Smart Cities for All:

A Vision for an Inclusive, Accessible Urban Future

BSR®

A Note from AT&T

At AT&T, we continuously look for ways we can use the power of our network to build a better tomorrow. It's part of our credo, Connect to Good. One way we bring that to life is through our smart cities solutions — powerful innovations in the Internet of Things (IoT) that will help transform our cities and enhance our lives as citizens.

We are committed to bringing smart city benefits to all citizens — including those who are aging and living with disabilities. From next-generation 9-1-1 systems and smart energy grids to digital information kiosks and intelligent lighting, we're linking people and city infrastructure to reduce energy use, enhance environmental resilience, and improve quality of life — all while making cities safer and more efficient.

Our commitment to make our products and our company better for people who are aging and people living with disabilities is a long standing one. We have a Corporate Accessibility Technology Office (CATO) that leads our efforts to make products and services accessible to persons with disabilities. We also regularly convene an Advisory Panel on Access & Aging (APAA) comprised of national leaders in assistive technology, aging and cross-disability issues. AT&T is also a dedicated supporter of the Global Initiative for Inclusive ICTs (G3ICT), an advocacy initiative launched in December 2006 through the United Nations.

These efforts have demonstrated the importance of listening, learning and collaboration to fulfill the promise of new technology that puts all people first. The private and public sectors must work together to champion, design, fund and sustain smart infrastructure and municipal services. We must collaborate with civil society organizations and community groups from the very beginning to empower citizens and communities without compromising values such as accessibility and privacy. We must incubate social entrepreneurs to develop next-generation civic technology devices, applications, and services that are of, by and for their communities. This collaboration will help us construct smart cities with improved utilities, infrastructure, transportation, public safety and citizen engagement that are accessible to all.

We are proud of our work to-date, and we also know we have a lot of work left to do. AT&T is looking forward to learning from and engaging with a broad coalition to build smart city technologies that benefit and empower people who are aging, people living with disabilities, and the greater city population. We hope this paper will enrich and expand the conversation on smart cities, and highlight the opportunities that our company and our communities can seize to help everyone *Connect to Good*.

Chris Penrose
President
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A Note from BSR

BSR believes that it is vital for business to collaborate with the public sector and civil society to create a just and sustainable economy in a fast-changing world. As governments embark on a new era of urban development and infrastructure upgrades, we encourage businesses, the public sector, and civil society to seize the moment in creating smart cities that leverage technological advancements to create environmental, social, and economic benefits for all.

We see inclusive smart cities as an important opportunity to advance three particular aspects of a just and sustainable world. Smart cities making investments in new infrastructure should focus on models that create economic benefits for all, with a particular focus on communities most in need of economic opportunity. Smart cities also can advance essential rights, including decent work opportunities, an adequate standard of living, and opportunities to participate in cultural life. In addition, 21st century urban development should be designed with a view to reducing harmful climate emissions, and building resilience into the built environment, transportation systems, and communities, to enable cities to remain vibrant amidst shifting weather patterns.

Cities can be the foundation of truly sustainable economic growth. Cities account for more than half of the world's population, 70% of global greenhouse gas emissions, and 80% of global GDP. Creating inclusive smart cities will therefore be an essential element of the global effort to achieve the Sustainable Development Goals. A coordinated effort to build low carbon, resilient cities will also help us achieve the ambitions of the Paris Climate Agreement. With new smart technologies capable of unlocking energy efficiency in housing and transport, smart cities can be instrumental to keeping global temperature rise this century well below the Paris Agreement's 2°C threshold.

BSR is proud to partner with AT&T to highlight smart city technologies that advance environmental, social, and economic benefits for all. This white paper, *Smart Cities for All: A Vision for an Inclusive, Accessible Urban Future*, identifies ways that smart city technologies can adopt a people-first approach to benefit people who are aging and people living with disabilities. We hope this paper highlights that potential and illuminates a path toward achieving it. We look forward to working with AT&T, other corporations, and a range of other stakeholders on the journey ahead.

Aron Cramer
President and Chief Executive Officer
BSR

About this Report

This report was written by David Korngold, Martin Lemos and Michael Rohwer of BSR, with funding and input from AT&T.

The purpose of this paper is to highlight the potential for smart city technology to enable benefits for people who are aging and people who are living with disabilities, and to indicate suggested practices for building more inclusive smart cities. The report focuses on North America, though it includes global examples and technologies.

The examples of applications in this paper are drawn from AT&T technologies as well as products, services and research from other companies and organizations. The applications included are not meant to be exhaustive or universal; rather, they represent a selection of current smart city technologies that are advancing benefits for the aging and persons with disabilities.

The findings of the paper are based on:

- A review of public research, including academic, corporate and non-governmental organization sources
- Interviews and engagement with select AT&T team members involved in fields such as smart cities, health, citizenship and sustainability, and accessibility
- Direct engagement with stakeholders and experts through the AT&T Advisory Panel on Access and Aging, including an in-person workshop and follow-up engagement

About AT&T

AT&T Inc. (NYSE: T) helps millions around the globe connect with leading entertainment, business, mobile and high speed internet services. We offer the nation's best data network and the best global coverage of any U.S. wireless provider. We're one of the world's largest providers of pay TV. We have TV customers in the U.S. and 11 Latin American countries. Nearly 3.5 million companies, from small to large businesses around the globe, turn to AT&T for our highly secure smart solutions.

About BSR

BSR is a global nonprofit organization that works with its network of more than 250 member companies and other partners to build a just and sustainable world. From its offices in Asia, Europe, and North America, BSR develops sustainable business strategies and solutions through consulting, research, and cross-sector collaboration. **Learn more** about BSR's 25 years of leadership in sustainability.

BSR publishes occasional papers as a contribution to the understanding of the role of business in society and the trends related to corporate social responsibility and responsible business practices. It sometimes does so with partnership and financial support from particular BSR members. BSR maintains a policy of not acting as a representative of its membership, nor does it endorse specific policies, standards, products and services, or corporations. The views expressed in this publication do not reflect those of BSR members.

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Introduction

Smart cities aspire to use technology to put people first. In an era of connected technologies, our cities have the potential to be built to respond to our needs and smooth the path as we lead our lives. This smoother path will help all citizens, especially those across a range of ages and physical or cognitive abilities. Imagine a city where a person in a wheelchair or pushing a stroller can chart a route to the local park using curb cuts and avoiding barriers. There she will wirelessly log onto the park itself and receive notifications of upcoming park events, and perhaps even participate in an interactive lesson on the trees and flowers currently in bloom. Imagine a city where refrigerators will provide alerts of any diminishing essentials so that caregivers can adjust their grocery list before they visit their parents' home. Smart cities offer a new vision for daily living where the world around us is conducive to making life easier, and lets us focus on the personal connections that make city life vibrant and full of purpose.

The global smart city market is expected to grow to $1.565 trillion by 2020[1], and this growing economic opportunity inherently involves the opportunity to engage, inform and improve the lives of citizens. For the 25% of people in U.S. cities who are aging or living with disabilities, these technologies must be built to deliver on better access and fuller participation in the life of their cities[2]. New interconnected solutions will enable improved mobility solutions, increased opportunity for aging-in-place, and other technologies that will support independent living and transform cities into more enabling environments. The ecosystem of impacts goes beyond any one community: this new connectivity will support millions of families and caretakers, and provide a platform for citizen entrepreneurs to craft unique civil tech solutions.

Smart city technologies make cities more manageable and more personal by deploying sensing and monitoring capabilities along with adopting data-driven approaches. They take the pocket-sized solutions that help us manage our homes from our phones and apply them at the city-scale to provide officials with detailed dashboards to understand their communities block by city block. They allow citizens to seamlessly integrate their daily lives with the urban space by connecting our personal devices with city services upon which we rely. Whether alerting emergency services when our smartwatches detect a fall, or using real-time data to manage traffic flows to keep citizens crossing the street safe in a busy city corridor, smart city technologies bring an unprecedented level of connectivity to city living.

From civic kiosks that incorporate Universal Design to the latest cloud-based accessibility features and health-tech innovations, AT&T seeks to advance an inclusive vision for information and communications technology

