCC announced its Report and Order (FCC, 2000) announcing the new video description rules, setting the calendar quarter of April–June 2002 as the effective date. In support of its new mandate, the FCC cited the benefits to persons with visual disabilities, as well as to senior citizens and children with learning disabilities. The FCC also pointed to the increased availability of video described programming, as well as technology improvements that had lowered the one-time routing and transmission costs for television stations to upgrade their systems for video description, estimated in 2000 to range from $5,000 to $25,000, down from the 1996 estimates of $30,000 to $1 million (FCC, 2000).

Over the next few months, the FCC received several requests for reconsideration of the orders from major industry players. The National Cable & Telecommunications Association (NCTA) for example, declared itself not opposed to video description, but argued that video description is best left to voluntary industry efforts based on perceived audience demand and cost (NCTA, 2000). The Motion Picture Association of America (MPAA) opposed the mandate, stating that "new content must be created and added to an existing program" (MPAA, 2000, p. 7) to enable video description, and therefore mandating it amounts to a form of "compelled speech" (p. 7). The National Association of Broadcasters (NAB) questioned the FCC's statutory jurisdiction to mandate video description, but also requested reconsideration of several procedural issues: for example, that reasonable exemptions might be granted to stations that intended to use the SAP for alternative audio content, such as Spanish language (NAB, 2000). On the other hand, the National Federation for the Blind (NFB) argued that the FCC had not gone far enough in promoting equitable access to audiovisual content, and had displayed a misplaced priority in privileging "entertainment" over "accessible information" by mandating video description for prime time programs and not for news and current affairs programming, emergency warning systems, and health, safety and citizenship information (NFB, 2000). The FCC considered these petitions in a Memorandum Opinion and Order (FCC, 2001) issued in January, 2001, but made only marginal changes to the rules in the original Report and Order.

In response, the NAB, the MPAA and the NCTA challenged the FCC's Report and Order before the Court of Appeals for the D.C. Circuit (Davidson, 2001). Surprisingly, the National Federation for the Blind (NFB) joined the petitioners, arguing that mandating video description for prime time entertainment programming was misplaced and counterproductive because it would divert resources away from the narration of onscreen information (Danielsen, 2003). In *MPAA v. FCC* (2002), the court rejected the FCC's claim that Congress had authorized the FCC to mandate video description, pointing out that the FCC had been ordered only to study it and report back to Congress. The court also ruled that video description involves the exercise of significant levels of creativity, and mandating it may amount to content regulation.

Case Study Two: DeafBlind Communicator (Device Access/Public-Private Partnership)

Name:	DeafBlind Communicator
Barrier:	Device Access
Means:	Public-Private Partnership
Objective:	Innovate accessibility device for the deaf-blind
Outcome:	Strengths: positive reviews in press and community; concessional supplies for state's distribution program

In December 2008, Humanware, a Canada-based company, introduced a new electronic device, the DeafBlind Communicator, intended to enable persons with visual disabilities as well as partial or total hearing loss to communicate with hearing individuals (Humanware, 2008). The device consists of two separate portable components linked by a Bluetooth wireless connection. The Deaf-Blind user retains the main unit, on which messages can be entered in Braille (or with optional Perkins or QWERTY keyboards) and hands to the other party the companion unit, a special cell phone with a visual display and a QWERTY keyboard. The companion unit can reproduce messages from the main unit on the visual display or translated into voice. Messages entered on the companion unit are in turn sent to the main unit and displayed in Braille. With pre-installed software and a landline connector, the DeafBlind Communicator can be used for a Teletypewriter (TTY) conversation (with no separate TTY device required). It can also be used to initiate Short Message Service (SMS) communications, if the user installs a Subscriber Identity Module (SIM) card purchased from a wireless provider (Humanware, n.d.).

The device itself, though it earned positive reviews from the Deaf community as well as the trade press, was not notably groundbreaking. Similar devices intended for the Deaf-Blind community, including the Block Letter Communicator, the BraillePhone, the Screen Braille Communicator, and others are available from many manufacturers—see a listing of available Deaf-Blind communication products at Abledata (n.d.). What is distinctive about the product was that it was developed through a partnership between the state of Washington State's Office of the Deaf and Hard of Hearing (ODHH) and Humanware (Lyle, 2010).

Traditionally, Deaf-Blind individuals have communicated using a variety of signed languages, based on their degree of vision loss (American Association of the Deaf-Blind, 2009). Persons with partial vision might be able to use American Sign Language (ASL); those with more advanced vision loss might use Tactile Sign Language, in which the Deaf-Blind person puts his or hands over the signer's to feel their motion and position; or Tactile Fingerspelling, for those who are less familiar with sign language. However, all these methods have shortcomings when communicating with hearing individuals or those who have limited skill with sign language. In these situations, trained interpreters called Support Service Providers (SSPs) may be required—but these services are expensive and personnel are in short supply. This presents problems when Deaf-Blind individuals have to travel using public transportation, order food in a restaurant, or are in any context where they have to communicate with the general public. Devices such as the DeafBlind Communicator are intended to enable communications in these contexts.

Founded in 1989, Humanware has specialized in assistive technologies for people with visual disabilities, including people who are blind or have limited vision, and for students with learning disabilities. In December 2006, the ODHH, a part of Washington State's Department of Social and Health Services, initiated a contract with Humanware to develop a new Braille-based Deaf-Blind communication device (Rozmaryn, 2006). Under the contract, ODHH and Humanware would collaborate at every stage of the design process: initially, ODHH would train Humanware engineers on the protocols and conventions of Deaf-Blind communication, and later would arrange

focus groups of Deaf-Blind individuals to offer feedback during the design process, and arrange user testing for prototype devices as they become available. In return, Humanware would incorporate design elements recommended by the user community and offer devices at preferential rates for distribution through ODHH.

In 2009, after nearly three years of product testing and development, the DeafBlind Communicator became available for retail distribution (Raff, 2009; "DSHS leads the nation in life-changing technology with DeafBlind Communicator"). In light of the ODHH's role in the design and development process, Humanware made available the sets at a discount of $2,000 below the market price of $8,000 per device. In turn, ODHH distributed the devices for free or on a means-tested sliding scale to users. Free training in using the device was also provided to users. An estimated 300 Deaf-Blind individuals in the state of Washington were expected to be beneficiaries of the program (Clarridge, 2009). In the United States, the total number of Deaf-Blind individuals is estimated to be 45,000–50,000 (Gallaudet University Library, 2010).

