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Wireless Telecommunications Bureau
And Consumer and Governmental Affairs Bureau

Accessible Mobile Phone Options for People Who Are Blind, Deaf-Blind, or Have Low Vision

Comments by:

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I am Kelly Pierce and I have worked on disability related technology and transit policy issues since the early 1990s. This included starting a technology user group for blind persons and consulting with the local transit agency on its audio interface for a new automatic stop announcement system. I have served on the Technology Watch committee of the National Council on Disability, a federal agency that plans and evaluates disability policy and programs. I have worked with major financial institutions including Bank One, J.P. Morgan-Chase, LaSalle Bank, and American Express in creating and developing audio interfaces to automatic teller machines for people with disabilities. I am a member of the Accessibility committees of the Cook County Clerk's Office and the Chicago Board of Election Commissioners. In the last several years, I have worked with Sequoia Voting Systems and the Cook County Clerk and the Chicago Board of Election Commissioners to develop significant improvements in accessibility to electronic voting machines in Cook County.

I am blind and personally would like greater and more affordable options for accessible wireless communications. Based upon my experience from a number of projects in the past and reviewing the efforts on wireless accessibility for the blind in the past decade, I believe I have substantial insights to offer in this proceeding. I will copy each question the Commission asked in its announcement below which will be followed by my response.

(1) The wireless phone features and functions in the current marketplace that are not accessible for people who are blind, have vision loss, or are deaf-blind and the extent to which gaps in accessibility are preventing wireless communication access by these populations.

The accessibility for blind persons in the wireless marketplace rests largely on the basis on who can pay for access. Nearly all phones in the wireless marketplace, including basic models selling for as little as \$20, have visual displays or indicators that offer no or minimal auditory feedback regarding information on display screens or indicator lights. Third party screen readers can be purchased for phones using the Symbian, Windows Mobile, and the Windows Pocket PC operating systems. The screen readers provide text to speech output of the visual display, using synthesized speech through the phone's speakers or a headphone. The screen contents can also be routed to a Braille display, with more than 20 refreshable Braille devices being supported. The screen readers, which can support speech and Braille output simultaneously, support all calling functions and many advanced data functions, including caller identification, contact directory management, text messaging, e-mail, web browsing, calendar, Mp3 file playback, and phone configuration menus. The screen readers offer text to speech output in more than 30 languages and enable blind end users to use keyboard commands to perform many tasks. This functionality comes at a price though. Both the Mobile Speak screen reader from code Factory and TALKS from Nuance can be purchased from dealers for \$275 with a retail price of \$295. An additional change fee of \$99 applies if Mobile Speak users change phone numbers or if TALKS users change phones for whatever reason, including a defective phone. TALKS also offer an alternate licensing system where the license is attached to a Subscriber Identity Module, or SIM card. The license fee is the same, but the full cost of a new license would need to be paid again if the blind end user loses the phone or if the SIM card becomes damaged and needs replacing. TALKS only support the Symbian operating system. Prices do not include the cost of the phone or inevitable upgrades as technology changes. The Blackberry Smartphone can be used with the Oratio screen reader from Humanware. The screen reader costs \$449 without the cost of the phone.

The price for access to wireless communications represents a cost greater in many instances than the phones themselves. In fact, the cost of a cell phone screen reader exceeds the cost of a Windows computer. If a blind person added a screen reader license, the entire cost, including access, would only be about \$50 greater. In August 2010, an Asus netbook with a 10.1 inch screen, wireless wi-Fi connectivity, speakers, video camera, and USB and Ethernet ports running Windows XP sold for less than \$200 at a major Internet retailer. A license for the System Access Adam screen reader cost only \$150. For about \$350, the blind person has full access to a highly versatile multifunction device with a nearly full size keyboard, which is slightly more than the cost of access without the phone to the Windows Mobile or Symbian platforms and less than the cost of Blackberry accessibility.

Another option for accessibility lies with phones with voice output and other accessibility features built into the phone. Most of these phones are available only from Verizon Wireless. Motorola offered the i880 for the IDEN Nextel service from Sprint-Nextel. These phones provide access, usually through tactile or voice output to all or most of the basic calling features of Battery-level indicator, roaming indicator, message indicator, phone lock mode, voice mail, keypad lock mode, phone book to create, delete, or modify a listing, timer, clock, signal strength indicator, ringer selection, backlight controls, sound settings, speakerphone switch, interactive menus, conference calling, volume control, speed dialing, and caller identification as well as enunciation of keys pressed when dialing. The phones, such as the LG enV3 VX9200 or the LG

VX8360 cost hundreds of dollars, require subscribing to a contract for \$30 to 40 a month, or require an additional data plan. The retail price of the i880 was \$500. In general these phones provide a limited ability to add, edit, or modify contacts. Some large carriers with tens of millions of subscribers, such as T-Mobile, offer no wireless service with sufficient voice output built into the phone to provide access to the basic calling features listed earlier. Recently, Samsung and Verizon introduced the Haven, a basic self-voicing cell phone that provides voice output access to the blind end user to all calling functions and sells for less than \$40 with a contract. Without subsidy, Verizon offers the phone for \$169.99, according to blind end users speaking in September 2010 on the BlindTech online forum who inquired at Verizon stores and call centers. End users report significant access to entire menu structures and nearly all of the phone's functions, including the tip calculator. Unfortunately, blind users report that the voice output quickly drains the phone's battery. A higher capacity battery and new battery cover to operate the phone with speech output for reasonable periods costs an additional \$53. While costing 11 times more unsubsidized than the least expensive phones providing basic wireless services, the Samsung Haven represents a significant price reduction from cell phones with screen readers.

