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Case Study White Paper Series

How a culture of inclusion and the adoption of Universal Design at AT&T drive business processes to serve persons with disabilities

Accessibility, Innovation and Sustainability at AT&T

G3ict

Global Initiative for Inclusive Information and Communication Technologies



A Flagship Advocacy Initiative
of the United Nations Global Alliance
for ICT and Development



About G3ict

G3ict is an Advocacy Initiative of the United Nations Global Alliance for ICT and Development, launched in December 2006 in cooperation with the Secretariat for the Convention on the Rights of Persons with Disabilities at UN DESA. Its mission is to facilitate and support the implementation of the dispositions of the Convention on the Rights of Persons with Disabilities promoting e-accessibility and assistive technologies. G3ict participants include industry, the public sector, academia and organizations representing persons with disabilities. G3ict relies on an international network of ICT accessibility experts to develop practical tools, evaluation methods and benchmarks for States Parties and Disabled Persons Organizations to implement policies in support of assistive technologies and e-accessibility. Since inception, G3ict has organized or contributed to 79 awareness raising and capacity building programs for policy makers in cooperation with international organizations such as the ITU, UNESCO, UNITAR and the World Bank. G3ict co-produces with ITU the “e-Accessibility Policy Toolkit for Persons with Disabilities” (www.e-accessibilitytoolkit.org) which is widely used around the world by policy makers involved in the implementation of the Convention on the Rights of Persons with Disabilities. For additional information on G3ict, visit www.g3ict.org

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Jody Garcia - VP Consumer Sales & Service
Roman Smith - Director - Public Affairs
Elizabeth P Dixon - Lead HR Specialist
Diane Rodriguez - Area Manager - Regulatory Relations
Cecilia Martaus - General Attorney
Mark Witcher - General Attorney & Associate General Counsel
Rob Earnhardt - Mgr - Sales Execution
Bob Gorman - Director - Business Development
Brooks Newton - Technical Architect
Jason Whorton - Lead Technical Architect
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Amanda Stent - AT&T Research - Principal Member of Technical Staff

AT&T's Advisory Panel on Access & Aging (AAPAA)
AT&T Labs
Citizenship and Sustainability
Consumer Sales and Service
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G3ict editorial team: Francesca Cesa Bianchi, Nilofar Ansher, David Ross.
Design by Manuel Ortiz - www.modesignstudio.com

Special Mentions

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1110 W. Peachtree Street, NW Atlanta, GA 30309-3609 – U.S.A.

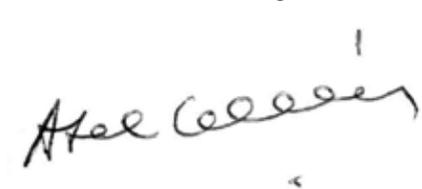
Foreword

For aging adults and persons living with disabilities, as for everyone, communications are essential to increased productivity, independent living, a sense of well-being and safety. Communications technology enables individuals with disabilities (and those without) to participate in social, educational and economic activities; retrieve information; receive warnings from government authorities in emergencies; and conduct a number of essential tasks that require access to phone or web services. Accessibility of communications is vital for an ever larger population of customers. In the United States, 54 million persons are identified by the U.S. Census Bureau as living with disabilities. Of those ages 65 and older, 52 percent live with a disability.

While accessibility is required by law, it is also an important element of a company's citizenship and sustainability strategy, as well as a market and employment opportunity. Many companies, however, have yet to fully integrate accessibility across companywide business divisions and into their product development and services design. Accessibility is a complex, multi-faceted discipline, one that can only be successfully implemented with the full participation and engagement of a number of business functions in large organizations and buy-in from senior leadership.

This case study describes how AT&T has integrated accessibility into its activities, from product development, human resources and talent retention to recruitment, marketing and customer service. As is often the case, AT&T's achievements result from a combination of factors: a rich history of developing products for persons with disabilities that dates back to the company's founder, a clearly defined set of citizenship and sustainability objectives, a commitment to Universal Design and, perhaps most importantly, a desire to involve persons with disabilities in these internal processes.

Our sincere appreciation goes to AT&T for opening its doors to G3ict and for sharing its experience with other corporations, disability and aging organizations, and the many stakeholders involved in promoting the accessibility of information and communication technologies.

A handwritten signature in black ink, appearing to read "Axel Leblois". The signature is written in a cursive, slightly slanted style. There is a small mark above the signature, possibly a stray pen stroke or a mark from the scanning process.

Axel Leblois
Executive Director, G3ict

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Why Accessibility Matters

Key Facts

At AT&T, knowledge of demographic realities is a key component of promoting Universal Design and assistive functionalities for products and services, and an integral part of the company's sustainability strategy:

Persons with disabilities in the United States

- 54.4 million, or 17 percent of the population, on the rise from previous U.S. Census (2002)
- 35 million (12 percent) with a severe disability
- 69 percent of those ages 21 – 64 with a severe disability are unemployed
- 30 percent of households have a family member with disabilities

Among persons 15 and older

- 7.8 million (3 percent) had difficulty hearing a regular conversation, with 1 million unable to hear at all. 4.3 million persons reported using a hearing aid.
- 3.3 million persons (1 percent) ages 15 and older used a wheelchair or similar device, with 10.2 million (4 percent) using a cane, crutches or walker.
- 7.8 million had difficulty seeing words or letters in ordinary newspaper print, including 1.8 million who were completely unable to see.
- More than 16 million had difficulty with cognitive, mental or emotional functioning.

Among ages 65 and older

- 52 percent had a disability and 37 percent have a severe disability.

Among ages 80 and older

- 71 percent had a disability, including 56 percent who have a severe disability.

Source: Matthew W. Brault, Americans with Disabilities: 2005, Current Population Reports, P70-117, U.S. Census Bureau, Washington, DC. 2008. See www.census.gov/prod/2008pubs/p70-117.pdf

How is Disability Measured?

The U.S. Census Bureau was among the first government agencies in the world to shift the measurement of disability away from the outdated medical model and to adopt functional measurements of disability, which provide far more accurate disability demographics. Questions are asked about an individual's ability to perform certain tasks, rather than asking to disclose medical conditions. For example, aging adults with macular degeneration who lose central vision may not be able to read a mobile phone screen. However, because their peripheral vision remains, they would not self-report as "blind" in the context of a traditional survey or questionnaire. The new methodology identifies such disabilities with questions about one's ability to read a newspaper.



AT&T Executive, Susan Mazrui (Global Public Policy), presenting at the NDI REI Tour National Press Club Kick Off event, October 2010.



Left to right: Gregg Vanderheiden (University of Wisconsin-Madison), Susan Mazrui (Global Public Policy), Tari Hartman Squire (AT&T Consultant) and Larry Goldberg (AAPAA member, WGBH National Center for Accessible Media) at the White House for the ADA 20th anniversary celebration event, July 2010.

Question: What is Disability?

According to the Preamble of the United Nations Convention on the Rights of Persons with Disabilities, signed as of December 2010 by 144 countries including the United States, “Disability is an evolving concept. It results from the interaction between persons with impairments and attitudinal and environmental barriers that hinders their full and effective participation in society on an equal basis with others.” Over the past two decades, this social definition of disability has been universally endorsed around the world, while the medical definition, which focuses solely on a person’s impairment, has been abandoned. It implies that society at large is responsible for eliminating barriers to access and ensuring full participation of persons living with disabilities. Disability is viewed as the intersection of the person and the built, electronic, or attitudinal environment.

