

PP Partnership for Progress
DD on the Digital Divide

**DEPARTMENT OF COMMERCE
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**NATIONAL BROADBAND RESEARCH AGENDA
Notice and Request for Comments**

**Comments of
Partnership for Progress on the Digital Divide**

October 11, 2016

Partnership for Progress on the Digital Divide (PPDD --<http://www.ppdd.org/>) engages a broad diversity of individuals and organizations to spearhead a multi-associational, multi-disciplinary partnership among scholars, practitioners, and policymakers to make significant contributions in closing the digital divide and addressing the many other challenges and opportunities presented by the digital age. Fully interdisciplinary and international, PPDD is the only academic professional organization in the world focused solely on the digital divide and on connecting research to policymaking and practice to strategize actions and catalyze solutions to this pressing societal concern.

With former U.S. Assistant Secretary of Commerce for Communications and Information and Administrator of the National Telecommunications and Information Administration (NTIA) Larry Irving as Honorary Director, PPDD was founded in 2002 as a not-for-profit organization. PPDD works in many ways to achieve its mission, including holding a biennial series of international conferences. As a major outcome of those conferences, to create a powerful critical mass of high-quality interdisciplinary scholarship that can serve as a deep resource and driver of future innovation, PPDD is producing edited volumes of the top papers as well as special issues of journals on specific themes within the digital divide area.

The academic community of hundreds of researchers represented by PPDD has been studying the digital divide for well over twenty years and has produced thousands of books, book chapters, journal articles, and presentations on the topic and carried out numerous community intervention initiatives, program evaluations, and engagements with practitioners. This community stands ready to collaborate with government researchers, policymakers, and practitioners to build on our shared interests, methods, and goals and further the National Broadband Research Agenda to find solutions to the digital divide.

Partnership for Progress on the Digital Divide applauds the effort by President Obama, the Broadband Opportunity Council, the National Telecommunications and Information Administration, and the National Science Foundation to improve data collection, analysis, research, and their applications for the benefit of broadband policy development, program implementation, and program evaluation. PPDD welcomes and appreciates the opportunity to contribute these comments to inform the development of the National Broadband Research Agenda. And, we look forward with enthusiasm to additional and continuing opportunities to provide input on the Agenda and its fulfillment.

A Note on the RFC Questions and PPDD's Comments in Response

We are aware that the RFC requests distinct responses to specific questions and that those responses are to be labeled with the corresponding question number. However, the nature of the questions and the attempt to parse out issues and answers reflects a lack of understanding of research in the digital divide domain. Essentially, discussions of broadband technology, broadband access and adoption, socioeconomic impacts, and

opportunities for federal leadership in data collection and research of necessity overlap and are interrelated as digital divide issues are complex, nuanced, multi-layered, and multi-faceted with interconnected interplays of influence. For example, questions 1-9 are inseparable and closely tied and intertwined with questions 10-19. Research that informs the digital divide must be person, not technology, centered; the presence of technology does no good if it is not used. And, we must address how technology can engage diverse uses and outcomes and solve, rather than exacerbate, social problems.

Thus, in our view, the common core of all the RFC questions is: what gaps exist in our understanding of the digital divide and its impacts, and what research, data, associated methodologies, and federal leadership and engagement with stakeholders are necessary to fill those gaps and find solutions. Indeed, over the past 20+ years since the recognition of the digital divide through social scientific research, the first wave of academic digital divide research concentrated primarily on inequality in physical access to computers and Internet technology. Then, as an increasing percentage of the population gained access to the Internet, the focus of a second wave of academic digital divide research has shifted from the gap in access and connectivity to social and cultural aspects of the divide, including the skills and digital literacy needed to interpret, understand, and navigate information presented online; the impact of socio-economic factors on user behavior; the role of motivation, attitudes, and interests; differences in patterns of usage; the ways in which people use the Internet to create content; the resulting socio-economic and cultural effects; and much more. Yet, despite all that we do know so far, there is a very large gap in our understanding of the digital divide and what it means to have and provide access and participation for a diverse population and, as a result, in America’s ability to craft effective and efficient policy and practice to combat this persistent pressing inequality and societal concern.

Consequently, rather than attempting to parse issues by the RFC question numbers, we have instead arranged our comments by critical thematic areas that must be prioritized, interwoven with associated research methodologies and federal action opportunities, as follows:

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Aging

A note of caution is needed when using the term “seniors”. There are striking gradients in technology use as a function of age for those 65+ years old (Smith, 2014). Different age/cohort groupings show very different technology adoption rates and probably also different attitudes toward technology. Research efforts need to pay attention to age ranges and associated unique characteristics in interaction with technology, such as the young-old (age 65-74), middle-old (age 75-84) and old-old (age 85+), particularly given that the age 85+ group is one of the fastest growing population segments.

It was first reported that rural Americans and seniors (those age 65+) lagged other population segments in the initial digital divide report by NTIA in 1995 (“...rural seniors rate lowest in computer penetration.”) Every representative survey since that time (such as those conducted by the Pew Internet and American Life surveys, e.g., Smith, 2014) has consistently shown that seniors lag younger cohorts in technology adoption. That includes broadband adoption (e.g., Horrigan & Duggan, 2015) where estimates showed 45% of seniors age 65+ reporting broadband adoption in 2015 lagging all other age groups (e.g., those 18-49 with about 75% adoption). Adoption declined slightly in all age groups between 2013 and 2015. Why worry about the senior lag in broadband adoption? It is pretty clear that health care provision is increasingly moving from hospital and clinic to home, relying on telehealth technologies, the remote provision of health care services and education by means of information and communication technology (Charness, Demiris & Krupinski, 2011). Seniors suffer high rates of chronic conditions: 75% have one or more chronic conditions (Fox & Duggan, 2014). Such conditions are likely best treated by careful monitoring, including remote monitoring. Given that broadband is necessary for real-time transmission of some types of health information (e.g., high resolution images), seniors are at risk of being left behind for telehealth services, particularly those seniors living in rural communities where cost and usability can take a back seat to the problem of basic access.

Why does the divide persist despite minimal age/cohort gaps in adoption of other technologies such as microwave ovens, digital televisions, and even to some extent for cell phones (though not smartphones where there is a wide gap)? To address the technology adoption lag phenomenon, we need further development of models of technology adoption and use, stressing factors that are unique to seniors. For example, models such as the Technology Acceptance Model (TAM) and the Universal Theory of Acceptance and Use of Technology (UTAUT) fail to consider tradeoffs that seniors (and those with disabilities) are willing to accept when privacy may be compromised by a technology (Beach et al., 2009).

In addition, we need to develop improved specialized models of technology adoption and use that can apply better specifically to broadband adoption by seniors. For instance, recent work suggests that concerns around privacy and confidentiality may be significant barriers to adoption and use of technology by seniors. Surveys have sometimes shown that seniors are more concerned about these issues than younger age groups, though they also seem to be less informed about how best to safeguard privacy (Charness & Boot,

2016). Research on how best to educate seniors about safeguarding themselves on the Internet when accessed with broadband technology also seems like a promising topic to pursue.

The CREATE (<http://create-center.org>) research group has been investigating factors affecting technology adoption and use for 16 years, focusing on a human factors approach of assessing person-technology fit. There are well-known cognitive, perceptual, and psychomotor changes with age that make using technology more difficult for seniors (Fisk et al., 2009) if the technology is not well designed for older users' capabilities. Some examples of those age-related changes are changes in vision that make small or low contrast print difficult to read, changes in hearing and comprehension processes that make it difficult to process speech by foreign tech support personnel with accents, changes in working memory that make it difficult to retain and perform instructions involving multiple steps (e.g., setting up a modem), and changes in motor processing (e.g., tremor, affecting Fitts' Law parameters: Jastrzemski & Charness, 2007) that make it difficult to execute a double-click with a mouse or select closely-spaced icons on a small screen (e.g., a smartphone).

Even if a product (e.g., a broadband modem) is usable by seniors it may not be useful to them. Some of the main reasons cited by non-Internet users for non-use were that they were not interested (21%), don't have a computer (13%), too difficult/frustrating (10%), don't know how/don't have skills (8%), and too old to learn (8%), though lack of access (7%) was mentioned by some (Zickuhr, 2013). Although such surveys are very helpful in identifying broad themes about adoption, we need to be able to drill down with more intensive questioning that would probe reasons for non-adoption with follow up questions such as why someone feels "too old to learn" (getting at attribution style, or simultaneously measuring cognition with an instrument such as the TICS), or why using a computer or the Internet "was too difficult/frustrating" (probing experiences with technology and technical support). It would be very useful to include these types of more detailed questions about technology adoption and use in national surveys such as the Health and Retirement Study and current technology-oriented ones such as the National Health and Aging Trends Study. Increased human factors work, focusing on assessing usability of current (and future) broadband technology would be useful, too. Usability testing involves assessing learning, efficiency, memorability, errors, and user satisfaction for a product, such as a broadband modem.

Further, older adults are often described as a single, homogenous social group. When it comes to broadband adoption, however, it is important to distinguish between digital older adults and older adult non-users. Different research and data are required for each of these groups and to investigate the unique perspectives older adults bring to their use of technology that are distinct from those of younger users. Older adult non-users of broadband face many challenges when it comes to adoption. By contrast, older adults who are connected to the Internet tend to make use of a wide range of digital tools to fulfill various needs and show curiosity to learn new means of engaging socially online (Quan-Haase, Martin, & Schreurs, 2014).

Data for this population is also needed on their skill level. Much research has focused on measuring digital skills (Hargittai & Walejko, 2008; Hargittai & Shaw, 2015), but few methods have been developed taking into account the unique cognitive and socio-emotional state of older adults. Older adults' skill level is not generic; rather it needs to be understood in relation to their life stage. For example, older adults may be less interested in consuming popular culture, but may be eager to find information about the weather, their local library, and local news. Research is much needed in supporting older adults' activities when online. Quan-Haase, Martin, and Schreurs (2016) found that digital older adults were using online sources of information extensively, but had difficulties evaluating their credibility. Data is needed on how digital older adults evaluate online resources and what kinds of training could further support their use of varied digital resources.

In addition, data is needed to gain a greater understanding of the social impact of broadband utilization on older adults' emotional and physical well-being. Digital older adults are able to mobilize social support through digital networks and thereby reduce loneliness and social isolation. Data is needed to shed light on the mechanisms by which digital support mobilization can function as a buffer for older adults. In Quan-Haase, Martin, and Schreurs (2016) asking for help around technology use was already perceived by older adults as a means of support mobilization. Many older adults connect with their children, and in particular with their grandchildren, through discussions of broadband adoption. Thus, broadband adoption and associated challenges help maintain intergenerational ties.