Since its launch, the DeafBlind Communicator has earned strongly positive reviews from users and the trade press. Other states and federal agencies, and even some foreign governments, have started including the DeafBlind Communicator in their lists of services ("DSHS leads the nation in life-changing technology with DeafBlind Communicator" 2009). For her role in leading the public-private partnership that resulted in the DeafBlind Communicator, Colleen Rozmaryn, the assistive communication technology project manager, received the Colleen Cook Memorial award from the Washington State Deaf Blind Citizens, a user group (Raff, 2009). The *Seattle Times* reviewed the DeafBlind Communicator positively, quoting one user who said that "It's brought me out into the world and given me freedom" (Clarridge, 2009). In the United Kingdom, the BBC referred to it as a "liberating device" (Adams-Spink, 2009).

There are several distinctive aspects of the DeafBlind Communicator case study worthy of mention. First, it represented an instance when a government agency proactively sought out the partnership of a technology company to fulfill a need in a disability constituency. Second, it successfully integrated the contributions of the user community. As Tusler (2005) has argued, it is not often even today that persons with disabilities are consulted in the design of products and services intended for their use. "When designing products, people often work from stereotypical and inaccurate beliefs about people with disabilities; they try to 'help the handicapped' by alleviating the problems they imagine people with disabilities encounter. Unfortunately, such products often miss the mark because their designs are based on unexamined assumptions" (Tusler, 2005, pp. 3–4).

Case Study Three: Assistive Technology (Device Cost/Government Program)

As presented in Section Five, one of the major conclusions from the survey research on barriers to computer and broadband access was the prohibitive cost of devices. This is especially true for persons with disabilities, who have higher unemployment rates and lower household income than persons without disabilities have; for example, in the Connected Nation (2008) survey, two-fifths of non-adopting persons with disabilities stated that computers were too expensive, and nearly a third pointed to expense as the main reason for

Name:	Assistive Technology
Barrier:	Device Cost
Means:	Government Program
Objective:	Create state-level distribution network for AT equipment
Outcome:	Strengths: state AT programs created in all states and U.S. territories. Challenges: high rates of AT abandonment; incentive for recycling

not subscribing to broadband. In both cases, the percentage of individuals without disability who gave the same reason was much lower (around a quarter). In this case we consider a government program of competitive grants to states, to create state-level assistive technology (AT) programs initiated by the 1988 Technology-Related Assistance for Individuals with Disabilities Act, and subsequently amended/renewed thrice by the 1994 amendments to the 1988 Act, the 1998 Assistive Technology Act, and the 2004 amendments to the Assistive Technology Act.

It was in recognition of the importance of affordable technologies in improving the lives of persons with disabilities that one of the first federal laws to be passed was in aid of assistive technologies. In 1988, Congress passed the Technology-Related Assistance for Individuals with Disabilities Act (following common practice it is hereafter referred to as the Tech Act; 1988). According to Morrissey and Silverstein (1989), three concerns motivated various stakeholders to press for the Tech Act:

- lack of knowledge of and training in the use of technology and support services
- uncoordinated and limited funding for technology and support services
- the absence of a comprehensive system to advise persons with disabilities about the appropriate technology for their needs and help them acquire it

Since state governments would be closer to the target population, and would be able to assess and address their needs better, the Tech Act was designed to incentivize states to develop comprehensive and effective programs to offer technology-related assistance to persons with all types of disabilities. The National Institute on Disability and Rehabilitation Research (NIDRR) in the U.S. Department of Education was put in charge of implementing the legislation (Tech Act, 1988).

Section 3(1) of the Tech Act (1988) defined the term assistive technology device as "any item, piece of equipment, or product system, whether acquired commercially off the shelf, modified, or customized, that is used to increase, maintain, or improve functional capabilities of individuals with disabilities." Thus AT can include a variety of technological interventions, including powered and manual wheelchairs, stair glides and lifts, prosthetic devices, vehicle adaptations, etc., that are not specifically relevant for ICT or broadband adoption. However, the list also includes ICT equipment such as enlarged computer keyboards and monitors, text-to-speech conversion, voice recognition software, specialized telephones, and accessibility software.

The key mechanism of the Tech Act (1988) was a system of competitive state grants, awarded to states initially for a period of three years, renewable for an additional two-year term (Morrissey and Silverstein, 1989). States that successfully implement an assistive technology program in this five-year period become eligible for non-competitive annual grants. To encourage states to contribute their own share to disability access programs, the competition process took into account (while not requiring) matching funds from the state. States were awarded $500,000 to $1 million a year for the first two years, and $500,000 to $1.5 million a year for the remaining three years. Since only $5 million per year was made available for the program, the number of grants that could be made was quite limited: the law itself specified that not more than 10 grants would be made in 1989, the first year of the program (Morrissey and Silverstein, 1989).

Ten years after the Tech Act was legislated, it was considered sufficiently successful that one set of experts concluded that the legislation "has resulted in numerous programs and services that have helped people with disabilities access and use AT devices" (Bryant and Seay, 1998). As evidence for their claim, they catalogued the many actions taken by states to fulfill the mandated performance goals in the Tech Act: hiring additional personnel for policy research and needs assessment, creating resource guides for users with disabilities, contracting with banks and lending institutions to

initiate lending programs, starting equipment loan services, instituting interagency collaboration at the state level and providing outreach to persons with disabilities belonging to underrepresented groups such as rural residents and minorities. Because of the Tech Act's mandate to serve individuals having *all* types of disabilities, Bryant and Seay (1998) also found that state agencies were making a more proactive effort to reach out to persons with learning disabilities, who had previously received much less attention in AT services than persons with sensory and ambulatory impairments.

It was in recognition of these positive results that Congress amended the Tech Act of 1988 in 1994, the main effect of which was to make state grants eligible for an additional extension period of five years (Association of Assistive Technology Act Programs [ATAP], 2010). However, since one of the goals of the 1994 amendments was to make state programs eventually self-sustaining, the legislation specified that funding would be cut by 25% in each of the last two years of the additional five-year extension term (i.e., funding in the fourth and fifth years would be 75% and 50%, respectively, of what the grantee had received in the third year) (ATAP, 2010). With the addition of the additional five-year extension term, states were made eligible for a total of 10 years of funding.

