

Proposed BEAD Performance Measures Guidance

The Broadband Equity, Access, and Deployment (BEAD) Program, established by the Infrastructure Investment and Jobs Act (IIJA), provides \$42.45 billion of funding to states, territories and the District of Columbia (“Eligible Entities”) for broadband planning, deployment, mapping, equity, and adoption activities. The National Telecommunications and Information Administration (NTIA), as the agency responsible for administering the BEAD Program, issued a Notice of Funding Opportunity (BEAD NOFO) describing the program’s requirements, including the requirement that each Eligible Entity ensure that every Funded Network meets certain speed and latency standards, as well as criteria related to network outages (i.e., reliability).

In response to inquiries from Eligible Entities and other stakeholders, NTIA is proposing to issue a Performance Measures for BEAD Last-Mile Networks Policy Notice to provide Eligible Entities and prospective subgrantees with additional guidance regarding BEAD NOFO performance measurement standards related to speed, latency, and reliability of last-mile deployment projects.

NTIA seeks comment from the public on this proposed guidance. If you wish to provide comment to NTIA, please submit to **BEAD@NTIA.gov** by **midnight on December 19, 2024**.

Please note that these are draft documents. Eligible Entities may not rely on NTIA guidance until it is finalized.

DEPARTMENT OF COMMERCE

National Telecommunications and Information Administration

Broadband Equity, Access, and Deployment (BEAD) Program: Performance Measures for BEAD Last-Mile Networks

ACTION: Notice

SUMMARY:

The Infrastructure Investment and Jobs Act (Infrastructure Act), enacted in November 2021, includes funding for robust investment in American infrastructure projects. The Infrastructure Act includes the Broadband Equity, Access, and Deployment Program (BEAD Program), which provides \$42.45 billion of funding to achieve reliable, affordable, and high-speed Internet coverage throughout the United States. *See* Infrastructure Investment and Jobs Act of 2021, Division F, Title I, Section 60102, Public Law 117-58, 135 Stat. 429 (Nov. 15, 2021). The U.S. Department of Commerce, in keeping with its mission to create the conditions for economic growth and opportunity for all communities, is ready to lead the building of equitable access to universal high-speed Internet coverage in the United States, in partnership with other agencies and Departments.

The National Telecommunications and Information Administration (NTIA), as the agency responsible for administering the BEAD Program, issues herein additional guidance to provide Eligible Entities and prospective subgrantees with the BEAD Notice of Funding Opportunity (BEAD NOFO) performance measurement standards related to speed, latency, and reliability of last-mile deployment projects.

This Policy Notice elaborates on, but does not replace, the BEAD Eligible Entity (States, Territories, and the District of Columbia) requirements outlined in the BEAD NOFO that each Eligible Entity must adhere to for the Assistant Secretary of Commerce for Communications and Information to approve its Initial Proposal and Final Proposal.¹

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¹ This guidance document is intended solely to assist applicants in better understanding the BEAD grant program and the requirements set forth in the BEAD NOFO and follow-on policies and guidance for this program. This document does not and is not intended to supersede, modify, or otherwise alter applicable statutory or regulatory requirements, the terms and conditions of the award, or the specific requirements set forth in the BEAD NOFO. In all cases, statutory and regulatory mandates, the terms and conditions of the award, and the requirements set forth in the BEAD NOFO, shall prevail over any inconsistencies contained in this document.

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1. Policy Notice Background & Purpose

This document defines mechanisms to validate that Broadband Equity, Access, and Deployment (BEAD) Program awardees have constructed networks in compliance with BEAD NOFO requirements and provides transparency to the public about the performance and reliability provided by these networks. This Policy Notice’s approach leans heavily on well-established FCC practices and is designed to minimize administrative burdens on Eligible Entities and subgrantees.

BEAD-funded last-mile broadband deployment projects are required to meet specific capacity, latency, and reliability standards. Network speeds must reach or exceed 100 megabits per second (Mbps) download and 20 Mbps upload for broadband serviceable locations and 1 gigabit per second (Gbps) for both download and upload for community anchor institutions (CAIs). To comply with the latency standard, a provider’s certified test results must show, for each state or territory, that 95 percent or more of all tests of network round-trip latency are at or below 100 milliseconds. Last-mile networks must not be unavailable for more than 48 hours over 365 days.²

This Policy Notice uses “subgrantee,” “service provider,” and “provider” interchangeably.