Finally, cost can be a significant barrier to technology adoption by seniors, as seen in surveys that show large gradients by income (and education) levels, such that seniors who are very well off resemble much younger cohorts in technology adoption rates. For instance, people with over \$100K in income show 90% adoption of broadband compared to 41% adoption for those with < \$20k in income (Horrigan & Duggan, 2015). Finding ways to spur competition among broadband providers should benefit everyone, and lower income seniors in particular. Research on regulatory and policy influences on broadband competition could be helpful.

Disability

Recently, Pew Research released the first of a series of reports that examines the World Wide Web at its 25 year anniversary. This report examined "why people were drawn to [the web]" and its role in their lives (Pew, 2014). While the report documents the pervasiveness of the web, it also, by what it does not measure, documents the challenge to achieve a general attitudinal shift towards web equality for those with disabilities. This important research into web usage does not consider why individuals do not use the web or the quality of the experience from the perspective of usability or accessibility. Respondents in the survey are characterized by demographics such as race and gender, but not by access needs, assistive technology use, or disability. In this research,

individuals who cannot effectively use the web as well as web users with disabilities (who may have different access needs) are invisible (Blanck, 2014).

Greater analysis of Current Population Survey (CPS) Internet Supplement data as well as the addition of new questions could help enlighten the nature of the disability digital divide. Rather than attempting to understand disability as one homogeneous category as has been the case to date in NTIA analyses, it is necessary to consider the various types of disability (e.g., hearing, vision, dexterity, mobility, cognitive and psychosocial, etc.) and how those interact with broadband adoption and use. The CPS already collects data on type of disability so that can be easily cross tabulated with Internet Supplement data to gain insights. In addition, given that many Americans with disabilities may need assistive technology in order to access and use broadband, new questions should be added to investigate the potential interrelationship of these variables. Specifically, respondents with disabilities should be asked if they need assistive technology in order to access and use broadband; and if so, whether or not they have that assistive technology; and if not, why not.

In terms of technology research proposals, those that prioritize user testing and universal design ought to be prioritized. All technology research proposals ought to adhere to best practices in accessibility for people with disabilities, including Section 508 of the Rehabilitation Act of 1973 and the World Wide Web Consortium's *Web Content Accessibility Guidelines 2.0* (Access Board, 2015; Caldwell, Cooper, Reid, & Vanderheiden, 2008).

User testing (also referred to as usability testing) is a crucial element in fostering the development of technologies that realize their stated benefits. Successful user testing is an indication of the potential for widespread adoption of a new or improved technology. User testing is most efficacious when it involves a wide diversity of users, with different levels of expertise and experience. This ought to include a diversity of ages, socioeconomic classes, and dis/abilities. Methodologies for such user testing might include experimental methods such as eye-tracking or keyboard tracking as well as qualitative methodologies such as think-aloud protocols, interviews, and surveys. Qualitative methods are of particular importance to understanding not only what users do with new technologies but why they do so, thus providing a window into users' expectations and desires for new technologies.

Universal design is "an ideology of inclusion and flexibility with a range of applications in education, technology, and other milieus" (Hamraie, 2012), and is particularly associated with maximizing access for all people (regardless of age, sex, ability, etc.) by designing from the perspective of non-normative bodies. Originating in architecture (Mace, Hardie, & Place, 1990), universal design has been taken up in broadband-related fields (Chisholm & May, 2008; Lazar, 2007). Research proposals that prioritize universal design and associated methodologies and techniques are likely to produce more widely usable technologies, fostering adoption of new broadband technologies across a range of industries and audiences.

For those with cognitive and psychosocial disabilities, advances in web content need to be equality validated by evidence-based practices that are part of a unified framework for user-centered participation in society (Blanck, 2014). Equality is furthered when individualized capabilities are built into the service from the start and augmented by auto-personalization tools in the cloud. For example, Diana Ruth-Janneck (2011) has attempted to isolate particular design characteristics that advance web content equality for persons with cognitive disabilities. Her objective was to pinpoint barriers as a function of disability, but importantly, to identify the means to address such obstructions. Although some barriers were found to be disability-specific, common barriers were found in regard to general ease of use; for instance, in terms of the lack of operability with user agents across platforms and components, in navigational structure and page orientation, in the use of pre-set forms and security controls, and in the general perceptibility of content and multimedia.

Further, on an even more fundamental level, research and development in web software markup languages and engineering is crucial (Barney, 2011). HTML5 is the newest version of the open architecture web programming language. The markup language has undergone study and testing by the W3C, and its features are considered stable enough to become a primary language in the next generation semantic web. HTML5 is a comprehensive language for web content and provides interoperability across devices, and with multimedia, entertainment, and gaming applications. As a complement to HTML5, CSS3 is a style and layout next generation markup language for content presentation in navigation functions, font, coloring and layout, across media types and groups such as visual, text, and audio style sheets. CSS3 enables these presentational styles to be separated from underlying substantive information, providing users flexibility and choice in the ways content is presented with user agents. Study of how HTML5 and CSS3 together enhance web content equality for particular users with and without disabilities is needed as opportunities for diverse presentations of online knowledge emerge (Blanck, 2014).

With these advances in code engineering, examination is needed on how developers integrate capabilities for captions and subtitles that make multimedia programming accessible and usable for individuals with hearing disabilities, and comprehensible for those with cognitive and print disabilities (Blanck, 2014). However, caption comprehension is intimately linked to individual reading skill level and studies show that captions and sign language video clips together improve online comprehension and learning for deaf individuals more than either alone (Yoon & Kim, 2011).

Moreover, it is important to encourage research on the wealth of practical information available to spur research and development, given that the Twenty-First Century Communications and Video Accessibility Act (CVAA) requires Advanced Communications Services (ACS) manufacturers and service providers to maintain records on their consultations with their customers with disabilities, and descriptions of accessibility, usability, and interoperability features as used by individuals with disabilities (Blanck, 2014). Analyses within and across market sectors will identify trends and best practices, and they will enable an evidence-based assessment of real-

world outcomes. Hopefully, these advances in research and practice will stimulate collaboration across the globe in furtherance of web equality among users and their advocates, online service providers, and researchers and practitioners from multiple disciplines.

Poverty and Digital Ecology

In order to fully comprehend and grapple with the digital divide, especially for those living in poverty, we must develop an understanding of the local, physical environments in which people experience digital inequality and related challenges. Most research on technology does not seriously consider local factors anymore, in part because of the potential for mobile tech in particular to transcend physical geography (or so the argument goes). As a result, we do not have rigorous investigations into how local resources -- infrastructure, social resources/support, institutions like libraries, schools, public wifi, etc. -- impact the strategies that residents devise to address being unconnected or under-connected. It is imperative to develop robust community-level assessments to contextualize individuals' and families' experiences in order to adequately assess where the best points of intervention may be to address digital equity concerns.

Three ecological tenets should guide these types of research projects (Katz, 2016). The first emphasizes accounting for local community features that constrain or enable individual behavior. The second stresses human agency; individuals and families make choices, as opposed to being solely at the mercy of structural factors. Third, ecological approaches involve data collection across levels of analysis to identify variations that explain differences in social outcomes. For example, a research project might be interested in variation at the:

- Micro-level, between children, and within their families;
- Meso-level of the local community, including institutions and organizations relevant to digital equity efforts; and
- Macro-level, which includes national, state, and district policies that impact local experiences of digital inequality.

Research questions in this type of study might include:

- Which local-level factors enable children's and families' efforts toward meaningful digital connectivity, and which constrain them?
- What forms of connected learning are children currently realizing, and what can be done to increase and deepen those opportunities?

While research has documented how digital inequality adversely impacts children's developmental trajectories, what remains to be uncovered are data-driven efforts to address digital inequality that are responsive and locally relevant to the children and families who face these challenges (Katz, 2016). Indeed, for many children living in poverty, access to the Internet remains a very serious challenge. A 2013 study, for example, showed that only 46% of families in low-income neighborhoods had broadband access compared to 86% in higher income neighborhoods (Rideout, 2013). Similar gaps

were reported in the number of mobile devices; 61% of low-income families were said to own mobile devices compared to 91% of higher-income families.

For many children, the safety net in their ecology is the local public library. In 71% of all U.S. communities, the nation's public libraries are the only source of public Internet access. This safety net, however, is stretched to the breaking point. The American Library Association (2012) reports that 87% of urban public libraries do not have enough public Internet computers to meet patron demand. Funding issues limit library hours and programs in many communities. Without the help of public libraries, however, children in low-income neighborhoods will face even greater odds in competing with their wealthier peers.

The nation's public libraries provide an enormous service to all children, but particularly to children living in poverty. But, research is needed to understand: How well are our nation's libraries handling the massive task of providing broadband access for many of our nation's neediest children? What types of resources and support do they need? What types of services and programming are working well? What needs to improve?

Another important ecological aspect is increased access to smartphones across socioeconomic groups, which means that technology is becoming increasingly prevalent in interactions between parents and children. Although access to the Internet via smartphone may be closing the digital divide, another gap may be growing for children living in poverty whose families may be using digital devices less effectively. For example, a recent survey showed that 57% of low-income families who owned a mobile device said they had downloaded educational games or activities compared to 80% of higher-income families (Rideout, 2013). In addition, low-income families are less likely to own a tablet, e-reader, or computer, technologies that would improve the chances for children living in poverty to use digital technology for their advantage (Vaala, 2013).

These differences in use lead to additional research questions that have great implications for many of our neediest children: How wide is the gap between families who use digital media and their supporting devices effectively and educationally and families who do not? What effect might it have on preparing our children for success, both in school and later in life?

Finally, research in Philadelphia libraries (Neuman & Celano, 2012) indicated that many parents believe new technologies have a self-teaching aspect, making their role as their child's first teacher less important when their children are using digital devices. As well, some parents are intimidated by new technologies.

To address this issue, the Association for Library Service to Children (ALSC) has called on librarians to take on the role of "media mentors." In this role, librarians guide families to use information technology in more efficient ways. No longer are librarians focused solely on one medium (the book); today's librarian promotes various experiences – both traditional and digital -- which translate into productive and positive digital literacy skills (Haines & Campbell, 2016).