The iPhone from Apple represents the most accessible of these efforts. Apple added the VoiceOver interface used to provide access for the blind on Macintosh computers when it introduced the iPhone 3 GS in the summer of 2009. The iPhone has no physical keyboard and the access solution uses a screen reader based on gesture interaction. Blind University of Arizona student Darrell Shandrow described his impressions of iPhone access to interviewer Shane Jackson of the BlindWorld Blog and Podcast in an episode released on July 31, 2010. "I have to say that I've had a number... of Smartphones over the years. Well, I've had a number of plain cell phones then Smartphones. I had a Nokia 3650... I had a Motorola Q9H... all of these with Mobile Speak.... So then there was a Samsung Jack and I still have a Nokia N86, which I use of course for the KNFB reader. In all of those phones, I never really felt like I could make full use of all of the phone's features despite the use of a third party screen reader. I never used them for keeping track of contacts. I did do some e-mail on the Q9 and the Jack but I did not like it very much. I just did not do a lot of the SmartPhone things with those devices, said Shandrow whose national efforts advancing technology access for the blind go back to 1994 when he created the first tutorial of a World Wide Web browser specifically aimed at screen reader users of UNIX systems. At this dawn of the commercial Internet era, it enabled thousands of blind people to access the resources of the Web for the first time. Since then he worked in the technology industry, including the technical support desk for an Internet service provider and later as a network administrator and technology trainer. Shandrow is best known for hosting a radio program on accessible technology for an online station sponsored by the American Council of the Blind."

"I got my iPhone at the end of June," Shandrow continued, "...I had done quite a bit of research and talked to [a] lot of people before deciding to do this. I also had a demonstration from one of our IT guys from Arizona State University. I played with his iPod touch for about 45 minutes with VoiceOver on. That was about all the experience I had using a touch screen. I listened to the vision Australia podcast on how to do some basic things with the device, so I would recommend those highly if anybody who is considering going the iPhone or the iPod touch route," reflected Shandrow and showing how quality resources for effective technology access

solutions are global in scope, easily shared widely in the blind community and available without a government-sponsored clearinghouse. “I researched this, you know, the iPhone user’s guide, ...I picked the device up and already pretty much knew what gestures to use and I used them and they worked! I activated the phone.... I was able to do all this... I plugged it into my Mac Book, it popped up in iTunes, and I was able to go in and click the universal access button and turn on VoiceOver. I was able to get my....iPhone’s serial number and SIM card ID and was able to call AT&T. I was able to activate everything by myself without sighted assistance, which I don’t think you can always do necessarily with some of the other phones equipped with screen readers. I think that varies widely. You can with this device. So once I was activated, so I decided... this is a more integrated solution. I’m going to try this. So I got into the Mac address book and I started adding...setting it up and synched it up with my phone. The cool thing about the iPhone and the I-devices folks is that despite the people who kind of whine about iTunes and say they don’t like it, it’s real controlling, all these objections, you know what, there’s something to be said for the fact it just works. It just works, you know. You do something...you add something to your iTunes library. You add a calendar entry in iCal. You add an address entry You go in and doc your phone and it synchs up and it just, it just happens! You don’t have to diddle around with settings or worry...about this change or that change. It just works. For me, even though... I do enjoy technology... and I do enjoy playing around with things...I like my essentials to just work when I want them to work. This solution does that for me.”

In an interview following the broadcast for this filing, Shandrow was asked why the screen readers for cell phones purported to be accessible limited his wireless access. “First of all it seemed to me that you have a similar situation with Mobile Speak or talks as you do with a windows screen reader on a pc. A significant number of apps on the phone were not intended to work with a third party screen reader so what you have is a phone with apps that is partially accessible, he said from his home in Tempe, Arizona. “The second major point of that is similar to a windows pc is that there is a secondary layer of commands that are counter intuitive.” Shandrow explained that many blind people have difficulty mastering these secondary commands and efficiently navigating their phones. Yet, he said, “I know a significant number of friends who use them just fine. I have a friend who does text messaging on a Nokia phone just fine.” For all blind wireless users though some access barriers are inherent with cellular phones that rely upon screen readers for access for the blind. “Since the screen reader is third party you can get into situations where you don’t have any speech. You can’t get the screen reader back with sighted assistance. Nokia sync is largely inaccessible and can’t be used independently. It is clear to me that once upon a time that Nokia and Symbian Developers were interested in accessibility but in the last few years they seemed to have strayed away from that,” Shandrow said.

Ringling endorsements are not given easily by this one-month blind iPhone user. He regularly reports on technology access barriers and corporate accessibility foibles in his web log “Blind Access Journal with recent news focusing on various iPhone application developers agreeing to greatly increase their accessibility and usability to blind VoiceOver users. Additionally, Shandrow was a plaintiff in a federal disability discrimination complaint he and leading blindness organizations filed in 2009 against universities, including his own Arizona State, who used the Kindle electronic book reader from Internet retailer Amazon in their curricula. Interviewer Jackson asked Shandrow if the iPhone benefited his overall accessibility to the

community. “yeah, absolutely, I mean...I don’t have to worry about there’s a lot of things now I don’t have to worry about any more that I used to just either memorize or keep in, keep in some other device or whatever. Now it’s, all, it’s all with me.” Shandrow said he listens to the radio on the iPhone and an application that reads bar codes. Using the SmartPhone’s wireless data connectivity, the application retrieves product information connected to the bar code and reads it to him. He anticipates in upcoming years the ability to take pictures of documents with the phone’s five-megapixel camera and having the phone read the contents to him using optical character recognition.

