DIGITAL OPPORTUNITIES COMPASS:
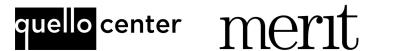
Metrics to Monitor, Evaluate, and Guide Broadband and Digital Equity Policy

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Digital Opportunities Compass:

Metrics to Monitor, Evaluate, and Guide
Broadband and Digital Equity Policy

By Colin Rhinesmith, Pierrette Renée Dagg,
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Pierrette Renée Dagg (she/her) is the director of Technology Impact Research for Merit Network at the University of Michigan in Ann Arbor, Michigan. The aim of her work is to bridge the gap between academic scholarship and practical application to positively impact technology and information equity. She is currently a PhD candidate at the University of Toledo in Social and Philosophical Foundations of Education and Education Technology, where she is completing a dissertation on AI in education. She is also a co-instructor at the University of Toledo. Prior to joining Merit, Pierrette held the position of Creative Director at *Crain's Detroit Business* magazine. She has been the recipient of multiple awards from the Society of Professional Journalists, PRism, the National Academy of Television Officers and Advisors and was also an Emmy nominee. Pierrette graduated from the University of Toledo in Interdisciplinary Studies and earned the Magna Cum Laude distinction. Pierrette completed her Executive MBA from the University of Toledo College of Business and Innovation in September, 2018.

Johannes M. Bauer (he/him) is Professor in the Department of Media and Information and the Director of the Quello Center for Media and Information Policy at Michigan State University. His research explores institutional choice and design problems raised by emerging technologies. Among other topics, he explores how public policy and management affect the benefits and risks of advanced information and communication technologies for individuals, communities, and society. He is currently working on a book on the governance of complex adaptive socio-technical systems.

Greta Byrum (she/they) is a digital equity practitioner and researcher working in the field since the 2010 Broadband Technology Opportunity Program. Over the last decade, she launched the Just Tech Program at the Social Science Research Council; founded Community Tech NY, a non-profit building collaborative community-owned broadband ecosystems with local partners; built the New School's Digital Equity Lab; founded the Resilient Communities Program at New America, and led the Field Team at New America's Open Technology Institute. Greta has a background in urban planning, communication technologies, and poetry, and serves on the boards of the Metropolitan New York Library Council, the Southern Connected Communities Project, the Howland Public Library Board of Directors, and the New York State Regents' Advisory Board on Libraries.

Aaron Schill (he/him) is Director of Research & Programs at the National Digital Inclusion Alliance (NDIA). Aaron joined the NDIA team in January 2022. He is experienced at working with local leaders and elected officials to build consensus and develop place-based solutions to the most pressing community challenges. Throughout his career, Aaron has advocated for data and information access to empower communities to affect positive change. Prior to joining NDIA, Aaron was the director of data and mapping at the Mid-Ohio Regional Planning Commission, where he headed the agency's work in data analytics, visualization, and GIS. He also established the organization's strategy and programming for broadband and digital inclusion and co-led the creation of the Franklin County Digital Equity Coalition. Aaron's career experience includes working as an urban planner and research director primarily in public and nonprofit organizations. He is a two-time graduate of The Ohio State University, with a master's degree in city and regional planning and a bachelor's degree in sociology.

Table of Contents

Executive Summary

This working paper introduces a measurement framework to guide state and local policy in the United States at a moment of unprecedented investment in broadband infrastructure and digital equity nationwide. The Infrastructure Investment and Jobs Act of 2021 (IIJA), together with the Digital Equity Act (DEA) included in IIJA, allocated 65 billion dollars to ensure that all Americans have access to affordable, high speed internet service–a prerequisite to achieve broader outcomes, such as "economic success, educational achievement, positive health outcomes, social inclusion, and civic engagement."

The IIJA includes five categories of measurable objectives to assist states in documenting and promoting: (1) the availability of, and affordability of access to, fixed and wireless broadband technology; (2) the online accessibility and inclusivity of public resources and services; (3) digital literacy; (4) awareness of, and the use of, measures to secure the online privacy of, and cybersecurity with respect to, an individual; and (5) the availability and affordability of consumer devices and technical support for those devices. The law is explicit in its goal to ensure that covered populations, or those most impacted by digital inequalities, benefit from these efforts.

The "Digital Opportunities Compass" framework builds on these core metrics and expands them in important ways. It builds on over 25 years of research and experience related to how broadband and device access, affordability, and digital skills relate to digital equity and broader social and development outcomes. This body or experience suggests that digital equity can be achieved more sustainably if the entire broadband ecosystem is considered. The framework is intended to assist stakeholders interested in metrics to monitor, evaluate, and guide broadband and digital equity policy now and in the future.

The Compass includes six components: Contexts, Governance, Connectivity, Skills, Application, and Outcomes. Each of these components includes indicators that have a bearing on the process and outcomes of digital equity initiatives "on the ground." The indicators under each component allow stakeholders to do an assessment of their overall conditions in order to determine where additional areas of attention may be needed.

As a framework, the Compass is intended to provide orientation and guidance rather than a rigid set of tools and metrics. It seeks to encourage a shared understanding of holistic digital equity, assess the current situation, and identify areas that require action. From that starting point, the Digital Opportunities Compass offers a customizable approach to create a baseline assessment of the state of digital equity, to monitor its changes over time, and evaluate the effectiveness of interventions to improve digital equity.

The Digital Opportunities Compass is intended to assist digital equity stakeholders with the development and long-term assessment of remediation and intervention strategies. This process could be leveraged to support grant narratives, measure the efficacy of programs or investment, or develop a common framework for inter-institutional discussion and action.

To this end, the Compass is intended to be a starting point, rather than the final word, in this effort to engage policymakers and others in developing a comprehensive set of metrics to measure policy interventions to advance digital opportunities

Overview & Purpose

Affordable robust broadband service, internet-enabled devices that meet user needs, applications and online content, access to digital literacy training, quality technical support, and measures to ensure privacy and cybersecurity are identified as six stepping stones toward digital equity. Both the IIJA and the DEA also establish requirements to monitor the effectiveness of programs. Specifically, they require the tracking of measurable objectives in accordance with the six stepping stones. IIJA also requires an assessment of how the measures based on the various funding programs relate to broader community outcomes.

Doing this well requires complementing the framework established in IIJA and DEA with additional insights from what we know about how broadband enables social and economic development. Digital connectivity opens a vast innovation space that enables the exploration of new ways to use technology for the public good. It is important to keep these broader digital opportunities in mind when navigating the next few years. Given the strict timeline of the IIJA and DEA programs and the legitimate need to be transparent about the use of public funds, there is a risk that decision makers will primarily focus on access and affordability. These are undoubtedly important intermediate goals and they are easier to measure than higher-level goals of digital equity.

The Digital Opportunities Compass offers a framework to assist in the development of state plans that meet the reporting and assessment requirements of IIJA and DEA but go beyond access and affordability to fully harness the benefits of digital technology. As communities and states develop plans to improve digital equity, it is important to establish a shared framework for developing goals and priorities, to identify opportunities, and to monitor progress toward these goals. With tremendous effort, states and local communities are developing a clear understanding of the current availability, quality, and affordability of broadband. Many realize that pursuing a longer-term digital equity strategy requires going beyond the mapping of availability, access, and service quality. However, there is less clarity on which other factors are relevant and should be considered when seeking to maximize the benefits of high-speed connectivity for community and economic development.