Universal Design

The Convention on the Rights of Persons with Disabilities states:

“Universal Design” means the design of products, environments, programmes and services to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design. “Universal Design” shall not exclude assistive devices for particular groups of persons with disabilities where this is needed. (Article 2)

States Parties undertake or promote research and development of universally designed goods, services, equipment and facilities, as defined in Article 2 of the present Convention, which should require the minimum possible adaptation and the least cost to meet the specific needs of a person with disabilities, to promote their availability and use, and to promote Universal Design in the development of standards and guidelines. (Article 4.1.f)

“Universal Design” means the design of products, environments, programmes and services to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design.”

The Inner Workings of Accessible Product Design at AT&T

Managing Accessibility along the Product Development Cycle

Making technology work for all requires a disciplined approach to product design. Evaluating a product's accessibility at an early stage of its development significantly reduces the cost of providing accessible features. Retrofitting a non-accessible product can be very expensive, when it is even possible. This is why, from the conception of a product or service, AT&T applies user-centered design. User-centered design calls for a deep knowledge and understanding of human factors, or how individuals with different mixes of abilities, needs and limitations interact with their environment.

This approach includes tools that help product development teams evaluate the accessibility and usability of products. For example, one of the components in AT&T's standard project process is to identify Universal Design requirements using accessibility checklists, which prompt the product development teams to think about how a person with a disability might use their product. Their evaluation is then entered into the checklists and becomes part of the official documentation of each project.

Start with the user



Design and Development

End with the user



- Who users are
- What users want
- What users know
- How users work
- User capabilities
- User limitations

- Objective user testing
- Subjective user evaluation
- Post-deployment analysis
- Iteration of design



Human Factors Lab: A control room where experimenters observe customers interacting with AT&T products and services.

AT&T has established a “Human Factors Group” to test many of the company’s designs in order to evaluate the accessibility and usability of products and services. When appropriate, the team invites aging adults and persons with disabilities to take part in these studies. AT&T professionals have experience with accessibility issues and frequently participate in local accessible technology groups. They also support their peers throughout the company in matters of accessibility of products or services.

For example, the Human Factors Group helped develop the ANSI/HFES 200 standard (Human Factors Engineering of Software). The objective of this standard is to provide design requirements and recommendations that make software more accessible and easier to learn and use. The ultimate beneficiaries are the end users of software, whose needs motivated the design recommendations in HFES 200. The application of this standard is intended to provide user interfaces that are more usable, accessible and consistent and that enable greater productivity and satisfaction. Its main components cover accessibility, interaction techniques, interactive voice response (IVR) and visual presentation and use of color.

AT&T does not develop or manufacture customer equipment such as handsets, although it does resell products from third-party vendors. Nevertheless, the company is committed to offering a range of equipment operating on its network that is accessible and usable to customers both with and without disabilities. Besides applying accessibility rules embedded in its own product development processes, AT&T collaborates with handset manufacturers and third-party accessibility, aging, technology and disability organizations to collect input on optimum accessibility specifications. AT&T also works with nongovernmental organizations (NGOs) for recommendations and assessments of product accessibility and usability.

How the Human Factors Group Works at AT&T

The Human Factors Group at AT&T conducts customer research, analysis, design and usability testing to help develop products and services that are accessible, useful and usable for customers with and without disabilities. The fundamental goal of the Human Factors Lab is to learn and adjust product design in the lab from inception, rather than after a product or service is deployed to tens of millions of customers.

The Human Factors Group supports product development project teams within relevant divisions of the company and champions the needs of customers. Members bring their technical background in the human factors profession, drawing on knowledge from both industrial engineering and psychology. The group uses scientific data collection techniques to find out how customers want to use services and how they think they should work. Most of that research is conducted in the Human Factors Labs, located in Austin, Texas, and Atlanta, Georgia. The labs are capable of testing any service AT&T provides, from traditional phone services, automated voice response systems, and web sites, to cutting-edge mobile devices and television services. The Human Factors Group has conducted studies with thousands of customers to find out how they interact with new products or services.

A key benefit of having actual customers test services in the Human Factors Lab is that it enables engineers to get the customer’s perspective firsthand, a perspective that may differ from an engineer’s.

Addressing Customers' Diverse Abilities

There is no such thing as a “typical” customer. What customers need and how they use products and services varies. For example, customers who are blind surf the web, too, but instead of seeing web pages, they listen as the text on the screen is read aloud by software called a “screen reader.” Listening to a web page, however, is not quite the same as seeing it. For example, a picture of a button for “Log in” cannot be read by the screen reader, so a text tag that says “Log in” is associated with the picture.

Taking the lessons learned from individual projects in different lines of business and applying them to similar services is another way the Human Factors Group develops solutions for customers. For example, building on a thorough understanding of perceived picture quality for television, the Human Factors Group applies that same research to watching video on cell phones. Ultimately, the goal is to adapt technology to people, rather than force people to adapt to the technology.

Enhancing Web Site Accessibility

The Web Accessibility Program conducts testing and reviews, retrofitting, accessibility training, and is also building relationships inside and outside AT&T. The Web Accessibility Team works closely with Creative Experience Team personnel, including Design Standards, Customer Insight & Usability Engineering, Design, Content, Rich Media, Interaction Architecture, and Motion, as well as other internal and external media and accessibility consulting organizations.

The Web Accessibility Team utilizes a two-part testing process of scanning for machine-detectable accessibility errors on the page, and human review. Using specialized software, the team filters through thousands of web pages each week, looking for accessibility issues. In addition, the program conducts time-intensive manual reviews of web page content, searching for hidden barriers to access for site visitors browsing with a disability. The team uses the results of automated testing to focus a human reviewer’s intervention. The program’s site retrofitting efforts have led to significant decreases in machine-detectable errors. To prevent accessibility errors from making it onto the web in the first place, the team provides accessibility training to the various disciplines involved in the web production process.

The WGBH National Center for Accessible Media in Boston and AT&T have worked together to develop a program that enables AT&T to provide captioning for online video produced and hosted through att.com. The captioning program is an example of how a corporate production process can adapt principles of accessible design to reach a wider audience, as well as give existing customers an enhanced user experience. Providing captioning enables rich media access for audiences who are deaf or have a hearing loss. It also adds utility for our mainstream users in noisy environments, for those whose primary language is not English, or for those who simply enjoy reading along with the audio turned off.

Universal Design at AT&T

“Universal Design” is at the center of AT&T’s strategy to ensure that new communications products and services are accessible to and usable by customers with disabilities. Universal Design is the practice of designing products, services and applications that are usable by the broadest possible range of consumers in the widest possible array of circumstances, including when physical, cognitive or sensory access to the handset or device is limited. Whether the limitation is short-term or long-term or related to vision, hearing, speech, cognition or dexterity, mobile products and applications need to be designed to enhance accessibility and usability.

Experiencing Accessibility

Try sending a text message from a dark room, listening to a voice mail message during a loud concert, or answering the phone with a grocery bag in each hand. These are some of the situations providing some experience, however temporary, of what it is like to be in a situation of sensorial or physical limitation.