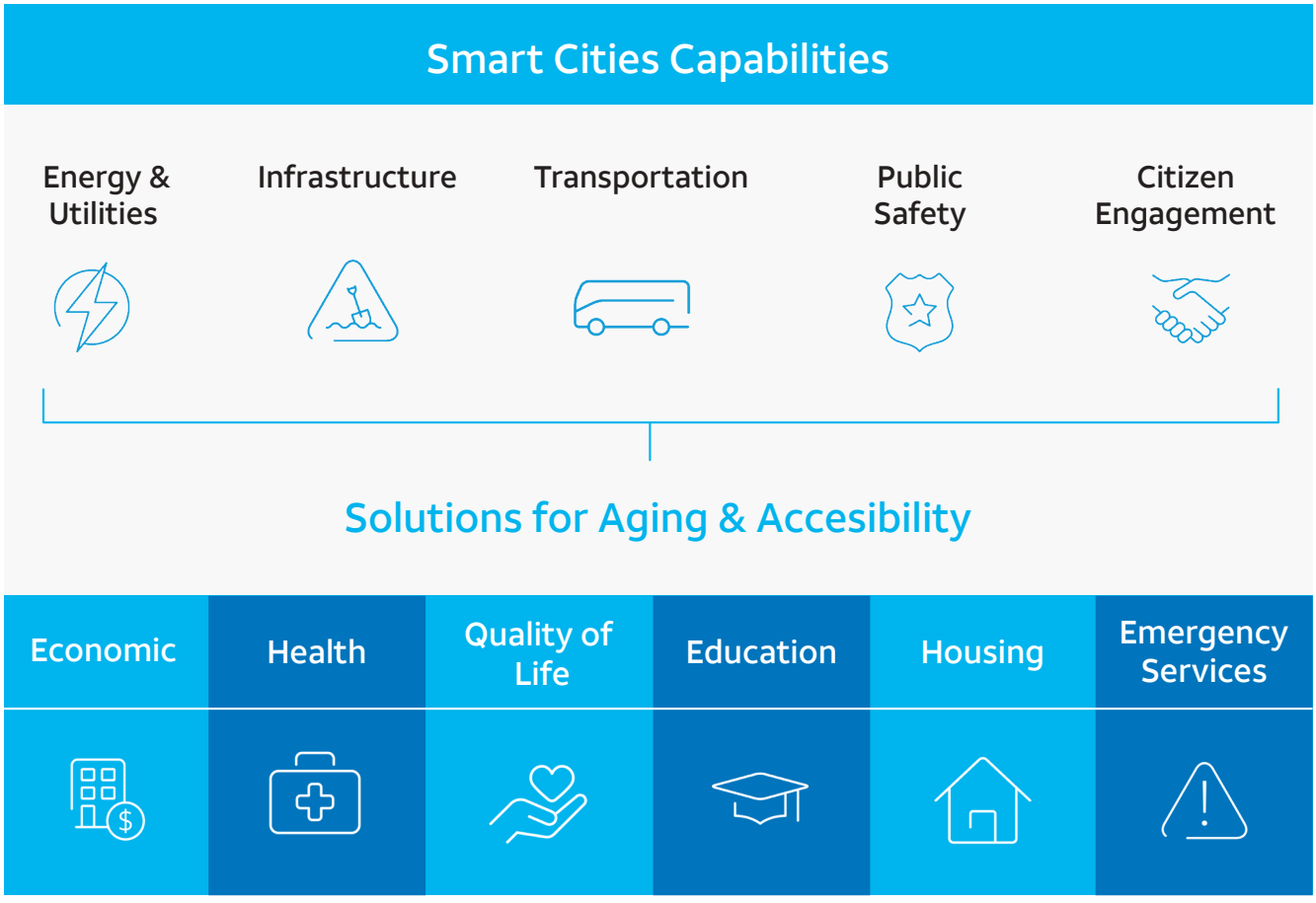
1 http://www.egr.msu.edu/~aesc310-web/resources/SmartCities/Smart%20City%20Market%20Report%202.pdf
2 BSR Calculation based on: U.S. Census Bureau, 2014 American Community Survey: 1-Year Estimates of Metropolitan areas in the U.S. Accessed via: https://www.census.gov/

(ICT) to integrate aging and accessibility considerations from the ground up. AT&T is developing new solutions to benefit people who are aging and people living with disabilities, and helping to create the conditions for a new wave of citizen-driven innovation. As these innovations proliferate and smart city technologies become more widely available, there is a clear and urgent imperative to ensure smart cities do not perpetuate digital divides that have historically prevented community access to new advances. AT&T is committed to creating smart cities where the benefits of these technologies are equally distributed and empower all communities.

This paper, *Smart Cities for All: A Vision for an Inclusive, Accessible Urban Future*, is the result of AT&T exploring the revolution of smart city technology and its enormous potential to have a positive impact on people with disabilities and the aging. AT&T convened BSR and the AT&T Advisory Panel on Access & Aging (AAPAA) to conduct research and gather insights from the diverse panel of external experts in October 2016. The paper maps the opportunities for smart city technologies to benefit all communities, as well as the keys to success to ensure these technologies advance more equitable and positive outcomes for people who are aging and people living with disabilities.

Executive Summary

Figure 1: A Framework for Smart City Solutions for Aging & Accessibility. The identified "smart city capabilities" reflect AT&T's categories of smart city products and services



- In the 100 largest metropolitan areas of the United States, nearly 25% of citizens are currently over the age of 65 or living with disabilities. By 2050, however, the population older than 65 is projected to more than double[3]. Though not defined by their challenges, these individuals may have physical or cognitive conditions that limit or prevent them from conducting major life activities such as walking, talking, hearing, seeing, learning, performing manual tasks or caring for oneself.
- Smart city technology should be defined not just as a means to improve existing infrastructure but also as an unprecedented opportunity to improve the lives of all citizens. For aging communities and those living with disabilities, these technologies present the prospect of an empowering and more human city that provides a host of economic, health and wellness, quality of life, housing, educational, civic engagement and emergency services benefits. In doing so, smart cities also enhance the resilience of cities and communities. While case-studies are still emerging for these technologies, in many instances AT&T and others have developed viable and tested solutions that provide inclusive and accessible city services.
- Just as curb cuts have proven beneficial to more than just wheelchair users, creating livable cities for people who are aging and people living with disabilities will benefit a majority of city residents. There's an equally sizeable population — nearly 17% of Americans — who annually serve as unpaid caregivers in the U.S.[4] In addition, the fastest growing workforce in the U.S. is that of healthcare professionals serving the needs of these individuals and their families. Furthermore, measures to make technology more inclusive often have broad effects on usability and quality that accrue to all users. Improving the quality of life for people who are aging and people living with disabilities will have a significant benefit across all demographics.
- Cities should enhance livability for citizens as a matter of civic responsibility and compliance. Livability also provides economic opportunities for cities to attract and empower Americans over the age of 50, one of the largest growing and financially empowered segments in the U.S. population.
- Smart city technologies offer the opportunity for systems solutions to updating infrastructure and revitalizing city services. These technologies enable city officials to take a strategic approach to sustainability, cost reduction, citizen wellbeing, and economic development through innovations that span across multiple sectors.

Smart city technologies will fundamentally alter city infrastructure and the ways city services are deployed. As these technologies are only now being tested and implemented, city officials will now have a critical opportunity to ensure the considerations of aging communities and communities living with disabilities are respected from the outset. City officials and their partners should use the following keys to success to ensure that smart cities are inclusive:

Design for Inclusion: To quote the guiding principles of a recent framework for state governments: "Disability is a natural part of the human experience that in no way diminishes one's right to fully participate in all aspects of community life[5]." Universal Design and protections against privacy abuses should be front and center as cities consider deploying these technologies. Universal Design criteria will ensure technologies are usable by all citizens. Additionally, there are opportunities for cities to embed smart city solutions that will leapfrog

3 http://www.aarp.org/content/dam/aarp/livable-communities/documents-2017/USCM-AARP-Aging-Report-1-17-17.pdf
4 http://www.aarp.org/content/dam/aarp/ppi/2015/caregiving-in-the-united-states-2015-report-revised.pdf
5 http://www.csg.org/NTPWD/documents/SEED_Report_2016.pdf.

barriers to adoption. Enhanced digital security and privacy protections will be a fundamental requirement as these new technologies will play a vital role in the lives of citizens – and may be directly responsible for the health and wellbeing of the most vulnerable communities. With proper planning, system designs for smart city infrastructure can ideally detect security concerns and have alerting and remediation capabilities for the broader public.

Engage Partners and Stakeholders: Smart city technologies must adopt a multi-stakeholder engagement process to ensure sustainable financing of these innovations and citizens' full participation in any projects. Partnerships with the private-sector will help co-create cost-effective and viable solutions that leverage companies' expertise in designing for inclusivity. Engaging aging communities and those living with disabilities in the planning of smart cities is critical to ensuring these solutions align with citizen needs and expectations.

Promote Adoption of Technology: City officials must work to bridge the digital divide that often prevents people who are aging or living with disabilities to access the full benefits of technology. Officials must work to empower these communities to participate in smart cities by increasing access both to broadband connectivity and connected devices, as well as the necessary technology education to fully utilize these benefits. Without addressing these issues, cities risk perpetuating disparities that keep these communities from accessing smart technologies.

Foster the Entrepreneur Ecosystem: Many of the applications and solutions that will benefit these communities will arise from social entrepreneurs and innovators of all ages. Beyond enhancing the accessibility of city infrastructure and services, a key role for city government is to enable this social innovation to flourish and direct entrepreneurship to benefit these communities. Publicly funded incubators and open data portals are some of the many ways city governments can foster citizen solutions.

Inclusive Smart Cities Built on Connectivity

> **Smart cities are human-centered cities. Sensors, networks, data analytics and visualizations, and so on are cutting-edge, 21st century tools. But those tools must serve us, not the other way around. Smart cities technology enables citizens and civil servants alike to achieve the goal of making a city that truly serves the needs and reflects the values of the entire community."**
>
> Aaron Bangor, *AT&T Lead Accessible Technology Architect*

By providing the connectivity that enables big data analytics and other applications, smart cities empower a network of citizen innovation and public solutions. While smart city technologies are often presented as large-scale efforts that connect an entire transportation or energy grid, they can also enable community and individual solutions. Innovators will have access to a world of data and tools to develop the innovations that

communities need. At the same time, businesses and city officials will use this same technology to make cities more efficient than ever. These twin promises of smart cities — to enable citizen solutions and make city services more efficient and effective — comprise the promise of these technologies.

But what makes a smart city smart? Essentially, smart cities deploy Internet of Things (IoT) solutions to large-scale problems. Simply put, IoT solutions connect devices and technologies that were never connected before, and enable communication between them to enable benefits for users. AT&T has created a framework to help cities better serve their citizens.

