From:	Brian Rathbone
To:	mappingrfc
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To: Mappingrfc@ntia.doc.gov
From: Brian Rathbone, Partner, Broadband Catalysts
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This memo is a response to the NTIA's request regarding "Improving the Quality and Accuracy of Broadband Availability Data." In this docket, the NTIA made a public request for feedback on how to improve the quality and accuracy of broadband availability data. I have spoken with NTIA extensively on these issues and was requested to file formal comments. The relevance of filing comments is that most state and federal financial assistance to deploy broadband in underserved and unserved areas rely on the least expensive and easily available broadband data, that being the FCC or NTIA broadband mapping data

My background and expertise in broadband data management includes: More than 25 years in private-sector high technology, 4 years at the North Carolina State Broadband Initiative as Technical Assistance Director for Western NC and later as Senior Telecommunications Specialist for the North Carolina Department of Commerce Broadband Division: NC Broadband. In 2013, I led the development of the North Carolina Open-Source Broadband Map, which was released in 2014. After returning to the private sector, I formed Broadband Catalysts with Jane Smith Patterson and Deborah T. Watts. Together with Stephanie Jane Edwards we compiled the Appalachian Regional Commission's Broadband Planning Primer and Toolkit. As part of that project, we created the Broadband Catalysts Open Source Broadband Map, which shows the FCC Form 477 data, citizen-sourced broadband demand data, and provider-sourced middle-mile fiber data. In 2016 and 2017, we provided technical assistance to 16 towns across the US as part of the EPA, USDA, ARC Cool and Connected program.

My comments will focus specifically on the following questions. 1) Identifying additional broadband availability data; 3) *New Approaches*: Are there new approaches tools, methodologies that could be used to capture broadband availability data, particularly in rural areas; 4a) *Validating broadband availability data:* What methodologies...can be used...to validate and compare various broadband..data; 4c) What thresholds..should be taken into account when validating broadband availability, such as bandwidth, latency; and 5a) *Identifying gaps in broadband availability*: What data improvements can the government implement to better identify areas with insufficient broadband capacity.

I. Methodological issues with FCC Form 477 & NTIA's BTOP original data collection method.

It is fair to say that the public now recognizes the inaccuracies in the maps currently created by both the FCC's current Form 477 data and by certain definitions allowed in the NTIA's original BTOP mapping grants. Both based the collection of data on census blocks, and for both, the source of the data was and is the industry broadband providers. Specific to the NTIA's BTOP data collection, as a general definition, if an industry provider concluded that it could provide broadband service to one home in a census block within 7 to 10 business days, that home was considered "served." And if one home was considered served, then all homes in the census block were also considered served. This led to large areas being mapped as

receiving broadband service when in fact none was available. As noted in the NTIA's public request, with regards to the FCC Form 477 data, it is again the provider itself who provides the data, by census block and based on its own assessment that available means can generally be made available in a reasonable amount of time; where speeds listed are also not actual, but those advertised, all this leading to maps that once again are challenged by members of the unserved public as highly inaccurate.

II. New Methodologies, comparisons, & sources of data

More accurate mapping could be created by collecting address-based data, and availability data from more than one source to allow for comparison between what the broadband providers says it provides and what the public is actually receiving, and which records actual speeds received versus advertised speeds claimed by the provider.

For instance, Broadband Catalysts has created open source software that allows residents to call up, for their address, the FCC Form 477 data, and then indicate if they can actually get the level of service reported to be available to them, as well as the ability to answer questions about the cost and quality.[1] The respondent can self-geocode their address record by dragging a pin over their actual location. This survey tool has been integrated with popular online survey tools to allow communities to generate their own custom list of questions to be included when surveying their community about broadband. This is important due to the limited number of opportunities entities like school districts have to survey their students. By including the broadband survey tool, they get the added benefit of nicely geocoded records. These benefits are especially important given what several school superintendents have described to me as "survey fatigue."

Locations reported via the survey tool are automatically added to the open source broadband map as point data, but we give the citizen voice equal weight to the provider data, and thus we aggregate the points up to the census block level and mark them as underserved. Each additional unserved citizen in census block darkens the red shading to indicate larger amounts of demand, just as the provider data gets darker when there are multiple providers for that technology in a given census block. It is my opinion that contested census blocks should be potentially given access to federal funds for broadband deployment provided sufficient verification can be performed.