"Integration of Universal Design into business practice is fundamental to our mission of equitable access to wireless technologies for persons of all ages and abilities."

Jim Mueller, Project Director, User-Centered Research, Rehabilitation Engineering Research Center for Wireless Technologies, Georgia Institute of Technology



Apps4Access ADA 20th anniversary celebration event: Sam Fabens, VOX Global.

Because of its commitment to Universal Design and its collaborations with handset and software vendors to develop new products and services www.att.com/gen/general?pid=10471, AT&T has urged its suppliers to consider applying a Universal Design methodology as they develop wireless products and applications, as well as to take into consideration the needs of aging adults and customers living with disabilities. In March 2008, the company made its Universal Design methodology available to suppliers and third-party developers in order to further facilitate collaborations and joint developments of innovative solutions for improved accessibility on a variety of platforms. The original document describing AT&T's Universal Design methodology explained the benefits of Universal Design. It also provided several scenarios to further illustrate the relevance of this approach in the context of mobile handset and software design. For example, to meet the needs of someone who may have difficulty hearing, the document advised manufacturers to consider text and picture messaging, vibration and light-emitting diodes displays in their design to alert the user to a call. In the case of someone who may have limited dexterity, the document suggested such features as speech recognition and voice commands.

As part of this collaborative process, AT&T also encourages its suppliers to submit a Voluntary Product Accessibility Template (VPAT), a checklist designed to gauge how easy it will be for aging adults and those with disabilities to use the product. For example, it would indicate that icons include additional descriptions so that screen readers can "read" these descriptions aloud. It also guides suppliers not to rely too heavily on visual representations for the main functionalities of a device. It also recommends specific icons that are non-textual so that users unable to read can understand them, and reminds suppliers to consider the needs of customers who are color-blind.

“It is our goal that the concept of ‘design for all’ is not viewed as a constraint but as a catalyst for innovation across the industry. We believe that, by making our methodology on Universal Design available for all to see, we can show the importance and value of creating wireless products and services that are usable and beneficial to as many persons as possible. The end result will be more choices for more consumers.”

Carlton Hill, Vice President of Marketing, AT&T

“TDI commends AT&T for the announcement on its Universal Design principles. AT&T fully understands the benefits and impact it brings to the needs of persons with disabilities and their contacts upon its addressing and conforming to these principles. AT&T understands that in order to make its products and services accessible and usable to both persons with disabilities and those without disabilities, it is promoting a climate of full inclusion and integration for all Americans in the community, as well as in the business market. TDI salutes AT&T for taking this special initiative, and calls on other companies and businesses to emulate this noble approach to ensuring one’s first-class pursuits of life, security and happiness in the community.”

Claude Stout, Executive Director, Telecommunications for the Deaf and
Individuals Living with a Hearing Loss, Inc.

How a Culture of Inclusion and Sustainability Supports Accessibility

While Universal Design methodologies provide a solid foundation for the company's product and services accessibility efforts, its culture of inclusion and management processes involving persons with disabilities deserves much credit for its accomplishments. Three processes help the company stay focused on accessibility and aware of accessibility challenges and opportunities:

- The AT&T Advisory Panel on Access & Aging (AAPAA)
- The Citizenship & Sustainability Expert Team – Access and Aging
- Developing an employee base that includes persons with disabilities

Each is a unique source of continuous innovations and refinements to serve customers and employees with disabilities.

AT&T Advisory Panel on Access & Aging (AAPAA)

The process of seeking input from representatives of the disability and aging adults communities is not new at AT&T; it engaged with both communities beginning in the 1980s. Input has taken several forms, including the former Wireless Access Task Force (WATF), mystery shopping with the assistance of community-based organizations, focus groups on a variety of topics and inviting constituency expertise. Today, AT&T's Advisory Panel on Access & Aging (AAPAA) meets three times a year with key decision makers from the company's major business divisions and provides recommendations on issues impacting customers and employees: emerging accessible and usable technologies, current products and services, customer service, strategic marketing and employment issues.

More than a decade ago, what is now AT&T Mobility created WATF, which was in charge of assessing the needs of customers with disabilities. The WATF panel, composed of representatives from consumer groups and advocates for aging adults and persons with disabilities, met twice per year with company officials to articulate their opinions, provide feedback and to learn about the wireless business. Members also had the opportunity to meet with handset manufacturers. WATF helped the company develop a range of accessible and usable products and services, including TTY and hearing-aid compatible handsets, network-based voice dialing, and a range of devices that can be used by persons with little or no vision. While the Wireless Access Task Force held its last meeting in September 2007, the knowledge and expertise developed in the past decade continue through its members who serve on the AAPAA.



AAPAA meeting, February 2010.

“Our progress in these areas is made possible by the tireless efforts and passion of our employees and by the support and guidance of our external stakeholders like the members of the AAPAA. We will continue to listen and cultivate those collaborations, as they challenge us to improve the way we run our business.”

**Charlene Lake, Sr. Vice President, Public Affairs,
and Chief Sustainability Officer, AT&T**

A more recent example of this collaboration resulted in the development of a stylus to be utilized by customers for capacitive touch-screen devices in 2010. AAPAA members provided feedback on the rise of the smart phone market with touch-screen devices and how these products impact customers with disabilities. Within a few months, the company was able to source a stylus to be utilized on all capacitive touch-screen devices and have it on the market at a competitive price. In fact, AT&T introduced the stylus at the next AAPAA meeting in the summer of 2010.



The stylus suggested by the AAPAA.

Citizenship & Sustainability Expert Team Access and Aging

While the AAPAA is charged with seeking input from the disability and aging adult communities and related market segments, the Citizenship & Sustainability Expert Team on Access and Aging is composed of employees and other representatives whose role is to champion the cause of accessibility across all business divisions of the organization. This is particularly important to ensuring that accessibility is taken into account in all aspects of new product and service deployments, customer management, and internal employment policies and recruitment practices.

As Roman Smith, AT&T's Director of Public Affairs for Corporate Citizenship & Sustainability, explains: "AT&T strives to keep all members of the communities that it services connected with their world, including those who have communications difficulties and disabilities. Through its Citizenship & Sustainability Expert Team on Access and Aging, the company brings together constituents who drive the most important accessibility initiatives. Corporate sustainability is woven into the fabric of the way the company does business. Our view of sustainability is broad. It includes environmental stewardship, as well as encompasses a wide variety of issues the company believes are integral to be a good corporate citizen — fostering an inclusive workplace and offering customers with disabilities products and services that support them to live more sustainable and independent lives."

The Expert Team on Access and Aging has been particularly effective in supporting awareness and competency training programs on disability and accessibility issues for hundreds of thousands of employees in all divisions of the company, providing inter-divisional briefings on innovative products and services and helping define and coordinate process adjustments for customers.

