Precision Agriculture Task Force Connectivity Mapping and Analysis Working Group, Interim Report FY 2022

Adopted on December 2, 2022

Content

Background

At the working group's first kick off meeting on March 10, 2022, its members decided to meet weekly to establish a regular cadence to learn and refine recommendations that address the challenges facing key stakeholders in the precision agriculture sector. The weekly meeting schedule also provided the group the opportunity to discuss recommendations, share new perspectives and to receive presentations from key experts in the precision agriculture, broadband mapping and technology sectors.

The group also spent time reviewing the charge (Appendix A) and work performed by the previous working group as a starting point for identifying the core focus areas of our current working group. Based on those discussions, the group identified four areas to explore further:

- Resources and policies to aid data mapping & analyzing connectivity
- Mapping Negative Space – gap in connectivity: Unserved, underserved vs served
- Multi-agency collaboration on whole farm data collection, data sharing and maintaining public facing ag focused data platform
- What should be mapped - level of coverage, speed, signal strength, resolution, etc.

Four individual subgroups were formed to explore each area in more detail and provide substantive recommendations to the Task Force. Subject matter experts spoke to the working group and shared valuable insights that spurred a robust discussion about the merits and opportunities of new mapping technologies and data collection

methodologies. The list of experts and topics of presentation can be found in Appendix B.

Based on the group discussions, meetings and presentations since March, the group identified two overarching themes:

1. Coordination across all relevant federal agencies with some jurisdiction over broadband as well as agricultural and federal lands is critical; and
2. Data collection methodologies vary widely across different agencies and are not accurately capturing the broadband user experience among agricultural producers (farmers and ranchers) as well as the level of service availability.

As a result, these disparities have created a fragmented data set that cannot accurately capture the challenges among farmers and producers who need reliable broadband access but cannot obtain it on their farm, ranch, pasture or farm office.

Interim Recommendations and Considerations

From the information collected by the working group, the following preliminary recommendations are respectfully submitted to the chair of the task force. These recommendations were developed to address the variety of data sets across federal agencies including the Federal Communications Commission (FCC) and several key agencies within United States Department of Agriculture (USDA) such as Rural Development's Rural Utilities Service (RUS), the National Agricultural Statistics Service (NASS), and the Agricultural Research Service (ARS).

Some of the data developed and collected by the USDA agencies listed above can benefit the national broadband mapping work performed by the FCC and should be integrated into the FCC's National Broadband serviceable location fabric (Fabric) and broadband maps. Ensuring that all relevant federal agencies with jurisdiction over broadband investments as well as agricultural lands coordinate more extensively on broadband mapping as it relates to agricultural, tribal, and federal lands.

Meaningful and dedicated coordination across these agencies is imperative and must be a top priority for policy makers interested in improving the level of connectivity on farmlands. Without this level of coordination, data sets will continue to remain fragmented and unhelpful to the precision agriculture sector.

Interim Recommendation 1 (Refer Appendix C for more details)

The FCC should adopt a standardized set of required measurements or key performance indicators for all parties engaged in broadband data collection and utilize existing third-party software and datasets in the federal and state collaborative efforts to collect network performance data and to analyze broadband connectivity on agricultural lands. The FCC has provided resources as part of its Broadband Data Collection (BDC)

on specifications for the data collected from providers, Fabric challenges, and speed test challenges.[1]

1. Embrace a multi-agency adage, combining network coverage and performance data from FCC Speed Test platform with third party data providers such as Ookla Speedtest, M-Lab, and NACo TestIT, and survey data from USDA NASS, state broadband offices, and other similar sources.

2. Promote a broader data collection ecosystem by engaging the participation of agriculture community through USDA and industry collaborations and incentive mechanisms to drive adequate coverage of agricultural lands in the verification datasets and challenge process.