The approach presented here is closely tied to the findings of 25 years of research and experience of how broadband and device access, affordability, and digital literacy relate to digital equity and broader social and development outcomes. One clear insight is that achieving such outcomes requires consideration of additional factors. Some, such as quality technical support and measures to ensure online privacy and cybersecurity, are mentioned in enabling legislation and in the NTIA internet for All initiative. Others, such as the importance of facilitating human-centered uses and the importance of local contexts for broader community social and development outcomes are at best mentioned implicitly. Moreover, it is necessary to adopt measures to safeguard digital equity over time so that the next wave of technology does not undermine earlier achievements.

Overview & Purpose

This implies, for example, working with additional stakeholders on technology design practices, adjustments in the education system, and adaptations in use cases such as health care and government services. It is also important to identify the underlying structural inequalities that impact people's access to technology (e.g., digital redlining). In the long run, it is necessary to include community, economic, and policy contexts that help individuals and organizations adapt to the next generation of services, devices, and applications. Federal and state program timelines create tremendous pressure to focus on access and affordability. Research and experience strongly suggest that states and communities that embed these initial goals into a broader vision will be able to harness much higher benefits of digital connectivity. The time to begin developing a more comprehensive vision, with appropriate priorities and timing for measures, is now.

This working paper seeks to provide a framework and concrete suggestions that can be customized to local and regional circumstances that affect digital equity plans. Specifically, the paper:

- Identifies key factors that affect digital equity efforts and outcomes;

- Develops a framework for stakeholders to assess their current conditions and develop appropriate digital opportunity strategies;

- Provides a flexible and customizable assessment framework for measuring digital equity and its effects on individuals and communities.

We adopted the name "Digital Opportunities Compass" to signal that it is intended to provide orientation and guidance rather than a rigid set of tools and metrics. It provides a framework for stakeholders to develop a shared understanding of holistic digital equity, assess the current situation, and identify areas that require action. From that starting point, the Digital Opportunities Compass offers a customizable approach to utilize a coherent set of indicators and metrics to create a baseline assessment of the state of digital equity, to monitor its changes over time, and evaluate the effectiveness of interventions to improve digital equity.

The Digital Opportunities Compass can be used as part of focus groups, capacity building programs for planners and decision makers, or to facilitate the multi-stakeholder, digital equity planning process. It identifies six broad areas that impact digital equity and its association with state, community and/or neighborhood level outcomes: Contexts, Governance, Connectivity, Skills, Applications, and Outcomes. These components of the Compass are closely tied to what research has shown about the factors that affect digital inequalities and, consequently, broader outcomes. These factors are also important starting points to mitigate digital inequality sustainably.

The Digital Opportunities Compass is intended to assist digital equity stakeholders with the development and long-term assessment of remediation and intervention strategies. This process could be leveraged to support grant narratives, measure the efficacy of programs or investment, or to develop a common framework for inter-institutional discussion and problem solving

Definitions & Assumptions

The Digital Opportunities Compass utilizes findings from over twenty years of research on digital inequalities, including studies of digital inclusion practitioners working with and in their communities to promote digital equity. The following definitions have been considered in the development of the Digital Opportunities Compass.

Digital inclusion - Digital Inclusion refers to the activities necessary to ensure that all individuals and communities, including the most disadvantaged, have access to and use of Information and Communication Technologies (ICTs). This includes five elements: (1) Affordable, robust broadband internet service; (2) Internet-enabled devices that meet the needs of the user; (3) Access to digital literacy training; (4) Quality technical support; and (5) Applications and online content designed to enable and encourage self-sufficiency, participation and collaboration.

Digital equity - A condition in which all individuals and communities have the information technology capacity needed for full participation in our society, democracy, and economy. Digital equity is necessary for civic and cultural participation, employment, lifelong learning, and access to essential services.

The National Digital Inclusion Alliance adds the following emphasis to its definition of digital equity, *"It is important to note here the use of 'equity' vs. 'equality.' When we use the word equity, we accurately acknowledge the systemic barriers that must be dismantled before achieving equality for all."*

In order to conduct activities to advance digital equity, we also draw upon existing research that has documented the following three levels of the digital divide that need to be addressed in these efforts.

Higher levels of digital divides require measures in addition to those necessary to close lower level aspects of digital divides. In addition to these three levels of the digital divide, the Digital Opportunities Compass recognizes that community, economic, and policy contexts need to be considered as additional criteria. These factors critically affect how digital connectivity and outcomes interact in a specific local context

(e.g., see Broadband Adoption in Low-Income Communities, Cultural (Re)production of Digital Inequality in a US Community Technology Initiative, Digital Inclusion and Meaningful Broadband Adoption Initiatives, Digital Inclusion in Native Communities: The Role of Tribal Libraries, The Ability to Pay for Broadband, Network Sovereignty: Building the Internet across Indian Country). Because of this variation, no single model will work under all conditions. Therefore, we begin with these sociotechnical contexts as a starting point, rather than simply add-ons for consideration.

Table 1. The three levels of the digital divide documented in existing research

Digital Divide Levels	Assumptions
Network and device access *(first level)*	Necessary but not sufficient to realize benefits of digital connectivity, requires alignment of local, state and federal policies
Digital skills and literacy *(second level)*	Necessary to utilize available technology for individual and social benefit, requires changes across all education systems, from K-12, post-secondary, and lifelong education
Uses and outcomes *(third level)*	Requires human-centric design of digital solutions, legal and institutional adjustments to change practices of health care, education, ...

Extant Metrics & Indexes

Important work has been done to create single metrics and composite indicators that allow for assessing the state of digital equity. Several mapping and measurement initiatives have included tools to document the state of broadband access (e.g., <u>Maryland Digital Equity Index</u>), the extent to which communities are disadvantaged (e.g., the <u>Digital Divide Index</u> and the <u>Digital Distress Index</u>), the extent to which digital skills are considered in policy contexts (e.g., the <u>State Digital Equity Scorecard</u>), and of the state of digital advancement within municipalities (e.g., the <u>Municipal Digital Advancement Index</u>). These indexes have in common their focus on scoring a location (municipality, census tract, county, state, nation) along multiple criteria, typically based on publicly available data, such as the American Community Survey (ACS). They may also integrate speed test data from various sources, such as Microsoft, M-Lab, and Ookla.

Additional insights may be gleaned from work used in international comparisons. For these purposes, international institutions, non-profit, and private stakeholders have developed broad-based indices, such as the <u>Network Readiness Index</u> (63 indicators), the <u>OECD Going Digital Toolkit</u> (46 indicators) or the more narrowly constructed <u>Inclusive Internet Index</u> (14 indicators). These indexes typically provide item-by-item and composite rankings for assessing digital readiness on a national scale but do not primarily focus on digital equity. Most internationally comparative indices include components to assess governance, people, technology, and impact. Like domestic indexing projects, they provide a range of visualizations. The Digital Opportunities Compass builds on these ideas to help states and communities to unleash digital opportunities which require improved digital connectivity as well as complementary measures to fully realize the benefits of high-speed connectivity.

Overall Approach

Building on existing research, frameworks, and measurement tools, the Digital Opportunities Compass includes six components: Contexts, Governance, Connectivity, Skills, Application, and Outcomes. Each component includes indicators that have a bearing on the process and outcomes of digital equity initiatives "on the ground." The indicators under each component allow stakeholders to do an assessment of their overall conditions in order to determine where additional areas of attention may be needed.

Six Components & Indicator Areas

1. **Contexts** - indicators related to sociodemographic, economic, and community level factors.

2. **Governance** - indicators related to local, state, and federal policy, governance, and power.

3. **Connectivity** - indicators related to the existence of necessary network infrastructure, as well as the accessibility, affordability, and adoption of internet service and network-enabled devices.