Recruiting and Career Advancements for Persons with Disabilities

Employees with disabilities help a company make the best informed decisions on accessibility and customer service for persons with disabilities. How better to reflect potential customers than through the societal realities of a diverse workforce that includes persons with multiple mixes of abilities? With these principles in mind, AT&T has implemented several programs over the years to promote the recruitment of persons with disabilities and workplace accommodations, including alliances with Career Opportunities for Students with Disabilities (COSD); The Washington Center, an initiative with historically black colleges and universities supporting work with students with disabilities; and a new customer care program staffed entirely by U.S. military veterans with disabilities. This latest pilot was launched in Atlanta in November 2010 with a goal of employing approximately 60 veterans with disabilities by March 2011. The veterans serve as front line customer service representatives, as well as in supervisory, operational and support functions.

AT&T has also invested in career development for managers with disabilities as a co-founder of the UCLA Anderson School of Management's Leadership Institute for Managers with Disabilities. So far, five AT&T directors and managers have completed the course. For its disability-inclusive diversity leadership in the workforce, AT&T was recognized by the U.S. Department of Labor's Office of Disability Employment Policy (ODEP).

To improve the working environment for its new recruits and employees with disabilities, the company's Integrated Disability Service Center helps them maintain regular work commitments when they are faced with situations that may affect their ability to perform essential job functions. A well-established job accommodation process allows employees to request temporary or permanent work restrictions, obtain appropriate accommodations to assist them in performing their job responsibilities, or be considered for temporary work assignments as needed. Since 1993, the "Individuals with Disabilities Enabling Advocacy Link" (IDEAL), one of 10 company-recognized Employee Resource Groups, has also served as a resource for employees with disabilities. Members of IDEAL deliver presentations on disability etiquette and other aspects of the employment experience as part of National Disability Employment Awareness month each October. IDEAL also provides employees with disabilities the opportunity for mentoring, networking and leadership development which directly supports the company's overall diversity and inclusion objectives. In 2010, AT&T ranked #3 in DiversityInc's Top 50 Companies for Diversity.



Career Opportunities for Students with Disabilities (COSD) Executive Director, Alan Muir, and Jim Skurka (AT&T Business Solutions).



Jim Skurka (AT&T Business Solutions) presenting at a COSD Student Summit.

Workplace Accessibility

As Dr. Aaron Bangor explained to diversitycareers.com, when he was five years old, he experienced juvenile rheumatoid arthritis that caused cataracts, leaving him legally blind. To assist in his work as part of the Human Factors Group at AT&T, Dr. Bangor uses Microsoft Windows to enlarge text and display it as white on a black background so he can read it more easily. He also uses a closed-circuit TV and camera that can send images to a screen, images he can then enlarge. Dr. Bangor ardently believes that technology should be designed around the needs of the user, regardless of their abilities.

Data Point: Consumer Attitudes Toward Companies that Hire Persons with Disabilities

A National Survey conducted in 2005 on sample of 806 consumers by Gary N. Sipersteina, Neil Romanob, Amanda Mohlera and Robin Parkera, University of Massachusetts, Boston, MA, USA and the America's Strength Foundation, Ellicott City, MD, USA.

Most of the participants (75 percent) had direct experience with persons with disabilities in a work environment. Moreover, these experiences were positive. All participants responded positively towards companies that are socially responsible, including 92 percent of consumers who felt more favorable toward those that hire individuals with disabilities. The participants also had strong positive beliefs about the value and benefits of hiring people with disabilities, with 87 percent specifically agreeing that they would prefer to give their business to companies that hire individuals with disabilities. www.worksupport.com/resources/viewContent.cfm/637



Accessibility and Sustainability: Q & A with Roman Smith, Director – Public Affairs, Corporate Citizenship & Sustainability, AT&T

For Roman Smith, Director – Public Affairs, Corporate Citizenship & Sustainability, sustainability is more than just an environmental principle. It is at the core of a company's corporate citizenship, particularly its commitment to the disability and aging adults communities.

How does AT&T define sustainability?

Sustainability is a way of doing business that recognizes our company's impact on society, as well as the impact that social issues have on our business. Our citizenship and sustainability efforts target areas where the needs of our company intersect with the needs of our communities. There are certainly many needs of society; however, at AT&T, we focus on the issues that are important to our business and communities and that provide us with an opportunity to make the most meaningful impact on areas such as accessibility, education and diversity.

How do you approach sustainability?

I approach sustainability as an "operating principle" of how we run our business. Sustainability is not a token program or marketing effort at AT&T, but a commitment to operate better, smarter, and in a way that makes sense for both our company and our world.

Is sustainability just about the environment?

No. While sustainability at AT&T does include environmental stewardship, it also encompasses a wide variety of issues that we believe are central to our responsibilities as a corporate citizen. Examples include making our communities stronger through volunteer opportunities such as job shadowing, fostering an inclusive workplace, supporting the National Disability Institute's Real Economic Impact Tour to help low-income persons with disabilities and their families gain financial literacy skills, protecting the environment by consuming less energy, and offering products and services to help our customers live more independent and sustainable lives.

What does sustainability mean personally?

At a personal level, sustainability is about choosing actions that create a positive and a sustainable future for myself, my community and my company.

Alexander Graham Bell – An Accessibility Pioneer

Alexander Graham Bell, the inventor of the telephone and the founder of the company that would become AT&T, was a teacher of deaf people. His father, grandfather and brother all studied elocution and speech, and both his mother and his wife were deaf. All of this exerted a profound influence on Bell. In fact, Bell's invention of the telephone in 1876 grew out of his efforts to develop the first hearing aid.

Early Accessibility Milestones

1922

Dr. Harvey Fletcher and R. E. Wegel of the Bell System, in cooperation with Dr. E. P. Fowler, a New York City ear and throat specialist, announce their experiments in the measurement of hearing. From their work, Bell Laboratories eventually developed the 1A and 2A audiometers for physicians to use in aiding deaf patients.

1924

Western Electric develops the artificial larynx for those who have lost their voices through surgical removal or paralysis of the vocal cords.

1925

AT&T produces its first telephone amplifier, the model 23A.

1931

AT&T introduces the Telex switched typewriter service.

1947

Bell Labs invents the transistor, which allows significant reduction in the size and weight of hearing aids. Bell Labs subsequently provides hearing-aid manufacturers with royalty-free licenses.

Accessibility Innovation: A Continuous Process

Today, AT&T Labs continue working on innovation, developing core technologies for advanced solutions to meet the needs of persons with disabilities and those without disabilities. For example WATSON, AT&T's speech and language engine, integrates a variety of speech technologies, including network-based, speaker-independent automatic speech recognition (ASR), Natural Voices text-to-speech conversion, natural language understanding (which includes machine learning), and dialog management.

WATSON has been used within AT&T for interactive voice response (IVR) customers for over 20 years during which time its algorithms and tools have been refined to improve accuracy, convenience and integration. WATSON has also been used for speech analytics, mobile voice search of multimedia data, video search, voice remote, voice mail to text, web search and SMS, with multiple web-based applications under development.



AT&T's Chris Boyer (Public Policy) presenting at Lights! Camera! Access! ADA event with the U.S. Department of Labor and Academy of Television Arts & Sciences. Photo: Christopher Voelker.



AT&T's Aaron Bangor (AT&T Labs) and Doug Burasco (Relay), attending UCLA Leadership Institute for Managers with Disabilities. Photo: UCLA Anderson School of Management.



AT&T's Susan Mazrui (Global Public Policy), first from left, attending UCLA Anderson Leadership Institute for Managers with Disabilities, along with other corporate executives. Photo: UCLA Anderson School of Management.