In 1998, as the end of the 10-year extension term was reached for the states that had received the first wave of grants in 1989, Congress repealed the 1988 Tech Act and substituted it with the Assistive Technology Act of 1998 (AT Act; 1998). Primarily intended to ensure continuity of funds for state programs that were reaching their federal funding limits, the 1998 AT Act created two separate programs: first, the state grants program, continuing the flow of funds initiated in 1988, and second, the alternative financing program, which provided federal support for loan programs intended to enable persons with disabilities to acquire assistive technology (U.S. Department of Education, 2006). To harmonize state programs and bring them to a common footing, the AT Act required that all states should undertake activities in four categories: public awareness programs, interagency coordination, technical assistance and training, and outreach. The matching funds requirement was made more stringent, with a stipulation that federal funds would be no more than 50% of any state's program (ATAP, 2010). In 2004, Congress amended the AT Act, extending the program to 2010.

In terms of results, the assistive technology programs have succeeded in establishing state-level AT agencies in all 50 states, the District of Columbia and the six U.S. territories (U.S. Department of Education, 2011). In fiscal years 2004–08 (the last five years for which full data has been published), a total of $111.3 million was provided through state grants. These modest amounts were augmented through state matching funds, so that total program impact was enhanced. The U.S. Department of Education (2011) reported that in fiscal year 2008 alone (the last year for which data are published), around 422,000 persons benefited from statewide AT programs, as recipients of technology assistance, participants in training programs, or recipients of information and advice. An additional 26 million persons were reached through public awareness activities.

However, reviews of the program also identify major problems, the most serious of which is technology discontinuation. An informal survey conducted by the Consortium for Citizens with Disabilities (CCD, 2005) estimated that up to 30% of the assistive technology devices and equipment provided under the program goes unused. In a comprehensive review of the literature on AT abandonment, Alper and Raharinirina (2006) identified the following reasons: failure to consult the needs of the person with disability and his/her family, selection of AT by a family member or therapist without involving the person with disability, complicated design factors of the device and lack of technical support, insufficient funding, unreliable technology and social embarrassment at being seen with an assistive device.

A solution to the problem of AT abandonment found by Alper and Raharinirina (2006) already exists within the AT program. Since AT abandonment occurs primarily because of incompatibility between user needs and the device, a solution would be to allow greater choice for persons with disabilities in selecting assistive technology by providing financial assistance directly to users. Since 2000, the Alternative Financing Programs (AFPs) have provided federal assistance to states to augment their loan programs to individuals with disabilities (Notice inviting applications for new awards, 2000). A total of $3.5 million was authorized in 2000, with each state applicant receiving a minimum of $500,000. To leverage additional capital, federal assistance is limited to 50% of annual funding for state AFPs, with the rest to be raised from state, local and private sources. In turn, states were expected to make micro-loans available to persons with disabilities, their families or guardians through a number of recommended mechanisms, as enumerated in Title III, Section 301(b), Alternative Financial Mechanisms of the AT Act (1998). These included low-interest loans, interest buy-down programs, revolving loan funds, loan guarantees or insurance programs, private-public partnerships for the purchase, lease or acquisition of AT devices, and any other state mechanisms that met program objectives. Federal funding for the program was terminated in 2005, but one of the conditions attached to federal funding was that the state programs should continue reinvesting repaid loans into the program in perpetuity, as long as investible funds remain. As a consequence, state-level AFPs have continued to make loans up to 2010 (the last year for which data are available). Over the period 2000–2010, data compiled by the Rehabilitation Engineering and Assistive Technology Society of North America (RESNA) (2012) show that the 33 federally assisted state AFPs have made cumulative loans of $123.3 million to 11,190 recipients ($11,000 average loan). Loan repayment rates are remarkably high: for example, for 2010, the default rate on loans was only 3.75%, and net dollar losses amounted only to 2.22% (RESNA, 2012).

Case Study Four: Universal Design (Device Access/Markets)

Name:	Universal Design
Barrier:	Device Access
Means:	Market Initiative
Objective:	Improve usability, accessibility and compatibility of all devices
Outcome:	Strengths: many new products designed with accessibility in mind. Challenges: to make it applicable to all design

Part of the greater sensitivity to disability rights recently is attributable to the growing recognition of the number of persons with disabilities and the economic potential of catering to this market segment. To serve this demographic, a number of businesses have arisen to provide accessibility products and devices, as well as services such as closed captioning and telecommunications relay (Riley, 2005). Some experts have argued that a key part of the struggle is to convince for-profit businesses of the potential of the disability access market, and to suggest effective ways of marketing to this segment (Tesler, 2005). These businesses then become valuable allies to disability advocates in their struggle for disability policies and programs.

The "universal design" movement is a market-driven approach based on the premise that designing products with usability in mind enhances the market potential of the technology not just for people with disabilities, but for the general population as well. Designing products with the "average" or "typical" user in mind, as conventional design does, is counterproductive because it neglects to accommodate the needs and preferences of the largest number of potential users. In contrast, designs intended to serve the needs of a disadvantaged population can have benefits for the general population as well (Stephanidis and Emiliani, 1999).

Universal design was defined by its inventor, the architect Ron Mace, as the process of designing "products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design" (Center for Universal Design 2007, online). Originally applied to buildings, it now finds application in the design of computers and telecommunications as well. The Center for Universal Design (2007, online) identifies the principles of universal design as follows:

- equitable use ("useful and marketable to people with diverse abilities")
- flexibility of use ("accommodates a wide range of individual preferences and abilities")
- simple and intuitive use ("easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level")
- perceptible information ("communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities")
- low physical effort ("can be used efficiently and comfortably and with a minimum of fatigue")
- size and space for approach and use ("Appropriate size and space is provided for approach, reach, manipulation, and use regardless of user's body size, posture, or mobility")

The distinctive aspect of universal design is that it does not differentiate between individuals on the criteria of disability alone, but assumes that *all* people approach designed environments with a variety of needs, all of which need to be accommodated to the greatest extent possible. A commonly cited example of this principle in operation is curb cuts on sidewalks, which were designed with wheelchair users in mind, but are also beneficial to parents with strollers, roller-skaters and delivery persons (Shneiderman, 2000). In the ICT realm, pay phones designed for comfortable use by wheelchair and scooter users also help parents with strollers. In addition to helping people with dexterity and mobility problems, telephones with big buttons and hands-free operability are useful for the elderly. Teletypewriter (TTY) services not only enable hearing- and speech-impaired subscribers to communicate with each other but also enable the rest of the community to communicate with them (Goggin and Newell, 2000). Closed captioning, intended for broadcast television viewers with hearing disabilities, also aids viewers in crowded bars, ESL (English as a Second Language) learners, stockbrokers who watch business news channels with the sound turned off, and other multitaskers in office environments (Downey, 2008).