Wireless data services can significantly increase the independence of blind people, including those who are already highly resourceful and extraordinarily independent. Shandrow explained to interviewer Jackson that “As far as a [favorite] practical app, I like Around Me. It’s a nice simple app. The cool thing about it is [that] It will automatically pull your location and so it knows where you are right now and it gives you all these categories like ATMs, restaurants and you can then flick through all the restaurants. It gives them to you in the order of closest to farthest away from you in distance and you can double tap the one that looks interesting and you can get the phone number, and the address, and all the details. I just think that’s one very good practical app that I use fairly regularly.” Jackson described how he double tapped the screen in the Around Me application to call and make a reservation at a Vestavia Hills, Alabama location of Johnny Brusco's 'New York Style' Pizza near his home and used the NAVIGON MobileNavigator iPhone application to provide turn by turn walking directions to the restaurant for a dinner with friends. The application describes distances in feet and can lead someone directly to the door of a building, as it did for Jackson going to the restaurant.

In 2010, Apple added Braille support to the iPhone when it introduced iPhone 4. Online technology commentators in web logs commented passionately about a video blind computer scientist and musician Victor Tsaran posted to YouTube demonstrating how the iPhone can be operated and information accessed with a Braille display with the phone in another room. In the blindness and technology communities, Tsaran is best known in his role at Internet giant yahoo as its Senior Program manager for Accessibility. Jackson, who is blind, found the wireless Braille support useful as well in his job as an Apple Specialist at a company store in Birmingham, Alabama. He has a severe hearing impairment and says the iPhone 4 “is the best experience as far as a mobile device I’ve ever had with Braille. It is fantastic! I work at Apple four or five days a week and I use my phone on the floor. I use it to contact people in the back. I use it to contact people I need to contact from Apple.” He does all of this with a 24 cell BrailleConnect display from Humanware that sells new for about \$3,000. The independence enabled by the advanced accessibility functionality of the iPhone is so inconceivable to many sighted persons that “It flips them out,” says Jackson, “when I pull that Braille display out of my pocket.”

Unfortunately, the iPhone has its limits that prevent it from being a universal wireless accessibility tool for the blind. The phone can only be used on the AT&T wireless network, which is not available in all areas of the United States where cellular telephone services are commonly available. Even when someone lives and works in or near the large population centers or major transportation corridors that constitute the bulk of the AT&T coverage area, some are highly uncomfortable with the phone’s design and others find the cost of the services

connected to the phone rather expensive. The phone has no buttons with input based on physical gestures and taps to the phone's touch screen. Some blind persons find this method of data input either highly inefficient for simple tasks such as dialing a telephone number or fully incompatible with their learning style compared to using a device with physical keys or buttons. Others are limited by cost. While the phone is relatively affordable with retail giant Wal-Mart selling a version of the iPhone 3GS in the spring of 2010 for \$99, the cost of AT&T wireless services for the iPhone limit its adoption in the blind community. Until recently, AT&T required use of a data plan with the iPhone, costing \$70 before taxes. In August 2010, an AT&T representative at the Dearborn and Madison store in Chicago said a \$40 a month voice only two year service plan was available. The service included 450 airtime minutes during weekdays and 5,000 minutes during night and weekend hours. By contrast, wireline service from AT&T for most Chicago residents costs as little as \$10.56 for unlimited incoming calls and 30 outgoing calls a month and six cents for each additional call. The price includes an infrastructure access charge used by the company. For blind people who are modest wireless voice users, the cost of accessible service from AT&T far exceeds the cost of wireline service by about four times.

Other carriers and service providers offer wireless services at or near the same price as wireline service. Prepaid wireless voice service can cost many consumers as little as \$10 a month or less. Contract based wireless service offering more than six hours of talk time can cost about \$20. For those with modest wireless voice communication needs, self-voicing handsets that would provide access to wireless services from companies offering basic voice service, such as TracFone, Virgin Mobile USA, and T-Mobile, do not exist. A blind person could of course spend several hundred dollars purchasing a cellular phone and another several hundred dollars adding a screen reader. However, the cost of this accessibility negates the cost savings from low airtime usage.

From what can be determined, no handset or voice mail service from any carrier provides voice output at no additional cost for the blind with prepaid wireless services or discount contract services, such as the \$20 a month wireless service recently announced by the Virgin Mobile brand of Sprint. The phones provided for basic service by the wireless carriers, some costing less than \$20, have no voice output or accessibility features for a blind person to use. The LG 101 is one-tenth the price of the subsidized iPhone that requires a service contract. Fully accessible Verizon phones for the blind with voice output cost 15 times more.

Accessible and affordable wireless is an important concern of most blind people. Of the approximately four million blind persons in the United States, the Bureau of Labor Statistics reports that more than three-quarters are not in the labor force, living on fixed Social Security checks. Of those blind persons in the labor force, the unemployment rate is more than 50 percent higher than the general unemployment rate for all Americans. Less than one half of one percent of Social Security beneficiaries with a disability receiving benefits through the Social Security Disability Insurance or Supplemental Security Income programs leave the rolls for work activity, reports Social Security. As the data show, most blind people live in poverty from not being in the labor force or from severe unemployment. Yet, the wireless services within reach to most blind people are the least accessible, with a number of carriers and service providers offering no handsets with voice output at no additional charge on their networks.

The Android operating system chiefly developed by Google, Inc. appears promising. It has been highly publicized, including at an FCC wireless workshop in May. All the major carriers supporting Android phones require a data plan with wireless service costing between \$50 to \$100 a month and more. The access solution is for all practical purposes still in development, with significant improvements happening on a near weekly basis. While end users report the ability to make telephone calls on the device and access to the calling features, e-mail functionality was supported in just the last couple of months and Web browsing accessibility will be available in the future. Google's lead software engineer on accessibility, T.V. Raman told the eyes-Free Android forum in June "stay tuned, the best is yet to come—we're only getting started." Documentation is extremely limited and rather rudimentary.