Pioneering Speech Synthesis - An Interview with Jay Wilpon and Amanda Stent, AT&T Labs - Research

Research on speech synthesis started in the 1930s and an early demonstration of a voice synthesizer was made at the 1939 World's Fair in New York City. Speech recognition research started in the 1950s in the early electronics research group at Bell Labs. However, it was not before the early 1970s that computers became advanced enough to develop speech recognition for commercial applications. The main purpose at that time was to automate services so that customers could access a variety of information and services without always having to go through an operator. This, in turn, allowed companies such as AT&T to scale up services.

It all started with “yes/no” choices, one word at a time. Recognizing natural conversation has always been the ultimate goal and, as higher performance computers became available, research began a push in this direction. In the early days, disability and accessibility were not really the purpose. For example, in 1979, the company started a research program to voice-activate call dial functions. At the time this was a real stretch for speech recognition technologies, and yet it was successful and patented by AT&T. This was 25 years before voice dialing became a mainstream application in telephony, especially on mobile phones.

Recognizing everyone's speech no matter what they said, however, remained the key objective R&D teams were pursuing. In the 1970s the issue was that if a model had to be built for each person, hundreds of millions of models would be needed. Obviously, this was impractical for broad use in the marketplace. Speech recognition, to be viable, has to be speaker-independent. AT&T's team invented algorithms to make speech recognition speaker independent. The company filed over 500 patents and thousands of papers. The team, led by Jim Flanagan and Larry Rabiner, fathers of many signal processing inventions at AT&T, contributed seminal concepts to this new scientific discipline. Over the years, many members of the team have been honored with fellowships in the IEEE, the National Academy of Sciences and the National Academy of Engineering. The team has laid out all the fundamental solutions to produce and recognize speech. The artificial larynx for persons with voice impairments was developed from the same fundamental technology out of the same group.

The notion that those technologies could benefit persons with disabilities gained momentum in the 1980s. The first application was a text-to-speech component for a dual-party relay solution using Telecommunications Devices for the Deaf (TDD). In TDD, a sentence is typed in by the caller at one end and sent to the operator who reads it back to the caller at the other end. With a speech synthesizer in the middle of the transaction, after the caller typed in the sentence, the speech synthesizer would read the text instead of the operator. This allowed increasing the speed and efficiency of relay services. It was first deployed in Washington State in 1984.

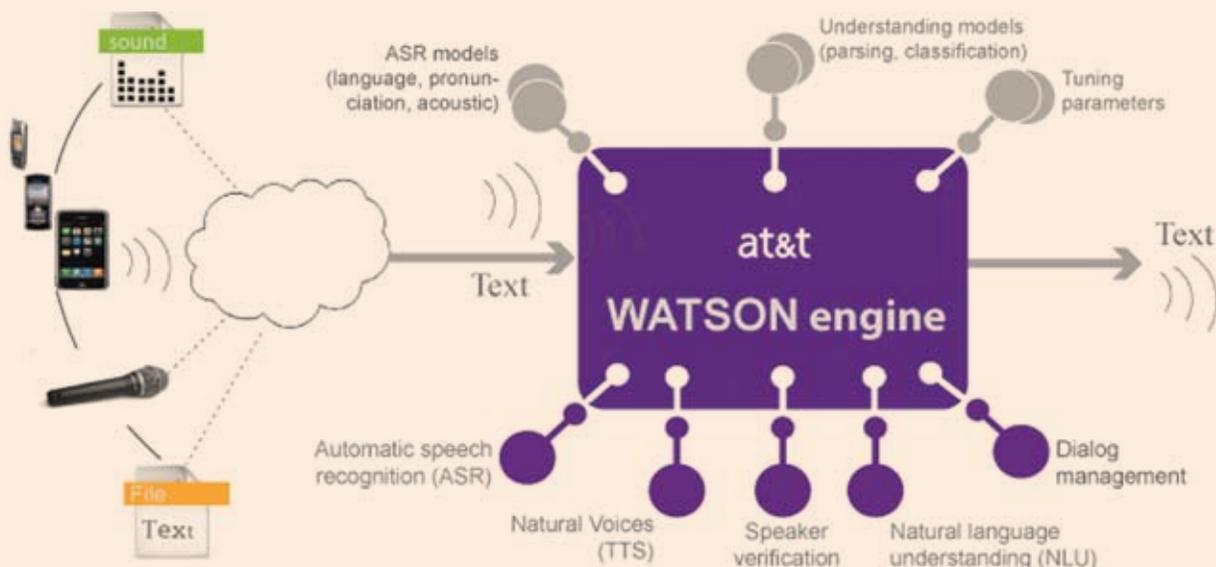
Using those leading technologies to address the needs of persons with disabilities gained further momentum as awareness and interest for assistive technologies grew in the general public. As a result, the AT&T Speech Research Group became more involved with numerous initiatives to develop solutions for persons with disabilities, from telecommunications to computer human interfaces. Some of its technologies were used by third parties developing new solutions, for example evaluating the emotional stability of autistic children. Over the past ten years a multimedia research group at AT&T has also applied speech recognition and language processing to the problem of automatic captioning and segmentation of multimedia videos.

cont.

While text-to-speech and speech recognition can help build very valuable applications for persons with disabilities, the assistive technologies market may be perceived as too small to justify investments in applications based on those technologies. AT&T Labs made a bold move in 2007 by evaluating offering its technology as a web-service with the ability for application developers to “mash it up” with other applications such as e-book readers and voice-enabled directions. When voice recognition was made available as a service ‘in the cloud’, the number of applications using it grew very rapidly. The company uses a business model that is free to use up to a limit and then costs users pennies after 1,000 or so licenses. Today, hundreds of organizations use AT&T speech technologies through its speech mashup prototype. Its customer base grew via word of mouth and includes a large variety of organizations from little Mom & Pop shops to universities to major enterprises across the world. Currently, AT&T is in the process of productizing “speech as a service” for broad market use and expects a robust offer by mid-2011.

Looking at recent trends, some of the promising areas for voice technologies include closed captioning of multimedia, accessible navigation services, assisted virtual remote console using mobile devices, searching the web, searching and browsing through music or video libraries or TV, e-readers available on the web as an application with an option to search, change speed, etc. All the while, scientists at AT&T Labs continue to push the scientific frontiers of speech research to better improve the recognition, synthesis and understanding of the spoken and written word.

One trend is certain: Mainstream assistive products and services will be more and more cloud-based rather than device-based. Cloud-based applications are easier to maintain and upgrade. As cloud-based applications multiply, the ability to build at greater scale will contribute to lower costs, to the benefit of both application developers and persons with disabilities.



AT&T WATSON Speech Technologies.



A New Frontier for Accessible and Assistive Mobile Phones

From Blueprint to Market: Accessibility in a Product Life Cycle

The product development cycle of a new handset follows a well-defined methodology incorporating accessible and assistive features at an early stage of design while allowing developers to check their usability as the product takes shape and is finally marketed. The launch of the Pantech BreZE, one of AT&T's most popular handsets among persons with disabilities and aging adults, is a good example.