4. **Skills** - indicators related to a broad range of activities centered around digital literacy (including secure online practices), training, and skills attainment.

5. **Application** - indicators related to the uses and application of digital connectivity and skills, while considering additional sociotechnical contexts.

6. **Outcomes** - Indicators related to the broader effects of improved digital equity on individuals, communities, and states

Potential Benefits

The Digital Opportunities Compass has several potential benefits for local, county, and state policymakers. It can be used as a vehicle for inter-organizational collaboration and engagement, as well as a holistic framework for digital equity planning, implementation, and evaluation, particularly for communities that may not know where to begin. The Compass can be used to:

- Identify key groups of factors that influence digital equity efforts and outcomes

- Measure and assess digital equity efforts and outcomes over time

- Utilize a standardized core set of metrics that can be expanded and customized to meet state and community needs

- Build, as far as possible, on existing data and indices

- Augment existing data with new (qualitative and quantitative) data

- Innovatively design infrastructure to help automate data collection (e.g., quality measurement in routers)

Components & Indicators

The proposed components of the compass offer a range of indicators that can be applied to a location's (neighborhood, community, city, county, state) needs and vision. Where possible, it should utilize existing publicly-available information, such as data from the American Community Surveys (ACS) and other state and local sources of information. Some metrics may be collected in other contexts (e.g., data collected in the educational systems, economic development statistics, public health and safety information). Where relevant data are not available, the compass provides guidance on which information would be useful for a robust digital equity strategy. Where no data are available, it is possible to substitute quantitative and qualitative assessments for missing data.

The components and indicators are intended as a holistic framework to stimulate discussion among key stakeholders and explore issues relevant to digital equity goals. Using the compass can be a starting point to assess existing efforts and discuss future opportunities to advance digital equity efforts and outcomes. For example, the indicators can be incorporated in a survey for stakeholders to assess current initiatives and determine where work needs to be done (e.g., see "Coalition Health Scorecard" in **Digital Equity Ecosystems Measurement Framework**, p. 40). However, rather than looking at the status quo as a deficit, it can be viewed as an opportunity that can be seized using the compass as a tool to guide these efforts moving forward.

Component #1:
Contexts

Indicators related to sociodemographic, economic, and community level factors that influence the process and outcomes of digital equity initiatives

Indicator Areas

Socio-demographic factors, Economic opportunity and Community development

Individual Indicators

Socio-demographic Factors

Information about individuals, households, populations, and communities is collected.

Economic Factors

Information about existing businesses and jobs, as well as possible future ones, is collected.

Business Digital Readiness

Digital readiness among the business community exists.

Community Health and Wellbeing

Information about community health and wellbeing is collected.

Community Assets

Community asset "buckets" are leveraged to foster digital equity.

Everyday Experiences

The lived physical, social, and emotional reality of the community is centered in digital equity planning, implementation, and evaluation.

Structural Inequalities Identified

The existence of digital structural violence and digital redlining have been identified and effective measures have been implemented to prevent these harms in the future.

Barriers Addressed

Other barriers to motivation, access, skills, and use are addressed in digital equity planning, implementation, and evaluation.

Equity Centered

Those most impacted by digital inequalities centered in the design of technologies, programs, and services to promote digital equity.

Geography Considered

Information on all of the indicators above include measurement at different geographic levels (community, city, county, region, etc.)

Component #1:
Contexts

Indicators related to sociodemographic, economic, and community level factors that influence the process and outcomes of digital equity initiatives

Considerations for Data Collection

- Data should be collected to be inclusive of all of the "covered populations" listed in the Digital Equity Act, as well as other historically marginalized populations.

- Local communities will need to be engaged and consulted on the categories included in this component, as well as the data that need to be gathered based on these indicator areas.

- Indicators in this component need to be supportive of an individual community's theory of change.

- Indicators could be gathered within an "ecosystem framework" to include micro (individual-level), meso (population-level), and macro (community-level) measures.

- Some data exist for some of the indicators; other indicators do not have any data yet; and other indicators need additional ways of thinking about measurement to help stakeholders better understand the influence of these contexts on digital equity initiatives.

- Rural and tribal communities need to be represented in the data gathered across these indicators areas.

- Power can be measured across several indicator areas, particularly in understanding where there are barriers to any of the indicators being measured or realized.

- Measurement considerations must be included at different geographic levels (community, city, county, region, etc.).

Existing Tools

Broadband and Socioeconomic Data

Municipal Digital Advancement Index

The Digital Divide Index

American Community Survey

Socioeconomic Data

Opportunity Atlas

Economic Tracker

Bureau of Labor Statistics

Community-Based Approaches

ABCD Framework

NDIA Asset Mapping for Digital Inclusion

Digital Inclusion Coalition Guidebook

Digital Equity Ecosystems Measurement Framework

DCTP Teaching Community Technology Handbook

Achieving Digital Equity In NY

Component #2:
Governance

Indicators related to local, state, and federal policy, governance, and power that influence the process and outcomes of digital equity initiatives

Indicator Areas

Local policy, State policy, Federal policy, Governance, Power

Individual Indicators

Appropriate Programs are Implemented
Given contextual conditions, the right amount of subsidies and complementary programs are being implemented (or planned).

Coordinated Policies
Federal, state, and local policies are coordinated to advance digital equity, and local obstacles to digital equity have been removed, and different areas of state and local government have effectively coordinated their actions (e.g., dig once, deployment of human-centric digital government services).

Community Participation and Ownership
Community and grassroots organizations are involved and have agency in digital equity initiatives, governance, and ownership of local processes.

Collaboration With Education Institutions
Institutions of continuing and higher education contribute as partners to develop, implement and monitor plans.

Holistic Approach
Digital equity is embedded across public policy domains (e.g., employment, welfare, and education).

Local Coalitions
Local digital equity coalitions exist and are governed in a representative manner.

Backbone Organizations
Digital inclusion activities are organized by a coordinating entity.

Policy Support
Policy and governance support digital equity from the ground up, including governance of local digital equity ecosystems.

Inclusive Digital Service
Digital public resources are truly inclusive. Forms of digital exclusion have been addressed.

Champions in Local Government
Government has local champions for digital equity.

Public-Private Partnerships
Partnership opportunities with private and non-profit organizations exist and are being developed.

Funding
State investments in digital equity, dedicated staffing and sufficient governmental capacity to implement and maintain programs.

Component #2:
Governance

Indicators related to necessary infrastructure, access, affordability, and adoption of internet service and network-enabled devices

Considerations for Data Collection

Relevance to IIJA/DEA requirements

- Stakeholder coordination plan
- Implementation plan
- Vision

- This component is the connective tissue between the other 4 components of the Compass.

- Community capacity and agency will be needed after IIJA ends.

- Interagency coordination and alignment with agency/state/municipal objectives; integration of policy measures into ongoing legislative/ policy measures

- Capacity of state/local government (as opposed to fed govt) needed to design and implement broadband and digital equity programs.

- Philanthropy can help both with supporting new and existing policy positions, as well as helping to influence policy and governance structures to advance digital equity.

- Multiple indicators can be used to measure how and where governance and power are understood.

- Qualitative data are needed to gain a deeper understanding of the existing landscape and to inform future planning efforts.

- Measurement considerations must be included at different geographic levels (community, city, county, region, etc.).

Existing Tools

State Digital Equity Scorecard

Policy Map

Digital Inclusion Trailblazers (6 criteria)

Component #3:
Connectivity

Indicators related to the existence of necessary network infrastructure, as well as the accessibility, affordability, and adoption of internet service and network-enabled devices.