Acting as media mentors is especially crucial in low-income neighborhood ecologies, where children not only lack access to information sources, both print and digital, but also lack capable adults to assist them in becoming proficient users of technology. In the Philadelphia study of libraries, children in a low-income area started using computers at a later age (around 7) than did their peers in wealthier areas who started at around 3. Children in the high poverty area also spent more time using the Internet for entertainment purposes as opposed to information-gathering.

The role of librarians serving as “media mentors” is intriguing. Public librarians operate in nearly every community in the country; what’s more, their services are free. But, research needs to investigate: How feasible is this? Can having librarians function as “media mentors” help close gaps in the ways children in poverty use digital technology? What does a “media mentor” do? Are librarians in a position to take on this role? What is needed for this initiative to be successful?

Anchor Institutions

Schools and libraries were identified as anchor institutions in the 2009 National Broadband Plan. Much information is gathered about the services they offer to individuals in their communities, the people they reach, and the infrastructure improvements still needed. These anchor institutions are instrumental in not only ensuring broadband access for people in their communities -- especially those without access at home or work -- but also training residents to use the Internet, providing access to expensive digital content and tools, and customizing services for specific marginalized populations such as non-English speakers, low-income families, persons with disabilities, and the elderly.

What is still needed, however, are measures and indicators that improve our understanding of their role as community anchor institutions. How do these institutions help communities -- not just individuals -- face challenges, make policy choices, and play meaningful roles not only in support of individual opportunity but also to enhance place-based community development and revitalization. What role are they playing and might they play to:

- Facilitate public-private partnerships,
- Help communities realize economic and social benefits,
- Make communities more attractive for investment and serving as growth attractors and economic engines,
- Leverage investment to achieve broadband policy goals,
- Extend connectivity and serve as public network hubs,
- Offer non-discriminatory access to information opportunities,
- Build partnerships with a broad range of community organizations

Anchor institutions assumed their role through the e-rate program, initially designed to provide telecommunications discounts. They have assumed far more of a role than connectivity, primarily through initiatives unfunded by the federal government.

Communities often want them to:

- Leverage resources
- Communicate transparently
- Ensure a community presence in decision-making
- Serve as a central community partnership office
- Assist with job training and job creation relative to broadband deployment

Community expectations for anchor institutions are often much higher than they can deliver. Among the shortcomings experienced are:

- Inconsistency of effort
- Institutional fragmentation
- Failure to foster community ownership of projects or data
- Lack of strategic focus

In order to optimize the potential role of anchor institutions in community-based broadband diffusion, the federal government can help by developing new indicators to measure their contribution. Leadership is needed to

- Join the international discourse about community indicators
- Measure the impact of broadband on community economic growth, productivity, and job creation
- Determine qualitative and quantitative impact
- Assess benefits that accrue over time
- Compare which actions by anchor institutions benefit the community and its residents most
- Determine how collaborative action with partners can improve community impact

“Isolating community impact is not possible if the ‘unit of analysis’ is the anchor institution itself.” (Dubb, McKinley and Howard, 2013) As anchor institutions, schools and libraries help bridge the digital divide for all across the country. Federal programs have helped move them forward as anchor institutions and they are now critical nodes in the networked community. Researchers/policymakers need to measure not just how schools and libraries change lives, but also how they transform communities. Their next challenge is to develop indicators to measure how broadband anchor institutions impact communities. Broadband connectivity is useful not just for its own sake, but to strengthen human bonds and services, economic opportunity, disaster preparedness, quality of life, and ability to create and maintain jobs -- in other words, to enhance and improve the lives of people in the communities they serve.

Illiteracy, Low Socioeconomic Status, Rural and Remote Areas, and Building a Pathway from Cell Phones to Computers

Literacy, including the capacity to read text and use information technology at levels required for functioning well in society, is a major societal problem. Data from the past

few years estimates that 14% of the adult population, or 1 in 7 Americans, are considered functionally illiterate. In Appalachia, for example, the second poorest region of the United States, illiteracy among the local non-university population ranges between 21% and 36%. People with low reading literacy typically also have low computer literacy skills. In a world in which broadband is critical to the accessibility of information and communication for all Americans and where many employers of low-skill workers, such as Walmart, require an on-line application, lack of reading and information technology competence is truly a handicap.

An opening to address this problem exists: a growing number of people with low reading and computing literacy already possess and use powerful computing devices in the form of mobile (i.e., cell) phones. We know from anecdotal evidence from practitioners as well as from research (e.g., Napoli & Obar, 2013) that mobile phones have many limitations and shortcomings relative to personal computers and so cannot serve as functionally equivalent substitutes for PCs. However, exploratory research by Kavanaugh, Puckett and Tatar (2013) as well as in-depth interviews and observation of training courses for the Austin, Texas public housing authority (Austin Free-Net Tech Starters -- <http://austinfreenet.net/classes/tech-starters/>) and participant observation and interviewing at two other Austin non-profit programs aimed at recent immigrants (TechComunidad at the River City Youth Foundation) carried out by University of Texas at Austin researchers suggests that the use of mobile phones by low computer literacy populations can help them learn computing concepts and encourage them to access information through other computational devices, such as kiosks and desktop computers that might be available in public libraries and local community action centers that focus on the needs and interests of lower socio-economic groups. That is, computing metaphors and skills learned on mobile phones can be transferred to other computing settings.

Thus, research is needed to explore this phenomenon to understand how we can help mobile-only users bridge to computers and how we can integrate mobiles in school and computer/Internet training. Crucial research and data are needed in the areas of:

- 1) study of mental models and social-emotional conditions of low-literacy cell phone users, including how cell phones fit into the lives and predispositions of low-literacy adults and how work with them interacts with the mental models, self-efficacy and progress of low-literacy learners with and without cell phones,
- 2) a focus on the use of cell phones by low SES groups as a way to explore computational ideas,
- 3) study of ways to utilize the cell phone in computer literacy tasks in the context of tutoring low literacy adults for reading and job training,
- 4) development of a tailored, simplified pathway from cell phone skills towards competency with the more complex environments of desktop and laptop computation over broadband networks.

Findings will affect interface design and computer learning strategies and materials for low computer literacy and low reading literacy groups. The design of scaffolding for the transition to computers and desktops addresses the on-going problem of life in a world of many devices.

One reason that current approaches have not been more successful with these populations is that they are so insensitive to cultural variation that they cause significant portions of the population to avoid learning basic functions that would allow them to engage in information acquisition. Based on axiomatic cultural anthropological theory, we see that these avoidances are rooted in culturally pervasive meaning relationships, such as what it means to be a man, how and what constitutes valued knowledge, and how morality can be maintained within families. Specific instances of mobile phone or computer usages entail meaning systems broader than the immediate context so that current teaching approaches and methods of human-computer design must take the broader implications of cultural meaning into account in their efforts to ameliorate or transform these avoidance or low usage practices.

For example, members of the indigenous Appalachian population, specifically the South Central Appalachians, are thought to belong to an identifiable culture that entails specific barriers to information technology learning. Working-age people in these rural settings tend to be unemployed or under-employed. They lack the computational skills required, for instance, to apply for a job at Walmart. The elderly may lack the skills to engage with online government and healthcare provision as well as with online sales and other facilities that might ease their lives. A significant portion of all populations may be functionally illiterate, but will still have access to and basic knowledge of simple cell phone technology.

Addressing research questions for these types of populations requires understanding how cultural meaning systems towards computer technologies can be used as a resource in designing effective artifacts and curricula in teaching low income/low literacy populations from variant cultural backgrounds. The goals of such teaching must not only include enhanced quality of life and civic participation, but also maintain key cultural systems and values that are critically important to them. Consequently, some of the central research questions raised by this are:

- How do cultural meaning systems matter in the design of information technology curriculum and interfaces for low-computer literate learners?
- How can mobile phone use and associated materials be used in culturally-sensitive ways to assist large segments of the low literacy populations in rural and economic periphery areas to participate more fully as empowered citizens in national and transnational political economies and societies?

Researching Marginalized Populations and Impacts

Critical data and research needs in the areas of broadband technology, innovation, and deployment are related to access for marginalized populations. There remain broadband access deserts, often in the same locations that are also considered food deserts (i.e., few to no nearby places to access fresh fruit and vegetables). Low income housing and schools in lower SES locations do not have the infrastructure to support broadband technology. The same is true in rural and remote areas of the U.S. Data are necessary to determine a plan of action to update infrastructure and inform citizens of broadband

availability. This research should be planned and conducted in close collaboration with local governmental and non-governmental/non-profit organizations that serve underrepresented populations.

Commonly-used demographic terms across the research community should include race/ethnicity as identified by the participant (not necessarily the check box on a census form); age range operationalized by elementary and secondary school age, young adult, adult, and senior as young-old (age 65-74), middle-old (age 75-84) and old-old (age 85+); income levels based on national poverty rate and standard income designations; and education. A fruitful area to include is homeownership; researchers may find differences among people who rent versus buy and apartment versus single family house.

Further, research on access and adoption of broadband technology across unserved and underserved segments must explore cultural factors in technology use to explain the heretofore unexplainable (Kretchmer, 2017). For example, by utilizing regression analysis, we know that differences in demographic, socio-economic, and geographic characteristics explain only a small portion of the gaps in adoption between White as opposed to Black and Hispanic households (ESA & NTIA, 2011). After controlling for socio-economic and geographic differences, the adoption gap between Asians and Whites disappears. In contrast, 69% of the broadband adoption gap between White and Black households and 73% of the gap between White and Hispanic households persists even after accounting for socio-economic and geographic factors. And, while, overall, computer owners displayed much less disparate broadband adoption rates across race and ethnicity, controlling for demographic and geographic characteristics again erases the Asian and White difference, but both the White-Black and White-Hispanic gaps are still 75% unexplained. Further, NTIA recently used their 2013 dataset to model individual-level Internet use to try to explain at least part of the remaining adoption gap among Hispanics (Morris, 2015). They found that adding indicators of language barriers and non-citizenship, both negative indicators of Internet use, to the model reduced but did not eliminate the estimated gap attributed to being Hispanic. Adding these two factors that are part of Hispanics' social context was an astute hypothesis, but again, this model does not eliminate the gap entirely; approximately 60% of the gap continues to be unexplained.

