July XX, 2022

ASSIA is pleased to submit our comment in response to *the FCC's Request for Comments on the Interagency Broadband Coordination Agreement [WC Docket No. 22-251]*.

ASSIA looks forward to engaging with the FCC in a further exploration of the issues we have raised in this comment through an Ex-parte presentation, or other appropriate public process, during the FCC's preparation of its report to Congress with respect to its mandates under the Broadband Interagency Coordination Act of 2020 (BICA).

Regards,

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FCC's Request for Comments on the Interagency Broadband Coordination Agreement [WC Docket No. 22-251]

Comment from Adaptive Spectrum and Signal Alignment, Incorporated (ASSIA®) 203 Redwood Shores Parkway, Suite 100, Redwood City CA, 94065

1. Introduction

The FCC in its request for comments[1]raises a number of critical questions with respect to requirements for interagency cooperation agreements under BICA[2]. BICA requires public comment regarding the interagency agreements in three specific areas:

- the effectiveness of the interagency agreement in facilitating efficient use of funds for broadband deployment;
- the availability of Tribal, State, and local data regarding broadband deployment and the inclusion of that data in interagency coordination; and

[1] WC Docket No. 22-251

[2] *The Broadband Interagency Coordination Act of 2020, Pub.L. 116-260, 134 Stat. 3214, Div. FF, tit. IX, § 904 (2020), codified at 47 U.S.C §1308 (BICA).*

- any modifications to the agreement that would improve the interagency coordination.

The agreement under review between the FCC, the NTIA, and the Department of Agriculture[3] specifies that information be shared between the agencies[4], that certain specified information be shared between agencies upon request[5], that confidentiality be protected[6], that the data be standardized[7], and that there is no requirement for the transfer of funds between agencies under the agreement[8]. The Interagency Agreement, while specifying a necessary bare minimum of what is required by the three BICA mandates, does not yet address that interagency coordination requires that the exchange of information be based upon the exchange of well-defined and accurate data between agencies. This is required if the sharing is to enable the efficient use of all funds appropriated by Congress. The mere agreement that data will be exchanged without also agreement on common requirements as to data definition, accuracy, and collection method would have insufficient detail to support the efficient use of congressional funds nor to ensure that the agencies, the public, and Congress have access to consistent and meaningful data on broadband deployment in the United States.

The Agreement specifies in Section 1 that information be shared, while Section 2 lists specific types of information to be shared upon request. Unanswered in the agreement are common characteristics regarding the shared data that will provide meaning to the data when it is shared. These common elements, which need to be coordinated across all three agencies include the common data model underlying that defines data shared, coordinated processes and requirements for collecting the data across the three agencies, and shared requirements for ensuring the data's statistical validity. The goal of all federal funding for broadband deployment being high-quality broadband service for all Americans requires the Interagency Agreement's address of these issues of commonality. Unless these issues are addressed, the shared information will neither support efficient funds use nor will the data have the highest utility. This is because differences in definition, accuracy requirements, or statistical validity between data collected by the three agencies would effectively render the data largely useless for its intended purpose. Basically, data without such agreed commonalities becomes meaningless to the agencies, the public, and Congress.

To ensure that data sharing is meaningful and supports efficient funds use across agencies, the Interagency Agreement must specify that the agencies will develop these common processes and definitions and that standardized processes are developed across the agencies as to how service quality requirements are measured, collected, and reported. These measures must provide meaningful, consistent, and accurate measurements that are cost-effective to perform and that preserve the privacy and data security of users' information while simultaneously providing a

[3] INTERAGENCY AGREEMENT BETWEEN THE FEDERAL COMMUNICATIONS COMMISSION, U.S. DEPARTMENT OF AGRICULTURE, AND THE NATIONAL TELECOMMUNICATIONS AND INFORMATION ADMINISTRATION OF THEU.S. DEPARTMENT OF COMMERCE, dated June 25, 2021 [the Agreement]
[4] Ibid, section 1.
[5] Ibid, section 2.
[6] Ibid. section 3.
[7] Ibid section 4.
[8] Ibid section 5.

broad and accurate overview of broadband performance both on a regional and national basis. The Interagency Agreement should specify that each funded deployment should have a standardized/normalized measurement system (including especially Wi-Fi and cellular for the last leg) to verify/certify the information required to be shared in Section 3 of the Agreement.