Regarding address-based data, and actually-served data, this prevents the false extrapolation that all homes are served in a census block when not even one is served. Actually-served data could be measured by whether broadband service could be turned on in one business day and would prevent large swaths of clearly unserved areas from being recorded as served. For instance, we are seeing various areas marked as "served" when they are actually unserved, or at the very least underserved, on the DSL deployments that are full, where service is being provided to existing customers but no new customers can subscribe. This is often due to there not being enough new subscribers to allow the provider to earn back the required investment within 2-3 years. Another common issue is cable internet service only being available on one side of the street. While traveling to 16 towns for the EPA, USDA Cool and Connected program, my colleagues and I encountered this issue repeatedly. If the cost to deploy to a single home on the other side of the street is too great, then areas that otherwise appear to be served are actually unserved. Only citizen-sourced data makes these gaps in our networks apparent, and it should be given much weight.

I think it is important to publicly display demand information gathered through public surveys. My colleagues and I have remained confused why confidentiality would be raised as a reason not to generate address-based data. Even home ownership is as public as turning to the property tax pages of a local community. Internet availability is as critical as water to the participation in modern life and as such represents the kind of critical infrastructure that a home buyer, a parent with a student, or a doctor choosing to relocate would want easy access to.

When creating the open-source broadband map, my greatest challenge was acquiring, storing, and processing the FCC Form 477 data. In order to afford the infrastructure required to host the map, I had to request the assistance of the non-profit Education Research Consortium (ERC). Caching multiple layers to transparent cache tile was required in order for the map to function in a responsive manner, which resulted in more than a billion images stored on disk. Architecture and configuration aside, it would have been far easier if I could access the FCC data via a standardized protocol such as the Web Mapping Service (WMS) and the Web Feature Service (WFS). With these protocols accessible, I can execute a Common Query Language (CQL) request with a given bounding box and only receive back from the server the specific images or geometric features within that bounding box. This is how the open-source map and some private-sector maps I've helped create function under the hood. WMS is installed with most Geoserver[2] (open-source software) configurations, which is what I believe the NTIA National Broadband Map was built upon and which is likely present within the FCC infrastructure. WFS requires additional configuration, but it allows the calling application to get all the attributes and geometries as features rather than "pre-formatted", WMS-provided, transparent image files. WFS queries, or some other API that provides access to features, will enable the calling application to perform its own analysis and rendering of the data, which is absolutely critical to developers.

The current API available, to my knowledge, allows you to query the server with a location and get back a rendered map of that location. This has value, but it is much less useful in cases where the requestor desires to aggregate multiple data sets together for analysis. For example, feature data would allow third-party maps and applications to analyze how many providers serve an area, which providers, using which technology types and at what speeds. WMS data would allow for nicely pre-visualized layers in addition to any dynamically rendered layers. This same map could now include census data to determine approximately how many homes are in a census block, citizen demand data to show where people have indicated they want better service than is currently available along side public and private data sets like these:

- Open access middle-mile fiber routes and POPs
- Private sector middle-mile fiber routes and POPs
- Communications towers, water towers, fiber-fed structures
- Telephone poles and ownership
- Parcel data

When these data sets are combined, they can illustrate opportunities for partnership between the public sector and the private sector to serve multiple needs simultaneously, such as public safety, tele-health, and residential broadband. Each one by themselves may struggle to fund communications expansion projects on their own, but much of the required infrastructure is common: fiber optics, towers, network operations centers. By utilizing common infrastructure where possible and practical, otherwise too-costly projects become practical. Adequate mapping of these resources is a necessary component of such planning efforts. An example of

this is taking place in Person County, NC.[3]

APIs that provide flexible, granular access to the data would greatly facilitate these types of efforts. There would be costs associated with hosting and serving up these data sets, but I would assert that the nation will likely derive greater benefit from having a centralized hosting option available to them. Appropriate rate limiting, large report scheduling, and developer best practices like caching frequently used data sets would likely be required to make this practical, but these things are technically achievable.

The primary challenge my colleagues and I faced when trying to get the most out of our broadband map has been awareness. The areas where we have provided technical assistance and made the community aware of the free tools available to them to assess and map their broadband demand are the same areas where we have the most respondents. There are numerous communities across the country who could benefit from the demand aggregation tools if only they were aware of them. I believe a nationwide broadband census is called for, and the broadband map we have developed is at the very least a solid starting point of what the data collection and rendering tool might look like. My colleagues and I at Broadband Catalysts are happy to make the data we collect available to the NTIA and the FCC with the express hopes the data will lead to investment in areas that might have otherwise gone without.

III. Measuring Availability

I would also encourage the NTIA to track latency and other factors as well as actual speed at the home. Latency can cause the home user to see signal droppage or buffering that also might turn them away from internet use or prevent access to critical technologies like telecommuting or telemedicine, despite ultimately gaining a connection with a wider communications channel.