Indicator Areas

Network infrastructure, Broadband access,
Device access, Affordability,
Technology adoption

Individual Indicators

Broadband availability
Access to high speed internet is available inside every household and outside (i.e., wireless access), including on tribal lands, that meets or exceeds the service goals and milestones set by the Federal Communications Commission.

Broadband affordability
High speed internet access is affordable and includes access to low-cost internet options.

Broadband adoption
Adoption rates continue to increase as service becomes available to more households. Information about adoption rates for various networked services is available at a granular level by location and demographic.

Device availability
Networked devices are available (by demographic, location, etc.).

Device affordability
Networked devices are affordable (by demographic, location, etc.).

Device adoption
Networked devices are being used inside and outside the home (by demographic, location, etc.).

Service plan availability
Information about service plans and prices are available and can be compared across geography to protect against digital discrimination.

Quality of network services
Information about the quality of network services (e.g., speeds, latency, jitter) is available and can be compared across geography to protect against digital discrimination.

Adequate broadband for CAIs
Sufficient bandwidth is available for community anchor institutions (e.g., public schools, libraries, hospitals, etc.).

Complementary assets
Locations that provide public and community internet access are available and accessible (e.g., public access technology centers, public WiFi).

Component #3:
Connectivity

Indicators related to the existence of necessary network infrastructure, as well as the accessibility, affordability, and adoption of internet service and network-enabled devices.

Considerations for Data Collection

NTIA Measurable Objective Categories

- The availability of, and affordability of access to, fixed and wireless broadband technology
- Availability and affordability of consumer devices and technical support for those devices

- It is important to keep in mind that each indicator has strengths and limitations. The FCC broadband map will likely suffer from accuracy challenges during the challenge and revision period

- In addition to measuring device adoption (outcomes), need supply side measures for device availability & provision

- Speed tests and hardware based devices should be used to determine speed and quality of service

- Device distribution - need data to support coordinated support within the device ecosystem

- Data should be gathered on general purpose devices and specific applications, such as medical devices

- Hardware-based testing devices are needed to measure network quality

- Crowdsourced tools should be included to measure indicators and provide opportunity and guidance on how to use additional/ alternative data sources

- Measurement considerations must be included at different geographic levels (community, city, county, region, etc.)

Existing Tools

Broadband Mapping

FCC Broadband Map

Speed Tests

M-Lab Speed Test
(+ Ookla, + Netrics, or others?)

Digital Equity Indexes

Maryland Digital Equity Scorecard Index Map
The Digital Distress Index

Framework and Reports

Building Digital Communities:
A Framework for Action
Digitunity - Exploring Community
Connectedness
Rural Communities & Digital
Device Ownership

Component #4:
Skills

Indicators related to a broad range of activities centered around digital literacy, training, and skills attainment

Indicator Areas

Training, Skills, Digital literacy

Process Indicators

Digital Skills Assessments
Digital literacy training needs and assets in the community are identified and evaluated, and a strategy for meeting the digital literacy needs of the community is adopted.

Culturally Relevant Pedagogies
Digital literacy training is rooted in cultural competency approaches.

Multilingual and Multimodal Training
Digital literacy training in multiple languages is provided to individuals, businesses, and institutions through a variety of formats, including formal classes, real-time virtual help, accessible trainings, and one-to-one assistance.

Coordinated Support
Digital skills efforts are coordinated across the ecosystem of support and include navigable pathways for individual learners.

Embedded Digital Skills training
Digital literacy instruction is embedded in all aspects of curriculum for K-12 and higher education, as well as in lifelong learning activities.

Lifelong Learning
Lifelong opportunities to obtain digital skills across age groups are available, including opportunities for upskilling (e.g., population age distribution, given that younger generations typically adapt faster).

Learning Together
Participants have opportunities to learn among peers and support each other as they develop and apply digital skills.

Outcome Indicators

Digital Skills
Information about prevailing levels of digital skills, including information about comfort and confidence, is available (e.g., demographic, location).

Digital Literacy
Digital literacy and the importance of connectivity are valued by the community and taught in multiple educational settings (e.g., K-12, higher ed, adult education programs).

Information and Media Literacy
Information and media literacy training and assistance are available within the community to help individuals learn to find electronic information, evaluate digital resources, and create their own digital media objects.

Adult Literacy
Adult literacy rates are available and are used to develop appropriate levels of digital literacy training.

Component #4:
Skills

Indicators related to a broad range of activities centered around digital literacy, training, and skills attainment

Considerations for Data Collection

NTIA Measurable Objective Categories

- Digital literacy
- Awareness of, and the use of, measures to secure the online privacy of, and cybersecurity with respect to, an individual

DEA Covered Digital Inclusion Activities

- Access to digital literacy training
- Quality technical support

- Safety & protection data including:
  - Mental health
  - Dis- & mis-information
  - Surveillance, predation
  - Harassment
  - Cybersecurity

- Develop navigation/wayfinding systems to help different populations move through learning achievement/outcome journeys

- Crowdsource specific tools to measure indicators, and provide opportunity and guidance on how to use additional/alternative data sources

- Measurement considerations must be included at different geographic levels (community, city, county, region, etc.)

Existing Tools

Skills Development & Assessment
DigitalLearn.org
ISTE Standards
NICE Workforce Framework for Cybersecurity
State Digital Equity Scorecard

Data Tracking
DITTO
NDIA Digital Navigator Data Platform (skills assessment, progress tracking, follow-up survey forms)

Broader Frameworks
Building Digital Communities: A Framework for Action

Component #5:
Application

Indicators related to the uses and application of digital connectivity and skills, while considering additional sociotechnical contexts.

Indicator Areas

Cultural relevance, Equitable design, Workforce development, Education, Health care, Public safety, Civic engagement, Social connections

Individual Indicators

Cultural Considerations
Digital literacy training needs and assets in the community are identified and evaluated, and a strategy for meeting the digital literacy needs of the community is adopted.

Equitable and Accessible Design
Opportunities to incorporate human centered and equitable design into networked technologies exist and are embraced.

Tech Training Support
Workforce technology trainers are available in sufficient numbers to support the needs of the community.

Job-seeking Assistance
Online career information and specialized assistance with online job-seeking is available through local and tribal governing bodies, libraries, and other community-based organizations.

Private and Secure Systems
Secure systems enable local medical professionals and community-based health clinics to share medical records privately and safely among health care providers.

Patient Portals
Patients have access to user-centered online health information systems, medical records, and private online interaction with healthcare providers.

Online Civic Engagement
The public connects directly to governments and their agencies, and with each other, in order to learn about and discuss public issues and policies.

Local Cultural Preservation
Communities support the use of technology for digital preservation and appropriate sharing of local history and contemporary culture in order to build an enhanced sense of community, belonging.

Accessibility and Assistive Tech
Physical space retrofits as well as digital accessibility.

Component #5:
Application

Indicators related to the uses and application of digital connectivity and skills, while considering additional sociotechnical contexts.

Considerations for Data Collection

NTIA Measurable Objective Categories

- The online accessibility and inclusivity of public resources and services

- Awareness of, and the use of, measures to secure the online privacy of, and cybersecurity with respect to, an individual

Types of digital resources/services that states and localities can shape:

- Procurement policies

- Policies re: municipal resources

- Fundable products of Capacity/Competitive grants

    - For ex, multiple languages, accessibility standards

- Develop a gradient (i.e., assessment) through which policymakers can be measured regarding the online accessibility and inclusivity of public resources and services (what they can directly influence and what they are able to indirectly influence)

    - What are the existing government resources to develop/change?