3. The minimum required data all parties must collect shall include:
   a. Network performance data such as download and upload speeds, latency at idle and saturation, jitter, packet loss, active connection type, etc.
   b. Provider network details (Internet Service Provider (ISP) name, advertised speed, etc.)
   c. Test location (GPS, service address, etc.)
   d. Active connection type (Wi-Fi, Ethernet, Long Term Evolution (LTE), etc.)
   e. Wireless RF metrics (Reference Signal Received Power (RSRP), Reference Signal Received Quality (RSRQ), Signal to Noise Ratio (SNR), etc.) when available

See Appendix G for complete set of recommended key performance indicators (KPIs)

Interim Recommendation 2 (Refer Appendix D for more details)

The FCC, in partnership with USDA, should adopt a framework, as described here, for determining and mapping unserved, also called negative space, and underserved agricultural lands and develop a pilot project with USDA to share the map with agricultural communities through a visualization platform hosted by the Agricultural Research Service.

1. FCC and USDA should adopt the following framework that utilizes the following list of data to determine unserved and underserved agriculture lands.

   a. The most recent Crop Data Layer from USDA National Agricultural Statistics Services and pastureland data layer from United States Geological Survey's Land Use Land Cover data will be used as the base layer for broadband connectivity maps in the lower 48 contiguous states.

[1] "Key Reference Documents" in "Broadband Data Collection Resources" FCC.gov https://www.fcc.gov/BroadbandData/resources (providing resources and additional specifications regarding the Broadband Data Collection).

b. The best available authoritative cropland and pastureland cover will be used over the remaining states and US territories.
c. The most recent FCC 477 or BDC data would be used to create the current state of connectivity layer on agricultural lands as indicated by providers.
d. Additional data layers will incorporate service areas of connectivity providers and technology types not currently represented in 477 or BDC data.
e. The map shall include verification data layers from third party measurement datasets and FCC challenge process to verify coverage and performance of connectivity layers. Examples may include state broadband data, Ookla Speedtest, FCC Speed test, NACo TestIT, National Telecommunications and Information Administration (NTIA) data, Tribal land data, etc.
f. Further data layers could be considered for additional context including existing non-commercial private networks, where known. Consider incorporating data from the Department of Interior Broadband Infrastructure Map including existing federal assets and right-of-way Homeland Infrastructure Foundation-Level Data (HIFLD) Cellular Tower Data.
g. The availability of unused spectrum for private network deployment. Examples may include TV White Space and Citizens Broadband Radio Service (CBRS).

2. Following the framework to develop the map, we recommend that FCC and USDA adopt a rubric or a categorization system with corresponding map colors, as explained in Table 1, for displaying the maps that can be easily understood by public.

a. **Unserved** – Providers do not indicate any connectivity available on the production land, or providers indicate connectivity availability, but verification data shows a clear lack of acceptable service.
b. **Unverified** – Providers indicate that connectivity is available based on 477 or BDC data provided for that agricultural land, but no verification data exists to validate acceptable service standards.
c. **Underserved** – Providers indicate that connectivity is available based on 477 or BDC data, but verification data sets indicate available services do not meet the performance and reliability threshold required for agricultural broadband use cases.
d. **Verified** – Providers indicate that connectivity is available and third-party verification sources confirm that in fact users have demonstrated connectivity to that piece of agricultural land.

Table 1. Suggested rubric for displaying connectivity map

	Unserved	Unverified	Underserved	Verified	
Cultivated land					*a.*
Pasture/Grazing					*b.*
Ag Structures					*c.*

Homestead					*d.*

a. *40 acres parcels wired/or wireless (A minimal broadband definition needs to be defined for agricultural lands and structures not included in the FCC Broadband Data Collection definition)*
b. *40 acres parcels wired/or wireless*
c. *Ag Structures that are on the tax roles wired/ or wireless*
d. *Main farm head/home location with connectivity meeting currently accepted federal minimum broadband definition (e.g. 100/20Mbps, 25/3Mbps)*

Interim Recommendation 3 (see Appendix E for more details)

Under USDA guidance, establish an inter-agency coordinating council focused on broadband connectivity data collection, verification, and analysis of coverage on agricultural lands as well as native farmlands to address the broadband connectivity challenges.