The FCC's current definition of the level of broadband necessary to participate in modern life is 25Mbps download/3 Mbps upload.[4] With the increased use of multiple devices in the home and business, and of video as the common means of communication, this standard will soon prove insufficient. We encourage the NTIA to measure higher levels of broadband speeds, particularly upload speeds which are the drivers of creative class business development. Setting goals for symmetrical connectivity on all new buildouts is highly appropriate in spite of additional costs. My colleagues and I also encourage measuring internet availability at traditional (schools, city hall) anchor institutions as well as nontraditional (churches, senior centers, public housing centers), which serve as public access points in areas where insufficient internet is available.

It is my opinion that a binary measurement of available or not available at *x* speed down and *y* speed up is insufficient in and of itself to clearly enumerate the state of broadband access in the United States. The binary measurement would have additional value if paired with a detailed analysis that takes into account more of the parameters that determine the user experience. An Internet Connectivity Quality Index (ICQI) could include the following factors:

- Download speed
- Upload speed
- Average latency (round trip times)

- Average jitter (variation in round trip times)
- Average packet loss (lost packets are a sign of network congestion)
- Average DNS server request response time (how long to look up www.ntia.doc.gov)
- Average cost per gigabyte of data transferred (cost based on actual usage of the service)
- Average cost per megabit of speed (cost for bandwidth with "up to" max actual width)
- Average downtime
- Dedicated versus shared internet connectivity (just for you or shared with your neighbors)
- Layer 1 media type future-proofing (fiber versus copper)
- Number of providers (competitively served addresses get better service at lower cost)

An Internet Investment Quality Index (IIQI) might include additional factors, such as:

- Average cost per home passed
- Average cost per home connected

Many of these factors can be estimated at the technology level and augmented with citizen-sourced data from speed tests and from data sets like the Sam Knows global platform, which monitors actual internet connection quality.[5]

By using an Internet Connection Quality Index, federal funds could be directed toward building the most effective, highest quality, and beneficial networks over the long term. For example, when allocating funds that could be spent on a DSL deployment versus a Fiber-to-the-Home deployment, it would be best to have a standardized mechanism through which broadband investment is judged. The DSL may have a lower deployment cost now, but it should be taken into consideration the long-term benefits and cost savings that can be realized by deploying more modern and future-proofed infrastructure. With this goal in mind, we must account for the affordability portion of the index. It does us no good to deploy world-class infrastructure if the subscriber base cannot afford the service. I experienced this while providing technical assistance in Carrizozo, New Mexico as part of the EPA, USDA Cool and Connected program. The local provider had made an investment in fiber-to-the-home, but the lowest cost to subscribe was more than the local market would bear, leaving the community largely disconnected.

In summary, having on demand access to broadband availability data, preferably at the address level, will help facilitate the public / private process required for our nation's broadband networks to grow to meet the rising demand. Data granularity, sourcing, plus flexibility and ease of access are chief among the things I believe we need to make informed decisions.

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[1] Broadband Catalysts Open Source Broadband Map and Demand Aggregation Survey
http://map.broadbandcatalysts.com/
http://map.broadbandcatalysts.com/geo-form.html

[2] Geoserver.org
http://geoserver.org/

[3] Person County, NC Cross-Sector Broadband Planning
https://www.ncruralcenter.org/2018/05/broadband-innovation-person-county/

[4] See the FCC's 2015 Broadband Progress report for an excellent discussion of the level of broadband needed to participate in modern life, data on uses available at 25/3 but not at 10/1, how the Form 477 constricted the FCC's ability to collected 4Mbps data (i.e., the form the only asked for 3Mbps)(Paras 26 and 69); and the disadvantages of using advertised speed (used by the NTIA originally) versus actual speed. See *Inquiry Concerning the Deployment of Advanced Telecommunications Capability to All Americans in a Reasonable and Timely Fashion, and Possible Steps to Accelerate Such Deployment Pursuant to Section 706 of the Telecommunications Act of 1996, as Amended by the Broadband Data Improvement Act*, GN Docket No. 14-126, 2015 Broadband Progress Report and Notice of Inquiry on Immediate Action to Accelerate Deployment, 30 FCC Rcd 1375 ((2015 Broadband Progress Report). https://docs.fcc.gov/public/attachments/FCC-15-10A1.pdf

[5] Sam Knows Global Platform.
https://www.samknows.com/global-platform

Thank you for your consideration of these comments. Do not hesitate to contact me if I can be of further assistance.

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"Dedicated to improving access to broadband through effective planning with a focus on rural and underserved urban areas."