    - What can be influenced through policy?

    - What can be influenced through encouragement?

- Crowdsource specific tools to measure indicators, and provide opportunity and guidance on how to use additional/alternative data sources

- Measurement considerations must be included at different geographic levels (community, city, county, region, etc.)

Existing Tools

Frameworks
Building Digital Communities: A Framework for Action

Standards
Ranking Digital Rights
Consentful Tech Project
Our Data Bodies
Surveillance Self-Defense

Broader Outcomes

Community impacts of internet access are influenced by factors other than broadband connectivity. Contextual factors at the beginning of a project, such as the sociodemographic characteristics of a community, will influence how digital connectivity translates into outcomes. Moreover, one of the goals of successful digital transformation is to change important community sociodemographic characteristics, such as income and education levels, over time. Thus, outcomes after year one of a program become contextual conditions in year two and influence the outcomes in year two. Outcomes in year two become contextual conditions that influence outcomes in year three. The key to unlocking the power of digital technology may be related to the general rules and regulations that affect broadband entrepreneurship, such as effective coordination between agencies that influence broadband investment or access to rights of way.

This interwoven and multifaceted nature of the broadband ecosystem raises challenges for measuring the impacts of broadband policy on community outcomes. However, it can be done with appropriate data and if approached with a robust measurement framework (e.g., Broadband's impact: A brief literature review, The impact of rural broadband development: Lessons from a natural field experiment, State broadband policy: Impacts on availability, Evaluating the Alabama Broadband Connectivity Program, Measuring the effectiveness of digital inclusion approaches, Ten years of fiber optic and smart grid infrastructure in Hamilton County, Tennessee, Assessing the effects of broadband policy on high-speed internet access, digital equity, and community development (Bauer, 2023)). What we know from past experience is that states and communities with a good understanding of these relations over time will fare better and will be able to realize the potential benefits of broadband more fully.

The following table (Table 3) lists a few selected indicators and sources that may be used in assessments of broader community impacts of broadband policy. In many instances, the data will be available from existing statistics, even though it may currently not be available at the level of individual communities. In these cases, the main challenge is to assess the effects of policy interventions. In other cases, data may not be available and new and innovative forms of data collection may have to be developed. Some information may be collected and analyzed automatically and there is great promise in fields such as community informatics and public interest technology, especially if data is made available in a public repository.

Broader Outcomes

Indicators related to the broader effects of improved digital equity on individuals, communities, and states

Indicator Areas

Economic Development: Jobs, Income, Start-ups, Growth
Social Development: Quality of life, Safety, Happiness, Mental Health, Social peace
Physical Enviornment: Water quality, Air quality, Housing, Transit
Civic Participation

Individual Indicators

- Number of new jobs generated

- Median household income, poverty (e.g., children living in poverty)

- Number of start-ups attracted

- Community economic and population growth

- Health outcomes (e.g., quality of life, length of life)

- Indicators for community safety (e.g., violent crime)

- Mental health data

- Indicators for the physical environment (e.g., air and water quality, housing, transit)

- Indicators for civic engagement and participation

Existing Data Sources

Data from the U.S. Bureau of Labor Statistics, e.g.

- U.S. Bureau of Labor Statistics, County Employment and Wage

- U.S. Bureau of Labor Statistics, Metropolitan Area Employment and Unemployment

County Health Rankings and Roadmap, University of Wisconsin

Data from the Centers for Disease Control, e.g.,

- Household Pulse Survey

- Behavioral Risk Factor Surveillance System

- Youth Risk Behavior Surveillance System

- Multiple private indices are available to assess happiness and the quality of life

- U.S. Census Bureau civic Participation surveys

Additional Suggestions & Notes

- Data may not be available at the desired geographic granularity, but it may be possible to develop it over time.

- Also, some indices may only be available for selected years and collected in long intervals.

- Some data is currently proprietary, as it was collected by private companies in the financial and healthcare industries.

Using the Digital Opportunities Compass in Practice:

Incorporating Compass Indicators in State Digital Equity Planning

The Digital Opportunities Compass provides stakeholders with additional metrics that can be used to help develop a baseline not only in the context of the IIJA, but also in ongoing digital equity planning, implementation, and evaluation contexts. This section provides examples to show how the Compass can be used right now, beginning with those working with States to develop statewide digital equity plans. Additional examples are provided to show how the Compass can support the development of local digital equity plans, measure broader outcomes and impacts of digital equity programs, and to build and sustain robust digital equity ecosystems.

Incorporating Compass Indicators in State Digital Equity Planning

The framework offered in the Digital Opportunities Compass is compatible with the requirements established by IIJA, DEA, as well as with existing state programs. It is sufficiently flexible to be adapted to emerging state and local programs. Measurable objectives identified in IIJA and DEA are included in Component #3 (Connectivity), Component #4 (Skills), and Component #5 (Application). Moreover, the framework offers guidance on additional dimensions (Components #1 and #2) that are important to achieve digital equity and to shape efforts aiming at broader outcomes that states and communities might want to consider.

As the Pew Charitable Trusts recently explained, collecting and using data can assist state broadband offices to help ensure that "data collection processes will support an informed planning process to identify community needs, develop a mapping plan, and understand the current landscape to support the design of programs." Some states have identified indicators (e.g., 2021 Update to the Michigan Broadband Roadmap, pp. 40-43). The Digital Opportunities Compass can be used to refine plans and to ensure useful data are collected to achieve the measurable objectives required by the

state digital equity planning process, and to align with state priorities or outcome goals named in the Digital Equity Act, such as economic and workforce development, educational outcomes, health outcomes, civic and social engagement, and delivery of essential services.

The NTIA's State Digital Equity Planning (SDEP) Notice of Funding Opportunity requires states to make sure they are gathering data from covered populations to inform the following five measurable objective categories:

- The availability and affordability of fixed and wireless broadband technology
- The availability and affordability of consumer devices and technical support for those devices
- Digital skills
- Awareness of, and the use of, measures to secure the online privacy of, and cybersecurity with respect to, an individual
- The online accessibility and inclusivity of public resources and services

While these objectives are critically important and must be addressed as required by law, they fall short in recognizing additional factors that often influence the ability of covered populations, and those who support them, to achieve these goals.

The following additional indicators found in the Digital Opportunities Compass are recommended in both the NTIA State Digital Equity Planning and Capacity Grant programs to help make certain that the measurable objectives are achieved. More concretely, Table 4 shows how the Compass offers additional indicators that we argue should be considered alongside the 5 SDEP measurable objective categories listed above.

Table 4. Incorporating Compass Indicators in State Digital Equity Planning

NTIA Measurable Objectives Category	Additional Compass Indicators	Potential Benefits of Indicators
The availability and affordability of fixed and wireless broadband technology	**Component #1 - Contexts** ***Structural inequalities identified*** The existence of digital structural violence and digital redlining have been identified and effective measures have been implemented to prevent these harms in the future.	A focus on identifying structural inequalities can help to address the existence of underlying discrimination that has prevented and/or continues to prevent historically marginalized communities from gaining access to affordable broadband service.
The availability and affordability of consumer devices and technical support for those devices	**Component #2 - Governance** ***Backbone organizations*** Digital inclusion activities are organized by a coordinating entity.	A focus on backbone organizations can help to ensure there is a dedicated organization working with other digital equity ecosystem partners to identify affordable devices for covered populations.
Digital Skills	**Component #4 - Skills** ***Culturally relevant pedagogies*** Digital skills training is rooted in cultural competency approaches	A focus on culturally relevant pedagogies helps to ensure that local cultural contexts are carefully and meaningfully considered in digital skills programs.
Awareness of, and the use of, measures to secure the online privacy of, and cybersecurity with respect to, an individual	**Component #1 - Contexts** ***Equity centered*** Those most impacted by digital inequalities are centered in the design of technologies, programs, and services to promote digital equity.	A focus on equity helps to ensure that the needs and aspirations of those most impacted by digital inequalities are centered in the design, implementation, and evaluation of digital skills training, including those focused on internet safety and other privacy and security-focused educational offerings.
The online accessibility and inclusivity of public resources and services	**Context #5 - Application** ***Equitable and accessible design*** Opportunities to incorporate human centered and equitable design into networked technologies exist and are embraced.	A focus on equitable design can help to make sure that needs assessments focused on the online accessibility and inclusivity of public resources and services embrace the perspectives of covered populations through human-centered design processes.