In 2007, AAPAA provided feedback indicating the need for a handset that would be easy to use for aging adults and persons of all ages. AAPAA recommended that such a handset should incorporate assistive features for persons with low vision, dexterity limitations or hearing loss and those needing simplified commands for frequent tasks. However, the Panel also suggested that such a product should look similar to mainstream handsets and be as stylish as any regular model. With this input, the User Experience Design Team developed a list of specifications and searched for a handset vendor capable of meeting those specifications. It selected Pantech, a South Korean company, with whom it developed a collaborative work process in order to design the new handset with the desired features.

During the first phase, the AT&T team briefed the Pantech team about accessibility guidelines, market segments, form factors, ergonomic features, display menus, text menus, text-to-speech software and voice output. The Pantech development team worked for approximately one year on developing the first prototypes. During this development stage, the AT&T team provided feedback to the Pantech team by testing the first sketches of menu flows and screen shots with third-party research services and user experience groups. This iterative process allowed Pantech to adjust both software and hardware design while developing the first prototypes.

Once available, the prototypes went through the standard rigorous lab quality control process that precedes any new product launch, typically 12 weeks (not including user testing). Once approved, market launch occurred four weeks later. Meanwhile, specific attention was given to make the supporting documentation for the phone accessible using large fonts, and going through the regular process of developing support tools for the customer service representatives handling calls from aging adults and persons with disabilities.

When the Pantech BreZE was launched, its unique features marked a step forward in intuitive mobile phone design. Besides its sleek and simple appearance, it offered an extra-large color display, a simple user interface to access its various features, lighted EZ One-Touch Quick Call keys, Bluetooth, magnifier, hearing aid compatibility and voice dialing. Product testing showed that most of the desired outcomes were being met.

As with any product, however, the company carefully collected user feedback and tracked issues. It does so through customer service and twice a year via a systematic review by its lab of all its phones, using several hundred data points including an entire section of questions on accessibility. The initial Pantech BreZE review led to a first iteration of suggested improvements: its documentation accessibility, for example, was further improved as well as its form factor for messaging. Also, keys were renamed (the "send" key was relabeled "call"). Future reviews will likely lead to incorporation of additional features as needed.

The success the Pantech BreZE has enjoyed since its launch is no secret at AT&T. It gained quick market acceptance and recognition such as its inclusion in the list of Oprah Winfrey's holiday gifts for under \$100. In May 2010 the successor to the Pantech BreZE, the aptly named Pantech BreZE, 2 included many of the improvements identified in the product and customer reviews. Some of those improvements included improving the UI menus and font sizes for better readability, added voice command feature for improved accessibility to basic phone functions, added a large visual indicator for call, message and batter life status and upgraded the technology to 3G HSDPA over 2G EDGE.

AT&T's Mobile Accessibility and Assistive Technologies at a Glance

As mobile devices and services expanded, AT&T systematically developed and introduced accessibility and assistive features in cooperation with a variety of third parties. Key features which significantly enhanced the usability of mobile phones by persons with disabilities and aging adults include:

- **Audible prompts** to assist persons with low vision. AT&T was the first major wireless carrier to offer screen-reading software, which makes handsets accessible to persons who are blind via voice output. This software reads basic handset functions aloud, such as battery life and network strength, as well as Caller ID, the calendar, text messages and e-mail.



The Pantech BreZE II

- Large Buttons and Display Text
- EZ One-Touch Quick Call Keys
- Email, Text, and Instant Messaging
- MEdia™ Net
- Bluetooth® Capable
- Voicemail
- Camera and Video Capabilities
- Hearing Aid Compatible

- **Voice input and voice output** for many of the handset functions such as key echo or dialing from a contact list, or for handsets that speak aloud each dialed number.
- **Mobile Speak by Code Factory:** Mobile Speak allows a user to have access to all elements of a mobile phone screen and functions and can enable customers with qualifying disabilities to read books in a specialized format (such as DAISY) designed for persons who are blind or have reading impairments.
- **Mobile Magnifier by Code Factory** enlarges the font size on the screen of the phone.
- Voice command software that allows customers to use verbal commands to dial a number or retrieve information such as the date and time.
- **TTY-Compatible Phones:** AT&T supports phones that are teletypewriter (TTY) compatible. The TTY device enables visual communication via a one-line or two-line electronic display between two users both equipped with TTY devices. When used in combination with a TTY-compatible wireless phone, customers with speech or hearing disabilities can stay in touch while on the go. TTY-compatible wireless phones have a 2.5mm port that accommodates the 2.5mm audio jack connector on the TTY device.
- **Hearing Aid Compatibility:** AT&T works closely with handset vendors to improve the user experience of customers who have hearing aids. Pursuant to FCC guidelines, handsets are tested and rated for Hearing Aid Compatibility (HAC). These HAC ratings, or “M-Ratings” and “T-Ratings,” help hearing aid users find the best phone for them.

Persons with disabilities are often early adopters of accessible technologies that migrate into crossover mainstream audiences. Those features and services that are developed to support customers with disabilities end up being useful to all customers. A vibrating phone helps persons with a hearing loss, but it also allows a user who can hear to avoid embarrassing interruptions during a business meeting. The talking Caller ID device is essential for users with vision loss, but it also comes in handy for a sighted person who doesn't want to leave the dinner table to check who is calling. User-selected ringtones are fun but can also be set to indicate specific callers and can help a person who does not want to take every call or wants to set a ringtone that is easier to hear because hearing loss may be more significant in certain frequencies.

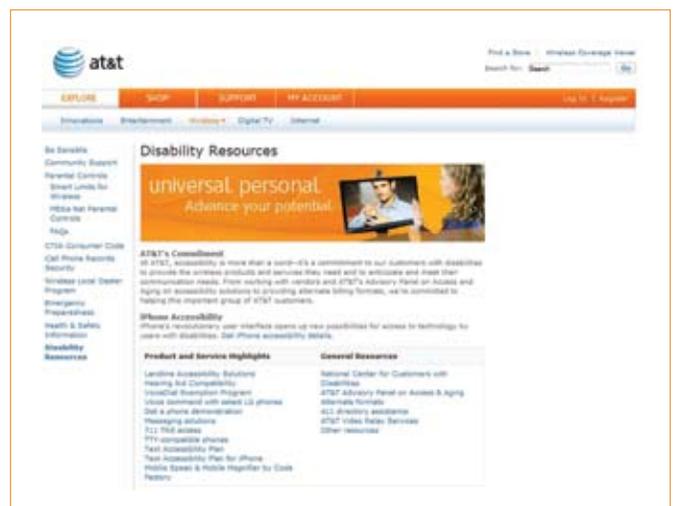
Making Customer Service Work for Persons with Disabilities and Aging Adults

Similar to product design, customer service for persons with disabilities and aging adults is organized along the principle of Universal Design, so that it may be available to the broadest possible range of consumers in the widest possible array of circumstances, including those when physical or sensory access is limited. Differences among customers, however, are not just due to disability or functional limitation; they may simply be a preference for how a customer wants to do business. If they have a question about their service, they can call for assistance. However, many customers would rather use a web site, conduct a chat session with a representative, or even visit one of AT&T's retail stores to have their question answered. This variety meets the preferences of a larger number of customers, but it also gives flexibility to a customer with a disability for how they choose to interact with the company.