Other accessibility barriers exist in the wireless marketplace in addition to accessible handsets and affordable and accessible phones. Both of the barriers identified below are attitudinal in nature without regard to the possibility of any blind consumers in the marketplace and either passively or intentionally limiting their access to wireless services. One of these barriers relates to the increasingly popular Android operating system developed largely by Google, Inc. The Slide from HTC Corp. is the only Android phone with a keyboard sold and supported in August and September 2010 by T-Mobile for use on its network. Google recommends that blind people only use Android enabled phones with physical keyboards to reach the software's accessibility functions. T-Mobile and HTC intentionally removed the built-in Android accessibility functions on the Slide. For a blind person to possibly use the phone, the Android accessibility components need to be downloaded from an online marketplace and installed on the phone by a sighted person. Even when all Android accessibility applications have been installed, another HTC and T-Mobile design prevents access. The design is not present in Android phones from other carriers and manufacturers, such as Verizon, Sprint, Motorola, and LG. T-Mobile has a proprietary interface on top of Android that does not allow highlighted information to be read by the blind end user. Specifically, the custom designed T-Mobile and HTC interface prevents highlighted information on lists of items, such as bookmarks on the browser, phone applications, contacts, and previously received and placed calls of being passed to the accessibility components of Android. As a result, the blind user cannot identify which item is highlighted or what item was selected, making the phone inaccessible for all practical purposes. Members of the Google access team say that the problem could be easily remedied with no visible change to the interface for sighted users.

Accessible documentation continues to be unavailable to blind owners of cellular phones. Accessibility representatives listed with the FCC will supply accessible documentation that includes tactile descriptions of handset layout in the format of the user's choice when specifically requested to do so. Unfortunately, many blind wireless consumers are not aware of these representatives or the Commission's explicit rules requiring accessible documentation. When requests are made through customer service channels or through stores owned by wireless carriers, these venues often say that documentation is either not available or available only in a format that the blind customer cannot use. Yet, mainstream channels are available to provide easy and unfettered availability the product documentation in a way accessible to blind persons. Many wireless phones and devices are shipped from the manufacturer with a CD-ROM in the package. Yet, no manufacturer of wireless telephones or devices includes a copy of the product documentation or manual in Microsoft Word, rich text, HTML, or ASCII text formats on the CD

shipped with the product. All of these electronic text formats can be fully and easily accessed by a blind person. Typically, the only version of the manual on the CD is one in portable document format, or PDF, that has no descriptions to the visually referenced items in the manual and is produced in such a way that the rendered PDF often places text randomly on the screen for the blind user, making the manual unreadable. For example, the i880 from Motorola is the most accessible self-voicing phone for the IDEN wireless network. Shipped with the phone is a CD-ROM that contains only the PDF version of the product documentation. The remaining space on the CD could accommodate more than 150 four-minute stereo MP3 tracks encoded at a bitrate of 128k or 931 copies of the accessible version of the product information in Microsoft Word format. Motorola could easily have included accessible product documentation on the CD-ROM at no additional expense or administrative difficulty, but it chose not to do so, providing an electronic version only after a written complaint charging disability discrimination was filed with the Commission. Similarly, all wireless manufacturers and carriers have a presence on the World Wide Web that describes the phones manufactured or supported on a carrier's network. The web pages contain downloadable PDF files of the manual for each phone. The manual is inaccessible to blind users. However, only one manufacturer or carrier, Apple for the iPhone, provides this information in accessible format. It would be simple and easy for manufacturers and carriers to place accessible electronic versions of manuals, user guides, and other product documentation on their websites and on CD-ROMs included with shipped products. Yet, this simple task on expanding accessibility eludes nearly everyone in the industry.

(2) The cost and feasibility of technical solutions to achieve wireless accessibility for these populations.

It is highly feasible to provide self-voicing handsets of not only basic voice calling functionality but of advanced functions, such as internet Browsing and mapping software, as demonstrated by the outstanding accessibility of the iPhone. Many have led others to believe that independence by the blind through technology was unfeasible, too costly, or unrealistic. Yet, the potential for technology to aid the independence of the blind is limitless. CBS News anchor Walter Cronkite awakened the world to this potential on January 13, 1976 with the news that a revolution had begun in how the blind access information. Inventor Ray Kurzweil and representatives from the National Federation of the Blind demonstrated the first working prototype of a reading machine that converted printed text of any type font into synthetic speech. Blind attorney Jim Gashel was at the controls when the legendary anchorman signed off his broadcast with the reading machine saying his famous signature line in synthetic speech "And that's the way it was, January, 13, 1976."

The machine and its constituent technologies that would deliver the wild dream of information independence to the blind were achieved through hard work, significant involvement by blind end users and a passionate organizing vision. These are the same skills used and needed today by blind end users in mastering current technology.

The big bang in information access started in 1974 when inventor Ray Kurzweil had a dilemma. At the time, computer programs that could recognize printed text could only recognize one or two type styles. Kurzweil had just invented a program that could recognize any style of print.

Kurzweil in his 1999 book “The Age of Spiritual Machines” described his next thought,” So the question then became, “What is it good for?” Like a lot of clever computer software, it was a solution in search of a problem.” An epiphany came when Kurzweil related how he “happened to sit next to a blind gentleman on a plane flight, and he explained to me that the only real handicap that he experienced was his inability to read ordinary printed material. It was clear that his visual disability imparted no real handicap in either communicating or traveling. So I had found the problem we were searching for — we could apply our ‘omni-font’ (any font) OCR technology to overcome this principal handicap of blindness.”