The Council should include USDA agencies as well as the National Telecommunications and Information Administration (NTIA), the Bureau of Indian Affairs (BIA), the U.S. Census Bureau and the Federal Communications Commission (FCC). The Council should also consult with the National Association of Counties (NACo) and state broadband offices to develop a comprehensive strategy towards mapping and expanding broadband access on agricultural lands. The Council should be directed to meet monthly and provide quarterly updates on its work to the House and Senate Agriculture appropriations and authorizations committees in Congress. Such updates will be provided until the next Farm Bill reauthorization in 2028.

USDA agencies should also be directed to coordinate internally to address the lack of connectivity on agricultural lands. Specifically, the USDA will be directed to:

1. Establish an intra-agency agricultural connectivity task force to coordinate broadband connectivity and mapping related efforts across relevant internal agencies such as National Agricultural Statistics Service (NASS), Farm Service Agency (FSA), Rural Development (RD), National Institute of Food and Agriculture (NIFA), Natural Resources Conservation Service (NRCS) and others within USDA as the Secretary and Congress deems appropriate. This USDA Task Force will consult with local, tribal, cooperatives, cooperative extension leaders and other agricultural stakeholders to increase agricultural producer participation in data collection efforts and use of broadband connectivity maps, and to develop strategies for broadband resource allocation to rural agricultural areas as well as those owned by native nations. The Task Force will provide quarterly updates to the inter-agency council, which will be part of the updates from the council to the House and Senate Agriculture appropriations and authorizations committees in Congress.
2. Ensure that NASS and the FCC collaborate to enhance NASS' Farm Computer Usage and Ownership Survey and Ag Census for the purpose of examining the lack of broadband coverage on agricultural lands including farmlands owned by native

nations. This will require engaging more agricultural producers and cooperative extension leaders in verification data collection and analysis.

3. The inclusion of language in the 2023 Farm Bill to authorize sufficient funds to USDA-NASS to collect and analyze a more comprehensive set of broadband coverage and usage data through its Farm Computer Usage and Ownership Survey and the Agriculture Census. Specific detailed questions regarding broadband coverage, usage, broadband enabled use cases on farms and the utilization of precision agriculture tools shall be included in both the survey and the Agriculture Census. The results of these surveys shall be analyzed and incorporated into a comprehensive USDA broadband coverage map illustrating the level of connectivity over agricultural lands to help the expansion and adoption of precision agriculture technologies.
4. Authorize additional funds in the 2023 Farm Bill to establish a new grant program similar to that administered by NTIA to fund outreach, education, broadband data collection and broadband mapping initiatives led by land-grant institutions through State Cooperative Extension Services and Experiment Stations in rural communities.
5. To work with, in conjunction with the FCC, the United States Census Bureau through a Memorandum of Understanding to utilize Census data or seek the necessary authority required to access that data.

Interim Recommendation 4 (see Appendix F for more details)

Incorporate precision agriculture connectivity profiles or use cases required to enable current and future precision agriculture adoption, based on "Connectivity Demand" working group recommendations. The precision agriculture use cases may include:

1. Real-time heavy data processing use cases such as Artificial Intelligence (AI) driven technology that require high bandwidth, low latency connection profile
2. Asynchronous bulk data transfer needs such as whole field mapping with drone or field robots that would help make decision for the next day or within a few days. Examples may include mapping soil fertility for future fertilizer applications, or crop senescence for harvesting decisions.
3. Realtime telematics data communication needs for farm machinery operational problems, livestock health and wellbeing, etc. Examples may include an irrigation system or machinery malfunction during operation, predation on livestock, etc.

See Appendix F for full use case and required connection profile recommendation

Additional Questions to Consider

- Should resource allocation for precision agriculture connectivity be based on population-based or geographical area based criterion? (In conjunction with the Connectivity Needs and Demand Working Group)

- Given the 0.73 square km (or 0.28 square miles, or 180 acres) hexagonal grid size of BDC data, how should this factor into our recommendation for a reporting grid size? We currently specify 40 acres.
- Given the comprehensive data collection efforts under BDC that brings data from multiple federal, state, tribal and private partners, should we reconsider some of our recommendations?

Appendix

Appendix A: FCC Charge Working Group

The working group has been tasked with the following charges:

- Identify and measure current gaps in the availability of broadband internet access.
- Recommend specific steps the FCC should take to obtain reliable and standardized data measurements.
- Recommend specific steps that the FCC should consider ensuring that the expertise of the secretary and available farm data are reflected in future programs on broadband.