Because many providers participating in, or likely to participate in, the NTIA BEAD Program are also subject to FCC Universal Service Fund (USF) rules through the Connect America Fund Phase II Action (CAF-II) or the Rural Digital Opportunity Fund (RDOF), the BEAD NOFO adopts the existing FCC performance measurement methodologies from those programs. The measurement methodologies for recent USF last-mile deployments are described in two FCC orders.³ These orders offer three choices to providers:

First, a high-cost support recipient⁴ may use [Measuring Broadband America (MBA)]⁵ testing by arranging with entities that manage and perform testing for the MBA program to implement performance testing, as required, for CAF. [...]

Second, a high-cost support recipient may elect to use existing network management systems and tools, ping tests, and other commonly available performance measurement

² BEAD NOFO § IV.C.2.a, p. 64-5. “Funded Networks shall deliver Reliable Broadband Service with speeds of not less than 100 Mbps for downloads and 20 Mbps for uploads. In addition, 95 percent of latency measurements during testing windows must fall at or below 100 milliseconds round-trip time. [...] Funded Network connections to Eligible Community Anchor Institutions shall be capable of delivering service at speeds not less than 1 Gigabit per second for downloads and 1 Gigabit per second for uploads. [...] Each Funded Network’s outages should not exceed, on average, 48 hours over any 365-day period except in the case of natural disasters or other force majeure occurrence.”

³ See Connect America Fund, WC Docket No. 10-90, Order, 33 FCC Rcd 6509, 6525-26, paras. 44-46 (WCB/WTB/OET 2018) (*CAF Performance Measures Order*) at [DA-18-710A1.pdf \(fcc.gov\)](#). See also Connect America Fund, WC Docket No. 10-90, Order on Reconsideration, 34 FCC Rcd 10109, 10119-23, paras. 27-38 (2019) at [FCC-19-104A1.pdf](#) (*Performance Measures Reconsideration Order*).

⁴ See 47 CFR § 54.313. High-cost recipients include any recipient of FCC high-cost support, typically an internet service provider. High-cost support includes all FCC-administered Universal Service Fund programs, including RDOF.

⁵ In August 2023, the FCC suspended the MBA program.

and network management tools — off-the-shelf testing — to implement performance testing.

Third, a high-cost support recipient may implement a provider-developed self-testing configuration using software installed on residential gateways or in equipment attached to residential gateways to regularly initiate speed and latency tests. Providers that implement self-testing of their own networks may make network performance testing services available to other providers.⁶

In Section 3, this Policy Notice describes how providers can measure download speed, upload speed, latency, and reliability for BEAD funded last-mile networks. Section 4 describes how providers may document the methodology, standards, and parameters used for their performance measurements of those networks. Finally, Section 5 summarizes the standards for compliance with the guidance in this Policy Notice and the BEAD NOFO.

2. Definitions

The following are terms relevant to the purposes of this Policy Notice:

- (a) BEAD Funded Network— The term “BEAD Funded Network” means a broadband network deployed and/or upgraded with BEAD Program funds.⁷
- (b) BEAD location— The term “BEAD location” means a broadband serviceable location (BSL) served by a BEAD Funded Network.
- (c) Active subscriber— The term “active subscriber” means a household or business at a BEAD location that is currently subscribing to broadband service provided by the BEAD Funded Network.
- (d) Committed speed tier— The term “committed speed tier” means the highest combination of download and upload speeds that a provider has committed to for a specific BEAD project as part of its subgrant conditions.
- (e) Test subject— The term “test subject” means an active subscriber who has been randomly selected and chosen to participate (if applicable) in network performance measurement.
- (f) Sample set— The term “sample set” is the collection of all test subjects within the same state or territory, served by the same provider, relying on the same broadband technology and subject to the same committed speed tier.

⁶ CAF Performance Measures Order, § 9.

⁷ BEAD NOFO §I.C.1, p. 13.