Introduced in January 2016, the framework, which is initially rolling out in select spotlight cities and universities, is based on four pillars—highly secure connectivity including Wi-Fi and 4G LTE, strategic alliances comprised of key technology leaders and industry organizations, AT&T's vast array of technology platforms and vertically integrated solutions such as public safety, transportation, aging infrastructure and more. Using this framework as a guide, we are able to help cities develop and deploy solutions that will address critical issues facing their communities and citizens.

The framework reflects how AT&T is using IoT innovations to create impactful solutions for cities and forming alliances with technology leaders and industry organizations. Within the home, an IoT solution may be a connected thermometer that can now be controlled remotely. At the city-scale these solutions can look like an infrastructure sensor that connects with a city control panel to detect snowed-over streets that need plowing. The benefits of increased connectivity and communication are clear: cities will be able to integrate technologies with a strategic approach to sustainability, cost reduction, citizen wellbeing and economic development.

Smart cities make connections among personal devices (like smartphones and thermostats) and city networks and assets (like power grids and snow plows), providing opportunities for citizens to seamlessly navigate the economic and social life of their cities. Sometimes these technologies are highly visible in everyday life (like bus countdown timers); other times they operate in the background to improve city functions (like smart bus routing systems). Ultimately, the connectivity afforded by smart city technologies enables a dynamic network of solutions that function between sectors and scales to provide both a granular and high-level look at community conditions.

Through increased connectivity, real-time monitoring of utilities and public services, and machine-to-machine communication, cities can now address system-wide issues with system-wide solutions. The benefits of smart city technologies comes from a network effect — linking millions of sensors, connected devices and data points, and turning a set of undetected, atomized data points into a coherent digital whole.

Smart cities are more than specific products or improved municipal services — the technologies contained within them facilitate a new and more beneficial interaction between citizens and their environment. Smart city technologies enable new increased citizen involvement and provide a suite of benefits available to all. These technologies will play a vital role in the development of sustainable cities by helping manage energy resources, conserve water, and unlock efficiencies that will reduce the environmental footprint and increase the resilience of our cities. These technologies will also help meet the social dimensions of sustainable development by pushing for more inclusive and equitable cities. As the global community looks to achieve the Sustainable Development Goals (SDGs), smart city technologies will help progress a broad range of targets. In particular, smart cities will advance the SDG 11 on Sustainable Cities and Communities and SDG 9 on Industry, Innovation, and Infrastructure, as well as a host of other SDG impact areas.

As smart city technologies begin to take hold, there's an opportunity for AT&T and others to work toward making smart city technologies synonymous with inclusive innovation and the empowerment of all citizens. Smart cities must provide benefits that are inclusive of its entire population and enable the inclusive participation of all its citizens to ensure the benefits of technology are equally distributed. The promise of smart cities is founded on the inter-connectivity of all aspects of the city and the potential for technologies that offer solutions for entire systems rather than isolated municipal services or city populations.

Smart city technologies should help empower all people to do what they want to do in a familiar and conducive environment[6]. Instead of resolving to patch inequities in later versions, AT&T and others will commit to ensuring that these technologies provide these benefits from the moment they are launched. This will require AT&T and others to adopt a stakeholder-informed design process that helps test and develop new technologies. There is no better opportunity to demonstrate the transformational nature of these technologies than by designing smart cities to meet the needs of citizens who are aging and people living with disabilities.

A Focus on People: Why Aging and Accessibility?

Cities are networks of individuals — and people who are aging and living with disabilities are integral to these networks, along with their families, neighbors and caregivers. Today more than 46 million Americans are over the age of 65 and 57 million Americans live with disabilities[7]. In the largest 100 metropolitan areas in the U.S. **nearly 50M or 25% of residents are currently over the age of 65 or living with disabilities.** With the size of the aging community expected to double by 2060, there is an imperative social responsibility to all citizens to make future cities more accommodating and supportive of these communities[8].

Nearly 17% of Americans have provided unpaid care for their parents in the past year — spending an average of **25 hours a week caring for loved ones.** With an average age of 49 and mostly residing in urban or suburban U.S., a new "middle generation" of caregivers simultaneously balances caring for parents with raising children[9]. Improving the quality of life and technology opportunities for people who are aging and people living with disabilities is essential to supporting another strong contingent of the American population.

Healthcare professionals are projected to be the fastest growing workforce in the U.S. and should be considered another valuable constituency of smart cities. In particular, the health occupation is projected to grow the most in the next 10 years. By 2024, over two million Americans will find work supporting families as personal care aides, registered nurses, home health aides and nursing assistants[10]. Traditionally these roles are performed by a diverse group of workers: **89% of home care workers are women, and nearly half are African-American or Latino.** As this workforce grows in the coming years, millions of young workers from all demographics will join a vital profession that supports people who are aging and people living with disabilities.

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6 Louis Coetzee and Guillaume Olivrin (2012). Inclusion Through the Internet of Things, Assistive Technologies, Dr. Fernando Auat Cheein (Ed.), ISBN: 978-953-51-0348-6, InTech, Available from: http://www.intechopen.com/books/assistive-technologies/inclusion-through-the-internet-of-things

7 U.S. Census Bureau, 2014 American Community Survey: 1-Year Estimates of Metropolitan areas in the U.S. Accessed via: https://www.census.gov/

8 "Aging Statistics." Aoa.acl.gov. n.d. Web. 10 Nov. 2016. Accessed via: http://www.aoa.acl.gov/aging_statistics/index.aspx

9 http://www.aarp.org/content/dam/aarp/ppi/2015/caregiving-in-the-united-states-2015-report-revised.pdf

10 http://www.chwsny.org/wp-content/uploads/2016/04/BLS-Health-Care-Employment-Projections_2016.pdf

Cities also have a powerful economic interest in keeping these communities in their cities. Cities that appeal to these communities will reap significant economic benefits: according to a Nielsen study, in 2017 the U.S. population **over the age of 50 will control a full 70% of disposable income**[11]. Cities are facing increased pressure to entice these communities to stay past retirement by demonstrating infrastructure and city services attuned to the needs and demands of these residents. The AARP's "Livability Index" and Milken Institute's "Best Cities for Successful Aging" annual reports are just two prominent examples of the public scrutiny cities should expect to face as Americans decide where to retire.

The Challenges of Aging and Accessibility

Smart city technologies offer an opportunity to make cities more hospitable by enabling new opportunities for all communities. These opportunities will be needlessly limited if they do not integrate with assistive technologies — for example, the screen readers, hearing aids, braille displays and technologies used by people with challenges.

For people who are aging and people living with disabilities, smart city technologies will assist individuals to overcome daily obstacles and address the systematic inequalities that can sometimes challenge quality of life. These challenges can be very significant:

Economic: **Almost half of the American population over the age of 65** is classified as "**economically vulnerable**" and our population living with disabilities faces systemic challenges that have led to disproportionate unemployment rates. With **one-third of Americans entering retirement with no savings**, the challenges of making ends meet will only become more pronounced[12].

Health: **Nearly 80% of older adults have a chronic disease like Alzheimer's and 68% have more than one**[13]. Though public benefits ameliorate the cost of health for these communities the personal and family expenditure on health is significant. **Nearly 15% of older Americans' spending is health related**[14] and researchers have calculated the direct and indirect costs to families of children living with disabilities to an **annual average of $30,500**[15].

Quality of Life: American life can be isolating to some people who are aging or living with disabilities. The AARP Foundation reports that loneliness has the health equivalent of smoking 15 cigarettes per day[16]. Obstructed access to community events, limited accessible transportation options, and limited social interaction are barriers to quality of life that have proven negative impacts on individuals' health and sense of wellbeing.

Housing: Aging communities and communities living with disabilities are significantly concerned with housing accessibility and affordability, as well as the opportunity to live independently. Some of these concerns stem from limited resources to maintain independence, while other concerns arise from difficulties of accessing housing environments that support independent living, including aging-in-place. For communities living with disabilities the ability to access housing is a significant challenge — currently **more than 40% of people who are homeless are living with disabilities**[17]

11 https://www.bloomberg.com/news/articles/2013-09-17/aging-boomers-befuddle-marketers-eying-15-trillion-prize
12 http://time.com/money/4258451/retirement-savings-survey/
13 https://www.ncoa.org/healthy-aging/chronic-disease/
14 http://www.aoa.acl.gov/aging_statistics/Profile/2015/14.aspx
15 https://www.ncbi.nlm.nih.gov/pubmed/22550686
16 https://stayingsharp.aarp.org/art/connect/15/loneliness-dementia.html
17 http://www.nhchc.org/wp-content/uploads/2011/09/disability2011_-final.pdf

Emergency Services: Hurricane Katrina serves as a somber reminder of the unequal risk borne by people who are aging and living with disabilities in times of disaster. While next-generation 911 services are beginning to incorporate assistive technologies to serve these populations, adoption has been slow, and more can be done to ensure city emergency services and systems account for these communities.

These challenges do not solely affect aging communities and communities living with disabilities. These are shared societal challenges that impact nearly all segments of city populations. Moreover, these challenges can interact and amplify — transportation impacts quality of life, quality of life impacts health, and so forth. The promise of smart cities lies precisely in how these technology solutions function across sectors and municipal services to provide system-wide improvements through connectivity. These technologies serve to create smart and enabling environments where people will find themselves empowered in an environment that is familiar and more conducive to tasks they want to execute[18].