While the Agreement need not specify the technical details of common process and requirements for defining and collecting the data, the agreement needs to require such commonality's specification, the scope of the commonality, and a cross-agency process for developing and enforcing these requirements. This comment explores the nature of such common data requirements and the processes to support them. These are requirements that can be met by tools commercially available today. An organized framework for broadband data is one that defines the phases of data collection from device extraction to cloud analyses, and which also defines levels of collected data from basic to detailed.

2. Criteria for Commonality of Interagency Data Sharing

- The data model and definitions for parameters should be consistent across agencies with the definitions of parameters in the various recently authorized funding programs[9], with those of new Congressional mandates[10], with those of existing government programs[11], and all parameters should align with technical-community's consensus understandings.
- The parameters' meaning shared among agencies must be well defined and provide information that is useful for the agencies, the public, and Congress: that is to enable determination as to whether the funds allocated are used efficiently to provide the public with Broadband Services that ensure high-quality broadband experience. This high quality of experience should be independent of the agency funding the improvements further and that the quality of these funded improvements is consistent with those services provided by carriers where no government subsidy or funding is required to enhance the infrastructure.
- The veracity of the data shared across agencies should be independently verifiable and does not depend solely upon self-reporting by a network operator.
- The values of parameters shared among agencies should be based on statistically sound measurements.
- The shared data should align with measurements made for any governmental purposes; such as, broadband mapping, verification of conformance with terms of a grant[12], required

[9] E.g., The Infrastructure Investment and Jobs Act: Division F – Broadband

[10] E.g., The Broadband Nutrition Label mandated in The Infrastructure Investment and Jobs Act, Pub. L. No. 117-58, 135 Stat. 429, § 60504(b)(1)

[11] This is mandated as a Sense of Congress in Sec. 50102 (m) of the Infrastructure Act: "It is the sense of Congress that Federal agencies responsible for supporting broadband deployment, including the Commission, the Department of Commerce, and the Department of Agriculture, to the extent possible, should align the goals, application and reporting processes, and project requirements with respect to broadband deployment supported by those agencies."

[12] E.g., Infrastructure Act Sec. 60102 (g)(1)(C)

reporting by a network operator,[13] or the location of challenges[14]. That is, regardless of the purpose for which the data is gathered or the agency gathering the data, the information should be comparable across various applications or programs.

- All broadband-performance-affecting network segments as seen by the broadband customer, including the customer's Wi-Fi link, the internet backbone, and the performance of a content provider's network and servers. The requirements for such sectionalization are one of the criteria underlying useful sharing of data among the agencies. The ability to sectionalize network performance thus becomes necessary to ensure the user's perceived overall service quality and to ensure the utility of broadband performance parameters to users, policy makers, and network operators. Different network operators offer different Wi-Fi equipment and Wi-Fi management practices, resulting in differences in Wi-Fi performances, so Wi-Fi is an important part of a broadband service offering in that poor Wi-Fi performance can reduce the value of infrastructure investment. Poorly performing Wi-Fi can be perceived as a poorly performing broadband service, and it is in the interest of public policy to understand the relationship between Wi-Fi performance, broadband access, and overall user-perceived quality of experience. Improved Wi-Fi performance should be encouraged. Unless the public receives Broadband services of acceptable quality, regardless of the agency funding the Broadband infrastructure, the use of the Federal funds will be inefficient and ineffective

  To support these requirements the values shared among the agencies should be based upon the same data models, data-gathering tools, procedures, and analysis methods, regardless of the funding source. The Interagency Agreement needs to specify that all the measurements should provide meaningful, consistent, and accurate data, be cost-effective to perform, and preserve the privacy and data security of users' information, while simultaneously providing a broad and accurate overview of broadband performance on a per offered service level, as required in the various Congressional mandates, on both a regional and national basis. While the Agreement can specify these requirements at a high-level, it also needs to specify a process allowing the agencies to expeditiously develop common detailed technical requirements and processes. This comment explores how these requirements for consistency and convergence can be met by tools commercially available today. An organized framework for broadband data is presented that defines the phases of data collection from device extraction to cloud analyses, and which also defines levels of collected data from basic to detailed. Support for such a framework across all the mandated performance measure will help ensure that the information in shared among agencies will be of maximum value to the agencies, the public, and to enable Congressional oversight.