The indicators above provide examples of the types of Compass indicators that can be used in the state digital equity planning process to ensure that a holistic framework is being considered in both the design and implementation of state digital equity programs. These and other Compass indicators could be included in surveys, focus groups, and interviews to ensure that additional contexts and issues are considered when identifying needs, barriers, assets, and strategies to advance digital equity statewide.

Using the Digital Opportunities Compass in Practice:
Including Compass Indicators in Local
Digital Equity Plans

State broadband and digital equity planning efforts are in full swing. However, this has not stopped local communities and municipalities from moving forward with their own digital equity planning efforts. In recent years, communities have developed digital equity plans to help local and regional stakeholders address barriers to digital access, skills, and use. In 2022, 26 local governments submitted digital equity plans to NDIA as part of their **Digital Inclusion Trailblazer** applications, and in Massachusetts the Massachusetts Broadband Institute launched a **Municipal Digital Equity Program** with dedicated funding for local digital equity plans.

The North Carolina Department of Information Technology (NCDIT) was one of the first state offices to provide a template for communities across the state to develop their own digital inclusion plans. NCDIT created the **Digital Inclusion Template & Guide** in collaboration with the NTIA to help communities

conduct a "needs inventory," among other things, to assist local communities in better understanding and documenting a community's "unique digital inclusion needs" and "to evaluate how and where the various aspects of the digital divide impact" the community.

In Table 5, the NCDIT's needs inventory is used to show how the Digital Opportunities Compass can provide additional indicators to support local communities as they work to develop digital equity plans.

Table 5. Including Compass Indicators in Local Needs Assessments

NCDIT Needs Inventory	Additional Compass Indicators	Potential Benefits of Indicators
Broadband Availability: where is broadband unavailable in your community?	**Component #3 - Connectivity** *Quality of network services* Information about the quality of network services (e.g., speeds, latency, jitter) is available and can be compared across geography to protect against digital redlining.	A focus on the quality of network services, along with the availability of services, can help communities better understand users' experience of broadband quality, including information that can help identify and prevent digital discrimination.
Broadband Subscription: what are your community's subscription rates? Who subscribes and who does not?	**Component #3 - Connectivity** *Broadband adoption* Adoption rates continue to increase as service becomes available to more households.Information about adoption rates for various networked services is available at a granular level by location and demographic.	A focus on broadband adoption, both inside and outside the home, as well as reasons for non-adoption can help those conducting needs assessments to consider people's everyday uses of the internet and how subscription rates can be understood within this local, cultural context.
Broadband Affordability: is broadband affordable in your community? How many households in your community are low-income and may not be able to afford the service that is available?	**Component #3 - Connectivity** *Service plan availability* Information about service plans and prices are available and can be compared across geography to protect against digital redlining	A focus on the availability of information about service plans can help fill gaps regarding the affordability of broadband and to ensure that higher price plans are not offered disproportionately to lower-income communities.
Computers/Devices: how many households in your community do not have access to a desktop, laptop, tablet, or other computer?	**Component #3 - Connectivity** *Device affordability* Networked devices are affordable (by demographic, location, etc.).	A focus on device affordability during a needs assessment process can help to identify barriers to device access, as well as to help connect individuals to information about affordable device programs, such as the Affordable Connectivity Program.
Digital Literacy/Skills: how many households in your community do not have the skills needed to effectively use the internet or digital devices?	**Component #4 - Skills** *Coordinated and equitable support* Digital skills efforts are coordinated across the ecosystem of support and include navigable pathways for individual learners.	A focus on coordinated support can help to ensure that digital skills assessments consider an ecosystem of support across a community to ensure that the needs identified in the assessment are addressed in a strategic way that supports learners "where they are."

This set of Compass indicators presented alongside the NCDIT's needs inventory, found in their Digital Inclusion Template & Guide, can help to ensure that local digital equity plans are developed with additional local, cultural contexts in mind. These specific indicators can also be included as questions in surveys, focus groups, and interviews conducted during the local needs assessment process.

Using the Digital Opportunities Compass in Practice:
Using Compass Indicators to Measure Broader Outcomes

Community impacts of internet access are influenced by factors other than broadband connectivity. Contextual factors at the beginning of a project, such as the sociodemographic characteristics of a community, will influence how digital connectivity translates into outcomes. Moreover, one of the goals of successful digital transformation is to change important community sociodemographic characteristics, such as income and education levels, over time. Thus, outcomes after year one of a program become contextual conditions in year two and influence the outcomes in year two. Outcomes in year two become contextual conditions that influence outcomes in year three, and so forth.

The Digital Opportunities Compass can be used to help develop a robust system of indicators beyond access, affordability, and skills to help guide improvements and measure outcomes over time. It supports developing a longitudinal knowledge base for the development of __national__, state, and community learning agendas and systems. In practice, the Compass can be used to assist in generating appropriate logic models for outcomes-based program evaluation purposes in different contexts (e.g., __Digital Inclusion Outcomes-Based Evaluation__).

In the context of IIJA, the NTIA's Digital Equity Planning Grant NOFO requires that state's conduct an assessment of how the measurable objectives, aligned to the five categories listed above, will impact and interact with the following other State goals and outcomes:

- Economic and workforce development goals, plans, and outcomes
- Educational outcomes
- Health outcomes
- Civic and social engagement
- Delivery of other essential services

The Digital Opportunities Compass offers "Broader Outcomes" indicators (see previous section) that can be used to measure the broader effects of improved digital equity on individuals, communities, and states, in the areas listed in the NOFO. More concretely, these measures can be incorporated into longitudinal studies and data gathering efforts to measure the outcomes and impacts of the NTIA's broadband and digital equity grant programs.

The individual "Broader Outcomes" indicators included in the Compass can be used to identify baseline measures, using existing data sources listed in this section, and to identify gaps in these existing data sources. For example, as States launch their statewide digital equity surveys, they can use the indicators in the Compass to ask questions about economic development: e.g., jobs, income, start-ups, growth; social development: e.g., quality of life, safety, happiness, mental health, and social peace; physical environment: water quality, air quality, housing, and transit; and civic engagement and visualize these outcomes using a logic model alongside the inputs, activities, and outputs needed to achieve these broader outcomes.

The digital equity logic model in Appendix I offers a template to understand how one might develop a program logic model that incorporates the measurable objective categories from the NTIA's State Digital Equity Planning NOFO, situated alongside the Compass indicators, with these broader outcomes. A logic model is a visual representation of a theory of change that helps to communicate the intended outcomes and impacts of a program based on the resources, activities, and outputs of a particular social program. The digital equity logic model included in Appendix I is adapted from Rhinesmith & Siefer's (2017) example and includes a __situated logic model__ approach.