Universal design has been cited as particularly useful in a new technology environment where it is not possible to predict all the uses to which the technology may be adapted in the future. The rapid pace of technological change increasingly makes it impractical to go back and "fix" a standard or technology once it has diffused in the market—the retroactive approach is untenable (Stephanidis and Emiliani, 1999). Instead, the added flexibility built into the technology in the design phase itself permits multiple uses as well as the serendipitous discovery of new uses (Sawhney and Jayakar, 2007). For example, the digital television (DTV) standard used in the United States has a flexible design that permits alternative uses (FCC, 1996). The standard has a larger number of audio channels, which may be used for any audio content, such as Spanish language broadcasting. When video description was reintroduced by the Twenty-First Century Communications and Video Accessibility Act of 2010, the auxiliary audio channel could be "repurposed" to carry the narrated descriptions. Digital set-top boxes and remote controls also can be easily reprogrammed to choose alternative audio channels.

For persons with disabilities, universal design eliminates the need for adaptive technologies, which are typically more expensive since their usage is restricted to a smaller target market. Instead, the technology is designed for a much broader market and the resulting economies of scale reduce prices for everyone. For example, users with hearing disabilities wishing to access closed captioning once needed to purchase a set-top decoder box, creating a significant barrier to access. But all

television sets sold after the 1990 Television Decoder Circuitry Act were required to carry caption-decoding microchips, eliminating this constraint (Gregg, 2006).

Critics of universal design question its practicality and cost justification. They argue that a design seeking to satisfy everyone may end up satisfying no one (Stephanidis and Emiliani, 1999; Shneiderman, 2000). They also warn of the "innovation restriction scenario," wherein focus on accommodating the low end in terms of technology and skill inhibits innovation at the high end (Shneiderman, 2000, p. 88). Proponents of universal design counter that the approach does not preclude multiple designs for different groups when necessary (Stephanidis and Emiliani 1999; Stephanidis and Salvendy, 1998). With regard to costs, sufficient data are not available to settle the question one way or another.

Case Study Five: Digital Literacy (User Demand/Consumer Initiative)

One of the major barriers to broadband access identified in Section Five was the perception that computers and broadband access were not needed, and could not contribute anything useful to the daily lives of persons with disabilities. About half of all non-adopters in NTIA (2011) and Connected Nation (2008) studies held this opinion. Horrigan (2010) too found that "47 percent of non-adopters listed their lack of comfort with computers or worries 'about all the bad things that can happen on the Internet' as reasons for not having broadband" (p. 31). About half of users also said that there was nothing of relevance online, and that going on the Internet was a waste of time.

Name:	Digital Literacy
Barrier:	User Demand
Means:	Consumer Initiative
Objective:	Improve familiarity with computers and broadband
Outcome:	Strengths: sensitized decision-makers to the importance of DL (e.g., NBP). Challenges: has remained mostly small, disjointed, localized initiatives

Experts have argued that in order to increase broadband penetration, especially among minorities and persons with disabilities, it is important to provide basic computer skills and training. Digital literacy, originally introduced as "the ability to understand and use information in multiple formats from a wide range of sources when it is presented via computers" (Gilster, 1997, p. 1), is now commonly defined as a multi-dimensional concept involving the ability to interact with computers and ICT equipment confidently; retrieve, store and evaluate information from online networks; use telecommunications networks to communicate and collaborate with others; create and disseminate new informational content using computers and ICT, and, in short, participate fully and confidently in an online environment. As networks and devices grow ever more sophisticated, it opens up new potentialities for action, and simultaneously raises the bar for the skills and knowledge base needed to be considered digitally literate.

Most of the initiatives to remedy broadband non-adopters' lack of digital literacy are located in the non-profit space. Kent and McClure (2009) profiled an organization called Net Literacy, a community-based, non-profit organization that has been active since 2003 providing training on computers, Internet use, and online safety to hundreds of thousands of individuals. The organization recruits high school students to provide one-on-one instruction to senior citizens living in local independent living facilities. Net Literacy also collaborates with state and local government, school districts and businesses to recycle used computers and electronic equipment and provide them to needy users. According to Kent and McClure, the Net Literacy model is a "proven nontra-

ditional training model" (p. 13), easily scalable and replicable by other non-profits and community organizations.

A research report sponsored by the European Union (Hilding-Hamann, Nielsen and Pedersen, 2009) has identified the key dimensions of digital literacy efforts that contribute to their success, based on a review of 87 large-scale (serving at least 500 users) digital literacy programs, drawn from 32 nations. These dimensions include the rationale for the project (projects should have a clear goal; for example, to improve employability or enhance quality of life); sustainability (financial and organizational backing); motivating target groups (intensity of communication effort); variety of ICT platforms (PCs, mobile, etc.); content (degree of customization possible); accessibility (outreach to disadvantaged groups); and usability (user friendliness, and availability of training and motivation).

Though Hilding-Hamann, Nielsen and Pedersen (2009) provide a comprehensive, well-researched and thoughtful framework for the evaluation of digital literacy programs, there may be practical constraints on any real-world program in achieving success on their criteria. Some of the dimensions are particularly challenging because they conflict with each other: for example, while larger programs are more sustainable due to scale economies, they are also more difficult to customize, especially when dealing with a target population such as persons with disabilities with highly variable and specific needs. In reality, many digital literacy programs—with the notable exception of some like Net Literacy—are not as long-lasting or self-sustaining as Hilding-Hamann, Nielsen and Pedersen envisage. It will therefore be interesting to observe if, and how, the Digital Literacy Corps envisaged by the National Broadband Plan (FCC, 2010a) will be implemented.

Case Study Six: Web Accessibility Initiative (Content Access/Public-Industry Partnership)

Name:	Web Accessibility Initiative
Barrier:	Content Access
Means:	Public-Private Partnership
Objective:	To create accessibility standards for online content
Outcome:	Strengths: created broadly but not universally accepted web accessibility standard. Challenges: may create complacency

Research reviewed in Section Five highlighted the lack of accessibility for online content, reducing the benefit of broadband subscriptions for persons with disabilities and contributing to lower penetration (Horrigan, 2010; Lyle, 2010). As Horrigan (2010) reported, 17% (one in six) of respondents with disabilities claimed that lack of relevance was the reason for their decision not to subscribe. Efforts to improve the accessibility of online content may therefore be expected to give persons with disabilities greater incentive to subscribe to broadband. In this case, we examine the Web Accessibility Initiative (WAI), a cooperative effort of industry, consumer groups, disability advocates and government to promote accessibility standards for online content.