There was one thing that Ray Kurzweil didn’t have: money. In 1975, he approached Jim Gashel who was the Governmental Relations Director of the National Federation of the Blind for funding assistance with his project. Gashel was intrigued and introduced Kurzweil to the radically visionary blind leader Kenneth Jernigan, who was the president of the National Federation of the Blind and director of the Iowa Commission for the Blind. In 1975, Kenneth Jernigan was riding high with national acclaim, demonstrated results, and an organized blind membership that approached 50,000.

Kenneth Jernigan came to Iowa in the early 1960s to improve the blindness service system there. He immediately applied his philosophy of self-reliance, independence, self-respect, and pride of blind people. He was one of the first disability leaders to identify his concerns as a civil rights issue and believed the blindness problem was one of poor societal attitudes, low expectations, and blindness service agencies that created and perpetuated dependency. In slightly more than a decade the blind furniture maker from Tennessee transformed Iowa to the place with the best blind school, best orientation center, and most employed blind people in the world. In the 1960s and 1970s, there was no better place on the planet for a blind person to be.

There was one significant problem in 1975 that still eluded Kenneth Jernigan, now the most powerful blind man in America: Neither he, nor any blind person could read print independently. Blind people relied heavily on people who read to them, either in their homes or on audiocassettes. Braille was not any better, as it was produced by a limited number of sighted transcribers who underwent weeks of training. No matter how good the agency, how high the expectations, or positive the attitude, print remained a major barrier. Ray Kurzweil’s idea, which had been turned down by dozens of charities, government and private funders, and other disability organizations, could transform the lives of the blind, but it was a bit of a longshot.

Intel had just perfected a microprocessor that could run a whole computer in 1974. By January 1975, the world’s first personal computer went on sale, with computer magazines picturing the Altair 8800 on their front covers. The Altair, created by a retired Air Force General in the desert near the airport in Albuquerque New Mexico, was not even a computer. It was a computer kit. You had to build it yourself and then it usually didn’t work. When it did, it had no keyboard or monitor, or input jacks for anything. Everything was entered by switches.

Not only had computers as we know them not been invented yet, but neither had the reading machine’s constituent technologies of speech synthesis and flat-bed scanning. Optical character recognition had not yet been deployed outside a lab. These three technologies would comprise the reading machine and later be the building blocks of access for the blind to the information

society. These technologies had to be developed from scratch to make the machine viable. Further, the extremely bright and innovative Kurzweil had only received a bachelor's degree from the Massachusetts Institute of Technology, and it was relatively recently in 1970. In 1974, he had formed Kurzweil Computer Products, his first company. All of this made him unseasoned, inexperienced, and not fully trained and professional in the eyes of some.

The word *impossible*, however, was not in the vocabulary of the charismatic figure that organized a succession of Iowa governors, dozens of business leaders, hundreds of state legislators, and thousands of blind persons to turn the vision of independence and equality for the blind into reality. Kenneth Jernigan knew the creativity and resourcefulness of blind people. They, through the Federation, could create the King Kong of machines for the blind, if they had the confidence in themselves and set their expectations high enough. It could have the impact that landing a man on the moon did six years earlier—creating and spinning off new technologies and opportunities.

Kenneth Jernigan then made a proposal to Ray Kurzweil that would be the model of technology design, manufacture, policy, and end user selection for the blind and later for the larger disability community in the decades to come. His Federation would organize the funding effort and lend his and the Federation's credibility to the project only if the NFB, specifically its blind engineers would be involved in the design of the reading machine and its user interface and controls. Further, this group would help evaluate and refine all aspects of the product's operation and various functions. These blind engineers would be equal partners throughout the entire process. Ray Kurzweil had not expected the request, but agreed reluctantly as he had exhausted all other leads and was at the end of the road. Jim Gashel coordinated the blind engineers and began working until midnight throughout 1975 at his Washington office drafting dozens of funding proposals needed to raise the \$350,000 for the project, which amounts to \$1.38 million in 2009 inflation-adjusted dollars. Eventually, the funds were raised, including funds from federal sources.

That single reading machine that sold for what was the equivalent of a small house about three and a half decades ago has led to a digital revolution that has transformed the lives of the blind. Now, nearly every written item is independently accessible through technology for as little as a couple hundred dollars, with Internet retailer Buy.com selling one of the best optical character recognition products—OmniPage 17—for only \$69. On May 6, 2010, the Internet Archive announced that more than a million books it had scanned in 20 centers in five countries were now available to the blind, becoming the largest single resource of accessible books anywhere in the world. Thanks to the reading machine and the spin off technologies of dynamic text to speech synthesis, OCR, and flat bed scanning, the access barriers of more than three decades ago have narrowed considerably and will be virtually eliminated in a few years.