To carry out these charges, evaluate:

- FCC broadband deployment data and department data to identify broadband coverage on ag lands;
- With Accelerate Broadband Deployment Working Group, evaluate specific steps the FCC should take to ensure the expertise of the secretary and available land data and precision ag technology data are accounted for in policy making
- The suitability of the Commission's and Department's data to appropriately identify and measure current gaps in the availability of broadband Internet access service on agricultural lands for precision agriculture purposes, and any limitations of the data; and
- Specific steps the Commission and Department should take to improve and/or merge their data to better evaluate and facilitate broadband deployment for precision agriculture

Appendix B: Expert Speakers Invited by the Working Group

Thus far our Working Group has heard from the following speakers:

1. NACo mapping of broadband – Tarryl Clark & Seamus Dowdall, National Association of Counties (NACo), 03/24/2022: Information on NACo broadband task force and efforts to map broadband at county level, including the mobile app for mapping connectivity called NACo TestIt.
2. Ookla's Speedtest Ecosystem – Luke Deryckx, Ookla, 04/07/2022: Ookla's platform for speed testing records middle mile connectivity and end-user experience and has coverage across the country. The data across agricultural lands is sparse at present.
3. Digitization in Agriculture – Use of Data in Modern Farming – Seth Crawford, AGCO, 05/12/2022: Current machine systems employing precision agriculture and the connectivity demand to accomplish the goal of increasing farm income.
4. TV White Space: Data-driven agriculture (Ranveer Chandra, Microsoft) & Connectivity, Data and AI in the Farm (Andrew Nelson, Nelson Farms), 05/19/2022: Microsoft's FarmBeats program for data driven agriculture and the role of TV White Space for connectivity on agricultural lands for AI driven digital agriculture through Azure IoT Edge. A farm use case scenario of TVWS and AI at Nelson Farms for micro-climate forecasting, precision seeding, and precision spraying.
5. Distance vs data rate – Joe Carey, Trimble, 06/09/2022: High data rate transmissions through mobile broadband require closely placed towers.
6. USDA-ARS Visualization Platform for agriculture & connectivity data – Patrick Ryan, ESRI, 06/16/2022: An update on the USDA-ARS platform for sharing connectivity data over agricultural lands with agricultural communities.
7. National Land Cover Data (NLCD) Products – Suming Jin and Jon Dewitz, United States Geological Survey (USGS), 06/23/22: The NLCD program serves as the authoritative source of national land cover data at 30 meters resolution or 0.22 acres/pixel that is updated every three years, with last update in 2019. The program publishes the National Land Cover Dataset, Forest Canopy, and Impervious Surface layers. They have developed protocols for assembling spectral, spatial, and temporal-consistent training data. Modeling and mapping efforts provide adequate land cover accuracies over land cover classes including grass/pasture/range areas. There are data harmonization efforts between USGS NLCD and NASS Crop Data Layer program
8. Presentation on satellite coverage and connectivity – Sampath Ramaswami, Hughes Network, 08/11/2022: The high-orbit satellite system for broadband connectivity, and how they may serve the precision ag needs.
9. Presentation from the American Farm Bureau by Philip Powell with Arkansas Farm Bureau Federation, Assistant Director of Local Affairs & Rural Development, 08/18/2022: Arkansas Farm Bureau Federation is working with the state broadband division in mapping and connectivity to agricultural operations.
10. Broadband Resources for Extension, Kenneth Sherin, Broadband Access and Education Coordinator, County Extension Director, NC Cooperative Extension,

Randolph County Center, 08/25/2022: North Carolina Cooperative Extension works with Extension Committee on Organization and Policy (ECOP) and state government in their efforts to map connectivity and digital literacy.

11. Connectivity Mapping at John Deere – Mark N. Lewellen, John Deere & Company, 10/6/2022: John Deere has developed a national map that combines crop data layer with tiger data (road miles from US Census Bureau) and 4G/5G LTE mobile broadband coverage data from FCC.
12. FCC Broadband Data Collection – Sean Spivey, Kirk Burgee and Kimia Nikseresht, Federal Communications Commission: Speakers shared the details of BDC efforts including the processes and data flow, timelines, challenge process for fixed and mobility, and data mapping plans.