Using the Digital Opportunities Compass in Practice:
Using Compass Indicators to Measure Broader Outcomes

Ultimately, the Compass can help identify indicators that a state (or community) might want to collect going forward to understand broader outcomes. Given the expense of collecting additional data, the costs and benefits of new collection efforts will have to be carefully weighed. However, seen in a broader context, existing data collection efforts might be modified in ways to assist digital equity policy. For example, questions assessing digital skills and literacy could be embedded into ongoing educational data collection efforts. They could be appended to existing state-wide services. In some cases, new efforts to assess the effects of improved connectivity on broader outcomes could be built with private partners or research institutions. It might be prudent for states to work with the federal government to develop an integrated data collection approach. Finally, policy could mandate that the information structure be designed to generate important information automatically, such as selected, periodic quality of service measurements that are posted to a public-facing data repository.

The framework offered here can also assist in prioritizing efforts and resources. BEAD suggests an implicit priority for closing connectivity gaps in unserved areas, followed by improvements of connectivity in underserved areas. DEA suggests parallel measures to improve digital skills and literacy. The Compass can help identify areas that need attention. Two principal strategies are available that can also be combined into hybrid efforts: (1) to build on existing strengths and leverage them to improve connectivity, literacy, uses and outcomes or (2) to focus on the elimination of weaknesses that can be identified. It is important to realize that not all strengths and/or weaknesses can be influenced by short-term public policies. Thus, policy needs to identify the most effective levers, which are contingent on where a state or community starts.

Complementary digital equity programs will likely be most effective if they address digital literacy and the development of human-centered applications simultaneously. Both require a spectrum of measures. For example, digital literacy training could combine the deployment of digital navigators as an initial, short-term measure, with sustained continuing education programs, and reforms of the K12 and other curricula. Measures to facilitate human-centered application and service design, could combine online training and awareness creation with the gradual embedding of such practices into K12 and other curricula, as has been done with some success around security and privacy aware software development.

Developing an Online Compass Tool

A digital opportunities compass tool is currently in consideration for prototype development. It is anticipated that this online application will assist planners in benchmarking tactics to increase digital equity and to ensure that the efficacy of interventions are assessed and thoroughly quantified longitudinally. Practitioners will identify an applicable subset of indicators for each component to address. Quantitative measurements could include existing and new data sources, extant proven measurement tools, and qualitative analysis. Inter-institutional stakeholder participation will be encouraged for qualitative measurements. This approach can provide a mechanism to develop state and local digital equity plans, adapt strategy and program deployment while potentially mitigating any unintended consequences, and to serve as a vehicle for community and institutional participation. Those interested in learning more about collaboration on practitioner tools should contact the authors of this paper.

Using the Digital Opportunities Compass in Practice:

Utilizing Compass Indicators to Build Healthy Digital Equity Ecosystems

Strong community relationships are key to building healthy digital equity ecosystems. Covered populations, such as low-income and aging individuals, individuals with disabilities, and those with a language barrier, can benefit from coordinated and equitable support as part of this ecosystem. A digital equity ecosystem has been defined as the "interactions between individuals, populations, communities, and their larger sociotechnical environments that all play a role in shaping the work to advance more equitable access to technology and social, economic, and racial justice" (Digital Equity Research Center). Community coalitions are often essential to the success of this work.

A healthy digital equity ecosystem depends on these interactions and interrelationships between local community assets. Similar to an ecosystem in nature, digital equity ecosystems need to be nurtured and maintained over time. Given the complexity of digital equity needs that exist in communities and the limited resources available to address them, unnecessary duplication of effort and gaps in digital inclusion services are both detrimental to the health of a digital equity ecosystem. The Digital Opportunities Compass can be utilized early in the process of mapping the ecosystem, as well as part of a process of continuous improvement. The Compass can also be used in conjunction with other tools, such as an asset inventory that has been developed in and with local community members. Asset mapping has also been identified as a key component in creating a statewide digital equity plan.

Asset mapping is "an approach to planning and community development centered on identifying and building on a community's existing resources. Deep community engagement is a key part of asset mapping, used to uncover existing strengths, skills, and connections that can be leveraged" (National Digital Inclusion Alliance). It has several benefits not only in the context of the IIJA, but also as an early step in building a healthy digital equity ecosystem.

In particular, asset mapping can help those working to advance digital equity to focus on the strengths of a community, rather than its deficits.

The National Digital Inclusion Alliance (NDIA) recommends that digital equity stakeholders include a diverse range of organizations, programs, and attributes in their asset mapping efforts::

- Digital equity organizations, such as nonprofit device refurbishers, digital inclusion coalitions, and community technology centers
- Organizations running digital inclusion programs, such as public libraries and senior and community centers
- Organizations serving covered populations, such as public housing authorities, returning citizen programs, and university agricultural extension programs
- Other community assets, such as anchor institutions, ISPs, gathering spaces, and policymakers

Asset mapping is essentially a community engagement and data gathering effort designed to identify resources that can be leveraged to support digital equity efforts; however, on its own asset mapping does not provide a complete picture of the ecosystem. This is where the Digital Opportunities Compass can come in to supplement asset mapping by providing a structure to organize and understand the relationships between assets. The Compass can be particularly useful when asking questions about how community interactions can be created and interrelationships built as part of this process. Table 6 illustrates how this might happen in practice.

Table 6. Utilizing Compass Indicators to Build a Healthy Digital Equity Ecosystem

Asset Mapping Inventory Categories	Using the Compass to Analyze Assets and Build Ties
Broadband Access & Affordability	How might similar organizations that represent specific **socio-demographic** groups be brought together to leverage their strengths to help increase access to broadband, including affordable internet programs?
Device Access	How might existing **economic factors**, such as the existence of local businesses and jobs, provide insights to help connect relevant organizations in the provision of device access to lower-income and aging individuals?
Digital Skills & Technical Support	How might the assets identified through a mapping inventory exercise be considered to bring community and grassroots organizations together to have increased agency and ownership in **coordinated and equitable efforts** to provide digital skills training and ongoing support?
Public Device & Internet Access	How might local organizations focused on **cultural considerations** of specific covered populations come together to help develop programs and services that provide public device and internet access solutions outside the home to support meaningful broadband adoption?
Digital Inclusion Funding	Who are the **champions in local government** that could be brought together with local assets to help leverage existing funding and identify new sources of funding to advance digital equity?

Once the Compass has been used as a next step in additional data gathering following the asset-mapping process, a local coalition should be established to help grow and sustain these efforts in a coordinated manner over time.

Using the Digital Opportunities Compass in Practice:
Utilizing Compass Indicators to Build Healthy Digital Equity Ecosystems

A coalition includes people who are committed to working toward digital equity by working together, across a variety of organizations and institutions, to advance these goals (Digital Inclusion Coalition Guidebook). A coalition often includes individual community members, community-based organizations, such as public libraries and non-profit organizations, as well as other entities, such as municipalities or internet service providers. Local coalitions have also been identified as a key part of building healthy digital equity ecosystems.

The **Digital Equity Ecosystem Measurement (DEEM) Framework** was created to address the lack of conceptual frameworks and measurement tools needed to gather data for planning, improvement, and argumentation purposes. While local coalitions are the primary audience for the DEEM framework, state policy leaders can also use the framework to identify areas where data can be used to build regional capacity for digital equity efforts. The DEEM framework is focused on the following three levels of measurement.

> **Coalition Health**
> Indicators related to the organization, structure and relationships of a coalition as a whole.

> **Member Strength**
> indicators related to the capacities and efforts of coalition members related to the valued impacts of the coalition.