Based on the significant gains in accessibility, blind people saw the potential for much greater access when Internet giant Amazon introduced the Kindle in 2007, a device that can display hundreds of thousands of electronic books that Amazon sells. Designed to be the size of a small book, Amazon sold out of its entire inventory within the first few hours of the device going on sale. Blind people suggested to Amazon shortly after the release to include speech synthesis not only for access but for those who might want their book read to them rather than actively reading

a screen. The Kindle remained popular in 2008 with the barrage of orders not being filled until April. The realm of accessibility to this gigantic pool of materials emerged in February 2009 when Amazon introduced the Kindle 2. This updated version included speech synthesis. Theoretically, the Kindle 2 could read an entire book out loud. Unfortunately, a blind person could not read a book with it. None of the menus or controls had audio output so a blind person could not select a book, adjust settings, place a bookmark or turn on or off the audio. More chilling to the blind leaders, Amazon announced a partnership with leading universities who agreed to use the Kindle book reader in some of their classes. The future seemed ominous: the world was marching toward electronic text and blind people were not going to be a part of it. The two national organizations of the blind, the National Federation of the Blind and the American Council of the Blind, filed federal disability discrimination complaints against the universities after administrators balked at stopping use of the Kindle until it was accessible for all students. Advocates also filed a suit in federal court in Phoenix where Darrell Shandrow sought an injunction against Arizona State University to stop use of the Kindle. In a web log post, Amazon said it had heard from many blind people and would incorporate more accessibility in the device in the future. Amazon did not specify a timeframe or the exact access solution. By the end of 2009, two schools voluntarily ended their Kindle experiment with Amazon. In early January, 2010 the other universities entered into legal settlements that pledged not to use any electronic book reader for the next two years unless it was accessible to people with disabilities. On June 29, the Departments of Justice and Education jointly issued a "Dear Colleague" letter to the heads of thousands of colleges and universities throughout the United States. The letter described the potential for electronic texts but balanced the obligations of these institutions to provide equal access to education for all students, including those with print disabilities. "Institutions of learning have an obligation to equal and accessible opportunities for all. Electronic book readers can and should be made accessible to individuals with disabilities by speaking text and menu options aloud while the user navigates the device, as well as tailoring other features for students who are blind and have low vision," Assistant Attorney General for Civil Rights Thomas Perez was quoted as saying.

A month later, the fears of blind leaders in 2009 materialized. Electronic book sales surpassed hardcover book sales for three consecutive months for the first time in Amazon's history, the company reported in a stunning announcement on July 19, 2010. On August 27, the Kindle 3 went on sale. This new version featured talking menus that a blind person could use. While blind leaders found that additional adjustments and changes are needed for full access, a new era had truly emerged as blind people could for the first time read almost any new book as soon as it was available to non-disabled persons.

Another example of accessible technology innovation for the blind includes web accessibility. Daniel Dardailler of the World Wide Web consortium has written a detailed and thorough account of the history of the Web Accessibility Initiative of the consortium. The account can be found at <http://www.w3.org/WAI/history>. It is important to note that within months after Tim Berners-Lee, the remarkable mind behind the World Wide Web, issued a call for member interest in a Web accessibility project, a meeting was held at the Clinton White House with Tom Kalil, Senior Director to the National Economic Council. At the meeting, representatives from the disability and technology communities met with representatives from key governmental agencies, including the FCC, the Access Board, the National Science Foundation and the

National Institute for Disability and Rehabilitation Research. By the summer, the United States government and the European Commission along with International Business Machines Corp. and Microsoft had provided substantial funding to the Initiative that would end up developing accessibility guidelines followed by governments, major corporations, web developers, software makers, and content providers across the world. The guidelines produced with those federal funds have been used by two federal courts in requiring accessibility of the websites of the Atlanta transit system and retail giant Target.

In the examples above, many well-known businesses and public agencies said providing access to blind people to the technology at the time would either be cost prohibitive or technically infeasible. However, the prices of the accessible technology, once developed, can fall dramatically over time. For example, the technology behind the Kurzweil Reading Machine can be purchased today for less than \$200, including OCR software, scanner, and a free screen reader and donated computer. By contrast, the reading machine cost more than \$200,000 in 1976 without a government subsidy to purchasers. The dollar figure used 2009 inflation-adjusted dollars. It represents a 1000-to-one price shrinkage that happened because the United States government became involved in the technology by funding it at its early stages, enabling private industry to develop it further. The 1000-to-one price collapse made the technology that many said was impossible to create affordable to every blind person in America.

A similar situation occurred in 2000 when the United States Architectural and Transportation Barriers Compliance Board was confronted with competing claims about the accessibility of automatic teller machines. In 1999, the Board issued draft guidelines to revise the Americans with Disabilities Act that explicitly required talking ATMs. The comment period ended in the spring of 2000 with many hundreds of blind people filing comments. Surprising everyone, access to ATMs was one of the five most commented upon items from all of the filers. Industry said providing such access would be extremely expensive and infeasible in most instances. In October, the Access Board convened a day long meeting to hear from all interested persons. While some financial institutions had started initial rollouts of talking ATMs, the accessibility had not yet become commonplace. Industry was concerned about the added expense. People with disabilities and academic researchers described how talking ATMs could be made accessible for little additional cost. The disability leaders pointed to other technology barriers and their resolution on a mass scale, such as incorporating closed captioning capability in all new television sets as required by the Television Decoder Circuitry Act of 1990.

One of the most passionate industry advocates was Bill Jackson, the Chief Technology Officer for Triton Systems, a manufacturer of low cost ATMs that are used in many independent retail businesses such as bars, restaurants, and bowling alleys. The ability to offer speech output of the visual display was thought to be expensive and difficult. However, in 2002, Triton Systems offered voice guidance on all the new ATMs it sold at no additional charge. This included the least expensive ATM on the market, selling for less than \$3,000. Again, the infeasible and impossible turned out to be doable when industry, government and the disability community came together.

In May, 2010, Paul Schroeder, the Vice President of Programs and Policy for the American Foundation for the Blind expressed the inability for blind people to obtain affordable and

accessible wireless services at an FCC workshop. He said that inexpensive self-voicing handsets were non-existent in the marketplace. In late July 2010, Verizon began selling the Haven by Samsung for less than \$40 with a two year contract. This is a self-voicing phone that offers access to all the calling features and functions. If Verizon and Samsung can offer wireless handsets for less than \$50 and Apple can offer a SmartPhone for less than \$100, then companies such as Motorola, HTC, LG, Nokia, and Research In Motion can as well.