Appendix C: Recommendation of Subgroup on Policies, Resources and Cultural Awareness to Aid Broadband Data Mapping

1. Direct and fund agencies to collaborate on common goals around data collection and/or analysis
    a. Who we want and what we want (the agencies, what are the goals)
    b. Funding will be required for this to work (Farm Agency, NASS)
        i. Farm bill - 2023
        ii. Annual appropriations - 2023
        iii. Joint USDA/FCC appropriated funding

2. Combine efforts to create or utilize third-party software collect connectivity verification data
    a. Multi-agency adage, combining efforts of USDA NASS (survey) + Ookla, state broadband office speed tests, FCC speed test, NACo TestIT, other apps meeting data requirements as outlined in Appendix G
    b. Instructing farmers/residents to check their connectivity around the farmland, instruction on testing connection and methods

3. Collect samples from various locations around rural and tribal areas, utilize Land Grant Universities personnel, extension agents, rural mail carriers, delivery drivers, drones to achieve this goal with autonomous methods.
    a. Autonomous meaning background testing ability.
    b. Drone addition could capture pastureland, could have privacy issues (FAA issues).

Appendix D: Recommendation of Subgroup on Mapping Negative Connectivity Space on Agricultural Lands

We propose the following:

1. Base map would be derived from the NASS Cropland Cultivated Data and the USGS MRLC/NLCD Grass/Pastureland data set. The map would be housed on and created by ARS for agriculturalists with a link to the FCC site for connectivity providers.
2. Best available authoritative cropland and pastureland cover will be used over US territories
3. The FCC 477 or BDC data would be used to create the current state of connectivity layer on agricultural lands as indicated by providers.
4. Additional data layers will incorporate service areas of connectivity providers and technology types not currently represented in 477 or BDC data.
5. Verification data layers will be incorporated from third party measurement data sets to verify coverage and performance of connectivity layers.
    - e.g. State broadband, Ookla Speedtest, FCC Speed test, NACo TestIT, NTIA data, Tribal land data, etc.)
6. Further layers could be considered for additional context including
    - Existing non-commercial private networks, where known
    - Consider including data from the DOI Broadband Infrastructure Map like existing federal assets and right-of-way
    - HIFLD Cellular Tower Data:
    - Availability of unused spectrum for private network deployment, e.g. TV White Space, CBRS

Some underlying assumptions

1. The map would be a point in time best effort with current data available.
2. The map would be updated and versioned quarterly as new source data updates are made available.
3. Third party verification data sets would need to conform to a standard set of parameters that measure the performance and reliability of connectivity, ensuring that multiple data sets from multiple sources can be combined.
    a. median download speed, median upload speed, latency, jitter, packet loss
    b. See Appendix G for complete set of recommended key performance indicators (KPIs)
4. Many base layer and verification layer data sets are available. Some are known to the writers of this recommendation, many are not. As such, the scope of recommended data sets will expand.
5. No consideration given to types of ag production just is there some type of production as indicated by the NASS and USGS data.

6. Negative space (unserved and underserved lands) map is to be based on a measured lack of coverage from verification datasets, and/or a lack of coverage from any/all reported coverage data sets, such as the BDC data. We will draw a clear distinction between an area where we've used data to confirm there is no service provided, and an area where we have no reliable data to make those inferences.
7. Acceptable performance thresholds to be based on federally defined broadband definitions, and specific agricultural use case thresholds as defined by the use case working group

	Unserved	Unverified	Underserved	Verified	
Cultivated land					a.
Pasture/Grazing					b.
Ag Structures					c.
Homestead					d.

e. 40 acres parcels wired/or wireless
f. 40 acres parcels wired/or wireless
g. Ag Structures that are on the tax rolls wired/ or wireless
h. Main farm head/home location with connectivity meeting currently accepted federal minimum broadband definition (e.g., 100/20Mbps, 25/3Mbps)

A categorization system with corresponding map colors will be used to indicate the following:

- Unserved - Providers do not indicate any connectivity available on the production land, or providers indicate connectivity availability, but verification data shows a clear lack of acceptable service.
- Unverified - Providers indicate that connectivity is available based on 477 or BDC data provided for that agricultural land, but no verification data exists to validate acceptable service standards.
- Underserved – Providers indicate that connectivity is available based on 477 or BDC data, but verification data sets indicate available services do not meet the performance and reliability threshold required for agricultural broadband use cases.
  Verified - Providers indicate that connectivity is available and third-party verification sources confirm that in fact users have demonstrated connectivity to that piece of agricultural land

We suggest the following draft recommendations:

1. FCC adopt the framework as a base to determine unserved and underserved ag lands in low 48 states.
2. FCC adopt the underlying assumption to the framework as the supporting clarification to framework.

3. FCC adopt the rubric that lays out the steps that could be taken when adopting the framework.

Appendix E: Recommendation of Subgroup on Multi-agency Collaboration on Data Collection and Sharing, and Maintaining Public Facing Ag-Focused Data Platform

Objectives:

- To establish a coordinated approach to broadband mapping on agricultural lands across multiple USDA agencies and led by the National Agricultural Statistics Service (NASS) in coordination with numerous USDA agencies that fund projects on or near agricultural lands or who support conservation efforts and educational initiatives on agricultural areas.
- To integrate the expertise as well as the financial and technical resources of various USDA agencies with jurisdiction over broadband infrastructure deployment, agricultural lands, conservation districts and survey analysis. These agencies include:
    - Rural Development (RD-RUS), Natural Resources and Conversation Service (NRCS),
    - National Institute of Food and Agriculture (NIFA)
    - Farm Services Agency (FSA)
    - The National Agricultural Statistics Service (NASS)
- To ensure federal funds dedicated to collecting, measuring and analyzing coverage data and the level of fixed and mobile broadband coverage on farms and agricultural lands are executed in the most cost-effective manner to provide the most comprehensive view of broadband coverage on rural agricultural lands and farms.
- To allocate sufficient federal funding to support a USDA wide initiative that leverages existing USDA staff from the agencies listed above to build a comprehensive broadband map that illustrates the location of unserved and underserved farmlands.
- To ensure the FCC and NTIA utilize the USDA broadband mapping information for all federal grant and subsidy determinations starting in Q1, 2023.

Purpose and scope

Several USDA agencies that work directly with and for rural communities, native nations and agricultural producers in rural unserved are maintain valuable expertise and familiarity with lack of connectivity on agricultural lands and its corresponding impact on the expansion and adoption of precision technologies to reduce input costs and increase efficiencies.

Rural Development (RD-RUS), Natural Resources and Conversation Service (NRCS), National Institute of Food and Agriculture (NIFA) and the Farm Services Agency (FSA) each have a wealth of insight to contribute toward the survey analysis conducted by the National Agricultural Statistics Service (NASS), which is the primary statistical USDA

agency and an official source of comprehensive information. NASS data are used to support research, education, and advocacy for the future of agriculture.[2]

Given its role in overseeing statistical analysis and data collection on farming activity in the U.S., expanding NASS' responsibility to maintain farm field broadband data will complement its primary role in managing and conducting the biannual Farm Computer Usage and Ownership Survey and quinquennial Agricultural Census. Enhanced broadband data collection also helps USDA support further research on precision agriculture uses and trends.

Broadband usage data collected by NASS is used widely by the precision agriculture sector as well as academic institutions, nonprofit organizations, regional federal reserve banks and many internal USDA agencies such as ERS and Rural Development.

Recommendation 1: To improve its broadband usage survey that examines the level of broadband coverage on agricultural lands, NASS be provided with the necessary funding to:

- support broadband mapping at the same frequency as crop production data;
- convert farm field mapping data into publicly accessible farm field broadband maps within the NASS agriculture database; and
- share data with relevant USDA farmer assistance agencies such as FSA, NRCS, NIFA as well as other federal agencies such as the NTIA, FCC, EDA.