3. Measurement Methodology for Last-Mile Projects

3.1 Measurement Obligation

All subgrantees must collect measurements twice a year during the period of performance⁸ and the subsequent federal interest period.⁹

3.2 Sample Size

The number of subscriber connections to be tested is based on the number of subscribers at BEAD locations for each broadband technology and committed speed tier across the state or territory (see Section 3.4 below). Subscribers are counted across all projects of a subgrantee in a state or territory, not separately for each project. Subgrantees with 50 or fewer active subscribers at BEAD locations for a technology and committed speed tier within each state or territory must test at least five locations; those with 51 or more active subscribers must test at least 10 percent of the total subscribed locations.¹⁰ The sampled locations sharing the same technology and committed speed tier are referred to as a sample set.

Subgrantees may, if they prefer, include a larger number of locations in their sample sets. For alternative technologies (i.e., technologies not considered Reliable Broadband Service¹¹), Eligible Entities may require a larger sample set or may require that specified geographic areas, such as a census block group or BEAD project area, contain a minimum number of sampled locations.¹²

3.3 Committed Speed Tiers and Technologies

The committed speed tier for all projects is governed by the subgrantee agreement. Eligible Entities may require a commitment in the subgrantee agreement to provide higher speeds where that provider received points or credits during the application process for that service level.

Since the performance and reliability of different last-mile technologies may differ, a subgrantee that offers service relying on multiple different technologies or has committed to multiple different speed tiers must sample locations for each technology and committed speed tier

⁸ See BEAD NOFO §IV.C.2.a.i, p.64 (“subgrantees must perform speed and latency tests from the customer premises of an active subscriber to a remote test server at an end-point consistent with the requirements for a Commission-designated IXP”) and § II.B.1, p. 18.

⁹ See *Policy Notice: Tailoring the Application of the Uniform Guidance to the BEAD Program*, p. 9. Available at https://broadbandusa.ntia.doc.gov/sites/default/files/2023-12/BEAD_Policy_Note_of_Uniform_Guidance_Part_200_Exceptions_Related_Issues.pdf.

¹⁰ The sample sizes are similar to those stipulated by the FCC performance measures orders except for the largest sets of active subscribers. Since the publication of the FCC performance measures orders, improved provider network management systems allow speed and latency tests without installing additional hardware or software. The sampling rate of 10% corresponds to the sample size used for rebutting area speed test challenges in NTIA’s BEAD model challenge process (see *BEAD Model Challenge Process*, p. 20). Available at <https://www.ntia.gov/sites/default/files/2023-09/bead-model-challenge-process.zip>.

¹¹ Such technologies include unlicensed fixed wireless (ULFW) or low-earth orbit satellite (LEO) service.

¹² For example, an Eligible Entity could require a sample equal to at least one percent of the served locations within each census block group or six locations, whichever is larger. If a census block group has fewer than six subscribers, all are measured. This roughly corresponds to the threshold used for the area challenge during the BEAD challenge process and ensures that performance is measured across all geographic areas.

separately. Technologies are considered different if they are assigned different FCC technology codes¹³. For example, a subgrantee offering service to 1,000 locations by fiber (FCC technology code 50) and to 400 locations by licensed fixed wireless (FCC technology code 71) must sample 50 locations served by fiber and 40 locations served by licensed fixed wireless. Similarly, if the subgrantee agreement contains different committed speed tiers in different areas, each committed speed tier offering is sampled separately among subscribers in the applicable projects.

However, if a provider offers different tiers above or below the committed speed tiers for sale, these do not have to be sampled separately. For example, if a provider has committed only to offering qualifying broadband service (100/20 Mbps) but sells service packages for 50/10 Mbps, 100/20 Mbps, and 1000/1000 Mbps, the provider uses a single sample set. The subscriber count includes all active subscribers for each committed speed regardless of the advertised speed they subscribe to. The provider is required to upgrade customers in the sample set, at no charge, to at least the committed speed tier during the testing period.¹⁴ Regardless of the subscribed tier, the test subjects need to meet only the committed performance, not the advertised one.

3.4 Sampling

Every last-mile subgrantee must test a random sample of their active subscribers, the “test subjects,” at grant-supported customer locations every six months. Test subjects must be randomly selected from among the provider’s active subscribers in each committed speed tier, as described above, in each state or territory.¹⁵

“Random selection will ensure that providers cannot pick and choose amongst subscribers so that only those subscribers likely to have the best performance (e.g., those on more lightly loaded network segments) are tested. Carriers may use inducements to encourage subscribers to participate in testing. However, to ensure that the selection remains random, carriers must offer the same inducement to all randomly selected subscribers in the areas for which participating subscribers are required for the carrier to conduct testing.”¹⁶ Inducements may include upgrades to the committed speed; for example, if a provider has committed to 1 Gbps symmetrical service, but one of the locations in the sample set only subscribes to 200/20 Mbps service, the provider may offer a speed upgrade.