(3) Reasons why there are not a greater number of wireless phones – particularly among less expensive or moderately-priced handset models – that are accessible to people who are blind or have vision loss.

The FCC has done little to encourage this accessibility, except issue guidelines and follow-up on individual complaints, crafting individual solutions that don't have broad applicability to the millions of blind people in the United States. In the examples cited above and in other examples that could be cited, federal officials or federal agencies took clear and deliberate action to solve a technology accessibility problem or in creating opportunity for people with disabilities through technology. In the instance of the Kurzweil Reading Machine in the 1970s, it was funding innovative technology that could transform the lives of the blind. In helping foster inexpensive talking ATMs that would arrive throughout Main Street USA, it was the Access board that brought industry and the blind community together to openly and candidly discuss the challenges, the opportunity and the clear feasibility of talking ATMs in both new and currently deployed machines. Sometimes these measures are not enough. This was recognized by the White House in the late 1990s when Tom Kalil of the National Economic Council brought multiple federal agencies together with the technology industry and the disability community to bring a coordinated federal funding response to develop access to the emerging technology of the World Wide Web. At other times, aggressive federal enforcement of civil rights laws was necessary to prevent a quickly emerging technology, electronic books using the Amazon Kindle, from becoming so commonplace that our society incorporates the new technology and leaves blind people behind.

Leadership is needed by the FCC to increase the number of self-voicing wireless phones overall, particularly those at lower pricepoints. As was found with other examples, leadership can take many forms, but the Commission should recognize that different kinds of leadership would be appropriate for different parts of the wireless marketplace. For example, aggressive enforcement may be entirely appropriate for the largest wireless carriers and manufacturers with enormous resources generated by tens of millions of subscribers who have done little to nothing to offer wireless phones accessible to blind persons. On the other hand, the Commission's efforts on generating access at small carriers might be better served by bringing government and academic experts, industry, and the disability community together to candidly develop a plan for wireless access for those not served by the large wireless providers who focus on service to the major population centers. Whatever form it may take, leadership is an active process rather than a passive one. It aims for systemic change across an entire industry, such as with banking, book publishing, or the Internet economy as with the examples mentioned above. Access for millions does not happen through piecemeal, ad hoc solutions for individualized problems.

(4) Technical obstacles, if any, to making wireless technologies compatible with Braille displays, as well as the cost and feasibility of technical solutions to achieve other forms of compatibility with wireless products and services for people who are deaf-blind.

Please review the earlier comments on the iPhone. The current model, the iPhone 4, supports a number of Braille displays through a wireless blue Tooth connection. The compatibility is built into the phone, which is sold for less than \$200. The access is so reliable that a blind man uses the phone connected to a Braille display to communicate effectively in his position at a busy Apple store in Birmingham, Alabama.

(5) Recommendations on the most effective and efficient technical and policy solutions for addressing the needs of consumers with vision disabilities, including those who are deaf-blind.

Before examining policy solutions, it is important to consider policy failures. One of these failures has been the Commission's reliance on compatible software to provide basic wireless handset accessibility to the blind. This has resulted to the place where the access solution costs much more than the item for which access is sought. Cell phone screen readers can and do provide a useful service when no other access option is available. Yet, as history has proven, it is folly to believe this policy approach alone will enable blind people to access wireless services at rates similar to those for non-disabled persons. As was described earlier, the cost for basic wireless service from some carriers is comparable to the cost of wireline service. However, blind people will never enjoy the benefit of falling prices for wireless communications as long as the FCC continues to focus on the policy strategy of wireless phone designs that are compatible with assistive technology rather than insisting that manufacturers and carriers offer phones with accessibility incorporated into the design of the phone, such as with the Apple iPhone, the Samsung Haven, or the LG enV3 VX9200 or the LG VX8360.

The Commission should work toward the introduction of more self-voicing phones into the marketplace. The barrier is not simply accessibility but also affordability. When the cost of access is spread across a large base, the price any one person would pay is minimal, such as televisions with closed captioning circuitry. The Commission would be best to maintain the accessibility regulations as product focused rather than applying access to a product line or being satisfied with one access solution for each company. The latter ideas do not contemplate the wide range of uses and prices by the public and blind people themselves.

(6) Recommendations on actions that our bureaus or the Commission should take to address the current lack of access. For example, is additional guidance needed on specific access features that should be included in wireless products? Should we facilitate a dialogue among stakeholders in order to reach a specific agreement to address the accessibility concerns outlined above?

The simple answer is yes to all of the above and more. The lack of access to wireless services is not a single problem but multiple problems requiring different approaches bundled into a single idea. For example, on January 10, 2010, Code Factory, the only company that produces any access solution for the blind for the windows Mobile platform, announced that the upcoming

Windows Phone 7 will not be usable with any screen reader upon the operating system's release. "Windows Phone 7 doesn't support native code development, which means that it is technically impossible to develop a screen reader application without the direct help of Microsoft, the OS maker", said Code Factory CEO Eduard Sánchez. "Therefore Mobile Speak, Mobile Geo, and Mobile Magnifier will not run on the initial version of Windows Phone 7. "We have been talking with Microsoft for the last few months to try to remedy the situation and come up with an accessible solution for Windows Phone 7 as soon as possible. In fact, we waited until now to make this announcement because we were hoping that together with Microsoft we could find a solution before the release of the first Windows Phone 7 devices, but unfortunately this will not be the case. We at Code Factory are at their entire disposal to provide our assistance and expertise," Sánchez added. While Code Factory will be at Microsoft's "entire disposal," Microsoft has decided to release Windows Phone 7 without an access solution for the blind, unlike Google and its Android operating system. The Commission should clarify policies as to whether developers of operating systems are responsible for incorporating self-voicing functionality into their phones, like Apple and Google have. In addition, this is an example where the Commission should bring assistive technology and mainstream companies together to facilitate a strong dialogue between the companies, the Commission, and blind Windows Mobile users so access could be available in a timely manner. Often, the large mainstream technology companies do not recognize the importance and significance of the assistive technology vendors and the empowerment and opportunity they offer for blind persons and those with disabilities. Some access problems do require multiple approaches.