Also by utilizing regression analysis, just like with race and ethnicity, we learn that differences in socio-economic and demographic characteristics explain only a small portion of the gaps in adoption between urban as opposed to rural households (ESA & NTIA, 2011). After controlling for demographic and socio-economic differences, 39% of the broadband adoption gap between urban and rural households persists. Plus, while, overall, computer users displayed less disparate broadband adoption rates across urban and rural residency, controlling for demographic and socio-economic factors again still leaves the urban-rural gap 63% unexplained. Likewise, after controlling for demographic, socio-economic and geographic differences, 21% of the broadband adoption gap between householders with no disability and householders with a disability persists (ESA & NTIA, 2011). And, while, overall, computer users displayed much less disparate broadband adoption rates across disability status, controlling for demographic

and socio-economic factors and geography again still leaves the disability divide 30% unexplained.

Thus, race and ethnicity, rural residency, and disability status are independently associated with technology usage patterns. And, these issues are ongoing and continually problematic for developing a clear understanding of digital divides and the best ways to address them. While ESA and NTIA have not published an updated version of the exact regression model described above using more recent datasets, they have internally periodically run the same basic model used in their 2011 report on newer datasets to see whether the results are similar, and they consistently are. But, *why?* What *explains* these divides and enduring gaps that are so impervious to current policy and practice initiatives and the ever-growing mainstream cultural assumption that computers and the Internet are essential for life in the digital age? And, based on the answers to those questions, what improvements must be made in policy and practice that seeks to foster digital inclusion in order to accurately combat digital inequality in the U.S.? (Kretchmer, 2017)

Cultural factors are important to understanding why users do or do not access and adopt new technologies. These factors include (il)literacy, socioeconomic conditions, community norms, identity categories, use conditions (public vs. private), and many others (DiMaggio, Hargittai, Celeste, & Shafer, 2004; van Dijk, 2005; Warschauer, 2003). Beyond quantitative and demographic studies of such factors, research that documents the deeper cultural dimensions of technology access and adoption includes survey, interview, focus group, discursive, and ethnographic approaches. Existing research in this vein has focused on underserved segments including racial minorities, urban and rural residents, persons with disabilities, and immigrant populations and on understanding such aspects as motivations, attitudes, interpretations, the meanings attributed to various devices and the Internet, and the unique digital literacy and web content needs within the social context of each culture (e.g., boyd, 2008; Kretchmer & Carveth, 2001; Graham & Choi, 2016; Leonardi, 2003; Brock, 2009; Ellcessor, 2016; Gilbert, Karahalios, & Sandvig, 2008; Gray, 2009; Larson, 2007; Tripp, 2011; Kretchmer, 2017).

The notion of culturally appropriate interventions has existed for a long time in Educational Psychology and Human-Computer Interaction. However, ethnographic work is deeper than “quick ethnographies” and what is required is a significantly more systematic response that cross-cuts settings. Useful corollary data collection activities also include, for example, stakeholder analysis, iterative refinement and design tension analysis advocated in value-sensitive design (Friedman, Kahn, and Borning, 2006), design-based research (Brown and Campione, 1996; Sandoval and Bell, 2004), and design framework analysis (Tatar, 2007).

Ethnographic research should include a special focus on current use of the technology being studied and the cultural meanings given such uses (e.g., “being bossed” when a wife phones or texts a husband’s mobile phone to do a task or a worker receives directions from a supervisor about a job). Data should focus on not only what is communicated, but also on meta-communicative data, such as how users talk about the

technologies and their functions. These investigations will result in a heuristic typology of technology uses by interpretive frames, or ways of classifying or analyzing technology uses. These data and the resulting typology should then lead to a theoretical model for developing curricula for instructional materials and settings.

In addition to fostering greater understanding of (non-)use, in order to understand the social and economic impact of (non-)broadband access and adoption for marginalized populations it is critical to have research that fully assesses what services, both government and corporate, are available only through broadband or only partially through broadband (or the Internet overall). Once this is determined, the impact of an absence of broadband access can be effectively identified. This assessment is particularly important for federal, state, and local government programs that target assistance to the least broadband-connected marginalized populations yet are increasingly becoming digital by default. Thus, a review of current programs as well as assessment prior to the implementation of any further migration of services online must be undertaken. Beyond other research that may be generated through government agencies or NSF, to further explore the impact of this issue, a question should be added to the CPS Internet Supplement asking respondents if within the preceding 12 months they were unable to access online content, application materials, or resources for federal, state, or local government agencies and/or potential employers. It should be understood that not only will research in this area help to determine the degree of disadvantage imposed on marginalized populations by those services available only or partially online, but also that this assessment will aid government agencies to accurately calculate the cost-effectiveness of allocating resources to bring services online when only a fraction of those they serve can access that online content.

Similarly, to determine the actual return on investment in broadband in all areas of American society, public and private, research is also needed to assess exactly how much value is being added in core areas such as medical services, emergency preparedness, and educational experiences; there is often an unchallenged presumption that there is endless value added relative to cost, but is that really the case when measured objectively and comprehensively through research? And, how much value in broadband investment is lost because significant segments of the population do not have broadband access and/or skills? What are the economic and social costs of digital exclusion (e.g., the costs of the “homework gap” and poor children attempting to handle their education needs with a smartphone from elementary school through college in terms of educational attainment, employability in the workforce, and psychological and social impacts; the costs of electronic health records and medical systems in terms of the exacerbation of health disparities in the population and disparate healthcare norms and experiences between medical institutions with varying degrees of technology implementation and expectation; the costs to small businesses in terms of lost business development opportunities, inability to be competitive, and difficulties in such areas as ordering, supply, and repair; the costs of providing unemployment compensation, SNAP, Medicaid, and other social services because the unemployed lack the digital skills necessary to find jobs and carry out the duties of workers in a digital economy; etc.)?

Beyond these broader impacts, it is crucial to understand and prioritize research that explores impacts at the often overlooked very specific level of non- or limited-use(rs). For instance, Robinson's work (Kretchmer, Pierce, & Robinson, 2015) demonstrates that students' use of the Internet for capital-enhancing activities cannot be understood apart from their access situations. Students with home access to Internet resources in addition to school/library/third places access engage with digital media in a fundamentally different way than do students without access at home. Those with home access go far beyond mere passive information retrieval, using their Internet engagements for self-teaching in a very active way. By contrast, disadvantaged students without the time and freedom afforded by home access treat the Internet as they would analog channels that provide information to be consumed. For them, the Internet loses its unique strengths as an interactive medium that allows students to enlarge their horizons and develop their intellectual capacities. In this way, this research indicates how first-order digital divides related to levels and sites of access contribute to second-order gaps related to capital-enhancing activities. Here we see how socio-economic disparities foster differential Internet access that can lead to yet other inequities down the line as offline and online inequalities are mutually reinforcing and self-perpetuating.

Further, Robinson's long-term fieldwork with economically disadvantaged youths (Kretchmer et al., 2016) also elucidates how everyday digital activities have radically different meanings and consequences for well-resourced, moderately-resourced, and under-resourced youths and how resource shortages force daily emotion management and identity work for disadvantaged youths. These types of impacts have profound and long-lasting effects not just on those who are digitally excluded, but also on American society and, thus, need to be uncovered through research.

Similarly, research that incorporates outcome-based evaluations of digital inclusion policies and programs should be prioritized. Those which can effectively convey and measure the impact of the initiatives both quantitatively and qualitatively ought to be a focus. Research is needed that examines the simultaneous social and economic impact of an intervention at the individual and group level.

Relevance, Interest, Want, Need, and Cost as Complex, Nuanced Issues

Research that seeks a more nuanced, multi-faceted understanding of why some populations have considerably lower rates of Internet adoption than others is needed. An example is the Digital Inclusion project, which engaged with individuals who live in low-income housing units located in Southern Ontario, Canada (Haight & Quan-Haase, 2016). The aim of the project was to learn first-hand from inhabitants of those units what it meant to them to be connected or disconnected to the Internet in the context of their lives. There was an emphasis on the experiences, attitudes, and opinions of inhabitants. Haight and Quan-Haase found that for many participants in the research, the response "no need/no relevance" was rooted in another barrier such as cost, lack of digital literacy, lack of confidence, and little understanding of what kinds of activities the Internet can facilitate. The study shows that further unpacking the meaning of "no need/no relevance"

is critical, as individuals in low-income housing units have a desire to be a part of the digital world, but need the right conditions in terms of pricing, availability of equipment, technical support, and mentorship. Like this study, new research must explore digital participation as a complex social process rooted in existing inequalities.

Moreover, research is needed that further unpacks the meaning of broadband adoption in the context of individuals with low incomes and educational attainment, low literacy, racial/ethnic minorities, older adults, those with disabilities, and other marginalized populations so that digital inclusion efforts can be properly designed and executed. How do these various populations uniquely construct their information environments? What do they do with their information environments and for what purposes? How do they use devices and the Internet? The answers to these questions and more that can be revealed by research will demonstrate how the structures created reflect the users' resources, values and perspective, and what they are trying to accomplish with the technology as a result.

While it is true that some people may not feel the Internet is relevant to them, recent studies have called attention to the issue of relevance as a more-nuanced phenomenon than previous research has described (Rhinesmith, Quan-Haase, & Haight, 2016). At the center of this lies connecting digital literacy training with relevant content and services (Quan-Haase, Martin, & Schreurs, 2016;). Thus, when CPS Internet Supplement respondents say that the Internet is not relevant, it may well be that it really is not relevant for them. Often research, policy and practice assume that all that is needed is to overcome misperceptions that the Internet lacks relevance (i.e., that non-users simply do not understand and need to be educated on broadband's benefits) when instead those assumptions must be unpacked and tested for validity through research that uncovers the true meaning of "relevance" as defined by marginalized populations, not by out-group researchers, policymakers, and practitioners. The same is the case for the other standard multiple-choice options researchers offer to respondents as reasons for non-use, namely "interest", "want", "need", and "cost". Current research suggests that there is no one way of making use of ICTs; rather, ICT use can only be understood in the social context of engagement, in what relevance it gains, interest it sparks, sense of wanting and needing it inspires, and value and cost-effectiveness it supplies *as defined by the user*. As such, research is essential to investigate this process to increase understanding of the actual reasons for use and non-use within various population groups, especially among segments that have traditionally not used or under-utilized broadband.