The Inclusive Smart Cities Framework

> **In our work at the Shepherd Center we constantly push the limits of technology to help our patients return to their community, school, work and recreation. Their goals. A well-developed Smart City will greatly enhance not only what is possible but also improve existing capabilities for each individual. It will improve people's lives."**
>
> John Anschutz, *Manager-Assistive Technology Center, Shepherd Center*

Stakeholders must collaborate to realize this inclusive vision for smart cities. Through insights informed by AT&T's Advisory Panel on Access & Aging (APAA), BSR and AT&T have identified opportunities for smart city technologies to positively impact aging communities and communities living with disabilities. Instead of classifying technologies according to the municipal departments or functions, this paper re-frames the capabilities of smart cities according to the benefits they provide to main dimensions of city life: economic, health, quality of life, educational, housing and emergency services. Across all of these factors, smart cities also enhance the resilience of individuals, communities and cities, in responding to and recovering from acute challenges such as storms, public health crises and financial downturns.

18 Louis Coetzee and Guillaume Olivrin (2012). Inclusion Through the Internet of Things, Assistive Technologies, Dr. Fernando Auat Cheein (Ed.), ISBN: 978-953-51-0348-6, InTech, Available from: http://www.intechopen.com/books/assistive-technologies/inclusion-through-the-internet-of-things

Economic

> **It is critical that the plans for the workforce in ten to thirty years from now are being supported by the instruction and curriculum from the secondary and post-secondary educational system. Those who are older or have a disability are often not the issue themselves, they are simply not adequately trained for jobs they seek to apply for."**
>
> Claude Stout, *Telecommunications for the Deaf & Hard of Hearing (TDI)*

The Challenge: Currently 48% of the aging population is classified as "economically vulnerable" with incomes that are less than twice the poverty threshold[19]. Likewise, nearly 35% of working-age people with disabilities are below the poverty rate and face unemployment rates twice that of the general population[20]. These impacts are devastating for communities that often facing additional significant costs that may not be covered by health or government benefits. Expenses such as home modifications, personal care, and assistive and adaptive technologies can significantly increase the cost of living for already economically vulnerable communities. In one study on European individuals, depending on the severity of disability, the additional cost of living for these communities compared to those without disabilities range from 14% to 78% for a single adult to almost 136% for couples both living with disabilities[21]. As an additional affront, U.S. aging communities are targets of financial exploitation at annual cost of over $37B[22].

The Opportunity: Smart city technologies present an opportunity to expand the economic empowerment and wellbeing of aging communities and communities living with disabilities. Smart Cities can support these communities by providing digital and integrated payment services that simplify financial transactions while also enhancing financial management. These technologies can also enable fuller and safer participation in the economic life of cities by providing these communities with new employment opportunities, as well as access to new digital portals for city benefits. These opportunities may serve to improve the welfare of these individuals while also counteracting some of the economic disadvantages that burden these communities.

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19 Elise Gould and David Cooper, "Financial Security of Elderly Americans at Risk: Proposed Changes to Social Security and Medicare Could Make a Majority of Seniors 'Economically Vulnerable,'" Economic Policy Institute Briefing Paper, June 6, 2013.
http://www.epi.org/files/2013/EPI-economic-security-elderly-americans-risk.pdf.

20 Rebecca Vallas, Shawn Fremstad, and Lisa Ekman. "A Fair Shot for Workers with Disabilities – Center for American Progress." Americanprogress.org. 28 Jan. 2015. Web. 17 Nov. 2016. https://www.americanprogress.org/issues/poverty/reports/2015/01/28/105520/a-fair-shot-for-workers-with-disabilities/

21 http://depts.washington.edu/selfsuff/docs/NewJersey2011Disability.pdf

22 True Link Report on Elder Financial Abuse 2015

Example — Seamless Financial Payment Services: Smart city technologies allow for cities to integrate public services with social benefits. This integration allows for an interconnected payment system that increases convenience for citizens and allow for greater financial inclusion by making it easier for people with visual and other physical challenges to navigate cities and their services.

Transport of London's Oyster Card exemplifies the benefits of the cross-cutting capabilities of smart city technology. By connecting London's multiple transport options, Transport for London — which manages this transport network — was able to launch a pre-loaded contactless smart card as its ticketless payment system. In addition to cutting costs for the transport agency, the contactless payment system — supported by MasterCard technology — reduces the transaction time for riders and simplifies the experience by eliminating the need for special registration at each link in the transportation chain. In surveys of riders across demographic groups the transport agency found the benefits of the card reaffirmed, "it saves time, saves money, is easy to use and eliminates the need to repeatedly load money onto another card." Seamless and secured by offline data authentication, a similar system in U.S. cities can smooth the transportation frictions often encountered by aging communities and people living with disabilities — such as obstacles of interfacing with point-of-sale touch screens — by reducing or eliminating the challenges with repeated transactions.

Example — Integrated City Benefits: Overlaying payment services over city services newly integrated by smart technologies also allows for greater efficiency and security of benefits payments. With nearly nine-out-of-ten individuals aged 65 and older receiving Social Security benefits, there is an opportunity for cities to better integrate these and other benefits with other city services and thereby eliminate the need for financial transfers that may make these communities liable to fraud[23].

Example — Increase Access to Employment Opportunities: Communities living with disabilities face significant barriers to employment; the unemployment rate for those individuals currently in the job-market is twice the national average, while the labor participation rate is three times higher for individuals without a disability[24]. While smart city technologies offer increased connectivity to allow for greater telecommuting opportunities, these technologies are increasingly capable of creating new applications that enable this community to access existing work. For those living with chronic health conditions or compromised immune systems, being able to "bring the workplace anywhere" can make the difference between new or continued employment and unemployment.

In Spain, the Vodafone Foundation designed custom mobile applications with an augmented reality platform provided by Qualcomm to help "overlay digital material onto physical environments." The result was a series of applications that greatly support people living with disabilities to interact with their work environment. One application, Easy Use, offers an interactive instruction guide to help operate equipment like printers, phones and washing machines to those with cognitive disabilities. Another application, Who is Who, provides a visual directory of employees superimposed over the physical office space. Using a tablet computer, the employee can now identify who is sitting at each work station and more easily locate their colleagues. A third app, Follow my Steps, uses location based augmented reality technology to deliver step by step audio and 3D graphics to help people commute to work. These assistive technologies may contribute to a future of extended employment opportunities for people living with disabilities[25].

23 https://www.ssa.gov/news/press/factsheets/basicfact-alt.pdf
24 http://www.bls.gov/news.release/disabl.nr0.htm
25 https://www.qualcomm.com/media/documents/files/spain-augmented-reality-for-e-labora.pdf

Other Potential Smart City Solutions — Economic

- **Inclusive Automation –** The American workplace will be transformed by automation[26]. While this transformation can pose serious challenges to overall employment, automation and robotics may likewise yield a future of workplaces of machines that augment rather than supplant human labor. For those living with disabilities this transformation may open new opportunities for employment. Already, many tasks are not eliminated by robotics but rather refigured through tools that provide better ergonomics and allow for remote management. These technologies may ultimately level the opportunities for people living with disabilities to apply their unique skills.
- **Big Data for Economic Development –** City policymakers could leverage the data analytic capabilities of smart city technologies to better plan urban economic zones. By layering health, transport and demographic information over projected economic development plans, for example, cities can ensure that new opportunities are equally available to those workers living with disabilities.

Health & Wellness

> **Smart cities have the potential to transform the way we support families and individuals touched by Alzheimer's by providing real time data, alerts, and educational content tailored to communities and integrated into health systems."**
>
> Jason Resendez, *Executive Director of LatinosAgainstAlzheimer's Network & Coalition*

The Challenge: For aging communities and people living with disabilities, maintaining good health is a top priority[27]. Yet these populations face significant challenges to not only improved health outcomes but also maintaining independence. While specific health difficulties vary, the size of the challenge cannot be exaggerated: nearly 80% of older adults have a chronic disease and 85% of people with cognitive disabilities live at home and receive care from a family caregiver[28]. Minimizing the impact on families who play a significant, and often, unpaid caregiver role is particularly important. According to AARP the value of unpaid caregiving for older adults was calculated at $470B in 2013 alone — exceeding the value of paid home care and Medicaid spending combined[29].

The Opportunity: Smart technologies can improve health outcomes and reduce hardships on caregivers through both individual-scale connected devices and city-wide public health interventions. Smart mobile health technologies are expected to continue their boom with an expected 36 million units of monitoring devices used

26 http://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/where-machines-could-replace-humans-and-where-they-cant-yet
27 http://www.unitedhealthgroup.com/~/media/UHG/PDF/2015/USofAging-2015-Fact-Sheet.ashx
28 http://www.giaging.org/issues/disability/
29 https://www.caregiver.org/caregiver-statistics-demographics

in 2017 compared to just 3 million units in 2011[30]. For example, cities can support adoption of these devices by collaborating to allow for greater integration of individual devices with city services. Smart city technologies can also support the creation of "health dashboards" that use willingly provided data to offer cities public health perspectives at the city-, community- and even building-level. A real-time and dynamic health dashboard would provide cities with increased information on all demographics in their city — and better map the health needs of aging communities and communities living with disabilities. Smart city technologies allow officials to overlay environmental data with demographic information — allowing for city officials to adopt health considerations, particularly for these vulnerable communities, when deciding issues of urban planning. This type of data could be leveraged by health professionals and entrepreneurs to address pressing health challenges, including the lack of diversity in clinical trials.