3. Some Interpretation of These Requirements for Shared Data

Broadband performance is now typically expressed only in terms of downstream and upstream speeds. This simple characterization does not account for many aspects that directly contribute

[13] E.g., Infrastructure Act Sec. 60102((j)(2)(B)
[14] E.g., Infrastructure Act Sec. 60102 (h)(2)(A)

to service quality such as latency and availability. Further, there are many aspects of broadband relevant to particular network segments, particular services, and particular service-delivery aspects. For example, while Wi-Fi is not strictly part of a broadband access line, the user perceives it to be. So, saturated Wi-Fi bandwidth usage or other Wi-Fi impediments directly impact perceived broadband service quality in many serving areas. The mandates in the programs imply an ability to sectionalize problem root causes, which becomes necessary to guide future policy directions, to best focus improvements on the limiting network segment(s).

Enforcement efforts and government oversight should focus on the mandated requirements, and thereby enable government and industry to cooperate to deliver acceptable broadband services to all Americans. Therefore, a wide range of performance parameters and relations between parameters should be evaluated and tracked over time to assess the entire network status comprehensively. Currently available technologies enable pervasive data collection regarding overall end-to-end and sectionalized performance of the broadband network. Such pervasive collection can be secure, preserve anonymity, be non-interfering, and be statistically valid, as it is based on a majority of network users' available performance information rather than on a small sample of volunteers who agree to provide information.

Further, the various programs' broadband-performance mandates address regulatory issues that include: evaluating and mapping the overall quality and availability of broadband services nationwide, by state, and by geographic location within the state; determining whether a deployment-support grantee for funds has complied with their grant's terms, enabling challenges regarding the promised services' quality, and supporting the future evolution of broadband services and policy. The data that underlies the analysis required to address these various mandates must ultimately have the same source and should be based on the same requirements with respect to the parameters gathered, their accuracy, and frequency of collection. Such data collection, based on common requirements and processes, can thus become a common resource that can be utilized by government, industry, and others for understanding America’s broadband infrastructure performance and for guiding its future evolution.

The data and analysis to address the various broadband performance mandates will be varied depending on the purpose. For example, the two purposes of broadband mapping and evaluating a challenge to a particular grantee's broadband-deployment quality can each require its own dedicated analysis tools and procedures.

4. Broadband Data Collection Framework

A broadband data collection framework is now presented. This framework defines the phases of data collection and stratifies broadband parameters into levels.

4.1. Data Collection and Analysis Phases

The need to enable the use of commonly collected and comparable data to support disparate analysis invites the following division into process 'phases' for gathering and analyzing broadband performance data:

Phase 0: Raw data and measurements are collected from network and user devices. Installing a software agent on the devices is an effective way to run tests and gather measurements.

Phase 1: Devices send data reports to a remote server or cloud database. Here, an agent is very useful for aggregating raw data, such as averaging many 5 second measurements and then reporting every 15 minutes to limit telemetry traffic. A standardized protocol such as Broadband Forum TR-69 or TR-369 is recommended for sending the data.

Phase 2: Determination of statistical performance across the population is performed. Histograms, max, min, average and other statistics are effective outputs of Phase 2.

Phase 3: Evaluation is performed, where metrics and figures of merit are produced and presentations generated (e.g. plots, trends, and overall scores such as the Quality of Experience Delivered (QED) metric as defined in Broadband Forum BBF MR 452.2).

Figure 1 illustrates the data collection and analysis phases.