A prototypical example of this is the pioneering work conducted on the U.S. digital divide in the mid-1990s when the on-ramp to the "Information Super-Highway" was access to the Internet via dial-up telephone lines. The conundrum in 1993 was: why did a significant number of U.S. households remain without telephone service? In response, ethnographic research interviewing householders in homes without telephones in Camden, New Jersey contributed new insights into a circumstance that adversely affected a diverse cluster of groups with complex motivations (Mueller & Schement, 1994; Schement, 1995; Mueller & Schement, 1996). Building on demographic, socio-economic and geographic data, the interviews revealed stories that clarified the unexplained larger

patterns observed via statistical analyses. Schement and Mueller's research enlightened what had been a perplexing issue for policymakers and practitioners by showing that, for low-income households on the margins of a rapidly evolving information society, the telephone proved a mixed blessing at best and a value choice based on perceptions and meanings unique to the interviewees' circumstances.

At present, in the case of the disability digital divide, for instance, there is ample evidence that persons with disabilities use Internet technologies at lower rates than the able-bodied population (Dobransky & Hargittai, 2006, 2016; Fox, 2011). While 81% of those without disabilities use the Internet, only 54% of persons with disabilities do so (Fox, 2011). This would seem to indicate a need to increase adoption and use of broadband and associated Internet technologies. However, data about usage rates for persons with disabilities tell only a partial story. In order to increase adoption and use, research must begin by asking *why* persons with disabilities are not already using the Internet and associated technologies. Research has shown that technological refusers of various sorts have complex reasons for choosing not to use a given medium (Portwood-Stacer, 2012; Wyatt, 2003). For many people, technological access and use are not obviously beneficial. For persons with disabilities, in particular, barriers of cost, assistive technology, and literacies may depress adoption and use. These barriers are, themselves, worthy of study as issues adjacent to broadband adoption and use.

Research on this matter ought not to assume that adoption and use are universally beneficial, but should engage with target populations in order to understand what they need and expect from technology, and their reasons for using it or not using it. In many cases, persons with disabilities are interested in not merely what is technologically possible, but in finding uses of Internet technology that are resonant with their experiences and identities (Elccessor, 2016). Thus, more qualitative research is necessary in order to respond appropriately to the diversity of factors that may stand in the way of higher rates of adoption and use.

Additional qualitative research that engages with people's experiences of broadband technology is likely to reveal unexpected assumptions about what access and use entails. For instance, many persons with disabilities find legal and technical accessibility policies to be limited, or even irrelevant; instead, they often define access in terms of inclusion in online social spaces and the ability to participate in desired activities (Elccessor, 2016). These activities include many of the same activities pursued by non-disabled Americans (Dobransky & Hargittai, 2016), revealing the limitations of access efforts that focus only on access to technology or information. In fact, persons with disabilities also demand access to production of digital content and technology and to entertainment and leisure uses (Dobransky & Hargittai, n.d.; Elccessor, 2016; Ellis & Kent, 2010). By studying lived experiences with technologies, and uncovering different understandings of access and adoption, policies, practices, and technologies may adapt to user needs and demands, producing better and more useful outcomes in technological design and use for marginalized populations.

Churn

Research suggests that a substantial percentage of households are cyclically unable to stay consistently connected to the network -- they may have service for a time, but then drop off (due to inability to financially support connectivity) and this churn persists (Kretchmer & Schement, 2011). There are four, often interrelated, aspects of this phenomenon:

- 1) disconnection of home Internet service, usually for failure to pay
- 2) disconnection of cell phone service, usually for failure to pay
- 3) hitting the data cap on the cell phone plan, which could either prevent Internet access or incur high overage fees
- 4) digital disruption, or technology maintenance issues

The stability of Internet access is most often overlooked, but is an increasingly central issue in the digital divide. And, the lack of a thorough and rich understanding of this phenomenon will have profound implications for crafting policy and monitoring the implementation, success, and consequences of broadband access and adoption programs.

A small amount of research has begun to document these issues. Dailey, et al.'s qualitative research (2010) shows that, among un-adopters, unanticipated, unpredictable costs for hardware and software, installation, deposits, equipment maintenance, transaction fees for disconnecting, and changes in subscription pricing were often cited as reasons for discontinuing home broadband access. And, respondents also reported recurring churn as household finances fluctuated. According to research by Smith (2015), 48% of Americans who only have Internet access through their smartphone had to cancel or disconnect their cell phone service for a period of time because they could not afford to maintain it. Further, 30% of smartphone-only Internet users frequently hit their cell phone plan's data cap and 51% at least occasionally reach their limit. And, these figures are substantially higher than for smartphone users who have additional Internet access options beyond their phone; only 21% of users with additional options had to disconnect or suspend service and only 35% at least occasionally reach their data caps (Anderson & Horrigan, 2016).

Rideout and Katz (2016) found that among lower-income families with mobile-only Internet access, 29% had reached the data cap on their plan in the past year (39% of those below the poverty line and 25% of those above poverty) and 24% had their cell phone service (and thus their Internet access) disconnected in the past year for failure to pay (31% of those below the poverty line and 21% of those above poverty). As well, 20% had their home Internet service disconnected at least once in the past year for failure to pay (29% of those below the poverty line and 16% of those above poverty). This study also brings in a corollary of the technology maintenance aspect of churn -- old or aging devices that run too slow and slow Internet service. For these lower-income families, 59% struggled with a computer that runs too slowly (58% of those below the poverty line and 59% of those above poverty) and 52% had Internet service that runs too slowly (50% of those below the poverty line and 53% of those above poverty).

Other research (Gonzales, 2014; Gonzales, 2016; Gonzales et al., 2016) has focused on how the poor are having a more difficult time maintaining access. Low-income citizens often use devices that are broken, borrowed, or dependably unstable, chronically cycling through periods of intermittent disrupted access. Although exact numbers on this issue are unknown, qualitative work finds that disrupted ICT access disrupts access to healthcare, part-time and shift employment, social services, and social support.

To develop a richer understanding of these issues and attempt to alleviate the consequences of churn, researchers and government agencies must collect longitudinal measures of under-connectedness through disconnection and technology maintenance practices. This includes questions like: how frequently are people that own and use computers, cell phones, and in-home Internet access disconnected due to the inability to pay monthly fees or replace broken systems? How many of those same people no longer have landline phones (59% of those in poverty; Blumberg & Luke, 2015), exacerbating the impacts of disconnection problems? What are the consequences of disconnection for access to healthcare, employment, interpersonal support, social services, etc.? How do people make due when access is down? These questions are critical to understand the scope of this problem and then formulate effective governmental and private solutions.

This research effort should include funding for academic studies to collect new data on churn and disrupted digital use and access as well as expansion of or collaboration on current federal data collection work, such as those conducted at the CDC or Health and Human Services. Collaborations between health entities and NTIA could help to deepen questions of access quality and stability and broaden assessment of well-being outcomes to data on employment, emotional support systems, and other non-health related resources that are essential for health and quality of life.

In addition, data collection by the FCC through the Form 477 process provides the best opportunity to routinely and objectively (versus respondents' self-reporting of incidences which may be under-representative) monitor the nature of this important phenomenon and trends. Thus, new questions should be added to Form 477 both for ISPs and cell phone carriers covering the number of disconnections for failure to pay and any other reasons (broken down by reason categories); for cell phones, the number of customers who did and did not go over their data plan limit; and, of those who did go over their data plan limit, at how many days into the monthly billing cycle was the limit reached, how many customers were simply disconnected from broadband use at that point, and how many were allowed to continue broadband use but were charged a higher cost per minute, what was that charge per minute, and how many minutes were charged at that higher rate. This data should be collected separately for both home/individual and business customers and at least at the census tract level, but preferably for greater detail, at the block group or block level. This is particularly key data for subsidized Internet and cell phone service and would give researchers and policymakers crucial information on the stability of access, especially in identifying "hot spots" where instability is most prevalent. For example, going forward, anonymized data on the stability of Lifeline access could be made available in a manner that serves to improve access and the interest of cooperating private companies.

Further, questions that should be added to the CPS Internet Supplement include:

- For households that currently have home Internet service: Were you without home Internet service for more than 24 hours within the preceding 12 months?
- For households/individuals who currently have cell phone service: Were you without cell phone service for more than 24 hours within the preceding 12 months?
- For households/individuals who currently have devices/systems used to access the Internet at home: Were the devices and systems you use to access the Internet at home out of service/in need of repair for more than 24 hours within the preceding 12 months?
- For households currently without home Internet service: Did you ever have home Internet service in the preceding 12 months?
- For households/individuals currently without cell phone service: Did you ever have cell phone service in the preceding 12 months?
- For households/individuals currently without devices/systems used to access the Internet at home: Did you ever have devices/systems you could use to access the Internet at home in the preceding 12 months?
- Was your home Internet service disconnected during the preceding 12 months? If yes, why?
- Was your cell phone service disconnected during the preceding 12 months? If yes, why?
- Did you hit the data limit for your cell phone plan at least once within the preceding 12 months? If yes, how often has this happened within the preceding 12 months?
- Does your home Internet service run too slowly?
- Does your cell phone Internet service run too slowly/
- Does the device you use to connect to the Internet at home (e.g., computer) run too slowly?

Please note the use of the term “Internet service” rather than “broadband service” as there still are households with dial-up Internet access and dial-up correlates with lower income and education so valuable information to capture.

Digital Citizenship and Users’ Engagement and Participation

Digital citizenship is the ability to participate in society online, requiring regular access to the Internet and the skills to use it effectively (Mossberger, Tolbert and McNeal 2008). In the context of the current evolution of the Internet and its applications, access to high-speed broadband is a necessity for digital citizenship. But, measures of access alone are insufficient to understand the extent to which broadband use matters for online participation. Both quantitative data and qualitative studies are needed to measure activities for civic and political participation, and activities relevant to employment, community economic development, education, health, transportation, public safety, energy conservation, and more. These are activities that matter for individual equality of opportunity and for collective benefits for society -- for digital citizenship.

This implies several needs for research. First, we need national data on activities online that can also be used to track general trends, with a large enough sample to understand

differences across demographic groups and to create estimates for communities. It is important that the Current Population Survey continue and even enhance the Internet Supplement, as this is an important source of data for tracking activities online. While the Pew Internet and American Life Project is able to highlight important trends, the much larger sample size of the CPS allows for better analysis for under-represented groups as well as community-level estimates.