At the onset, it must be mentioned as a caveat that web accessibility guidelines are not solely the result of the industry-public partnership represented by the WAI. The U.S. Congress, state legislatures and various government agencies have all periodically produced accessibility guidelines within their areas of jurisdiction. For the United States, the World Wide Web Consortium (W3C, 2006) has compiled the following list of applicable federal laws: the 1996 Telecommunications Act accessibility guidelines applicable to telecommunications equipment and customer premises equipment (CPE); Section 504 of the Rehabilitation Act of 1973, prohibiting discrimination

against individuals with disabilities by any executive agency or entity receiving federal funds; Section 508 of the Rehabilitation Act as amended in 1998 requiring federal agencies to make their electronic and information technology accessible to employees with disabilities and members of the public; and the 1990 Americans with Disabilities Act (ADA), Title II of which states that communications with persons with disabilities must be "as effective as communications with others." In addition to these, the National Institute on Aging (NIA) and the National Library of Medicine (NLM) have produced their own guidelines intended to make websites accessible to older individuals—but unlike the federal laws listed above, adherence to the NIA/NLM guidelines is voluntary (Jaeger and Xie, 2009).

The relevance of the WAI process emerges because the laws listed above do not themselves create accessibility standards, and/or are applicable only to very specific circumstances. For example, Section 255 of the 1996 Telecommunications Act refers only to the accessibility, compatibility and usability of electronic equipment, or of the manuals and websites that provide information about them. The Rehabilitation Act of 1973 and the 1990 ADA mandate a non-discrimination requirement but do not specify standards, and Section 508 of the 1998 Rehabilitation Act amendment applies only to federal agencies and contractors.[5] The WAI process, on the other hand, produces accessibility standards that have been widely adapted by public and private entities, domestically and internationally. Even the Section 508 standards applicable to federal agencies and contractors are based on a subset of WAI guidelines (Peters and Bradbard, 2009).

The WAI of the World Wide Web Consortium (W3C) develops accessibility guidelines, technical reports and other resources with the objective of improving accessibility of the web for persons with disabilities. In conformance to the W3C's decision-making process, the WAI also works on an open membership format to ensure broad stakeholder involvement, and aims for consensual decision-making. WAI produces guidelines in three broad areas (see WAI, 2008): the Web Content Accessibility Guidelines (WCAG) relating to accessibility standards for web pages, images text etc.; the Authoring Tool Accessibility Guidelines (ATAG) dealing with authoring tools such as HTML and XML editors, desktop publishing formats, content management systems etc.; and the User Agent Accessibility Guidelines (UAGG), dealing with the software tools that users with disabilities might use to interact with computers, such as web browsers, media players and assistive technologies.

The WAI follows the W3C process in arriving at its decisions, as described in the W3C Process document (W3C, 2005). The first step in the process is when a member or group of members expresses interest in a topic in the form of a member submission. Team members (the permanent staff of W3C) canvass other members, and if there is enough interest in a topic, the director may create a new "activity proposal" or "working group charter," depending on the breadth and importance of the topic, which are again reviewed and commented on by members. If there is enough evidence of support from the membership, the director approves the new activity and assigns it to a group or groups. The groups' work product passes through multiple stages of review and recommendation: working drafts, "last call" working drafts, candidate recommendations, proposed recommendations and finally, a W3C recommendation or Web standard.

All W3C Working Groups are comprised of three types of members: member representatives, invited experts, and team representatives (permanent staff) (W3C, 2005). Member representatives are drawn from the general membership of the W3C. In pursuance of its goal of ensuring broad stakeholder involvement, the W3C permits any entity to become a member, including for-profit corporations, advocacy groups, government agencies and consumer groups. Each member entity's paid employees are entitled to represent their employer and participate in all W3C activities. There

is no separate class of individual membership, but individuals may join on the same terms as members do (W3C, 2009).

The process of standardization followed by the W3C/WAI is a relatively new decision-making style. Traditionally, there are five processes by which standardization is achieved (Farrell and Saloner, 1987):

- First, proprietary standards may be set internally by firms, especially if they are the innovator of a technology.
- Second, standards may emerge out of mutual agreement between different firms.
- Third, a *de facto* standard may be set by an industry leader, which is then adopted by the entire industry. *De facto* standards can also emerge from competition between firms, when one standard achieves a predominant market share over its competitors.
- Fourth, the government, usually a regulatory agency, may set standards for the entire industry.
- Fifth, international organizations introduce standards through specialized agencies like the International Telecommunications Union (ITU). Standards set by government or international agencies are called *de jure* standards.

The W3C/WAI procedure is remarkably different from these approaches: by emphasizing consensual decisions and open membership, it avoids the competitiveness inherent in proprietary and *de facto* standards, as well as the closed membership and legalistic tendencies of *de jure* standards. The wide acceptability that the WAI standard has achieved might be indicative of the greater salience of the new standard-setting processes in the Internet era.

Still, the WAI standard is not uncontroversial. Burston, Dyer-Witheford and Hearn (2010) list two common complaints that recur in the literature: first, that adherence to WCAG "does not necessarily result in genuine accessibility" (p. 383) because the needs of the population with disabilities are so diverse, and second, that the guidelines are too technical and jargon-laden to be understood and applied by an average web designer. Somewhat echoing the latter criticism, Kelly, Sloan, Brown, Seale, Lauke, Ball and Smith (2009) have argued that the WAI process does not focus on users enough, and recommend a more inclusive and transparent process of standard-setting. Another problem might be that since WAI standards are purely voluntary, there may be no incentive for entities to improve their online accessibility if the costs of compliance are more than the potential costs of the negative publicity and lost traffic. A survey of the websites of Fortune 100 companies shows that web designers have improved their performance on WAI guidelines over a period of five years (Loiacono, Romano and McCoy, 2009). However, the authors show that while "easy-to-fix" problems, such as giving all images alternative text and providing all frames a title, have been eliminated, more complex and technical aspects of web design remain unaddressed. "Accessibility appears good on the surface, but deeper exploration reveals potentially serious problems for visually impaired users." (p. 130).