Example — New Connected Health Devices: The increasing availability of health tech and connected health devices signals a new era of healthcare. Citizens have unprecedented access to understand their personal health. These new devices automate health delivery and can relay real-time health information to medical professionals, as well as family members and caregivers. Devices like Medtronic's Continuous Glucose monitoring allow for constant reading of blood glucose levels through a "wearable" electrode inserted under the skin. Cellular enabled mPERS (mobile personal emergency response service) devices provide emergency notification and peace of mind using a small wearable device that can detect when older users fall, and quickly identify location to alert emergency services. Given that at least one-third of adults over 65 in North America suffer a serious fall each year[31], this technology can protect the health of aging communities and extend the opportunities for independent home living.

Smart cities create opportunities for more of these personal health devices by providing innovators with access to large sets of data and new opportunities to connect with broader public service systems. One such innovation center, **AT&T's Foundry for Connected Health**, uses its base on the Texas Medical Center's campus to support entrepreneurs developing digital health innovations that benefit those in a clinical care environment — helping caregivers and patients bridge the gap between a clinical setting and the home.

> **The AT&T Foundries are fast-paced and collaborative environments spanned across 6 global locations where AT&T connects with cutting-edge innovators and technologies that will deliver new valuable products and services to our customers.**

Example — Transforming In-Home Health Services: These new connected technologies can augment caregiving and develop new models for in-home health services that will benefit aging communities and communities living with disabilities.

In Japan, a new partnership between Apple, IBM and Japan Post has built on Japan Post's already impressive health offering to integrate new health monitoring capabilities. The Japan Post Group, which operates post offices, banks and other services in Japan, had previously also launched a "Watch Over" program where aging communities could subscribe for a service in which mail carriers would check-in with elderly adults periodically

30 Journalist Inquiry. "Home Monitoring for Seniors Will Drive 36 Million Wearable Wireless Device Market." Abiresearch.com. n.d. Web. 11 Nov. 2016. https://www.abiresearch.com/press/home-monitoring-for-seniors-will-drive-36-million-/

31 *Center for Disease Control and Prevention - Older Adult Falls*

to provide assistance and update their families. This year, Apple and IBM partnered with Japan Post to pilot a program that would provide iPads, software and necessary training to older adults. These devices would be equipped with health monitoring information to alert these communities to take medication, connect them with information on exercise and diet, as well as offer new opportunities to communicate with distant family members. The program is set to reach 4 million customers by 2020[32].

Likewise, the University of California Irvine has piloted a similar program of providing aging communities with iPads for remote health monitoring. As part of California Delivery System Reform Incentive Program (DSRIP), a pay-for-performance initiative for public health care systems, the Irvine experiment integrated health monitoring technology with educational and home visits. To date among the targeted group the usage of emergency services has fallen by 27% since the launch of the program[33].

Example — Public Health Improvements: The deployment of environmental sensors and more efficiently managed transportation also provides significant health benefits for these communities. For example, at a community level, multiple studies have shown the higher levels of air pollution and particulates in U.S. urban areas and the outsized impact on health outcomes. Studies have also demonstrated that exposure to air pollution and traffic noise was positively associated with mild cognitive impairment (an "intermediary state between typical cognitive aging and dementia"). Smart cities can yield significant health benefits for people living with disabilities by ameliorating the pollution issues that worsen their conditions. This type of innovation will directly impact communities of color who are on average exposed to 38% higher levels of outdoor NO2[34].

Cities are already deploying these environmental sensors to improve quality of life for their citizens. Ericsson has deployed an environmental sensor solution within the recently launched Dallas Innovation Alliance (DIA) Smart Cities Living Lab. The solution measures four different types of pollutants, as well as temperature, humidity, atmospheric pressure and particulates (allergen levels). Additionally, Ericsson will provide the DIA the ability to monitor environmental data via a web application that is powered by the Ericsson AppIoT Platform. Environmental monitoring requires analyzing high volumes of time-coded data that is generated by numerous sources. It is important to have a highly secure platform that can ingest the data, apply common logic, and then make this data available to the city, the developer community and all local stakeholders[35]. San Diego and Atlanta are also already working to transform their cities with intelligent nodes that capture air quality through a partnership between Current by GE and AT&T[36].

In Atlanta, the adoption of smart city technologies has already yielded impressive results. The Atlanta Smart Corridor project resulted in an adaptive traffic control system that uses real-time data to best manage traffic flows in a previously congested city area. This "smart" transportation system provides clear efficiency benefits for the city and reduced driving time by as much as 40% in some instances. Environmental sensors also captured emissions and have also shown that there are significant health benefits from smart technology: NOx and VOC vehicle emissions have reduced by 1% and 8.5%, respectively[37].

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32 http://www.wsj.com/articles/japan-post-teams-with-apple-ibm-to-better-serve-elderly-1430395318
33 http://caph.org/wp-content/uploads/2015/10/CA-DSRIP-2010-2015-Successes-to-Build-On.pdf
34 https://www.washingtonpost.com/news/wonk/wp/2014/04/15/pollution-is-substantially-worse-in-minority-neighborhoods-across-the-us/?utm_term=.4e90253e8182
35 http://about.att.com/story/att_smart_cities_dallas_innovation_alliance.html
36 http://about.att.com/story/ge_current_intelligent_lighting.html
37 http://www.itsga.org/Knowledgebase/Atlanta%20Smart%20Corridor%20Project%20Fact%20Sheet.pdf

Another public health benefit of smart cities relates to efficient management of energy and loss of power. Life sustaining equipment such as respirators relies on access to power. Being able to monitor and restore energy by prioritizing people for whom power is critical to survival, can ensure that people with disabilities have access to the equipment they need to survive power outages.

> **The City of Atlanta's Information Management department in collaboration with its newly formed SMART ATL office has made great strides in being in the forefront of the implementation of the Internet of Things or IOT throughout the city. IOT has the ability to bridge gaps and connect all of the residents and visitors in a more effective and efficient way."**
>
> Torri Martin, *Director SmartATL Office City of Atlanta*

Quality of Life

The Challenge: Multiple studies have shown that these communities disproportionately experience loneliness — in an extreme example, 28% of young adults with autism were reported to have no social contact at all[38]. One study found that adults over the age of 60 who "identified themselves as lonely were 59% more likely to experience decline in their ability to perform daily activities and had a 45% higher likelihood of dying"[39]. There are severe costs to lack of community engagement and social connection. These risks sometimes extend to family caregivers who take care of more than 60% of the U.S. aging community: these caregivers are at "increased risk for negative health consequences, including stress and depression, and need increased support to preserve their own health"[40] [41]. These impacts are exacerbated by these communities' sometimes limited options to mobility and social environments.

The Opportunity: Technological enhancements of infrastructure and transportation have a definite and positive impact on how city residents enjoy a city, and there are specific ways that smart cities increase access to social and cultural resources to ameliorate the isolation often challenging these communities. These technologies would benefit said communities by increasing opportunities to engage in the life of their city. Cities can facilitate that interaction by improving the walkability and accessibility of their city. Additional resources are needed to allow for better navigation of U.S. cities and to provide up-to-date information.

Example — Mapping for Access: Fundamental to improving the quality of life for all communities is the ability to access cultural and social resources. From visiting parks and attending a concert to even enjoying the opportunity to tour one's neighborhood, satisfactorily engaging with the life of a city requires transportation. In Seattle, the OpenSidewalks Project has launched AccessMap, a trip planning tool that supports those with

38 https://www.disabilityscoop.com/2013/05/08/study-socially-isolated/17905/
39 http://jamanetwork.com/journals/jamainternalmedicine/fullarticle/1188033
40 https://www.healthypeople.gov/2020/topics-objectives/topic/older-adults
41 http://www.ioaging.org/aging-in-america

limited mobility. While many solutions are available for car-sharing and public transit options, Access Map provides trip planning support on pedestrian ways by gathering and maintaining open data about sidewalks, curb ramps, construction information and other data that maps the specific challenges and nuances of navigating city walkways. Beyond knowing how to find a location, AccessMap marks where there are sidewalks, the elevation of these pathways, and whether conditions are favorable for wheelchair access. The effort, set to be expanded to other major cities, presents one solution of aggregating city data, sensor information, and crowd-sourcing to generate a real-time map that can help aging communities and communities living with disabilities to better plan and therefore enjoy their city[42].

Example — Interactive Civic Information: Cities are also capitalizing on the integration offered by smart technologies to provide interactive platforms that provide citizens with real-time information on their cities.

New York City's City24/7 Collaboration with Cisco leverages information from open government programs, local businesses and citizens to provide public information in public spaces. Smart Screen locations throughout the city incorporate touch, voice and audio technology to deliver "hyper-local information" and services in real-time. Aging communities and communities living with disabilities were front-and-center in these considerations as these smart screens were "designed to deliver 'access for all'" through several design elements. Screens include headphone jacks for users who are hard-of-hearing, a high-contrast screen mode for those with visual disabilities, visual recognition for people with guide dogs, and features to support blind communities and those who use wheelchairs. Cisco intends to help expand into Los Angeles before rolling out to new cities where these smart screens will be adapted to local context. Information kiosks provide city information and alerts that can play a pivotal role in helping to support aging communities and people living with disabilities to interact with their city[43].

AT&T Smart Cities in Chicago, building off a similar system in Dallas, is partnering with Civiq Smartscapes to install five interactive Civiq Waypoint touchscreen kiosks throughout the city's busy commercial avenues. These kiosks provide free Wi-Fi and announce information about city attractions, activities and points of interest. AT&T and Civiq applied Universal Design features to ensure these new kiosks were accessible to a greater number of citizens.