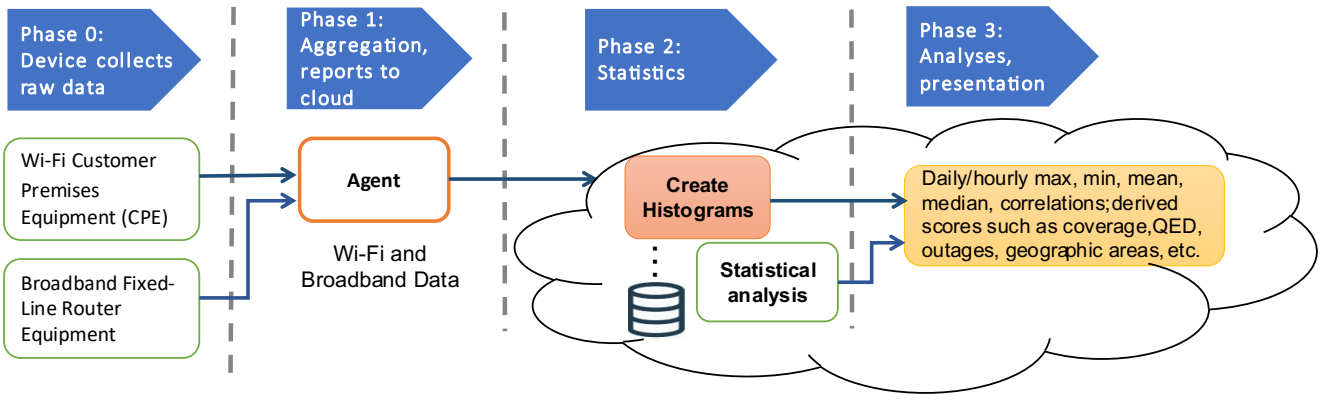

Figure 1 – Overview of the Phases of Data Collection and Analysis of Broadband QoS and Reliability Data

Examining the QoS and reliability requirements of Section 60102 of the BIL, the regulations promulgated by the Department of Commerce should specify requirements for Phase 0 and Phase 1 as seen in this model to enable a wide and versatile range of Phase 2 and Phase 3 data aggregation and analysis. NTIA, possibly in coordination with the FCC, the Agriculture

Department and other interested government bodies, would specify the parameters and their characteristics that need to be collected in Phase 0, then Phase 1 requirements would support uniform collection formats and reporting intervals. The requirements to support Phases 2 and 3 would largely relate to the analyses and presentation of the final data.

The following subsections explore important criteria for defining the Phase 0 and Phase 1 broadband data collection requirements, and to also support versatile Phase 2 and Phase 3 analysis and presentation of the collected data.

4.2. Broadband Parameters and Levels

One can divide the type of information that needs to be collected as supporting a number of 'Levels' of information to validate. The information required to meet the mandates with respect to data collection in the various programs are those related to the parameter levels as described below.

- Level 0: Advertised broadband speeds as stated by service providers or regulation. Level 0 values are not measured per-se but rather are stated and published. The rules being developed must specify the Level 0 parameters that underly the regulations.
- Level 1: Salient performance measures (e.g., measured speed and latency). Perceptible by consumers, these measures required for evaluating conformance with broadband performance targets.
- Level 2: Further parameters that directly influence service quality (e.g., availability, loss rates). For network operators to determine service issues, perform diagnostics, and determine performance as mandated by the BIL. Also, a level of sectionalizing problems is needed for determining network bottlenecks, for example between the Broadband access and the customers Wi-Fi. Sectionalization is important firstly because a grantee is not necessarily responsible for the performance of a customer's Wi-Fi and secondly because information about location of problems can be used to guide further regulatory actions such as allocation of spectrum to Wi-Fi, or the encouragement of industry research or standardization to address these quality issues. Such knowledge could have very significant impact on the use of infrastructure funds. For instance, if expensive fiber deployment is undertaken in an area where the in-home end broadband connectivity is limited, then the fiber investment does not produce immediate benefit; instead funds to improve spectrum use and assignment might best first be spent.
- Level 3: Level 3 parameters may not be of explicit concern for these rules. These parameters indirectly influence performance, for deep-dive diagnostics and troubleshooting. Level 3 measurements are used by a network operator to diagnose issues and engineer their networks.

The parameters to be collected to support the broadband measurement requirements are listed in Table 1 and defined in the text below.

Table 1. Broadband access parameters and levels

Parameter	Direction	Recording Frequency	Unit	Level
Offered speeds	Downstream and upstream	N/A	Mbps	0
Throughput	Downstream and upstream	Daily (hourly also optional)	Mbps	1
Latency	Roundtrip	Daily (hourly also optional)	Milliseconds	1
Traffic	Downstream and upstream	Daily (hourly also optional)	GBytes/day MBytes/hour	2
Packet loss rate	Downstream and upstream	Daily	Percent	2
Internet Down Count		Daily	Number of occurrences/day	2
Internet Down Duration		Daily	Seconds/day	2

Broadband throughput

Broadband throughput (speed) is measured as the average throughput for upstream and downstream in Megabits per second (Mbps). Speed tests measure the upload/download speeds of Broadband service. The speed is measured between the broadband gateway and a test server. Test servers are geographically distributed, and the broadband gateway dynamically selects the closest speed-test server (through cached latency tests), performs throughput measurements, and reports the results to the remote server. Each speed test result sent by the device contains broadband throughput data.