Communications and Points of Sale

Communications with aging adults and persons living with disabilities include web sites, company-owned points of sale, and targeted advertising campaigns that explain the benefits of accessibility and assistive features for different types of customer situations.

The company developed a dedicated web site to help wireless customers with disabilities identify products and services that may better address accessibility needs. It includes comprehensive disability resources and information on products such as Mobile Speak & Mobile Magnifier, HAC devices, AT&T 411 Info, 711 TRS Access, Video Relay, TTY compatible telephones and TTY compatible devices, and Text Accessibility Plan (TAP). Customers have the option to call a voice or TTY number displayed on each web page to ask for more information.



The AT&T accessibility web page.

The company also uses targeted advertising campaigns emphasizing how accessibility features of its phones may benefit persons with disabilities or aging adults. In doing so, it uses efforts to enhance the usability of advertising messages for persons with disabilities. Since June 2007, for example, nearly all of its television commercials have been close captioned. The company runs ads in appropriate publications tailored to persons with disabilities such as “Diversity Careers in Engineering and Information Technology” or regional editions of the AARP magazine. It also uses StarLines, a state-specific insert which is sent with telephone bills to 11.4 million residential customers in nine southeastern states (including a Spanish version in Florida), dedicated to customers with disabilities and their families. The insert includes information on AT&T’s products and services for customers with disabilities. Other customers are reached via direct mail campaigns, requesting that they contact company representatives at the National Center for Customers with Disabilities (NCCD), a toll-free number if they, or someone they know, has a disability.

For its points of sale, the company has deployed Section 255 of the Telecommunications Act and Hearing Aid Compatibility (HAC) training for all its U.S. stores in order to ensure that sales personnel are well-versed in HAC programs and protocols as well as provided with basic information about the Americans with Disabilities Act (ADA). Every other month, the company conducts audits of all its retail stores to ensure that it meets the legislation’s requirements to serve aging adult customers and those with disabilities.

Customized Services for Persons with Disabilities

Beyond accessible and assistive solutions offered on handsets, customized services were created and marketed to customers with disabilities that meet their specific requirements:

- Video Relay Services (VRS) connect individuals with an interpreter who translates between American Sign Language (ASL) and spoken English. Users can download a free VRS videophone software, Video Link. Video Link is only available for persons who are deaf or living with a hearing loss www.att.com/vrs. An iPhone VRS application is also available in the iPhone App Store.



Video Relay Services (VRS) for deaf viewers on YouTube.

- Instant Message (IM) Relay www.att.com/relay is a text-based solution for individuals who are deaf or have a speech or hearing loss and that has been ported on many mobile devices. Customers can also use an Internet connection and an AOL Instant Messenger (AIM) account. To relay with one-step dialing, users send the phone number they are calling via instant message to a screen name “ATTRelay.” An AT&T Relay operator calls the phone number and translates the text to voice to the other party. There is no charge to use this service, but users must register. Aside from using IM relay on personal computers, IM relay is accessible on the many mobile platforms on which AOL is available such as iPhone, Android, iPad, Blackberry, and Windows Mobile. Customers can also get their own personal 10-digit phone number and people can call them via the IM Relay.
- AT&T 411 Info lets users dial 4-1-1 from their wireless phone for live directory information, send a text message with the listing and connect at no additional fee. AT&T 411 Info can also find a business near the user’s location. It also offers movie showtimes, turn-by-turn driving directions, reverse lookup and business category search, all with access to live operators 24/7.
- Text Accessibility Plans (TAPs) were developed for persons who are deaf or have a speech disability and/or hearing loss and who use almost exclusively text messages rather than voice calls. Those data plans were designed with input from users via focus groups. Rates are more favorable than those of voice plans with similar text usage, and voice calls are charged by the unit if needed.

The AT&T National Center for Customers with Disabilities

The National Center for Customers with Disabilities (NCCD) handles inquiries and requests relating to AT&T Mobility's products and services.

Based in Baton Rouge, LA, it includes customer care personnel who have received training on disability-related wireless products and services. In addition to training required for all customer service representatives and customer facing personnel, the NCCD staff members are trained to address the specific wireless product and service needs of aging adult customers and those with disabilities. The Center uses specialized channels (including TTY and e-mail) to help customers with disabilities who have accessibility and usability questions.

Customer service representatives are given specialized training on hearing aids, screen reader software, voice dialing, and TTY compatibility. They provide referrals for phone peripherals meeting customer needs. In addition, a list of customers using specialized programs such as Voice Dial, TAP Rate Plans and buyers of Mobile Speak & Mobile Magnifier software that have applied for a rebate is maintained, and representatives can arrange for alternate formats such as Braille or large print billing, as well as materials in alternate format when requested by the customer. Finally, for each product launch, a specific customer support knowledge base is made available to customer service representatives, product briefings are conducted, and sample phones are distributed.



Operator serving a customer via TTY.

One of the most impressive features of the NCCD is its ability to interface with the communication medium of choice of customers with disabilities. It may be a live text exchange, a mini-video relay call or a TTY call. All customer service representatives have been trained to handle any and all of those customer communication preferences. For Tier Two support requiring specific technical knowledge beyond the knowledge base used by AT&T's own customer service representatives, third parties are chosen who have both the required technical knowledge and the ability to interact with customers with disabilities in a similar fashion.

“AT&T has a long legacy of providing products and services designed to meet and exceed our customers' expectations and supporting the disability community. The goal of AT&T's care centers is to understand our customers' needs and preferences and help identify the best options available -- whether they have a disability or not.”



Point of Sale Accessibility.



Point of Sale Accessibility.

A Brief History

It was 1978 when AT&T opened its first call center dedicated to serving the disability and aging adult markets. The center served wireline customers in California through voice and TTY access.

Today, centers located in Oakland, CA, Lees Summit, MO, and Albany, GA, are dedicated to serving the disability and aging markets, in English and Spanish, across AT&T's entire wireline footprint.

Employees are trained to assist and advise customers with hearing, vision, mobility and/or speech disabilities about equipment, accessories, features and calling plans, as well as choices for TV and wireless products and services. They can also arrange for an alternate billing format, such as Braille or large print.

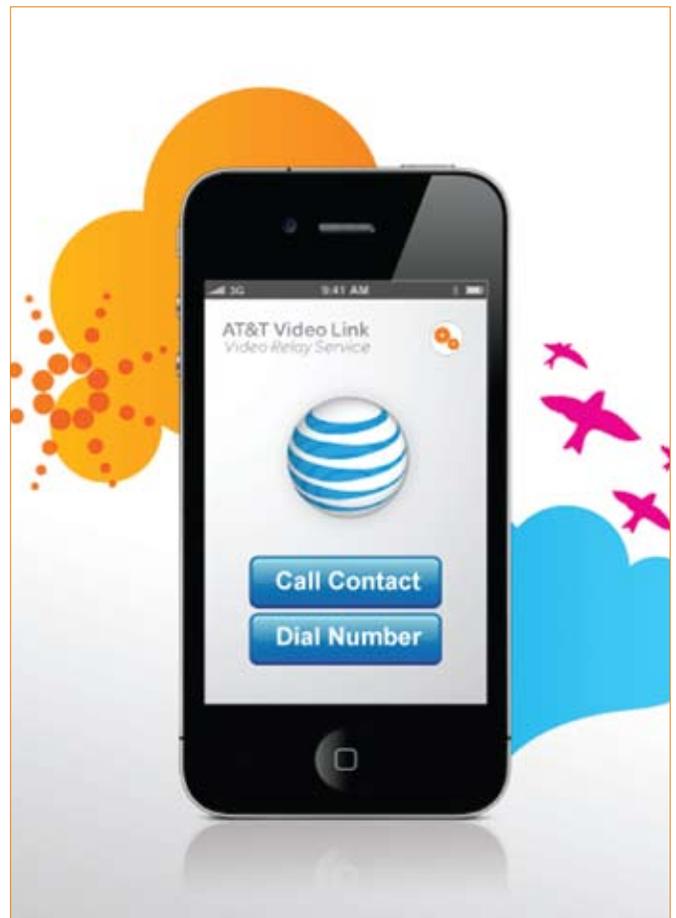
Serving Persons with Disabilities: Involving All Employees