Case Study Seven: Computer Reuse (Device Cost/Consumer Initiative)

In Case Study Three, federal funding to states to set up a system of assistive technology (AT) programs was seen as a solution to the prohibitive cost of computers and other devices. The program was initiated by the 1988 Technology-Related Assistance for Individuals with Disabilities Act, and subsequently renewed thrice by the 1994 amendments to the 1988 Act, and the 1998 Assistive Technology Act and its 2004 amendments. However, a downside of the program was the high rate of assistive technology abandonment and disuse (CCD, 2005) due to a variety of reasons (Alper and Raharinirina, 2006).

Name:	Computer Reuse
Barrier:	Device Cost
Means:	Consumer Initiative
Objective:	To provide refurbished computers to the disadvantaged
Outcome:	Strengths: wide acceptability in the form of a network of small, localized, community based organizations. Challenges: increasing policy support, government funding

The problem of redundant equipment is much larger than and substantially predates the assistive technology program. On the one hand, an enormous amount of electronic waste is generated every year. The Environmental Protection Agency (EPA, 2011) estimated that in 2009, 2.37 million tons of electronics were ready for end-of-life management, of which only about 25% was collected for recycling with the rest occupying space in landfills and contaminating the environment. And only about one-third of the equipment collected for recycling is ultimately refurbished and reused, with the rest dismantled for material recovery. On the other hand, thousands of Americans with disabilities or low incomes identify the high cost of computers and electronic equipment as the principal reason for their inability to go online. The computer reuse movement emerged as a response to these twin problems. There now exists a very large but disorganized network of for-profit and non-profit, large and small organizations that acquires used computers from a variety of sources, including corporate donors and large universities. They clean, refurbish and update them, and supply them to community organizations, disadvantaged schools and needy individuals. The Pass It On Center (www.passitoncenter.org), a national clearinghouse for assistive technology equipment reuse and recycling, lists 109 agencies, most of them community-based non-profits, involved with reuse of computers and related equipment. Not all organizations refurbish computers themselves; some provide locator services that put donors and potential recipients in contact. Many provide their services free of charge, while others charge a small fee, or work on an at-cost basis. Another list of computer recyclers is available from the EPA and includes major retail electronic distribution chains, computer manufacturers, non-profit agencies, and community organizations (EPA, 2012b).

Due to the highly disorganized nature of the computer refurbishing/reuse sector, precise data on the number of units refurbished are hard to come by. The EPA (2011), extrapolating from available data collected from only eight states, estimates that of the 47.4 million computers ready for end-of-life management in 2009, 29.4 million units were disposed (consigned to landfills); the remaining 18 million (38%) were collected for recycling. Assuming that computers were refurbished/reused at the same rate (25%) as all electronic equipment, this represents 4.5 million computers available for use by disadvantaged schools, community organizations and individuals. This is a sizeable number; if efficiently distributed and utilized, it can make a major impact on computer access among persons with disabilities and other disadvantaged population groups.

Recognizing the potential of the computer refurbishing movement, both to increase computer and broadband penetration and to mitigate environmental impacts, the program has received policy and material support from all levels of government. The Resource Conservation and Recovery Act, enacted in 1976, put guidelines in place for the disposal of solid and hazardous waste and encouraged efforts, such as recycling and reuse, to reduce the amount of waste generated (EPA, 2012a). Through a program called Computers for Learning, the federal government itself has become a major donor of refurbished computers, donating surplus computers and electronic equipment to schools and non-profit educational organizations (U.S. General Services Administration, [GSA], 2012). Recycling and reuse has also been made an increasingly important part of the AT Act's state-level programs (Case Study Three). The Pass It On Center (www.passitoncenter.org) closely coordinates with state AT programs in its recycling efforts.

Despite the popularity of computer reuse programs, the rapid pace of technological change implies that the computers and other equipment delivered to users are often obsolete and lacking in the functionalities the mainstream population takes for granted. They may also lack the accessibility features built into newer versions of the product, making them harder to use by persons with disabilities. Computer reuse advocates need to ensure that programs aiming to reduce the disability divide do not end up perpetuating it.

This section covered seven case studies of efforts to improve broadband access to persons with disabilities. We can now turn to a comparative evaluation of these cases to identify success factors and challenges.

Section Seven: Assessing Program Impacts

The seven cases presented here had a variety of objectives, though all dealt with some aspect of accessibility for persons with disability. Not all cases dealt specifically with broadband, because cases fitting all goal-approach combinations identified in Table 6 could not be found. Therefore, cases were selected that could prove instructive for the promotion of ICT and broadband access for persons with disabilities, even though the cases themselves may not have dealt with broadband. The cases also used a variety of means, ranging from direct government intervention (funding, management and oversight) to purely industry efforts to cooperative initiatives from the community. The outcomes in all the cases were also different. As a preamble to comparative analysis, the findings from the case studies are summarized in Table 7.

Table 7: Summary of Case Study Observations

No.	Name	Outcome
1	Video Description	Withdrawn after *MPAA v. FCC;* laid groundwork for successful reintroduction of video description provisions in CVAA (2010)
2	DeafBlind Communicator	Strengths: positive reviews in press and community; concessional supplies for state's distribution program
3	Assistive Technology	Strengths: state AT programs created in all states and U.S. territories. Challenges: high rates of AT abandonment; incentive for recycling
4	Universal Design	Strengths: many new products designed with accessibility in mind. Challenges: to make it applicable to all design
5	Digital Literacy	Strengths: sensitized decision-makers to the importance of DL (e.g., NBP). Challenges: has remained mostly small, disjointed, localized initiatives
6	Web Accessibility Initiative	Strengths: created broadly but not universally accepted web accessibility standard. Challenges: may create complacency
7	Computer Reuse	Strengths: wide acceptability in the form of a network of small, localized, community based organizations. Challenges: increasing policy support, government funding

Table 7 displays the mixed outcomes of the cases, with some outright successes (DeafBlind Communicator) and others clearly failures (video description). Most outcomes are, however, in the middle. Some have achieved substantial success, while not completely achieving their objectives (the WAI, universal design). Still others are works in progress, moving from small disjointed initiatives to achieve national prominence and a place in the mainstream of disability policies (digital literacy, computer reuse). Finally, one of the case studies achieved its programmatic goals while creating unintended consequences (assistive technology). Six lessons emerge from the comparison of case studies along the horizontal and vertical dimensions identified in Table 7.

Lesson One: Government mandates cannot move industry in anticipation of consumer demand, especially in fast-changing technological environments, but they can legitimate other stakeholders' actions and ensure wide acceptability.