Providers must select the random sample through a public source of randomness. The provider must publish a list of candidate locations along with the difficult-to-predict string.¹⁷ Details are described in Appendix A.¹⁸

¹³ See *Fixed Technology Codes*, FCC; available at <https://help.bdc.fcc.gov/hc/en-us/articles/5290793888795-Fixed-Technology-Codes>.

¹⁴ See *CAF Performance Measures Order*, § 51.

¹⁵ NTIA anticipates that most providers will use their deployed last-mile network management infrastructure to conduct these tests, rather than install hardware measurement devices.

¹⁶ *CAF Performance Measures Order*, § 40.

¹⁷ As defined in the Internet Draft “Simple Random Candidate Selection.” available at <https://datatracker.ietf.org/doc/draft-hoffman-random-candidate-selection/> (last retrieved November 21, 2023).

¹⁸ Letting providers assemble the sample set greatly reduces the overall time to completion as providers have access to their location list likely four months earlier than Eligible Entities. This is particularly important during the early

3.5 Semiannual Measurement Period and Alignment with Semiannual Reports

The most recent performance reporting data and compliance information becomes part of the semiannual report submitted by the Eligible Entity.

To avoid duplicative data collection efforts for the Eligible Entity and the providers, the measurement sample sets must rely on the BEAD locations reported to the National Broadband Map. The sample set is to be drawn from the locations available for service with an as-of date **7 months** prior to the semiannual report due date. For example, the semiannual report due on January 31, 2026, reflects the performance of locations reported to the FCC Broadband Data Collection (BDC) available as of June 30, 2025.¹⁹

The provider may conduct the performance measurements for one sample set during any single week after generating the list of locations. The provider must submit the measurement results by the deadline announced by the Eligible Entity. Eligible Entities should allow providers at least 120 days between the as-of date of the National Broadband Map and the submission deadline.

3.6 Measurement Methodology

For privacy and reproducibility reasons, performance metrics are measured by active measurements (i.e., devices or software sending packets to servers located at the edge of the provider network), rather than classical network management systems. Providers may rely on TR-069²⁰ and TR-369²¹ CPE WAN Management Protocols (CWMP), rely on custom software on a residential gateway supplied to the customer, or install dedicated network measurement devices. To minimize the burden on providers and subscribers, providers are encouraged to plan for speed and latency measurements that rely on capabilities built into optical network terminal (ONT) or other customer premise equipment (CPE) such as a residential gateway rather than installing additional measurement devices at subscriber locations. However, providers may choose to deploy separate measurement hardware devices for some or all locations in the sample set. For example, they may use built-in (software) measurement capabilities for subscribers that use a provider-supplied or provider-specified residential gateway and hardware devices for locations with customer-supplied residential gateways.

years of the build-out period where the list of BEAD locations may change significantly for each reporting period. The use of a publicly verifiable source of randomness ensures that providers cannot influence the composition of the sample set and that both the broadband office and the public can verify the selection.

¹⁹ The FCC publishes the list of locations and their service level approximately four and a half months after the as-of date. Thus, for the example, the provider can create the sample set in July or August 2025. If we assume that Eligible Entities ask providers to submit relevant data by November 30, 2025, providers have at least three months to deploy measurement hardware, if necessary, conduct measurements, and collect data.

²⁰ See “TR-069 CPE WAN Management Protocol,” Broadband Forum, available at <https://www.broadband-forum.org/pdfs/tr-069-1-6-0.pdf> (last retrieved May 22, 2024).

²¹ See “TR-369 Issue 1: User Services Platform (USP),” Broadband Forum, available at <https://www.broadband-forum.org/pdfs/tr-369-1-0-0.pdf> (last retrieved May 22, 2024).