Broadband latency

Broadband latency is measured and recorded as a daily average in milliseconds, using round-trip latency measurements between the broadband gateway and a network-located broadband speed test server. The broadband gateway periodically measures the Round-Trip-Time (RTT) to all the pre-configured speed-test servers and reports the results to the remote server. These measures could be performed hourly, on the quarter-hour, or perhaps when there is no traffic, such as during down-time. Broadband latency results are also used for detecting the closest speed-test server and for detecting Internet disconnections.

Broadband traffic

Broadband traffic is the total traffic in Gigabytes (GBytes) for upstream and downstream. The traffic is presented as a single total across a time period, e.g., daily and hourly. The broadband gateway is to track traffic usage (upstream and downstream) every 5 seconds and report the summary of the usage (average, min, max, and histogram) to the remote server every 15 minutes.

Broadband packet loss rate
The packet loss rate (PLR) is defined as the loss rate after all error correction is applied. The count of all lost or discarded received packets is divided by the total received packet count to determine the PLR.

Internet down count
Internet down count is a tally of the number of internet disconnections in a day. The device can record an internet down event if it cannot establish a connection to any remote speed-test server. While the internet is down, the broadband gateway or device will not have a connection to remote servers. In such times, the device will record the internet connection error. When the internet connection is restored, the device uploads all the results to the server. The internet down count is incremented if the internet connection was down for all the speed tests (to different servers) reporting connection errors.

Internet down duration
Along with the detection of disconnections, the approximate time duration of internet disconnections is provided. Internet down events can be recorded on the device and these events are uploaded to the remote server once the connection is restored.

Internet down count and down duration are raw data that are useful for calculating broadband availability. Another way of determining availability is to run speed tests by only adding a limited amount of "headroom" test traffic above the current rate of user traffic; such tests can determine if the user perceives broadband to be available for their needs.

4.3. Wi-Fi Parameters

While not required by the various Broadband funding programs, determining the performance of the Wi-Fi link of the broadband connection is highly useful for sectionalization and identifying bottlenecks that will effect Quality of Experience as seen by the user. Salient Wi-Fi performance parameters are: throughput, latency, traffic, frame loss and retransmission rates, interference, congestion, channel utilization (airtime), Wi-Fi coverage, transmit rate, surrounding BSSs density, and received signal strength.

4.4. Stratification Dimensions

Each parameter may be further stratified into a list of separate parameters, one for each dimension or for each combination of dimensions. Upstream and downstream can typically be specified for each parameter, except for round-trip measurements such as latency.

Broadband parameters can also be further dimensioned or stratified by:

- Broadband type: DSL, cable, fiber, satellite, fixed wireless, LTE, and 5G
- Upstream and downstream
- Area: Urban, suburban, and rural areas (can similarly stratify by for income level across a geographic area; e.g. zipcode)
- Per service level or per application type

5. Suggested Requirements

5.1. Uniformity

As stated in the introduction to this section of our comment, the performance and measurement requirements stated in the various Broadband programs serve a number of purposes, which include verification of grantee compliance with grant terms, addressing challenges from third parties, and gathering data by the government that indicates compliance with overall Congressional mandates and to guide future policy directions. Measurements made by a particular system or for a particular purpose should be comparable to the same or similar measurements made by other systems for other purposes. Systems to collect data, to store, and to analyze the data for the various purposes should have identical data definitions, algorithms, and presentation when the same types of data are collected and analyzed. Standardized, reusable systems and methods should be encouraged to perform Phase 0 and Phase 1 broadband data collection activities, and these systems and methods should be optimized to enable Phase 2 and 3 analysis and presentation.

5.2. Accuracy

Requirements for accuracy of the measurements need to be specified. Tools and systems should enable collecting information that is statistically sound from as large a sample space as possible to provide accurate statistics across the population. Ideally data is collected from most, if not all, customers served by a broadband network.

5.3. Cost Effective

The requirements must be supportable by systems and processes that are cost effective. These systems should add little to the marginal cost of the broadband deployment, customer equipment, and support systems. Parameters can be sent from the device using standard protocols such as Broadband Forum TR-69 or TR-369. There should also be support for control of the collected data's parameters and frequency of collection.

Another "cost" is adverse impact to the user's service. This can be limited by, for example, injecting only a limited amount of "headroom" test traffic and then summing user traffic plus test traffic to get total traffic.