One important dimension of digital citizenship is civic engagement and political participation online. To what extent do individuals and communities have the resources and capacities they need for exercising voice, for deliberating on issues, and for participating in democratic processes? Civic engagement can be defined as knowledge, discussion, and interest in public policy and politics, and prior research has shown that Internet use, including use of online news, matters for these measures of civic engagement as well as for participation such as voting (Mossberger, Tolbert and McNeal 2008; see also Shelley Boulianne 2009 for a meta-analysis). The Current Population Survey Internet Supplement has occasionally included measures that are relevant to civic engagement, political participation, and access to government. These should be collected on a more regular basis and extended, on topics such as use of e-government, online news, information on politics, information on local communities, and discussion of issues (for instance, on social media). This is important not only for understanding trends in relatively small subgroups -- for example, among minority youth, or American Indians and Alaska Natives -- but also for estimating trends at the community level, which is important for political representation. Sources supported by the NSF, such as the American National Election Survey, should also emphasize how technology is being used, especially for demographic populations that have been less likely to participate online (and often less likely to participate politically as well).

Research demonstrates that political participation increases with education, income, and age. To what extent does broadband use ameliorate these disparities, and if this is possible, for whom and under what conditions? There is a need to understand how the Internet influences civic engagement and local problem-solving in communities, especially in low-income communities that have been a focus of digital inclusion efforts. This could be one aspect of program evaluations, in which particular interventions and approaches could be studied. Case studies and participant observation could also help us to understand the dynamics within communities, and how technology does or does not influence civic engagement. Another promising area of research, for which better data is needed, is civic engagement among youth. While young people are among the least likely to be civically engaged, they are also most likely to be online. Use of online news has particularly large effects for political knowledge among youth (Mossberger, Tolbert and McNeal 2008). The European Union has sponsored research initiatives on the Internet and civic engagement for youth, and private foundations, such as MacArthur, have conducted some initial explorations of civic engagement among youth. Better funding and data in the area within the U.S. could lead to some fruitful comparisons as well as recommendations for public policy and education here.

In addition, much research and data collection in the past two decades has focused on narrowly defined issues of adoption and use of ICTs by various social groups. The crucial need moving forward is data about users' engagement and participation focusing on the extent to which different social groups utilize ICTs in content production. Even social groups that are thought to contribute to content creation are in fact only minimally involved. For instance, Millennials are often described as digital natives or the Net generation, presuming they are heavy users of ICTs (e.g., Prensky, 2001). Yet, while Millennials tend to engage in some online activities heavily, several studies have questioned both their skill level (Bennett, Maton, & Kervin, 2008; Margaryan, Littlejohn, & Vojt, 2010) and their overall contribution to online content creation beyond personal content and clicktivism (Shulman, 2009). Critical data needs to be collected to obtain an understanding of the extent to which various social groups engage in content production and specifically how their skill levels either aid or hinder participation and engagement. This will shift the debate around broadband because it will focus not only on the capabilities of "downloading" content, but also on challenges associated with producing and uploading content to the Internet.

Indeed, digital participation through content creation and uploading of content is to a large extent the new divide in society. Central questions here include: What does digital participation and engagement mean, and what is the social and economic impact on users? Should digital participation be limited to shallow forms of engagement, such as liking, forwarding, and retweeting? What additional measures of engagement could be useful to establish a baseline of what constitutes digital participation? How are the skills needed to engage in the production and uploading of content learned? What are the broadband needs for facilitating uploading?

Research Collaborations with Federal, State, and Local Digital Inclusion Programs

To enhance understanding of the nature of the digital divide and the most effective strategies to bridge it, the federal government should build in opportunities for research in the burgeoning number of federal programs targeting marginalized populations. This would increase knowledge of these populations' unique challenges and opportunities and provide program evaluation to determine benefits and shortcomings. Likewise, the federal government should encourage state and local governments and national and local private initiatives (e.g., Google Fiber) to partner with researchers, including in the development stages of programs.

One major initiative and a major opportunity for comparative research is the multi-city ConnectHome program announced by President Obama on July 15, 2015 that offers free or low cost broadband access, technical training, digital literacy programs, and devices to residents in assisted housing units. An example of research that has been conducted with a similar program in Austin, Texas sheds light on the value of partnering with local universities. Launched in November 2014, an Austin program called Unlocking the Connection (<http://austinpathways.org/unlocking-the-connection/>), involving the city public housing office (Housing Authority of the City of Austin), Google Fiber, local non-

profits, such as Austin Free-Net, and the University of Texas at Austin, has been cited as a national model. Several researchers at UT Austin are doing the evaluation of the project, and have done a baseline study of all public housing residents, discovering that less than half have a computer at home and less than two out of five have a home Internet connection. Residents will receive computer and Internet training, free computers for completing training, and free broadband from Google Fiber. UT has evaluated the initial training with surveys and in-depth interviews. The program appears to be very useful to residents because it was customized to residents' needs, not a generic training on the Microsoft Office suite, as many are. Later, the impact of devices and access will be evaluated. (Chen, et al., 2016)

These types of research partnerships also are advantageous because they facilitate cooperation from and, thus, yield insights into vulnerable populations and the digital divide. For instance, the Wave 1 Baseline Survey in Austin was a census of all households in all of the 18 public housing projects operated by one of the largest Housing Authorities in the U.S. (N=1825) from March to October 2015. Door-to-door paper-and-pencil surveys were conducted in all the 18 housing sites located across the northern, central, and southern regions. This survey method effectively reached a hard-to-access population. Researchers including a team of two professors, several postgraduate students, and a professor serving as the project manager made great efforts to promote the research project and spent more than 280 hours in the field, posting flyers in all the community centers at the 18 housing projects, helping residents conduct the surveys, and participating in various community events such as Tech Feria informing residents of opportunities to sign up for free Internet services and digital literacy classes, special resident meetings, leasing parties, training sessions, and so on.

In addition, if federal programs and national private initiatives were to build in research programs in collaboration with the academic research community, there would be very useful comparison, cross-fertilization, and learning opportunities. For instance, it would be possible to compare programs at public housing sites across the country as the ConnectHome digital inclusion program rolls out across the country. Another example would be to compare Google Fiber cities as their broadband fiber project expands to more cities across the country. As well, there is likely to be quite a bit of overlap between the two sets of cities.

Other possibilities for research partnerships with university digital divide expert researchers exist in city-wide surveys and training courses. And, these partnerships, too, would allow comparisons of data, programs, challenges, and opportunities across the nation. For instance, the City of Austin, Texas has conducted the Austin Internet and Global Citizens Project, a series of city-wide surveys about digital media access and use aimed at profiling and examining digital divides and guiding digital inclusion programs. The City has begun to do these every three years in a research partnership between the city telecommunications and regulatory office (TARA) and researchers at University of Texas at Austin (Straubhaar, et al, 2011; Strover, et al., 2014). This systematic profiling has revealed an increase in broadband access, a turn toward smartphone Internet use among the poor and the young, and a need to focus on the relevance of access and use to

the most excluded groups: the elderly, recent immigrants, Latino and African-American minorities, the poor, and the least educated. Creating a comparison group across U.S. cities based on this model might be very interesting in revealing larger patterns.

Research Methodologies

While the most productive research methodologies have been presented in prior sections, we provide a more detailed discussion of selected topics here.

Research proposals should be prioritized that are community-based and focus on micro research (qualitative research methods). NTIA, the Pew Research Center, and others (e.g., Gant, et al., 2010; Horrigan and Duggan, 2015) have a wealth of reports based on surveys and quantitative data; however, getting to the heart of digital divides and broadband inequities in underserved areas requires a nuanced approach that is only met through community-based, qualitative research methods, particularly participatory action research, ethnography, and participant observation (Bishop, Bruce, et. al, 2012; Pierce, 2015).

Qualitative research data from scholars in such disciplines as communication, education/literacy, social work, anthropology, sociology, and more through collaboration with a community-based organization will produce the most accurate and useful information in an effort to provide broadband services in unserved and underserved areas. The power dynamics associated with communities and academics is at times strained. Becoming part of the community through an established organization and connections with community opinion leaders and authority figures builds trust. Trust in underserved communities is required in order to gain a full understanding of socio-cultural needs and priorities. Religious institutions and community action agencies are already embedded in lower SES areas and providing critical services, such as Head Start, reading literacy programs, job training, support groups, information sessions, and emergency provisions for clothing, food, and other essentials. These organizations are trusted and frequented by low SES groups, primarily because they are not government agencies and they are run by people in their local community. Moreover, low SES groups turn to these community action agencies and similar organizations (e.g., ProLiteracy America chapters all across the U.S.) rather than public libraries and schools because they are not comfortable in libraries due to low reading literacy nor in public schools where they typically had negative experiences. Thus, research proposals that should be favored must exhibit knowledge of and the ability to work with the community organizations and leading community members needed to facilitate trust and connection with potential research participants and must have specific planned efforts to gain high response rates from marginalized populations.

Measures of Broadband Adoption

Federal policymakers and other key stakeholders need additional research to understand how to measure broadband adoption both inside and outside the home. Traditionally,

broadband adoption has been measured by numbers of household Internet subscriptions. The data can be useful in helping to predict rates of broadband adoption. However, as more people adopt and utilize broadband via mobile Internet devices outside the home, the federal government and others need new methodologies for understanding how and where broadband adoption and utilization occurs. In addition, significant questions remain with regards to how the Internet of Things and other emerging technologies are shaping rates of adoption regardless of where people are physically located.

To address these and related issues, NTIA in partnership with the academic and private research community should develop new methodologies for understanding broadband adoption and utilization. This effort should build on previous initiatives focused on defining and measuring meaningful broadband adoption (Gangadharan & Byrum, 2012). Rather than focusing solely on the human-to-computer interactions in local broadband adoption efforts, meaningful broadband adoption can be useful for understanding the human-to-human interactions that are most helpful to individuals and families (Rhinesmith, 2016). This approach values a more holistic method for studying broadband adoption, which can help policymakers to understand the role of community anchor institutions in supporting broadband adoption and use, particularly in low-income communities.

Qualitative Research

The types of methodologies that stress ethnographic work and community involvement need to be prioritized. Action research has gained much influence in the past decade and is an excellent supplemental method to big data analytics (Kemmis, & McTaggart, 2008). It is also often described as participatory research or collaborative inquiry emphasizing the relevance and inclusion of community members in the research. Collaboration between members of these disadvantaged groups and researchers will allow for a more effective approach to dealing with issues of digital inclusion in these specific populations (Brydon-Miller, Greenwood, & Maguire, 2003). First, community members often understand their needs best. Second, Haight and Quan-Haase (2016) show through their case study approach that community members were hesitant to share knowledge with researchers at first. Once a positive relationship was established with the community, individuals were more willing to engage in knowledge sharing and creation. Finally, data accuracy and hence the validity of findings is much increased when community members are involved in the research and committed to it. In Haight and Quan-Haase's (2016) study of low-income housing communities, these benefits were apparent in terms of how respondents were willing to not only share what lack of broadband meant in their lives, but also in terms of what the social and economic significance was of being disconnected. As social and economic impacts are rather personal matters, these are often elusive from large-scale quantitative methods of data collection. To learn more about the complexity of broadband adoption/non-adoption in the context of individuals' daily lives, interviews, focus groups, and ethnographic approaches tend to be better suited.