Providers need to obtain consent from their subscriber if they deploy measurement hardware on customer premises.²² Consent cannot be made a condition of service, but providers may offer subscribers a uniform financial incentive. Since software-based performance measurements impose no burden on the subscriber, do not require a technician visit, do not collect user data, and many providers already routinely conduct such tests as part of their network management, the provider may perform software-based tests using CPE furnished by the provider without obtaining subscriber consent.

Providers shall follow the basic measurement methodology summarized in Appendix A of the FCC *Performance Measures Order*, as modified here. Where needed, the remainder of the *Performance Measures Order* provides additional explanation and details and is part of these requirements by reference. Items relevant to NTIA programs are reproduced in the detailed section below, with adjustments noted in italics.

A test is defined to be a single, discrete observation or measurement of speed or latency conducted from the customer premises of an active subscriber *at a BEAD location* to a remote test server located at, or reached by, passing through an FCC-designated Internet exchange point (IXP).

3.7 Measurement Period

Speed and latency testing must be conducted for one week, repeated at each measurement interval, with a default of two measurement periods per year unless the Eligible Entity requires more frequent testing of no more than quarterly. In those weeks, testing must be performed between the hours of 6:00 pm and 12:00 am local time each day, including weekends (testing hours). Testing for all locations in a single committed speed tier in a single state or territory must be done during the same week. If a provider has more than one committed speed tier in a state or territory, testing for each speed tier can be conducted during different weeks.

3.8 No Prioritization of Measurement Traffic

Providers must not use any technology that prioritizes test traffic or customer connections selected for testing over those of other customers. Such traffic must receive the same priority and travel the same route as non-test traffic and customer connections not selected for testing, traversing the same IXP. Providers may prioritize measurement traffic within the traffic envelope of the test subject to reduce or eliminate the impact of any customer application traffic.

3.9 Internet Exchange Points

The FCC designated the location of the IXPs: New York City, NY; Washington, DC; Atlanta, GA; Miami, FL; Chicago, IL; Dallas-Fort Worth, TX; Los Angeles, CA; San Francisco, CA; Seattle, WA; Denver, CO; Salt Lake City, UT; St. Paul, MN; Helena, MT; Kansas City, MO; Phoenix, AZ; and Boston, MA. Should the FCC update the location list of IXPs in the future, providers supported through the BEAD Program shall use the updated list. For testing purposes, we define an FCC-designated IXP as any building, facility, or location housing a public Internet

²² See, for example, the FCC consumer FAQ at <https://www.fcc.gov/performance-testing-carriers-receiving-high-cost-universal-service-fund-support>.

gateway that has an active interface to a qualifying internet autonomous system (ASNs). The qualifying ASNs are listed in Appendix B of the FCC *Performance Measures Reconsideration Order*.

For providers serving non-contiguous areas more than 500 air miles from the contiguous United States, testing must be conducted from the customer premises of an active subscriber to a point in the non-contiguous area where mainland traffic is aggregated for transport from the non-contiguous area.

3.10 Speed Testing

A speed test is a single measurement of download or upload speed of 10 to 15 seconds duration between a test subject location and a specific remote server location.

For speed testing, a provider must conduct a minimum of one test per testing hour in each direction (download and upload) and start at the beginning of each test hour. If the consumer application traffic load is greater than 1% of the committed speed tier in the relevant direction, the provider may defer the affected test for one minute and reevaluate whether the load exceeds the threshold before retrying the test. For example, for a committed speed of 100 Mbps, the default cross-traffic threshold is 1 Mbps. A provider may choose a higher threshold.²³ This load check-and-retry must continue at one-minute intervals until the speed test can be run or the one-hour test window ends and the test for that hour is canceled. A provider that begins attempting speed tests within the first fifteen minutes of a testing hour, and repeatedly retries and defers the test at one-minute intervals due to consumer load meeting the adopted crosstalk thresholds may report that no test was successfully completed during the test hour because of crosstalk.²⁴

3.11 Required Download Speed and Required Upload Speed

For all projects, the “required download speed” or “required upload speed” is the speed that the provider committed to as part of the subgrantee agreement, as described in Section 3.3. These speeds may exceed some of its service offerings and fall below the highest speed offered to subscribers.

To comply with the speed standard, a provider’s certified test results, for each state or territory and speed tier, must show that 80 percent of the upload measurements are at or above 80 percent of the required upload speed, and 80 percent of the download measurements are at or above 80 percent of the required download speed. For example, for priority projects that have committed to 100/20 Mbps, 80 percent of measurements must meet or exceed 80/16 Mbps.