Software-based data collection and analysis is more cost-effective than deploying a dedicated hardware box at the user's premise. A most cost-effective solution is to deploy a small software agent on home gateway devices which collects data and sends them up to the cloud. Running tests to measure speed and latency generally require such an agent. Speed and latency of both the broadband line and the Wi-Fi link can be accurately measured with an agent The agent can also assist in reading and averaging or otherwise combining a great many performance parameters.

5.4. Support Problem Sectionalization

A broadband system comprises a number of architectural components: the customer's LAN, the broadband access itself, the middle-mile infrastructure, the backend network, and the systems

providing content. A true measurement of broadband-access performance requires that the information can support sectionalization. A broadband provider receiving a grant under the various funding programs may have a system that meets the requirements set by regulation, yet the customers' perceived QoS may be subpar due to problems in other components of the network, e.g., the customers' Wi-Fi networks, the internet, or the content provider's systems. The ability to separate these performance components is not only necessary to ensure that performance issues are addressed in systems that are supported by the grants, but also provides information that may identify global performance issues where government and industry cooperation may be appropriate to ensure the goals of a nationwide broadband infrastructure are met.

5.5. Stakeholder Independence

Measurements and analysis of the measurements could be made from and by a number of sources, each a stakeholder with different and possibly conflicting interests. These include the grantee, challengers, users, and government agencies at the local, state, and national level. The measurement and reporting systems and definitions should enable such multi-sourced measurements and ensure that the measurements are comparable regardless of source. The architectural separation of the problem of broadband data collection into the phases described in this comment will enable this independence.

5.6. Privacy

The systems, requirements, and methods must ensure anonymity of the data, and protection of the user's personally identifiable information as an inherent quality of the requirements and design of the system. Data collection must be supported by secure systems and processes that enable anonymous, non-interfering and non-invasive collection of performance information.

6. Conclusions and Summary

The 'phased approach' to broadband data collection separates data collection from analysis as described in Section 4. Section 5.3 describes how data collection incorporating a software agent on devices is cost-effective and can run speed and latency tests as desired. Broadband performance parameters, parameter levels, and requirements are also presented here.

The suggestions and methods outlined here can assist the FCC, the Department of Agriculture, and the NTIA in specifying high-level, consistent requirements for shared broadband performance data collection and analysis. These suggestions and methods also can enable flexible, low cost, secure and anonymous analysis that meets current needs and supports identifying future directions in broadband implementation and policy. Such high-level requirements can then guide the inter-agency development of detailed requirements and processes that will ensure that the shared data will be both accurate and useful in ensuring the efficient use of funds to enable high-quality and cost effective Broadband access for all Americans.[15]

[15] ASSIA has made similar recommendations regarding data collection to those made in this comment in response to the FCC's NPRM on the 'Broadband Nutrition Label' in '*Docket No. 22-2*

ASSIA looks forward to engaging with the FCC and other agencies in a detailed exploration of the issues raised in this comment through an Ex-parte presentation, or other appropriate public process, during the FCC's analysis of BICA mandates.

7. About Adaptive Spectrum and Signal Alignment, Inc. (ASSIA)

Adaptive Spectrum and Signal Alignment, Incorporated (ASSIA®) develops and licenses innovative technologies for service providers that improve internet connectivity worldwide. ASSIA's market-leading AI-driven technology makes internet connections run faster and more reliably by optimizing the performance of whatever infrastructure is in place, be it copper wires, fiber, various generations of Wi-Fi including Wi-Fi 6, or 5G. ASSIA's IPR licensees directly and indirectly include 35 service providers worldwide with more that 125 million broadband and Wi-Fi lines under contract, in 17 countries, across 5 continents.

– *FCC 22-7: Comment from Adaptive Spectrum and Signal Alignment, Incorporated (ASSIA®), 203 Redwood Shores Parkway, Suite 100, Redwood City, CA 94065* submitted on March 8, 2022, and in response to NTIA's request for comments on the Bipartisan Infrastructure Law, *[Docket No. 220105–0002] Comment from Adaptive Spectrum and Signal Alignment, Incorporated (ASSIA®) 203 Redwood Shores Parkway, Suite 100, Redwood City CA, 94065* submitted on January 31, 2022. That these two comments made to different agencies make similar recommendations underscores that cross-agency requirements with respect to Broadband data collection and analysis are fundamentally identical and thus any data sharing agreement must recognize this identity.