NASS stakeholders and staff can benefit from improved and more precise coverage data as well as other inputs collected by other USDA agencies to increase the value of its mapping and surveying of broadband over farm fields which is a natural addition to crop production surveys and the Agricultural Census. Through NASS as the record keeper of farm field broadband mapping, the aggregate of US farm data will be enhanced for better research and service to farmers.

Recommendation 2: To ensure the necessary funds allocated to each USDA agency are used to facilitate the appropriate level of broadband mapping on farmlands, we urge Congressional Agriculture committee leaders in the House and Senate to adopt the following.

1. Include language in the 2023 Farm bill that allocates funds to each USDA agency listed above to contribute staffing, travel and operational funds toward a department wide intra-agency broadband mapping and data analysis task force.
2. Require the internal USDA task force to create an action plan that draws upon the core competencies of the relevant mission areas and agencies to develop an interactive broadband coverage map across agricultural lands.

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[2] https://www.nass.usda.gov/About_NASS/pdf/NASS_TalkingAboutNASS_ExternalGuide_2022_V01.pdf

- The task force will be directed to meet weekly to develop a stakeholder engagement strategy to conduct outreach and field analysis of broadband coverage on farmlands including those held in trust or on reservation lands.
- The USDA Internal Broadband Mapping task force will utilize the geospatial tools of each assigned agency to identify areas where coverage is insufficient for growers and producers to access and effectively operate precision technologies consistently.
- The task force will also consult with local, regional, tribal and federal and agricultural stakeholders about their coverage needs and experiences. Input received from consultations will be incorporated to provide the following:
- A comprehensive rural broadband coverage map on farm and agricultural lands using existing data from the RUS ReConnect broadband program map, NRCS and conservation easement mapping data and NASS mapping data.
- Allocate at least $1.5 million to each agency listed above to support intra-agency coordination involving broadband adoption, research and education, network deployment and technology expansion involving precision technologies and tools. The expansion and adoption of precision technologies across the proposed funded service areas ("PFSA") will also be included in each grant and loan program administered by RUS in all future broadband loan and grant programs.

Recommendation 3: Direct NIFA to establish a new competitive grant program to support rural field coordination and outreach to local and tribal producers on farms and agricultural lands.

- Land grant universities may apply for funds to build programs that support cooperative extension involvement in the education and collection of broadband usage and adoption data on farms and agricultural lands.
- Cooperative extension divisions of each land grant college and or university is uniquely qualified and best suited to support education, outreach and training performed by its cooperative extension agents to assist farmers and ranchers understand NASS surveys and complete them correctly to illicit the best data responses.
- Direct the NIFA to allocate funds to support the USDA's broadband mapping platform and goals.
- NIFA and RD shall distribute grant funds to local and regional organizations like the National Grange, to support the local survey and field analysis performed by Cooperative extension agents.
- USDA broadband mapping portal will be publicly launched in 3 years from the date of enactment of these provisions.

Appendix F: Recommendation of Subgroup on What Should Be Mapped - Level of Coverage and Resolution of Maps

The subgroup was tasked with determining the "level of coverage" needed for precision agriculture purposes. Understanding that there is at least one other working group in the Precision Ag Task Force that is working on this topic, the subgroup tried to focus on how the "level of coverage" necessary for precision ag purposes could be mapped.

We have learned that there are three main categories of use cases for broadband service in precision ag based on current and projected future industry needs:

1. Real-time heavy data processing use cases such as Artificial Intelligence (AI) driven technology that require high bandwidth, low latency connection profiles
    a. Data transfers for this use case may include real time streaming if HD video, exceptionally large image transfers for near-real time processing, and other high-definition sensor data.
    b. Meeting the needs of this use case would require at least a 100 Mbps download with a 100 Mbps (synchronous) upload connection, with low and consistent latency of 50 milliseconds or less.
    c. Connectivity technologies best able to serve this connection profile would include as fiber or fixed wireless to farm with high performance on-site Wi-Fi, 5G or other high quality connection technologies
2. Asynchronous bulk data transfer needs such as whole field mapping with drone or field robots that would help make decision for the next day or within a few days.
    a. Examples may include mapping soil fertility for future fertilizer applications, or crop senescence for harvesting decisions.
    b. Data transfers for this use case may include image and video data which is not needed in real time and can be downloaded after the farm equipment is parked for the night. Sometimes this type of transfer can be a cache of a week's worth of data. For example, this data provides a farmer with information about how many bushels per acre they are harvesting the field. It provides the information for a farmer to know what land is producing the most. Farmers may use that data to obtain support from the government and make determinations such as whether to change what is planted in a particular area.
    c. This large download includes large files and needs to be at least a 25 Mbps download with a 3 Mbps upload ("25/3") connection.
    d. The best type of broadband for this task is last mile fixed service or a hybrid of fixed and mobile service (Wi-Fi, 5G, LTE) in combination.
3. Realtime telematics data communication needs for farm machinery operational problems, livestock health and wellbeing, etc.