Though the FCC's initiative to mandate video description ended when the courts rejected it, it was not so much a failure as premature. A pragmatic approach will stress that policies succeed and fail based on the economic constituencies supporting (or opposing) them. In 2002, video description was still a relatively untried technology with no organized business constituency supporting it; there were not enough production companies offering their services and no broadcaster offering narrated programs on a voluntary basis. Technologically, the prevailing analog standard had only a limited number of audio channels and video description had to compete for space with well-entrenched Spanish language audio. Finally, set-top boxes and remote controls were not available with pre-programmed menus for choosing video description. By 2010, when the Twenty-First Century Communications and Video Accessibility Act reintroduced video description, all these elements were in place: a production infrastructure; several program providers such as CBS, Fox, PBS, TCM and TNT all already providing video description voluntarily; and a digital standard, the transition to which was well underway, with more space for auxiliary audio channels (FCC, 2011). The current version of the video description policy in the CVAA (2010) has a much better chance of success due to these changed circumstances. The FCC's initial attempt at video description set the stage for the current effort.

In the case of the WAI, the importance of the government's role is evidenced by the consequences of its absence. The WAI, following the inclusive, open-membership, consensual W3C procedure, produced a set of guidelines for online content and tools that are widely implemented. However, as research on web accessibility compliance has shown, the adoption is not universal and it is imperfectly implemented even by the entities that have adopted it. Despite the wide participation that W3C/WAI seeks, the standards have neither the economic weight of de facto standards, nor the legal justification of de jure standards..

For government mandates to succeed, an infrastructure needs to be in place, as well as consumer expectation of the products or services. If an infrastructure is in place with a certain critical mass of customers, it reduces the costs to industry of "filling in the gaps" and thus makes industry more amenable to the mandate. Consumer expectation is importance because it helps government recruit political support, and also communicates to industry that there is a viable market for its products and services. In the case of the WAI standards, an explicit legislative and/or regulatory endorsement of accessibility guidelines will ensure better compliance from different online content providers. The government does give prominence to the WAI guidelines in its Section 508 standards, but only within a restricted field of applicability.

Lesson Two: Government has an important role in helping stakeholders coordinate their actions.

Government can, and should, catalyze specific programs and policies that would be beneficial to disability access, serve as a clearinghouse for information, facilitate communication among disparate interest groups, and help them coordinate their actions.

Lesson One should not be interpreted to imply that the government cannot act, or that there is no role for government in ensuring social justice and equity. Two other cases demonstrate the constructive role that government can play: the DeafBlind Communicator and the Web Accessibility Initiative. In the first case, Washington State's ODHH perceived a problem in the lack of an adequate Deaf-Blind communication device, proactively located a leading innovation company, and then recruited members from the disability community to help with the design process. The

outcome was a win-win for all parties, because Humanware benefited from the ready market for its product as well as the positive publicity, Washington's Deaf-Blind consumers obtained the device at concessional rates, and the wider Deaf-Blind community obtained an electronic communication device that adapted to their requirements. In the WAI case, as previously stated, the government's role was absent, and as a consequence, the WAI standards did not become as widely accepted as they could have become.

Lesson Three: Policies and programs are improved by the active involvement of the beneficiaries in the design, execution and evaluation phases.

The choice of assistive technology, the process of acquiring digital literacy, etc., are deeply personal, and cannot be implemented without substantial input from the intended recipient. It is not only unfair to the user, but also reduces the effectiveness of the intervention.

This lesson emerges from a comparison of the the DeafBlind Communicator and universal design cases. It is also applicable in the digital literacy and assistive technology cases. The main success factor behind the DeafBlind Communicator, according to this author, is the input from the user community. The active engagement of Deaf-Blind users in the design and prototype testing phases succeeded in making the device better adapted to user needs. Universal design also succeeds because it takes into account usability by a wide range of clientele: included in the Center for Universal Design's design criteria are principles such as equitable use, flexibility, simplicity and intuitive designs. In the digital literacy case as well, research has identified user friendliness, customization and accessibility as key success factors behind individual efforts. In the assistive technology case, experts have identified lack of consultation with users and the non-involvement of the person with disabilities as key reasons for the abandonment of assistive technology. In the case of assistive technology, this lack of consultation with the intended recipients is a holdover from the paternalistic attitudes of the medical model of disability..

Lesson Four: Public-private partnerships work better when programs have distinct outcomes to be achieved over distinct timelines.

Comparing the DeafBlind Communicator and the universal design movement generates this lesson. However, here the comparison is complicated by the fact that the former aimed at a distinct, time-bound outcome while the latter was a long-term, large-scale transformation of attitudes towards the design process itself. Universal design, aiming to bring about a fundamental change in mindset by incorporating the principles of usability and accessibility into every aspect of the design process, is by necessity a long-term project. It will require sustained education of engineers, programmers and design professionals, as well as awareness building in the design community about the legal requirements and the business case for universal design. For example, engineering schools may need to provide systematic exposure to students on the legal requirements of Section 255 of the Telecommunications Act of 1996 and the CVAA (2010). This takes time. On the other hand, the DeafBlind Communicator project aimed at a distinct outcome within a clearly defined timeframe. Within its restricted field, the public-private partnership was very successful, but by definition it may be less scalable and effective when tackling larger programs with more amorphous outcomes.

Lesson Five: Decentralized models work better in cases where demand is heterogeneous and customization is important.

The two cases dealing with device cost as a barrier to access include one government program (assistive technology) and one based on consumer activism later augmented by government support (computer reuse). It is instructive that the assistive technology program realized its

organizational (instrumental) goals very well by creating a nationwide network of state-level AT programs, but fell short of the ultimate goal of providing appropriate assistive technology to persons with disabilities. Two problems were identified with the AT program—first, that the total annual investment never exceeded $25–30 million, and second, the high levels of AT abandonment. At the same time, the computer reuse program appears to have gone mainstream with several large electronics retail chains, manufacturers and even the federal government now participating in recycling/reuse efforts. The problem is that centralization in the assistive technology program made it less responsive to user needs. The program's efforts after the 1998 Assistive Technology Act to harmonize state level offerings was counterproductive; instead, the program would have benefited from moving the point of delivery of service closer to users, and allowing local autonomy and customization. In this respect, the Alternative Financing Program's direct microloans to users enabled them to purchase technology most applicable to their individual circumstances; unfortunately, alternative financing never received the support it deserved. In contrast to the needless centralization of the AT program, the computer reuse movement benefited from the energy of local communities and was more responsive to local demand.