In addition, past scholarship has focused on collecting data around Internet utilization, for example by examining the number of activities a user performs when online. These

measures, however, have many shortcomings. For instance, instead of focusing on people's everyday real life activities, they look at people's digital activities as a starting point (Quan-Haase, et al., 2016). But, most online activities are grounded in the rhythms of everyday life. For example, an individual's reading habits -- whether daily newspapers or books -- help explain their use of e-reader technology (Quan-Haase, et al., 2014). Thus, research must move away from approaches that are too limiting in their view of how people engage online and build on approaches that stress the meaning of broadband adoption in the context of everyday routines and practices.

Moreover, research on digital inclusion has typically focused on large-scale quantitative data to comprehend reasons for non-use. While this approach can improve understanding of Internet access more generally, amongst specific communities, the intricacies of their use/non-use of the Internet is often complex. As such, innovative approaches that can delve further into these complexities have the potential to improve our understanding of the way Internet and broadband adoption are conceptualized by disadvantaged groups. Working with social groups who have traditionally under-utilized broadband technology means also understanding other factors that affect their adoption choices. Therefore, approaches that engage the community directly, including in the early design stage, are critical for the success of the project.

Research that utilizes qualitative data collected through interviews, focus groups, and ethnographies can provide insights into experiences, attitudes, and reasons for broadband adoption and exclusion and, thus, yield a more nuanced picture of Internet (non-)use by these communities (Haight & Quan-Haase, 2016; Quan-Haase et al., 2016). To better understand experiences and attitudes in often marginalized social groups (e.g., seniors, low-income families, persons with disabilities), research employing new methodologies is needed. For example, photovoice is a method that makes use of mobile technologies for taking snapshots of a person's everyday life. Photovoice provides the initial data for further follow-up interviews. Visual data can be critically relevant for understanding how broadband adoption fits into the everyday life experiences of individuals, that is, it facilitates an understanding of the meaning it gains. Photovoice is also considered a method that employs participatory research because the cameras allow participants to take control over what stories they wish to share with researchers and how they chose to frame their stories. It also gives them the opportunity to show how they see themselves and their surroundings. (Rose, 2008)

Consequently, the federal government needs to prioritize and serve as a source of funding for qualitative research that is generally underfunded, but is always time-consuming and often expensive. Interviews, ethnographic fieldwork, and associated methods are often used by researchers in social science and humanities fields, which often have little direct financial support. Funding opportunities for this kind of work are rare and would be welcomed by the qualitative research community, and would yield crucial understandings and data to find solutions to the digital divide.

Community-Based Participatory Research (CBPR)

Community-based participatory research (CBPR) should be prioritized as a methodology for investigating and evaluating initiatives targeted at increasing rates of broadband adoption and utilization. CBPR has been embraced as a methodology by other federal domains, such as the U.S. Department of Health and Human Services. As the National Institute on Minority Health and Health Disparities (2016) has explained, “CBPR begins with a research topic of importance to the community and combines knowledge with action to improve health outcomes and eliminate health disparities.” Similarly, the NTIA, NSF, and other federal agencies should encourage researchers to use CBPR, particularly those working with communities to understand how broadband access, adoption, and use can promote social and economic outcomes. CBPR could have several benefits in a national broadband research context, including its use in enhancing community capacity, establishing sustainable programs, and accelerating the translation of research findings to those communities most impacted by a lack of broadband access, adoption, and utilization.

Thus, the use of CBPR should be prioritized within federally funded projects. For example, applicants could be required to provide evidence in their applications to show how CBPR will be used to pursue a broadband research topic with a particular community. This approach could also be used to develop new, more meaningful measures of broadband adoption that are rooted in people’s everyday experiences with technology. Finally, CBPR could also be used by researchers to determine how community anchor institutions can use outcomes-based evaluation techniques to show the impact of their broadband adoption efforts in communities.

Meta-Analysis

Studies summarizing the domain of research on digital divide issues (meta-analytic reviews) are generally lacking and very much needed (Blanck, 2014). As widely used in the sciences, meta-analysis is a way to digest a body of research quantitatively and qualitatively. It enables comprehensive and accurate estimates of the relationships being investigated, and the statistical and practical significance of the research domain. Using meta-analytic techniques, researchers and practitioners learn from the particular field of study to retroactively assess its significance and to proactively frame new conceptual models, research, and practice.

For example, Constantinos Coursaris and Dan Kim (2011) conducted one of the first qualitative meta-reviews of more than one hundred studies of mobile device usability undertaken between the years 2000 and 2010. They considered technological capabilities (e.g., device memory), user characteristics (e.g., cognitive and physical skills), task type, and contextual demands (e.g., time constraints), among other dimensions. Several meta-functional dimensions of usability emerged, including device efficiency, effectiveness, and ease of use, along with general user satisfaction (all of which may encompass dimensions such as learnability and understandability). However, these researchers found the study of Human-Computer Interaction (HCI) and individuals with disabilities

only in 2% of the investigations they reviewed, with that small percentage involving only users with visual and memory impairments. The researchers conclude that their findings affirm the need for systematic research involving mobile users with disabilities and other disenfranchised groups, particularly given the global dramatic rise in the use of mobile devices.

The few available meta-reviews reinforce the need for development of conceptual frameworks to coordinate, and more importantly, to cumulate findings from studies on digital divide issues (Blanck, 2014). For instance, regarding web equality for individuals with cognitive and other disabilities, multi-dimensional concepts of accessibility, usability, and user satisfaction are capable of assessment within and across groups of individuals. There are also many variables moderating web content equality that are open to study that include individual characteristics, access to technology, digital literacy, type of technology, and content engineering, as well as contextual, organizational, and environmental demands (Bargas-Avila & Hornb, 2012). The synthesis of decades of HCI study and practice, using qualitative and quantitative methods, must encompass diverse individuals with multiple and complex disabilities across the life span, and the web products and services they use at points in the product and service life cycle -- from inception to content updates and add-ons as well as third-party applications. Meta-studies help organize the developing body of information and are crucial for the coming generation of researchers, web designers, policymakers, practitioners, service providers, consumers, and their advocates to chart a course for the future of digital equality (Blanck, 2014).

Data Utilization

One of the greatest challenges for governments today is to gain awareness of what data are available with regards to issues concerning the digital divide and how to effectively make use of these data to best inform policy and practice. In a world of information overload, while new data is needed to elucidate gaps in knowledge and understanding, an additional key concern is the meaningful utilization, integration, and aggregation of existing data into a coherent strategy.

Evaluations of the effective utilization of data in policy decisions has demonstrated that despite the availability of data, many policy decisions are made without taking the available data into consideration (Kennedy, 2016). This problem seems to be particularly evident when it comes to interpreting and making use of visual data, as these are often complex and multi-dimensional. This suggests that resources need to be allocated not only into the collection of more data, but also into the utilization of the existing data in decision-making. The federal government can play a central role in facilitating the process of data utilization by providing further training in data analytics and critical data engagement. What frameworks exist to evaluate data? How can data from different sources be synergistically connected?

Not all data carry the same weight, and often data quantity does not solve problems of data quality. For example, in a study by Haight, Quan-Haase, and Corbett (2014),

immigration was identified as an important predictor of adoption and use of broadband. This association was based on an analysis of 22,623 respondents, representative of the Canadian population. More detailed analysis, however, demonstrated that the association was more complex. The authors document how “recent immigrants” show a different profile than the grouping “early immigrants/born in Canada”. Recent immigrants were somewhat more likely to be connected and to have greater skills and much greater use of social media. This shows that aggregation can occult significant nuisances in the data that would be important to take into account in policy decisions.

Early research on the digital divide tended to favor approaches relying on large data sets, often referred to as quantitative research. These large-scale approaches were valuable in shedding light on the state of Internet adoption and identifying important gaps in adoption in terms of demographic characteristics of users and non-users of the Internet. Despite the many contributions that these large-scale approaches have made, recent work has tended to also consider qualitative research based on interviews and case studies of sub-groups (Rhinesmith, et al, 2016). This work has resulted in additional valuable understandings around adoption barriers and challenges and opportunities afforded by various technologies. However, effectively combining large-scale quantitative data of digital access with case study research is not always straightforward. First, data are collected at different scales. Quantitative work tends to aggregate data, while qualitative work tends to examine the experiences of individuals and their social context. Second, quantitative and qualitative research often tends to ask different types of questions, making it difficult to triangulate the data in a meaningful way.

Two solutions can aid in greater integration of disparate data types and approaches. The first solution is to encourage mixed methods approaches where a single research problem is addressed within an overarching research design. In this way, data will converge and provide a more complete picture of the research problem at hand. The second solution is more ambitious and demanding. Through the combination of qualitative and quantitative research components at the research synthesis level, greater understandings of the current state of knowledge of broadband adoption and utilization can be gained (Heyvaert, Maes, & Onghena, 2013). This approach has several strengths, but there also remain some methodological challenges. One main advantage is that this form of synthesis provides more complete, concrete, and nuanced answers to complex research questions. Also, this approach can better aid in developing more appropriate and effective policy and practice than synthesis that only draws on quantitative or qualitative approaches alone.

The federal government could play an important gatekeeping role in terms of connecting different research projects in the design stage. This would help scholars address similar questions from different perspectives and methodologies, thereby building larger research agendas through the utilization of existent resources. Furthermore, the federal government could take on the role of producing exhaustive and comprehensive research synthesis that combine findings from diverse methodologies and approaches to serve as guiding documents not only for researchers, but also for policymakers and practitioners.