Similarly, the Commission should be making strong commitments to policy when it is needed. For example, two Android SmartPhone manufacturers, HTC with the Slide and Motorola with the Droid 2, produced phones in which the accessibility functions of the Android operating system were intentionally removed from the phone. Is this a 255 violation or does the provision of being "compatible with" leave Motorola and HTC completely off the hook in being expected to include any accessibility support in the phone? Also, who is responsible for Smartphones with third-party operating systems when more access is desired: the phone manufacturer, the operating system developer or no party under the 255 provisions?

Besides bringing parties together and clarifying policy, the Commission should aggressively enforce current regulation on a systemic basis. Some large carriers have no self-voicing phones that a blind person can use independently. Such phones are technically feasible as other carriers have such phones. Aggressive enforcement of existing law can yield substantial results, as was the situation when the Justice Department eliminated the academic market for Kindle books until Amazon made the reader accessible to the blind. Many times companies don't believe they have a responsibility or have no interest in changing corporate practices, which occurred with Target Corporation. The company designed its website in a way that a blind person could not complete a transaction using a screen reader. Target refused to change the website, arguing in court papers it had no legal obligation to do so. The company was sued and after several unfavorable rulings, Target settled with damages and attorney fees costing nearly 10 million dollars. This sum did not include the cost of making the website accessible, which likely would considerably less. Blind people and blindness organizations met with Target executives and had dialogues. At some point, clear action is needed rather than endless policy making or discussion between parties.

In all instances where high quality access to technology has been obtained by the blind, industry and blind people themselves have worked together in a close cooperative relationship to achieve extraordinary results. This model is highly effective on the local level as it is on the national level. In May 2005, the Cook County Clerk chose the only direct-recording electronic voting machine that had produced a voter-verified paper audit trail in an actual election. While the Sequoia electronic voting system had significant accessibility problems, assurances were provided by the company's Chief Executive Officer to devote resources on dramatically improving access.

The company followed through on its commitment. On June 13, 2005, Sequoia Voting Systems then President and CEO Tracey Graham met with disability leaders and the Cook County Clerk and described the company's substantial commitment to improving the accessibility of the AVC Edge. An audio recording of a voting experience was produced that day following this meeting. The recording and end user experiences with the Sequoia AVC Edge were used to produce a June 30, 2005 report on the audio interface of the machine. Since completion of the report, Sequoia representatives spent more than 100 hours in enhancing and improving the audio script used by the AVC Edge, states a December 2005 memorandum by Sequoia President Jack Blaine. In the two years following the report, Mr. Blaine met with disability leaders to learn about access concerns and develop paths for forging solutions. City and county officials and leaders from the disability community spent hundreds of hours conducting usability tests, analyzing the control box, and reviewing the effectiveness of each audio prompt on the machine. Further, Sequoia redesigned its control box for the audio interface. The new control unit included easy to locate volume control buttons and a switch that increased or decreased the rate of speech in the audio recording. The new control unit also enabled those who could not use their hands to vote to plug in a sip and puff device so the ballot could be voted completely from someone's assistive technology.

Additionally, Sequoia produced numerous changes for the November 2006 election. In August 2006, Sequoia representatives met with the Cook County Clerk, the Executive Director of the Chicago Board of Election Commissioners and leaders in the disability community to demonstrate the new and enhanced accessibility features of the Sequoia Edge II Plus voting machine, which was used in the November 2006 election. The Sequoia Edge II Plus replaced the AVC Edge used in the March primary election. The audio interface now includes navigational prompts on the contest menu and an interactive ballot review mode so blind and disabled voters can exit the review mode at a particular contest and change their selection as sighted voters can. The now accessible ballot review will largely resolve the problems that were described in an earlier report. The re-designed touch screen on the Edge II Plus has legs that can be adjusted to different levels for various wheelchair heights. For the first time, people who have low vision will be able to view the ballot using a zoom function which magnifies the type up to 400 percent its normal size as well as view the ballot at a high color contrast. Sequoia has re-designed its audio control unit yet again. The buttons are concave and recessed so those with head or mouth sticks and pointing devices can operate the machine independently. There are now also separate large plug-in "buddy buttons" for people with limited dexterity to use.

This rapid and remarkable increase in accessibility did not happen by accident. It came about through a deliberate process when a government purchaser, as its largest customer, put forward

clear access expectations. Also, Cook County Clerk David Orr and Lance Gough, the Executive Director of the Chicago Board of Elections, became personally involved in the process, actively pursuing effective accessibility as one of their important goals. Further, company management from the CEO on down became focused on access goals and talented and seasoned disability leaders along with company representatives devoted considerable time and resources innovating and creating powerful solutions. When representatives of industry, government and the disability community work together cooperatively as partners in using technology to solve accessibility problems, the inconceivable becomes possible enabling a new level of independence never before achieved.

The FCC could open up much opportunity for the blind if it follows the paths others have taken by bringing together the disability community, industry and government to develop transformative solutions to independence that do not exist today but could be available tomorrow if the FCC undertakes deliberate and ongoing action on multiple fronts and levels to achieve success.