Other Potential Smart City Solutions:

- **Beacon Technology –** Cities are using beacon technology to help people who are blind navigate airports[44]. Patrons can use an app to help them reach their destination, but also explore the other amenities around them. One such example is EnLight[45], one of the winners of AT&T's ConnectAbility challenge. Further, in the spirit of Universal Design, other uses for these same beacons are possible, such as augmented reality and targeted advertising.
- **Connected and Automated Vehicles –** Paving the way for autonomous vehicles will make smart cities more accessible for these communities, as well. Research has found that access to transportation is a limiting factor twice as often for people with disabilities compared to those without for everyday activities such as

42 https://opensidewalks.com/
43 http://www.cisco.com/c/dam/en_us/about/ac79/docs/ps/motm/City-24x7_PoV.pdf
44 http://www.smithsonianmag.com/innovation/indoor-mapping-lets-blind-navigate-airports-180952292/
45 https://devpost.com/software/enlight

commuting to/from work, running household errands, visiting the doctor, and participating in social activities[46]. The potential of providing more available and accessible mobility options to individuals who cannot drive can dramatically increase quality of life for the aging community and people living with disabilities in numerous areas, such as health, education, employment and social interaction.

> **Technology is essential in our daily lives. As a result of perpetual inventions and innovations, we expect to see self-driving or autonomous cars in the market very soon. Integrating this technology would be a blessing for our seniors, their caregivers and people with limited mobility. In a survey conducted by the National Hispanic Council on Aging (NHCOA), 70% of Hispanic seniors were in favor of autonomous cars if proven affordable, safe and available. Although, many of the survey participants indicated that they drove, the majority lived in large urban areas with congested traffic, raising their concerns about increased risks being involved in car accidents. Autonomous cars represent an opportunity to improve the quality of life for our seniors through the acquisition of a once lost independence."**
>
> Dr. Yanira Cruz, *President & CEO, National Hispanic Council on Aging*

Education

The Challenge: For aging communities and people living with disabilities, accessing the benefits of education can be a challenge. People living with disabilities face significant educational inequalities — at 63%, the high school graduation rate for students living with disabilities is 20% lower than the national average[47]. While health studies continue to affirm that life-long education plays a significantly beneficial role in preserving mental health, aging communities face lower adoption rates for internet usage that hinder their ability to capitalize on the explosion of learning opportunities, courses and programs now available online[48]. A 2015 report published by Pew Research found that only 58% of adults over the age of 65 use the internet[49].

The Opportunity: Smart city technology offers the prospect of integrated life-long learning and improved educational outcomes for younger citizens. These technologies are enabling new devices that bring educational opportunities home and allowing for young students living with disabilities to more fully participate in their classes through virtual platforms. It is critical that the plans for the workforce in 10-30 years are being supported by the instruction and curriculum from the secondary and post-secondary educational system.

46 http://gov.texas.gov/files/disabilities/GCPD_Report_84th_TxParatransit.pdf
47 http://nces.ed.gov/ccd/tables/ACGR_RE_and_characteristics_2013-14.asp
48 https://www.alz.org/documents_custom/2016-facts-and-figures.pdf
49 http://www.pewinternet.org/2015/06/26/americans-internet-access-2000-2015/

Example — Assistive Technologies: Twenty-first century education requires computers and internet devices, so innovations that facilitate students with disabilities to better manage these tools are essential. Assistive technologies like head and face tracking features allow for greater range of communication and interactivity. AT&T has long worked to launch and support the development of these assistive technologies. In addition to pioneering services like text-to-speech and speech recognition applications that allow students to more fully engage in their classrooms, the company has supported the innovation of cutting-edge assistive technologies. In New York, the AT&T's ConnectAbility Challenge sought to spur innovation like the Kinesic Mouse, the grand prize winner of the challenge. The software solution uses a 3D camera to detect facial expressions and head rotation to allow for hands-free use of personal computers[50]. For successful education outcomes, it is imperative that education programs and facilities plan for and include compatibility with these types of assistive technologies, rather than approaching this challenge with a series of one-off solutions.

> **"The American Foundation for the Blind (AFB) supports fully inclusive, accessible Smart City Initiatives, where people who are blind or visually impaired can learn, work, and live independently."**
>
> Lee Huffman, *AccessWorld and Technology Information Editor, American Foundation for the Blind*

Example — Virtual Classroom: Virtual reality technologies are increasingly geared toward improving education, including for communities with disabilities. A project at the University of Georgia is developing a "virtual classroom" located in the virtual world Second Life. According to researchers this virtual classroom would "let students with disabilities — ranging from blindness and low vision to learning challenges — connect with a hand-picked mentor within a digital space[51]". In the virtual classroom, students can meet their mentors as an avatar (a virtual embodiment), set up meeting times, and freely roam around the virtual world to engage in several learning environments. The implications for STEM education are particularly important as this virtual classroom will allow students living with disabilities to participate in science labs and activities that may be unavailable in a traditional classroom. Virtual reality technologies are helping de-stigmatize health conditions like Alzheimer's and have the potential to assist in vital public education efforts.

Example — Virtual Senior Center: In New York, the nonprofit Selfhelp Community Services has partnered with Microsoft and the City of New York to develop a Virtual Senior Center that offers "some 30 online classes to homebound clients, from tai chi and exercise to contemporary history discussions and gallery talks with museum curators, as well as music appreciation and singing — even Mandarin[52]." Participants log-in to the virtual center through touchscreen computers, often paired with assistive technologies, and select opportunities from a menu of course schedules. The classroom environment can handle up to 20 video streams/participants

50 http://engineering.nyu.edu/press-releases/2015/07/27/att-nyu-announce-winners-100k-connect-ability-challenge
51 http://www.nbcnews.com/id/41889904/ns/technology_and_science-tech_and_gadgets/t/avatars-go-school-virtual-classroom-could-help-disabled/#.WDLVDaIrJE4
52 http://www.nextavenue.org/the-online-classes-that-help-the-homebound-connect/

who participate in active discussion with an additional "spectators" area where they can "audit" the course in session. The courses take advantage of the virtual world by allowing for museum tours and interactive science workshops. In addition, the courses can also serve as informational portals providing seniors with important civic and health information[53].

Housing

The Challenge: Housing is a priority and common concern for aging populations and communities living with disabilities. They want to maintain independent living that is affordable and comfortable. According to AARP, nearly 90% of people over age 65 prefer "aging in place" but only 43% of those over 70 find living independently "very easy[54]." Affordability remains a concern as older adults are more likely than younger adults to spend more than half their income on housing[55]. These costs are not always spent on rent or mortgage payments. Aging communities and those living with disabilities must often retrofit their homes to assist independent living — and it is calculated that that approximately 80% of home modifications and retrofits are paid out-of-pocket by the residents[56].

The Opportunity: Between urban planning solutions and individual home devices, smart city technologies can ameliorate the challenges of housing on these communities by enabling independent living, minimizing housing costs, and supporting city officials to better plan for inclusive housing. Building efficiencies afforded by smart energy technologies can provide "savings in the range of 10% to 25% when implementing" these measures[57]. These savings can be significant for homeowners and their caregivers and equally significant for community organizations developing assistive and senior housing projects. New IoT devices will allow for greater ease of independent living by automating difficult tasks and provide safeguards against potential health and security risks. Finally, big data and analytics capabilities will improve city planning to ensure assistive housing is located with considerations to health impacts and other factors.

Example — Independent Living Solutions: The range of connected products designed to make home life more efficient, safe and comfortable have skyrocketed with the proliferation of IoT. Given that nearly 90% of people over age 65 want to stay in their home for as long as possible, these devices have clear benefits for aging communities and people living with disabilities[58]. These web-enabled devices can serve a wide range of functions: they contribute to better security through automated locking systems, and motion sensors like Microsoft Kinnect have applications that allow them to recognize gestures and perform everyday tasks like adjusting lights or opening doors[59].

Example — Caregiver Assistance: Solutions are also being developed that help caregivers and healthcare professionals to serve people who are aging or living with disabilities. Often the most useful tools for the communities and their caregivers are fairly simple health management tools – for example, electronic alerts and

53 http://www.leadingage.org/uploadedFiles/Content/Centers/CAST/Pilot_Projects/SelfHelp_Community_Services_Case_Study.pdf
54 http://www.aarp.org/content/dam/aarp/livable-communities/learn/research/the-united-states-of-aging-survey-2012-aarp.pdf
55 http://www.aarp.org/content/dam/aarp/livable-communities/learn/housing/housing-an-aging-population-are-we-prepared-2012-aarp.pdf
56 Ibid
57 http://blogs.intel.com/iot/2016/06/20/costs-savings-roi-smart-building-implementation/
58 https://assets.aarp.org/rgcenter/ppi/liv-com/ib190.pdf
59 https://www.datainnovation.org/2015/05/the-internet-of-things-means-a-more-accessible-world/

devices that set reminders to take prescriptions and connect with pharmacies to automatically fill orders. But there are other potential connected applications that help caregivers, such as scheduling apps to track doctor's appointments and programs that can automate tasks like reading and shopping for common household items[60]. In addition to supporting caregivers to provide the best service, these new solutions should also be designed in an accessible manner to ensure that caregivers who also have a disability may fully take advantage of these advances.