Lesson Six: Policies and programs able to establish linkages with other important policy goals will be able to leverage new networks of support

Finally, a lesson emerges from the two cases that are both based on consumer activism but have different goals: the first computer reuse to reduce device cost, and the second to start up digital literacy programs and thus create user demand. While both programs are based on a large number of small, local, community-based organizations, the former has also succeeded in recruiting powerful allies, including electronics retail chains, manufacturers and government. The critical difference between the two is that the former also fulfills other public policy objectives, namely reduction of electronic waste and environmentalism. Because of this linkage, the computer reuse program has gone mainstream, while digital literacy still remains largely a small-scale, localized enterprise.

It is interesting in this regard that the National Broadband Plan has proposed a new Digital Literacy Corps in order to impart training to disadvantaged groups. As of this writing, no policy action has been taken on this goal and it remains only an idea. But if implemented, and digital literacy programs are able to establish connections to other policy goals such as alleviating unemployment, or adding to the labor force, their chances of success might be improved.

To summarize individual and comparative analysis of the cases yields useful lessons for program implementation. However, there is no single approach or policy mechanism that works best in all circumstances. Instead, the promotion of broadband access for persons with disabilities is a complex goal, implicating multiple barriers to access, and requiring a combination of policies and programs to tackle.

Section Eight: Conclusion

The objective of this report is to examine the current status of broadband access for persons with disabilities, with the aim of identifying programs and policies that promote disability access. Based on a review of the literature and available surveys of broadband non-adopters, this report identified four principal barriers to access:

- problems with the accessibility and usability of commonly used electronic devices, and their lack of compatibility with assistive technologies needed by persons with disabilities
- expenses associated with the purchase and use of ICTs and broadband technologies such as computers and mobile devices, especially for a target market with high unemployment and low household income
- inaccessible online content
- users' discomfort with technology, and lack of awareness of the benefits of ICTs and broadband

The different approaches used to mitigate these barriers to access were then considered. Broadly, programs and policies were seen to adopt the following approaches:

- regulatory mandates in which a regulator or a legislature prescribes formal legal requirements to provide a product or service
- government programs where an agency directly funds and administers a program
- public-private partnership between government and private agencies to create or distribute new products or services
- pure market initiatives
- consumer initiatives in which consumer groups or advocacy organizations create cooperative arrangements to distribute products or services, usually on a not-for-profit basis

The seven case studies represented different combinations of ends and means that were then identified for detailed review. Case selection was done in a manner that would ensure that every case could be compared to another along the vertical or horizontal dimension. This helped answer questions about the comparative efficacy of a method for different issue areas or the effectiveness of different methods in the same issue area.

The comparisons show that there is no single approach or policy mechanism that works best in all circumstances. Broadband access programs for persons with disabilities are designed and implemented by a variety of stakeholders, as the cases discussed in this report showed: legislators and regulators, government departments, public-private partnerships, for-profit firms and community groups. However, some common themes emerge that will contribute to the success of programs initiated by any of these stakeholder groups: the importance of goal clarity, of responsiveness to the needs of persons with disabilities, of customization of products and services considering the heterogeneity of user populations, and the government's important role in coordination and legitimation of the efforts of other stakeholders.

Endnotes

1. "Current generation broadband access" is defined as 3 megabits per second (Mbps) downstream, 768 kilobits per second (Kbps) upstream (Singer and West, 2010).
2. Next-generation broadband networks are expected to deliver peak-period speeds of at least 50 Mbps downstream and 20 Mbps upstream (Singer and West, 2010).
3. The U.S. Census Bureau did not collect data on computer penetration in the years between 2003 and 2010. The Census Bureau's Computer and Internet Use database site (http://www.census.gov/hhes/computer/about/) explains that the CPS began collecting data on computers and Internet use in 1984, but only discontinuously. In 1984, 1989, and 1993, only questions about computers were asked. In 1997, the survey collected data on Internet access for the first time. In 2000, 2001, 2003, and 2010, questions were asked about both computers and Internet use. In 2007 and 2009, the CPS asked only about Internet use and broadband access.
4. The adoption rates for disabled and non-disabled persons at different age levels were as follows: age 18–29 (59% v. 72%), age 30–49 (56% v. 77%), age 50–64 (43% v. 72%), age 65+ (25% v. 44%) (Horrigan, 2010, Exhibit 35: Broadband adoption by age for people with a disability, p. 38).
5. Since Section 508 guidelines also apply to all vendors of electronic equipment and information technology, some have argued that it creates an economy-wide accessibility standard. See Peters and Bradbard (2010).

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About the Time Warner Cable Research Program on Digital Communications

The Time Warner Cable Research Program on Digital Communications will be dedicated to increasing public understanding of the benefits and challenges facing the future of digital technologies in the home, office, classroom, and community.

The Research Program will focus on the following areas:

- Increasing knowledge about the marketplace and the consumer
- Increasing knowledge about digital technologies
- Increasing knowledge about communications policy
- Increasing knowledge about innovation in digital communications

About the Research Stipends

Individuals receiving a stipend should produce a 25- to 35-page report. The report should be submitted no later than six months after the start of the project.

Proposals from any discipline with research interest in digital communications will be considered. Multidisciplinary research teams, consisting of two or more authors from different fields, are encouraged.

Size of Stipend: $20,000

Application Deadlines for 2013 Awards: April 1, 2013 and November 1, 2013

Submitting Applications: Applications should be submitted online at www.twcresearchprogram.com. Applicants should submit:

- A three-page description of the proposed project
- A resumé (no more than three pages per author)

Applicants will be notified when their application is received and when the proposal review process is completed.

About Time Warner Cable

Time Warner Cable Inc. (NYSE: TWC) is among the largest providers of video, high-speed data and voice services in the United States, connecting more than 15 million customers to entertainment, information and each other. Time Warner Cable Business Class offers data, video and voice services to businesses of all sizes, cell tower backhaul services to wireless carriers and, through its NaviSite subsidiary, managed and outsourced information technology solutions and cloud services. Time Warner Cable Media, the advertising arm of Time Warner Cable, offers national, regional and local companies innovative advertising solutions. More information about the services of Time Warner Cable is available at www.timewarnercable.com, www.twcbc.com and www.twcmediasales.com.

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Digital Communications

www.twcresearchprogram.com