Community Impact
Indicators related to positive changes to the lives of individuals and the broader community that a coalition is hoping to bring about through its efforts focused on advancing digital inclusion, equity, and justice.

Indicators at each level are offered as a menu of options, rather than a prescriptive formula, to assist local coalitions in gathering data to help build stronger relationships and achieve common goals. Several recommendations are provided in the DEEM Framework report for various stakeholders including state broadband and digital equity offices. Ultimately, as the authors argue in the report, the framework provides a roadmap for how states can engage with covered populations to ensure their needs and aspirations are both included and met in state broadband and digital equity grant programs.

Table 7 provides a visual to show how these three existing tools can be used to map existing assets, ensure digital opportunities, and build healthy digital equity ecosystems in a systematic manner. The table offers a brief summary to describe how each of these tools can be used together.

Table 7. Using Existing Tools to Build a Healthy Digital Equity Ecosystem

NDIA Asset-Mapping Inventory	Digital Opportunites Compass	DEEM Framework
Use to uncover existing strengths, skills, and connections that can be leveraged.	Use to make connections between existing assets and ensure that equity is centered in the process.	Use to grow and sustain healthy digital equity ecosystems over time.

The Digital Opportunities Compass complements the asset-based approach of NDIA's asset-mapping tool by helping to establish a foundation upon which the DEEM framework can be utilized to ensure coalition health, member strength, and community impact to advance digital inclusion, equity, and justice.

Conclusion

In this paper we presented the Digital Opportunities Compass as a holistic set of metrics to monitor, evaluate, and guide state broadband policy. The framework is offered to support state agencies as they develop their digital equity plans this year as a requirement of IIJA. It is also introduced as a comprehensive framework to ensure that additional factors and contexts are considered that research has shown can influence the outcomes and impacts of digital inclusion and broadband adoption initiatives.

The ideas presented in this paper are grounded in over a quarter century of research and scholarship on digital inequalities, as well as more recent experiences of digital equity practitioners in the field. As such, the Digital Opportunities Compass attempts to fuse research and practice to benefit policy, support local programs and practitioners, and to assist those tasked with implementing state programs required by the IIJA. In doing so, the Compass seeks to connect the following within an evaluative framework: what is known about the needs of covered populations; the barriers to advancing broadband and digital equity; the assets that exist to support community-wide efforts; and strategies to advance digital equity as a social and economic justice issue, as recognized in the IIJA.

The Compass includes the following six components: Contexts, Governance, Connectivity, Skills, Application, and Outcomes. Each component includes specific indicators that have a bearing on the process and outcomes of digital equity initiatives "on the ground." The indicators are intended to assist stakeholders in assessing their overall conditions in order to determine where additional areas of attention

may be needed. The Compass is unique in that it goes beyond what is known about digital connectivity, skills, and the application of networked technologies to consider the broader sociotechnical contexts that are known to influence the adoption or non-adoption of computers and the internet. Governance is also recognized, in this vein, as a metaphorical weight that should be measured particularly because of its power in either bringing down or helping to elevate specific broadband and digital equity programs.

The Digital Opportunities Compass is intended to be a starting point, rather than the final word, regarding the development of a comprehensive assessment framework to monitor, evaluate, and guide state broadband and digital equity policy–now and in the future. In this context, the Compass seeks to be useful both during the early stages of the Broadband Equity, Access, and Deployment (BEAD) and Digital Equity Act (DEA) grant programs this year administered by the **National Telecommunications Administration** (NTIA), as well as during and at the end of the grant programs. The Compass should be useful to NTIA as the agency seeks to develop a comprehensive and humanistic evaluation framework to assess the outcomes and impacts of these national programs.

Beyond IIJA, we hope that the Digital Opportunities Compass encourages deeper discussion, debate, and reflection not only regarding how to measure digital equity, but also to inspire new directions for research, practice, and policy in an increasingly networked society that demands broadband connectivity.

Appendix I. Digital Opportunities Compass Situated Logic Model

States' or Communities' *Planned Work*

Inputs	Activities	Outputs
In order to accomplish our set of activities we will need the following:	In order to address out problem or asset we will accomplish the following activities:	We expect that once we have accomplished these activities they will produce the following evidence or service delivery:

IIJA Measurable Objectives Logic Model

• Options for affordable fixed and wireless connections • Options for affordable consumer devices and technical support for those devices • Coordinated support for digital skills programs that include training on internet safety (privacy and security) • Options for user-informed, streamlined, and accessible online resources and services • Support from and collaboration with local government and/or community partners	• Work with individuals and households to gain access to affordable fixed and wireless broadband connections • Work with individuals and households to gain access to affordable consumer devices and technical support for those devices that meet the needs of the user • Work with individuals to gain access to digital skills training, including training programs on internet safety (privacy and security) • Work with Individuals to gain access to inclusive public resources services	• # of available and affordable fixed and wireless broadband connections • # of available and affordable consumer devices and technical support for those devices • # of people that have obtained digital skills • # of people that have gained awareness of, and the use of, measures to secure the online privacy of, and cybersecurity • # of public resources and services that are more accessible and inclusive

Digital Opportunities Compass Logic Model

• Options for identifying structural inequalities • Options for backbone organizations exist • Options for culturally relevant pedagogies exist • Options for individuals and organizations to receive training in culturally competent in order to know how to center equity in their broadband and digital equity programs • Options for individuals and organizations to receive training in human-centered and equitable design pedagogies in order to center those most impacted by digital inequalities in their work	• Work with individuals and households to identify where digital structural violence and digital redlining exist and implement effective measures to prevent these harms in the future • Work with individuals and organizations that provide digital inclusion programs and services • Work with those who offer digital skills programs to receive training to become culturally competent and accessibility-focused • Work with those most impacted by digital inequalities in the design of technologies, programs, and services to promote digital equity. • Work with those most impacted by digital inequalities in human-centered and equitable design initiatives	• # of individuals and families who have benefited from measures that have been implemented to prevent digital structural violence and redlining • # of individuals and organizations that provide digital inclusion programs and services have benefited from the backbone organization's efforts • # of individuals and families that have gained digital skills in a culturally relevant way • # of people who have been centered in the design of technologies, programs, and services to promote digital equity. • # of people who have been involved in human-centered and equitable design initiatives

Appendix I. Digital Opportunities Compass Situated Logic Model

States' or Communities' *Intended Results*

Short-Term Outcomes	Mid- to Long-Term Outcomes	Impacts

IIJA Measurable Objectives Logic Model

• Increased access to available and affordable fixed and wireless broadband connections • Increased access to available and affordable consumer devices and technical support for those devices • Improved digital skills capacity to become confident, safe, secure, and self-directed learners • Increased access and use of public resources and services	• More jobs, local businesses with digital readiness, and increased wages • Higher levels of educational attainment • Increased access to healthcare and wellness • More robust civic engagement activity • Increased levels of social connections, social capital, and collaboration • More inclusive for people with disabilities	Full participation in our society, democracy and economy, which is necessary for civic and cultural participation, employment, lifelong learning, and access to essential services particularly for the following covered populations: • Low-income individuals; • Aging individuals; • Incarcerated individuals, other than individuals who are incarcerated in a Federal • correctional facility; • Veterans; • Individuals with disabilities; • Individuals with a language barrier; • Individuals who are members of a racial or ethnic minority group; and • Individuals who primarily reside in a rural area.

Digital Opportunities Compass Logic Model

(Same as Above)	(Same as Above)	(Same as Above)

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Digital Opportunities Compass:

Metrics to Monitor, Evaluate, and Guide
Broadband and Digital Equity Policy

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