Example — Urban Planning Solutions: Just as new devices enable personal and home automation, cities will have community-wide solutions to automate city services and improve the quality of life for residents. In Chicago, the Array of Things project (the connectivity for which AT&T provides) was designed as a "fitness tracker" for the city — collating the disparate data a city gathers. At the city-scale these devices are — in essence — city sensors and monitors that measure environmental metrics to help improve urban planning. With new data on flood zones, air quality and traffic, city planners can better develop resilient and healthy housing for new and existing residents[61]. To offset concerns around data privacy the city will make all data available through a Data Portal[62].

Emergency Services

The Challenge: Cities will face increasing risks of public health disasters and must ensure their emergency services are accessible and available to the 25% of city residents who are perhaps most vulnerable during disasters. Historically aging populations have been gravely at risk during these crisis scenarios. As an example, nearly 71% of those who died as a result of Hurricane Katrina were older than 60[63]. And the CDC acknowledges natural disasters present a "real challenge" to people with disabilities who will need additional assistance to obtain the services required to be safe during emergencies[64].

The Opportunity: Smart city solutions can support governments to better integrate alert systems and significantly improve delivery of emergency services. Smart 911[65] and other next-generation systems can provide first responders with important, useful information during calls, as well as during large emergency management situations. Smart city technologies will also enable governments to centralize control of their monitoring and alert systems for more efficient deployment of emergency responders. Cities will detect more issues more quickly by integrating data from various city departments with new information provided through citizen alerts and sensor detections. Smart detection connected with next generation response systems will greatly improve the safety of all city residents.

Example — Emergency Response Efficiency: Smart cities can increase the efficiency of emergency responses by rolling out next generation 911 systems, increasing access to these systems, and providing first responders with technologies to help them serve citizens more effectively.

The smart corridor transportation systems installed in Atlanta and elsewhere could potentially be integrated with emergency systems to significantly reduce response times. A study by the University of Zaragoza in Spain found that integrating dedicated short range communications (DSRC) along roads to allow for vehicle-to-

60 http://www.aarp.org/content/dam/aarp/home-and-family/personal-technology/2016/04/Caregivers-and-Technology-AARP.pdf
61 https://ci.uchicago.edu/press-releases/chicago-becomes-first-city-launch-array-things
62 https://arrayofthings.github.io/
63 AARP, We Can Do Better: Lessons Learned for Protecting Older Persons in Disasters (2006). http://assets.aarp.org/rgcenter/il/better.pdf
64 https://www.cdc.gov/features/emergencypreparedness/
65 https://www.cdc.gov/features/emergencypreparedness/

vehicle and vehicle-to-infrastructure communications would drastically reduce arrival times. The researchers calculated that such a system would reduce emergency response arrival time by an average of 48%[66].

Example — Integrated Command Centers: One clear opportunity is to create smart response systems that integrate information from existing public systems, as well as new smart surveillance systems. City officials will be able to monitor emerging crisis in real-time with an unprecedented level of visibility. As these technologies develop, it's imperative that these public dashboards and command centers are themselves built with a consideration toward accessibility that enables a diverse set of candidates to work in city government.
In Rio de Janeiro, IBM worked with city government to develop a data-driven control center. In Rio, information from over 30 city agencies was centralized and integrated with sensors and live video feeds to map potential public safety interventions. According to IBM, this effort has improved emergency response times by 30% since the launch of the program[67].

AT&T is developing a series of Smart Surveillance systems that employ cutting edge detection technology to provide real-time analytics and streamline emergency responses. Through predictive policing technologies, heat mapping and facial recognition software, AT&T's government partners can detect situations before they escalate and provide the real-time information that hastens response times.

Other Potential Smart City Solutions:

- **EMS and Wearables**: As health IoT devices and wearables propagate, there is a clear opportunity to integrate these technologies with EMS services. One potential challenge faced by people living with disabilities is the ability to communicate with EMS during critical moments. Those with speech, hearing or visual conditions often encounter EMS who are not trained to provide adequate service. Video technologies that allow for EMS interpretation or wearables that automatically transmit health data to EMS providers could greatly increase the efficiency of EMS for these communities.

Keys to Success

The opportunity for aging communities and communities living with disabilities to optimally benefit from these new technologies depends on several keys to success. Technologies must support adoption within a community that is already challenged by a digital divide that disproportionally excludes these communities from participating in new technologies. Additionally, these technologies should be designed for inclusive benefits by integrating Universal Design principles and providing safeguards against privacy and security concerns. Connected to the adoption and design considerations, smart city technologies must conduct a multi-stakeholder engagement process to ensure sustainable financing of these innovations and guarantee that citizens' voices are central to any city modifications. Finally, these technologies must foster an entrepreneurial ecosystem that democratizes innovation and enables the citizen solutions that will define inclusive smart cities.

Supporting Adoption

James Thurston of the Global Initiative for Inclusive Information and Communication Technologies (G3ict) offers some important perspective regarding smart cities: "If we look at smart cities through the lens of accessibility

66 https://www.newscientist.com/article/dn24126-reroute-towns-traffic-to-get-emergency-vehicles-through/
67 https://www.technologyreview.com/s/532526/a-closer-look-at-smart-cities/

we have the tremendous opportunity to address a digital divide that today prevents the full benefits of the digital revolution from reaching all citizens, including those with disabilities and age-related impairments." Not until 2012 did more than half of all adults over the age of 65 report using the internet[68]. To date only 54% of adults living with a disability use the internet compared to 81% of other adults[69]. These statistics only serve to underline the fundamental starting point for all smart city technologies: increased connectivity and inclusive access to broadband internet in all U.S. cities.

Yet usage of internet technologies is not limited to a question of access but also involves a question of adoption. Among aging populations who have access to these technologies, only 13% would feel comfortable attempting to use a new technology device without assistance[70]. There is a risk that the benefits of smart city technologies will be limited due to barriers to adoption — and not only for our focus communities – but also their caregivers and family members. As a result, the reach and benefits of smart city technologies can be enhanced with attention to programs aimed at adoption by these communities.

Many cities with smart city initiatives are already training these populations as an essential component to deploying new technologies. Computer and digital training, as well as access to connected devices, are central to extending to aging communities the myriad available connected education and virtual classroom opportunities. AT&T's Digital You training program specifically includes targeted training for people who are aging and people living with disabilities, as well as caregivers. Built on a collaboration with prominent national organizations like Common Sense, AARP, The Oasis Institute and the Rehabilitation Engineering Research Center for Wireless Inclusive Technologies, the program serves to increase digital literacy and promote online safety information. Digital You helps teach beginners of all ages the basics of using a smartphone or tablet, keeping online information private and secure and activating accessibility features to support users with disabilities through training resources and tip sheets[71].

> **AT&T's Digital You website is a helpful resource for people who have a device and a level of comfort using the internet. Last mile adopters also need numerous opportunities for in-person instruction that builds confidence and proficiency with their device and conducing online searches before they can be expected to use web-based instruction. It's not that they are unwilling to use such services. Without exposure to and practice with online resources, people do not think of them as a source of help."**
>
> Amy VanDeVelde, *National Connections Program Manager, The OASIS Institute*

Aging communities have been shown to lag on technology adoption but also report having fewer skills and are less confident in their ability to use these technologies[72]. In Chicago, a partnership between Microsoft,

68 http://www.pewinternet.org/2015/06/26/americans-internet-access-2000-2015/
69 http://www.pewresearch.org/daily-number/internet-challenges-for-the-disabled/
70 http://www.pewinternet.org/2014/04/03/older-adults-and-technology-use/
71 http://www.prnewswire.com/news-releases/att-launches-digital-you-program-300129394.html
72 http://oats.org/white-papers/getting-turned-on-using-ict-training-to-promote-active-aging-in-new-york-city/

the city government and Connect Chicago helped develop DigiSeniors, a new training curriculum for aging communities[73]. This example of civic tech collaboration helped create a lesson plan for in-class learning to introduce senior citizens to Windows and also train these new users to access the internet and beware of safety and security considerations. In Westchester County in New York, the Telehealth Intervention Programs for Seniors (TIPS) program brings telehealth solutions closer to aging communities by coupling remote health monitoring with personalized assistance by local university students[74].

In New York City, the Older Adults Technology Services (OATS), a nonprofit organization, has built the country's largest and most comprehensive municipal technology program for seniors, serving over 20,000 people each year and sustaining 24 technology labs across the city. Through trainings provided in on-site tech labs in the city OATS engages, trains and supports aging communities in using technology to improve their health, finances and civic and social engagement. The measured impacts of these trainings has been overwhelming positive: six months after the OATS training 93% of the participants were still using their computers and 89% reported they had maintained their skills and were still able to do what they had learned in the course. In addition, AT&T is making wireline home internet service more affordable for low-income households through Access from AT&T.

These solutions succeed in adoption of new technologies by acknowledging that innovative solutions cannot succeed without "analog" methods to promote adoption. Those launching smart city technologies must anticipate barriers to adoption by bearing in mind the current digital divide. Instructions and education services that are online or only available via smartphones will not necessarily work for aging communities and communities with disabilities, especially if they are not usable by people with disabilities or compatible with assistive technologies.

Designing for Inclusion and Privacy

> **If we look at smart cities through the lens of accessibility, we have the tremendous opportunity to address a digital divide that today prevents the full benefits of the digital revolution from reaching all citizens, including those with disabilities and age-related impairments."**
>
> James Thurston, *VP-Global Strategy & Development, G3ict*

Universal Design principles and protections against privacy abuses should be front and center as smart city technologies begin deployment and new citizen innovations emerge to support aging communities and communities. While Universal Design is often considered a criterion for consumer product and service design, the fundamental principles remain relevant to smart city technologies launched by municipalities.