²³ The *Measuring Broadband America - Technical Appendix to the Twelfth MBA Report* (<https://data.fcc.gov/download/measuring-broadband-america/2022/Technical-Appendix-fixed-2022.pdf>, pg. 33) stipulates a uniform threshold of 200 kbps, which is roughly 13% of the lowest downlink speed among the sampled speed tiers. The percentage-based threshold better reflects modern network background traffic and range of network speeds than the fixed 32/64 kbps thresholds in the 2018 FCC rules and makes it less likely that the measurement system will not be able to gather enough samples during the busy period.

²⁴ See *Performance Measures Reconsideration Order*, § 26.

3.12 Latency Testing

A latency test is a single measurement of latency, often performed using a single User Datagram Protocol (UDP) packet or a group of three Internet Control Message Protocol (ICMP) or UDP packets sent at essentially the same time, as is common with ping tests.²⁵

For latency testing, a provider must conduct a minimum of one test per minute — 60 tests per hour — for each testing hour. If the consumer load during a latency test exceeds 200,000 bits per second downstream,²⁶ the provider may cancel the test and reevaluate whether the consumer load exceeds 200,000 bits per second downstream before retrying the test in the next minute.

To comply with the latency standard, a provider’s certified test results must show, for each state or territory, that 95 percent or more of all tests of network round-trip latency are at or below 100 milliseconds when measured between the test subject and a remote server that is located at or reached by passing through an FCC-designated IXP. Providers must record the observed latency for all latency test measurements, including all lost packet tests. Providers may not discard lost packet tests from their test results; these tests count as discrete tests not meeting the standard.²⁷

3.13 Reliability Tests

The BEAD NOFO specifies: “Each Funded Network’s outages should not exceed, on average, 48 hours over any 365-day period except in the case of natural disasters or other force majeure occurrence. Each Eligible Entity should ensure a prospective network is designed to meet this requirement and should develop metrics for measuring outages to be utilized in connection with this requirement once the network is operational.”²⁸

This reliability requirement corresponds to a reliability (uptime) of approximately 99.5 percent. The measurement applies separately for each technology, but across all speed tiers, and is measured across all test subjects in all sample sets.²⁹

Providers shall report the violated interval ratio (VIR) according to RFC 9544,³⁰ using the interval measures described below, to the Eligible Entity.

In addition to the reliability metric, providers shall also supply a count of all funded locations that experienced continuous outages exceeding eight hours (i.e., a time-to-repair of greater than eight hours), beyond subscribers in areas affected by natural disasters, and the 80th percentile duration of such eight-hour-or-longer outages. This Policy Notice uses this metric rather than the all-faults mean-time-to-repair since many network outages are quite short and are repaired within minutes (e.g., by a route update). Thus, the mean time-to-repair may be low even if a significant number of subscribers experience extended multi-hour or multi-day outages that may

²⁵ *CAF Performance Measures Order*, § 18.

²⁶ Again, we follow the more recent guidance of the Measurement Broadband America technical appendix.

²⁷ *CAF Performance Measures Order*, § 50.

²⁸ BEAD NOFO, § IV.C.2.a, p. 65.

²⁹ It appears unlikely that different speed tiers using the same technology experience different reliability. Using the combined sample sets maximizes statistical reliability, without increasing the overhead of managing test subjects.

³⁰ RFC 9544, “Precision Availability Metrics (PAMs) for Services Governed by Service Level Objectives (SLOs),” published March 2024. Available at <https://www.ietf.org/rfc/rfc9544.html>.

significantly impair their ability to work from home, run their business, take classes remotely, or follow through on telehealth appointments.

A location is unavailable (i.e., in outage or in a “violated interval” (VI)³¹) if subscribers cannot access common internet services, expressed if any of the following are the case:

- The physical or link-layer connection to the customer cannot carry network traffic.
- The packet loss to the customer exceeds 5 percent.
- The average round-trip latency to the customer exceeds 100 milliseconds during the interval.
- None of the default Domain Name System (DNS) servers are responding to queries.³²
- More than one-fifth of the border routers or other test hosts of the organizations and AS numbers listed in Appendix B of the Performance Measures Reconsideration Order (or any subsequent update provided by the FCC) are unreachable.