a. Examples may include an irrigation system or machinery malfunction during operation, predation on livestock, etc.
b. It helps a farmer know for example, if one of the rows is plugged (on the planter). Most equipment provides an alarm to the farmer so he can fix this problem quickly because if not rectified it may impact your whole season.
c. This use case can be served by connection profiles similar to CAT 1 LTE, at around 10 Mbps download with a 5 Mbps upload ("10/5") speed at 200 milliseconds latency.
    i. For reference, a typical cell phone is CAT 12 - 16 LTE which talks to multiple towers more frequently. That kind of service is unnecessary and not likely possible in rural areas due to lack of density.

Recommendation 1: Broadband data maps of agricultural lands should include layers that reflect the availability of fixed or mobile connectivity that is able to serve each category of agricultural use case. For example, a map of precision ag areas should show where mobile service of 10/5 Mbps or above is available and what the radius is. This would be a useful map for a farmer who needs to support telemetry/telematics and correction services and remote work orders. Additionally, it should show what the reliability of that link based on the topography of the area (e.g., down in the valley versus up the hill), in other words what is the probability the service will consistently perform above or below CAT 1 LTE speeds at 200 milliseconds latency, with additional layers representing connectivity able to serve the bulk data transfer and real-time AI driven use cases as outlined above.

Recommendation 2: A map of precision ag areas should show where there is fixed broadband service capable of meeting the minimum federally accepted definition of broadband. This enables farmers wishing to do large data transfers know where they can reliably make those transfers using fixed connectivity.

In so much as we make specific speed recommendations herein, we defer to the other working groups in the FCC's Precision Task Force that may be making specific speed recommendations for the same or equivalent purposes as described above.

To make both recommendations as beneficial as possible we note this Working Group's prior recommendation that there be a designation in the Broadband Data Collection Fabric for agriculture lands so that the overlaid service availability is shown on top of where agriculture lands and farms exist.

Appendix G: Recommended Broadband Measurement Key Performance Indicators (KPIs) Standards for Participating Data Sources

1. Broadband Performance KPIs
    a. Download speed, in Mbps
        i. Maximum sustained throughput measurement for download speed
    b. Upload speed, in Mbps
        i. Maximum sustained throughput measurement for upload speed
    c. Latency at idle, in milliseconds
        i. The time it takes for a given packet to make a round trip during an idle network condition
    d. Latency under load (saturated network condition), in milliseconds
        i. The time it takes for a given packet to make a round trip during a loaded/saturated network condition
    e. Jitter, in milliseconds
        i. The delta between low and high latency measurements for a given test
    f. Packet loss (if available)
        i. Percentage of network packets that are lost in transmission between the client and server
2. Active connection type
    a. Physical connection type in use by the measurement client, if available
        i. e.g. Ethernet, Wi-Fi, LTE
3. Wireless RF signal data, if available
    a. Band/Channel (e.g. LTE/5G band, Wi-Fi Channel)
    b. Signal strength (RSRP)
    c. Signal quality (RSRQ)
    d. Signal to Noise Ratio (SNR)
    e. etc.
4. Location where measurement was conducted
    a. Precise GPS location, if available
        i. ~10-meter precision
    b. Generalized GeoIP derived location
5. Network details
    a. Internet Service Provider (ISP) Name
    b. Mobile MNC/MCC code, if available
    c. IP address (truncated)
    d. Autonomous Systems Number (ASN)