Serving persons with disabilities and aging adults, however, cannot be accomplished successfully in isolation. In 2009, the company embarked on an ambitious program to train employees on disability awareness. With input from AAPAA members, it designed a training module delivered as an instructor-led course or self-paced e-learning program lasting approximately 45 minutes. The training module covers definitions of disabilities and demographics, Section 255 of the Telecommunications Act, how to interact and communicate with persons with disabilities (including practical etiquette guidelines and communications techniques) and understand the requirements that they may have in relation to mobile phones and wireless services. More than 160,000 AT&T employees have completed the training program. When asked if all those efforts, in addition to meeting the company's sustainability objectives did translate in some form of competitive edge, the answer among AT&T executives has been "absolutely."

Using Innovation for Accessibility: iPhone and Smart Phone Features for Persons with Disabilities

As technology evolves and third parties develop new hardware and software solutions, wireless service providers need to constantly assess how these may present challenges or opportunities for aging adults and customers with disabilities. AT&T does this through systematic advance briefings and exchanges with third parties providing handsets, middleware or applications, and by leveraging its own research and market surveys.

For example, the launch of smart phones has opened an entirely new chapter in the development of assistive solutions for persons with disabilities. Today, iPhone customers living with disabilities enjoy a vast array of breakthroughs in accessibility and usability www.apple.com/accessibility/iphone/vision.html. Some of the key features are standard on the iPhone, but many other are third-party applications that have proliferated since its launch.



AT&T Video Link app for iPhone 4 can be used to place video relay calls.

“When AT&T and Apple brought closed captioning to the iPhone, Universal Design met cutting-edge technology. Deaf and hard-of-hearing persons celebrated, and everyone who appreciates captioning benefited from this remarkable achievement.”

Larry Goldberg, Director, Carl and Ruth Shapiro Family National Center for Accessible Media at WGBH (NCAM)



AT&T Video Link user interface.

VoiceOver, which was originally a screen reader for the Mac, has been adapted by Apple for iPhone 3GS and comes standard on the iPhone 4. It allows users to operate the phone even if they cannot see the screen. VoiceOver reads aloud a description of each item touched by the finger of the user. It also reads aloud all critical indicators on the phone such as connectivity choices, battery level, signal level, screen orientation and whether the screen is locked or unlocked. As is the case for the Mac version, VoiceOver lets the user choose the speaking rate. It offers an innovative capability, the “Rotor.” Turning the rotor — by rotating two fingers on the screen as if you were turning an actual dial — changes the way VoiceOver moves through a document based on a setting you choose. VoiceOver also offers a Bluetooth-enabled Braille interface, which can be used both for output and input devices. Voice recognition can be activated by pressing and holding the home button to choose and play music or make a phone call.

Perhaps most intriguing and promising is the array of new applications that have been launched for persons with disabilities by third-party developers. For users with a hearing loss for example, TuneWiki enables the iPhone to display closed and open captioning similar to a TV set, a real breakthrough in accessibility for mobile platforms. Other programs offer additional resources, such as the iSign application to assist in learning American Sign Language or “A Special Phone,” an application allowing dialing a number by simply shaking the phone. For children with autism or developmental delays, several innovative applications have emerged demonstrating that the iPhone intuitive graphical user interface and ability to let the user manipulate pictures can boost non-verbal communications to a much higher level than traditional paper based methods.

The future looks bright for new types of communications for deaf and non-verbal users who converse in sign language.

Conclusion

This review of AT&T's internal processes to address the market of persons with disabilities and aging adults provided G3ict with important insights on four key success factors that may be replicated in a number of industries or services:

- First, AT&T leadership sees the benefits of the link between innovation and opportunity as it applies to the communication needs of people with disabilities and aging adults.
- Second, it was clear during our data collection and interviews that the culture of inclusiveness and commitment to sustainability were the foundation of its achievements; it permeates all areas of the company, allows accessibility advocates to have their voice heard in product development, marketing and services and facilitates the involvement of persons with disabilities at all levels of the decision making process. AT&T's training investment on disability awareness is considerable, enhancing its entire workforce effectiveness in interacting with customers and colleagues with disabilities and aging adults.
- Third, the incorporation of accessibility criteria at an early stage of development of all products and services has become an integral part of the company's way of doing things. It is not a process forced on the product development teams but a philosophy that permeates their product development methodology and that of their suppliers. In that regard, the company's Universal Design public guidelines for suppliers constitute an innovative step rarely seen in any industry.
- Fourth, the systematic research conducted on human factors and on the needs of persons with disabilities and aging adults with a good understanding of market demographics via customer research or direct input from various advisory councils enables the company to develop integrated, sustainable and consistent strategies. Those include all stages of a product life cycle from product design to marketing, communications, points of sale and customer services. Such an integrated strategy is essential to reach out to new customers, managing sales and offering dedicated customer services trained to handle the specific needs of persons with disabilities and aging adults.

As for the future of accessible and assistive mobile products and services, this review of AT&T's accessibility strategies points to a sea change in how new technology and solutions will evolve. Most remarkable, in our opinion, is the fact that the best solutions are increasingly the result of cooperation involving multiple players: hardware manufacturers, operating system vendors, application developers, service providers, experts with disabilities. The emergence of smart phones with unifying trends such as the use of HTML 5 among developers opens an unprecedented opportunity for the creation of specific applications addressing the many specialized needs and preferences of persons with disabilities and aging adults.



AT&T's Elizabeth Dixon (Human Resources) sharing her experience in promoting inclusion among the AT&T work force at the U.S. Department of Labor/ODEP Listening Tour in Boston, March 2010.

Ultimately, however, technology solutions for persons with disabilities and aging adults will always require dedicated and appropriate customer support and services. With hundreds of new applications appearing on platforms such as the iPhone, Android and other major operating systems, the next challenge will be for service providers to develop new processes and business models that are sustainable and work for customers in this complex environment. Companies such as AT&T, which have adopted Universal Design principles, rely on the ongoing input of persons with disabilities and aging adults, and invest heavily in nurturing a culture of inclusion among their workforce, will be well-positioned to successfully tackle these challenges for generations to come.

G3ict

Global Initiative for Inclusive Information
and Communication Technologies

www.g3ict.org

1110 W. Peachtree Street, NW
Atlanta, GA 30309-3609 – U.S.A.