Packet loss and latency are measured to a server that meets the qualifications for the latency test in Section 3.12. The end system DNS server and border router reachability tests shall be performed at least once, at any time, during the time interval.

Availability metrics shall use time intervals of no more than five minutes.³³ Any failed test causes the interval to count as a violated interval (VI), and each successful completion of all tests makes the interval a violation-free interval (VFI).

Providers may ascertain reachability and packet loss using link-layer management protocols such as ONU Management and Control Interface (OMCI), ICMP or UDP echo requests to or from the residential gateway (RG). Either the UDPEchoPlus measurement methodology of Broadband Forum TR-143³⁴ or the TWAMP approach of Broadband Forum TR-390³⁵ are recommended, using either network-initiated or client-initiated measurements. Thus, latency and packet loss metrics can use the same test packets. Each measurement interval shall include at least 200 latency and packet loss samples.³⁶

Providers may use a single test point within each state or territory to check the reachability of the border routers or other test hosts or default DNS servers.

³¹ See RFC 9544, Section 3.2.

³² To test the DNS server, probes should query a random, non-repeating non-existing sub-domain.

³³ A five-minute interval allows accurate packet loss and round-trip time estimates and reduces the measurement burden for the test subjects and any measurement servers.

³⁴ “TR-143 Enabling Network Throughput Performance Tests and Statistical Monitoring,” Broadband Forum, published February 2023. Available at <https://www.broadband-forum.org/pdfs/tr-143-1-1-2.pdf> (last retrieved May 22, 2024).

³⁵ “TR-390 Performance Measurement from IP Edge to Customer Equipment using TWAMP Light,” Broadband Forum, published May 2017. Available at <https://www.broadband-forum.org/pdfs/tr-390-1-0-0.pdf> (last retrieved May 22, 2024).

³⁶ For 200 samples, the 90% confidence interval for a measured packet loss rate of 5% is between 2.7% and 8.3%.

Outages are included in the outage time total regardless of whether the subscriber reports the outage to the provider or not. The outage period starts when the provider’s network management detects the outage or the subscriber reports the outage, whichever occurs earlier.

Power failures at the subscriber location are not included in the outage periods. Such outages may be reported by ONTs via the OMCI, or CPE may log such outage periods internally and make them available to the provider’s network management system. Providers may disregard outages that occur where the FCC has activated the Disaster Information Reporting System (DIRS) during its activation period and within one month thereafter³⁷ or during the incident period of Federal Emergency Management Agency (FEMA) “declared disasters.” Funded Networks shall tabulate, at a county or parish (or equivalent subdivision) level, any claimed disaster periods.

Providers must compute the reliability for the past 180 days preceding the submission of the performance report (see Section 6) to the Eligible Entity. To allow for analysis, the subgrantee may choose a 180-day period that ends no more than 30 calendar days before the report submission.

3.14 Failure of the Test Infrastructure

All test results must be retained and published, as described in the Transparency section below. Providers cannot delete, trim, edit, or otherwise exclude any test measurements. If a provider knows or suspects that the testing infrastructure has failed or has negatively impacted test results, the provider may submit evidence of the test infrastructure failure with sufficiently detailed information to the Eligible Entity and NTIA to understand its cause and determine the extent to which any test results should be discarded or adjusted when calculating compliance. Providers must still retain such test results.

3.15 Flexibility Afforded to Eligible Entities

Eligible Entities may strengthen the measurement requirements described here, e.g., by increasing the size of the sample set or detailing corrective actions but may not change the speed and reliability requirements spelled out in the NOFO. Any additional requirements, deadlines, and corrective actions must be documented in the grant conditions.

Eligible Entities may choose how and when they want to receive the performance measurements, (e.g., whether data files should be uploaded to a portal or be stored on the provider’s site only) so long as they can submit complete and accurate semi-annual reports, including required performance measurement reporting.