73 http://www.smartchicagocollaborative.org/digiseniors-microsoft-chicagos-new-computer-training-curriculum-for-senior-citizens/
74 http://www.smartchicagocollaborative.org/digiseniors-microsoft-chicagos-new-computer-training-curriculum-for-senior-citizens/

G3ict has long advocated to ensure that "digital services of smart cities can be more accessible." In 2016, G3ict partnered with World Enabled to launch the global **Smart Cities for All initiative.** Working with AT&T to promote accessibility of mobile equipment and services, G3ict has done extensive work to demonstrate how Universal Design can be implemented across an organization and how innovation can be leveraged to develop services dedicated to persons with disabilities and seniors[75]. G3ict has collaborated with AT&T to define guidelines that ensure "content can be made available in multiple formats and languages, services can be offered remotely to home-bound or geographically isolated citizens, digital formats can serve multiple disabilities, and interact with a broad range of assistive technologies used by persons with different types of disabilities[76]." Writ large these considerations can extend to how walkways are developed and emergency services are delivered to ensure they equitably assist all populations.

> **We are delighted to work with AT&T and other partners to address the digital divide and expand opportunities for persons with disabilities and older persons. These efforts make our cities more innovative and more inclusive."**
>
> Dr. Victor Pineda, *President & Founder, World Enabled*

As cities build smart infrastructures, serious thinking about the citizen experience with all of the various touch points with the city and the community must take place. How will people with disabilities and aging citizens interact with web sites, mobile apps, self-service kiosks, smart meters and other emerging devices? How will the needs of an individual who is blind be supported as equitably as a 93 year-old with Parkinson's? One strategy is to go beyond Universal Design to instill new technologies with the capabilities to adapt to each user based on their own needs and, further, to know these needs based on global preferences available in the cloud, such as the **Global Public Inclusive Infrastructure** (GPII) project has proposed.

Another important user consideration is the privacy and security of services offered by smart city technologies that often rely on the absorption and real-time analytics of personal data. Likewise, many of the benefits of these technologies rest on the automation of necessary functions. The sensitivity of the data and the safety of these automated functions require that these technologies prioritize privacy and security concerns. As researchers investigating the intersection of privacy and smart city technologies concluded: "Comprehensive architecture with security built in from the beginning is necessary. In order to achieve user consent, trust in, and acceptance of Smart Cities, integration of security and privacy-preserving mechanisms must be a key concern[77]." Ensuring security is not only a back-end technical issue. There is also a need to inform and engage with the communities that will receive these benefits to ensure that communities agree to releasing data in exchange for the offered technological benefit. Attention to digital rights extends to the application of data, ensuring that data is not used in any way (even unintentionally) that discriminates or marginalizes individuals or populations.

75 https://www.att.com/Common/merger/files/pdf/Accessibility_Innovation_and_Sustainability_at_ATT.pdf
76 http://g3ict.org/resource_center/g3ict_smart_cities_initiative#sthash.635eGgZv.dpuf
77 http://smartcitiescouncil.com/resources/security-and-privacy-your-smart-city

Engaging Partners and Stakeholders

> **The overall goal of implementing the Internet of Things or IOT is to connect all of the residents and visitors in with the City of Atlanta, and keep them informed about all of the great improvements that we are making. Without truly investing in citizen's needs, and equipping them with access to what the city has to offer, there is no forward progression. Atlanta is a great city and has potential to be a leader in this effort, not just locally but globally.**
>
> Denitra Gober, *Public and Community Engagement Specialist SmartATL Office City of Atlanta*

As smart city technologies offer systems-wide solutions the deployment of these technologies require participation by all of the city's sectors and communities. These stakeholder partnerships and engagements are not about acquiescence on new technology nor are they informational opportunities to share upcoming changes, rather these are partnerships that bring all the diverse resources a city has to bear in order to facilitate the deployment of these solutions. This includes working with the financial sector to support sustainable financing of new technologies, as well as academics and university institutions to measure impact and scale successful trials.

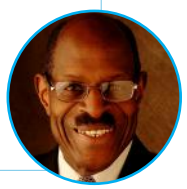
In Europe, several models for this partnership are already enacted. The European Innovation Partnership on Smart Cities and Communities (EIP-SCC) is an initiative supported by the European Commission bringing together cities, industry, SMEs, banks, research and other smart city actors to develop and implement smart city solutions. The EIP created a stakeholder engagement framework that includes a high-level group with representatives from cities, research and industry to help define how smart cities concepts are enacted[78]."

In the U.S., similar models are emerging with even more citizen participation. In Dallas, AT&T and other founding partners created the DIA — a coalition of stakeholders from the City of Dallas, corporations, Civic and NGO organizations, academia and private individuals who are invested in Dallas' continued evolution as a forward thinking, innovative 'smart' global city. The Smart Chicago Collaborative (Smart Chicago) is a civic organization "devoted to improving lives in Chicago through technology" that brings together municipal, philanthropic and corporate investments in civic innovation[79]. In 2013, the city released its Chicago Tech Plan outlining the city's approach to deploying smart technologies. Smart Chicago along with Local Initiative Support Corporation (LISC) and the MacArthur Foundation have devised a plan and funding strategy to make "every community a smart community[80]."

78 http://ec.europa.eu/eip/smartcities/about-partnership/how-does-it-work/index_en.htm#
79 http://www.smartchicagocollaborative.org/
80 http://datasmart.ash.harvard.edu/news/article/the-chicago-tech-plan-building-a-model-for-cities-and-technology-306

Fostering the Entrepreneur Ecosystem

> **There's probably an important role for AT&T or stakeholder groups to train and integrate private- sector startups in a way that promotes accessibility. There may be a way for AT&T and others to say "if you want to use these data, if you want to have access to the platform, let's talk about how we design this system in your individual technology to allow for accessibility."**
>
> Alfred Moye, *Ph.D, Director of University Affairs, Retired, Hewlett-Packard*



Smart cities technology will benefit aging communities and communities living with disabilities to the extent they engage citizens in the process of developing and deploying these solutions. Smart technologies can equitably distribute benefits and enable democratized innovation where citizens can develop peer solutions that are specific to cities, communities and even individual city buildings. Opportunities for "civic technology" also allow for a multi-generational approach to technology solutions by allowing young innovators to collaborate with aging communities and people living with disabilities to co-create devices, services and programs. As one of many examples, in 2015 AT&T partnered with New York University to launch the ConnectAbility Challenge, a three-month global software development competition leveraging mobile and wireless technologies to improve the lives of people living with disabilities[81].

Globally and in the U.S., cities have made civic technology a cornerstone of their smart city strategy. Cities are releasing APIs to allow for greater transparency but also to multiply the benefits of smart technology by encouraging civic-tech or "civic hacking." In New York City, the government has eight APIs available through a developer portal — allowing developers to access all publicly available data sets. This preponderance of rich data encourages new devices or apps and allows for new data visualizations and insights that can guide citizen engagement on wide array of issues[82]. New York City has also launched a Big Apps competition that serves as a hackathon to inspire civic tech. In 2015, the solutions awarded grand prizes include a tool that assists tenants with housing issues to facilitate getting apartment repairs as well as a benefit screening tool that allows low-income residents to better assess their benefits options[83]. San Francisco also features an OpenData portal and clarifies the theory of change for such open access: "open data portals enable a data driven ecosystem, which supports a range of positive outcomes[84]."

One extraordinary example of entrepreneurship is Aira — a startup technology company that is using wearable smart glasses to improve the lives of people living with vision loss. Aira connects individuals with diminished vision to a network of "certified agents" who literally serve as the wearer's eyes — relaying what they see back to

81 https://connectability.devpost.com/
82 http://www.programmableweb.com/news/how-smart-cities-are-promoting-api-usage/analysis/2015/05/04
83 http://bigapps.nyc/p/
84 http://www.programmableweb.com/news/how-smart-cities-are-promoting-api-usage/analysis/2015/05/04

the wearer. AT&T is providing wireless connectivity to Aira to support their innovative technology platform. With the help of the AT&T's Dynamic Traffic Management, the company can prioritize data traffic to provide a more predictable experience, especially in times of network congestion[85].

The enablement of civic technologies and public-private partnerships opens a new frontier of opportunities for people who are aging and people living with disabilities. New data means researchers and community organizations have greater resource to identify needs in their cities. Public sector support for entrepreneurs developing these solutions means smart city technologies will not be limited to large-scale systems. Instead, smart city technologies will proliferate by harnessing the innovation and energy of millennials and baby boomers committed to social impact.

Conclusion

With the promise of major infrastructure investment, Americans once more ponder the future of their cities. Will our imagination conform to ideas of repaved landscapes dotted with more gleaming buildings and railways? Or will we instead reimagine cities founded on vibrant principles of innovation and community — built to welcome new populations without trading on the human connections and personal comforts of city-living? Smart city technologies hold the potential to deliver on this uncompromising vision for new cities by connecting citizens, governments and the private sector in a united effort to improve our communities.

AT&T is committed to the shared responsibility of making inclusive smart cities. Fundamental to this vision of advanced – yet human – cities is meeting the keys of success outlined above: supporting adoption, designing for inclusion and privacy, engaging partners and stakeholders, and fostering the entrepreneur ecosystem. More than technology and connectivity is essential to making smart cities a reality — a renewed sense of community and civic participation will ensure that our smart cities are both technological marvels while remaining accommodating, enjoyable and deeply human.

85 http://about.att.com/story/aira_to_use_att_wireless_connectivity.html