Data, Collaboration, the Federal Government, and the Academic Community

Data Generation and Availability

RFC Question #17 asks: “What data (whether public or commercial/proprietary) would facilitate ground-breaking research related to broadband, if that data were to become available?” The only realistic answer is that there is no way to know that -- there is no way to predict what might be discovered through data analysis. Thus, as much data as possible must be generated and made widely available for analysis to facilitate the vigorous pursuit of research on all aspects of the digital divide. In particular, it should be clear from the preceding discussion in these Comments that the key to advancing the digital divide broadband research agenda is to collect and analyze in greater detail than ever before, to drill down deeper, to ask “why?” and find the answers from the perspective of non-users, to go beyond quantitative to qualitative understandings. And, there is an army of academic professors and graduate students standing ready to analyze any usable data that is made available to them. The federal government’s role in this must be data generation, funding, collaboration with non-government researchers, and working to ensure that all the data that is collected across government agencies, government-funded projects, public, academic, practitioner, and industry/commercial/proprietary research is publicly available for further analysis as well as utilization in developing sound policy and practice.

Many important opportunities to expand current data sets within federal programs that produce research were outlined earlier in these Comments. Although not perfect, there is no substitute for the level of accuracy and thoroughness that the Census Bureau achieves. While other data sources may garner more publicity and, thus, public attention (e.g., Pew), their methodologies are not nearly as rigorous as the Census Bureau's (e.g., telephone surveys conducted in only English and Spanish versus telephone and in-person interviews conducted in many languages). And, consequently, routine non-Census Bureau surveys are less likely to represent the population as a whole, particularly when it comes to the most vulnerable marginalized parts of the population. Therefore, as much quantitative data as possible should be collected through the CPS Internet Supplement. Likewise, FCC Form 477 produces invaluable data for analysis that is available nowhere else.

Therefore, the NTIA, the Census Bureau, the FCC, the NSF, and other federal agencies should do everything possible to increase the availability of data they generate. And, that data should be collected and made available at least at the census tract level, but preferably at the block group or block level so that granular level analyses can be conducted to produce meaningful research for cities, neighborhoods, and communities; critical variations, for example, are lost when data is only available for larger geographical areas. As well, those agencies need to properly address any privacy, proprietary, or corporate competitive concerns while reconsidering policies in light of the tremendous public interest value of data availability.

Beyond that, the federal government needs to carefully assess federal policies and program to identify changes that can enhance and increase broadband research. And, the NSF and other government funding agencies must advocate for the introduction of digital divide topics into research that otherwise would not have considered those issues even though they are central to fully understanding the proposed area of work. For instance, when soliciting or funding research on various aspects of technology implementation within local, state, and/or federal governments, the NSF should prioritize proposals that focus on the human dimensions related to digital inequality as well as the usual consideration of the technology and data parts of the equation. As an example, important questions not normally incorporated in research proposals on Smart Cities that should be asked include: Which communities are most likely to undertake initiatives, and what role does Internet use in the population play when controlling for other factors? Do cities with higher rates of Internet use have more effective or more successful Smart Cities efforts? Are they more able to achieve measurable outcomes for energy efficiency or other sustainability goals? (Mossberger & Tolbert, 2015)

In addition, it is essential that federal agencies and departments working on digital divide issues (per the Broadband Opportunity Council model) communicate and coordinate for the greatest effect and cost-effectiveness. As well, it is crucial that those agencies reach out to create knowledge sharing relationships with their international counterparts; while some digital divide issues are country-specific, many are not and there is much to be learned from research, policy, and practice and successes and failures in other countries such as Canada, England, and Australia.

Cross-Disciplinary Collaboration

There are benefits to cross-disciplinary research, including the ability to tackle single problems from multiple perspectives. There are also of course challenges in bringing together researchers from different backgrounds each with their own languages, cultures, and commitments. However, as broadband technology pervades almost every aspect of our society, bringing together research teams that span a wide variety of disciplines can be beneficial in understanding how to address the persistent challenges that negatively impact the most well-intentioned broadband adoption policies and practice.

Cross-disciplinary collaboration in broadband research can be fostered through two avenues. First, NSF and other federal agencies should incentivize collaboration through prioritized funding of proposals from diverse teams. This diversity might entail collaborations among industry, government, and academia, cooperation between academic researchers from across various disciplines (e.g., engineers, social scientists, and humanists), or diversity of identities within the team. These diverse research teams may produce more complex answers to the problems of broadband research and offer new ways forward. Secondly, cross-disciplinary collaboration can be fostered by providing opportunities for diverse researchers to encounter one another's work. Too often, researchers are aware primarily of work only in their own field and miss the insights of those working in adjacent parallel areas. Opportunities to engage with work from other fields already takes place at Partnership for Progress on the Digital Divide's

International Conferences, but might additionally take the form of roundtables, workshops, virtual meetings, exchanges, or other real time events that PPDD could facilitate in collaboration with NTIA to enable participant researchers from various disciplines, government, and industry to share knowledge and present their work, explain its importance, and respond to questions.

Partnership and Knowledge Sharing with the Academic Research Community

Partnership for Progress on the Digital Divide brings together scholars from a very wide range of academic disciplines, including anthropology, communication, community informatics, computer science and human-computer interaction, disability studies, law, Latino studies, library and information science, planning, political science, public affairs, public health, public policy, psychology, sociology, and more. For well over twenty years, this community of hundreds of researchers has created a broad and deep body of work that informs issues related to the digital divide, including:

- gaps in access and connectivity
- digital inclusion
- digital exclusion
- digital (dis)engagement
- challenges and opportunities
- social and cultural aspects of the divide
- the skills and digital/information literacy needed to interpret, understand, and navigate information presented online and the requisite curriculum
- effective use by individuals and communities
- the impact of socioeconomic factors on user behavior
- the role of motivation, attitudes, and interests
- differences in patterns of usage
- characteristics and conceptualizations of non-users
- the ways in which people use the Internet to create content
- different forms of capital and power relationships
- the impact of new and evolving technologies
- the mobile divide
- the interplay of influence with mobile technologies
- socioeconomic and cultural effects
- social equity, social and economic justice, and democracy
- the ethics of digital inequality
- community informatics
- social informatics
- social planning
- international development
- indigenous populations
- education
- ICTs and well-being
- health
- disability and accessibility

- politics, digital government, digital citizenship, smart cities/citizens/government, civic engagement, adoption issues, and (in)equality
- global citizenship
- law and policy and its impacts, including information/telecommunications policy, net neutrality, open access, open source, copyright, Internet filtering software, and censorship
- public access initiatives
- anchor institutions
- practitioner-oriented topics considering aspects of design, management, implementation, assessment, collaboration, challenges, problem solution, and opportunities
- architectural challenges and deployment experiences
- Internet access cost analyses
- the application of research to communities, practice, and public and private sector initiatives

Researchers who work on digital divide issues have no desire to hide in “ivory towers”; rather, they have a passionate desire and crucial ability to not only provide evaluations and data to back up practitioner funding requests, advocacy, and policy efforts, but also to bring new issues and insights to the table and find solutions to help drive policy and practice forward. However, this army of researchers out there doing stellar, important work on the digital divide has had no opportunity to transmit their work to the practitioners and policymakers for whom it is intended. Getting research results into the hands of government researchers, practitioners, and policymakers has always been a constant uphill battle with no easy solution because there simply were no connection points or channels of communication between the various parts of the field. At the same time, it has been very hard for government researchers, practitioners, and policymakers to locate widely dispersed digital divide research published in academic journals and books. Indeed, as just one example of the volume of digital divide research produced on a yearly basis, consider that PPDD’s Conferences in 2014 and 2015 received a total of hundreds of submissions. Yet, nearly all of that work is to this day unknown to the vast majority of government researchers, practitioners and policymakers. Bridging these disconnects is the core of PPDD’s mission.

PPDD urges NTIA and NSF to view the National Broadband Research Agenda as an effort on which all areas of the field must come together to move forward. Further, the Agenda must be a living document that is constantly (re)considered, modified, and improved to match the consistent as well as ever-changing challenges and opportunities presented by the digital divide. Further, it is important to point out that, while funded research is essential, there also is and always will be an army of researchers who work on digital divide issues without funding and this community is a no-cost but invaluable resource with which the federal government must partner to achieve a successful outcome for the Agenda and the broader purpose of bridging the digital divide. For instance, it might be useful for subject area experts from the PPDD community to be available to NTIA and other agencies to advise as needed on critical topics, such as disability, aging,

low SES, American-born and immigrant Latinos, African Americans, non-use(rs), research methods, ethnography, etc.

To fulfill PPDD's mission and to advance the National Broadband Research Agenda, PPDD has two important initiatives on which we hope NTIA, NSF, and other federal agencies will join with us to create solid, permanent connection points and channels of communication as well as knowledge sharing and collaboration between the federal government and the academic research community:

1) PPDD Conferences bring interdisciplinary researchers together with policymakers and practitioners to enrich the dialogue; share insights, expertise, and cutting-edge research and practice across borders; identify new areas of necessary, productive research focus to foster greater understanding and enlighten policy and practice going forward; and strategize actions and catalyze solutions to advance the agenda on the digital divide.

Starting at PPDD's 2017 International Conference and continuing at all subsequent Conferences, the third day will be a full-day workshop for all Conference attendees focused on the National Broadband Research Agenda, including discussion of updates, input, and action plans with NTIA, NSF, and representatives from other agencies; what research is being done and can be done by academic researchers to further the Agenda; what data is available from the federal government and what data are particularly important foci for academic analysis; and the development of collaborations between multi-disciplinary academic researchers and between researchers and federal and private programs (e.g., ConnetHome, Google Fiber, etc.) that would benefit from and provide useful opportunities for research.

2) In collaboration with the U.S. Impact Study at the University of Washington Information School, PPDD is working to create a Digital Divide Research Library. The Research Library will be a fully searchable, high-quality, robust, enduring repository database to serve the digital divide field and connect research to policy and practice by making research easily and quickly available to all who seek it. This task is of course complex and a major, serious undertaking and involves many aspects of necessary planning from needs to concept to platform to implementation to financing and staffing the project for perpetuity and more, as well as all the details of robust taxonomy creation, upkeep on the collection, dealing with copyright issues from submitted materials, developing a highly useful and usable system that will stand the test of time by having material entered into the database meticulously and methodically by those trained as librarians to ensure proper cataloging and metadata creation so the materials are then easily and reliably discoverable through the search and browse function and the collection can be properly maintained.

In addition to these initiatives, PPDD stands ready to partner with and assist NTIA, NSF, and others in any way possible to facilitate sharing of knowledge and connections among the federal government, the academic research community, and other stakeholders and researchers and to advance the National Broadband Research Agenda.

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