4. Transparency

Each provider shall document the methodology, standards, and parameters used for their performance measurements applicable to BEAD-funded networks, preferably available on or

³⁷ The post-activation period of one-month accounts for the time needed to restore normal network service after disasters.

through a link on their network management practices page.³⁸ The page must indicate that these disclosures apply to BEAD-funded networks, even if they also apply to other measurement obligations. In particular, the description must include at least:

- The vendor, product name, and release (version) identifier of the performance testing software;
- If applicable, the Internet Engineering Task Force (IETF) Requests for Comments (RFCs), Broadband Forum technical reports, and other standards relied upon, along with any relevant parameters such as probe packet intervals and availability time intervals;
- The number of concurrent Transmission Control Protocol (TCP) connections used for measuring download and upload speed;
- Any “warm up” period for throughput measurements.

For each round of performance testing conducted, providers must publish their throughput, latency, and reliability measurement results, at the location level, as a CSV file linked from their network management practice page, retaining at least three years of data. Eligible Entities are encouraged to collect the data and publish the data through the state or territory open data efforts. Providers must retain such measurement data and make it available for inspection by the Eligible Entity or NTIA for the duration of the federal interest period.

The MBA technical appendix offers an example of a methodology explanation.³⁹ Different methodologies, such as a different number of concurrent TCP connections, may yield substantially different measurement results under some circumstances.⁴⁰

The measurement report, including the methodology, standards, parameters, and data, must include a certification as to the accuracy of the information reported by an appropriate official of the filer, along with the title of the certifying official.⁴¹ The certifying official must be a corporate officer of the service provider with supervisory and budgetary authority over network operations in all relevant service areas. Information related to compliance with these requirements will be collected as part of the semi-annual reporting.

5. Compliance

For speed, NTIA requires that 80 percent of download and upload measurements be at or above 80 percent of the required speed tier. Upload and download tests are counted separately (i.e., both must meet the 80/80 standard individually).

³⁸ See, e.g., 47 CFR 8.1. “Any person providing broadband internet access service shall publicly disclose accurate information regarding the network management practices, performance characteristics [...] Such disclosure shall be made via a publicly available, easily accessible website or through transmittal to the Commission.”

³⁹ Technical Appendix, Technical Appendix to the Twelfth MBA Report, FCC Office of Engineering and Technology, January 2023, <https://data.fcc.gov/download/measuring-broadband-america/2022/Technical-Appendix-fixed-2022.pdf>.

⁴⁰ See, e.g., Kyle MacMillan, Tarun Mangla, James Saxon, Nicole P. Marwell, and Nick Feamster, *A Comparative Analysis of Ookla Speedtest and Measurement Labs Network Diagnostic Test (NDT7)*. Proc. ACM Meas. Anal. Comput. Syst. 7, 1, Article 19 (March 2023), 26 pages. <https://doi.org/10.1145/3579448>.

⁴¹ See 47 CFR 1.50007 (d) and 47 CFR 9.19 (3) for related provisions.

For latency, 95 percent of measurements must be at or below 100 milliseconds.

For reliability, the provider must show an average outage across its locations below 48 hours per calendar year.

A provider is non-compliant if it fails to meet any of the four thresholds (i.e., download, upload, latency, or reliability) for any of the applicable speed tiers and technologies.

A provider is also non-compliant if it fails to use a compliant testing methodology, fails to report measurement results to the Eligible Entity on time, or fails to comply with transparency requirements, in accordance with the BEAD NOFO and terms and conditions of an award.

Subgrantees must submit their measurement results, including the reliability metrics, by the due date for their semiannual report. The CSV file uses the format specified by Universal Service Administrative Company (USAC),⁴² including any updates published by USAC. Since NTIA locations do not have a High Cost Universal Broadband (HUBB) Location ID, the first column contains the BSL identifier instead. Providers submit a separate file for each committed speed tier; thus, the CSV file does not include the speed tier.

Subgrantees are responsible for reporting any non-compliance to the Eligible Entity within 15 days of completing the measurement cycle or failing to meet the reliability benchmarks. Regardless of any other actions or consequences, any non-compliant provider must increase its testing frequency to quarterly until compliance is achieved for two consecutive quarterly measurement periods. Following the FCC measurement framework of compliance levels,⁴³ Eligible Entities may establish percentage compliance thresholds where the enforcement mechanisms specified in the BEAD NOFO⁴⁴ are invoked.

⁴² Universal Service Administrative Co., PMM Data Formatting Guide, <https://www.usac.org/wp-content/uploads/high-cost/documents/Tools/PMM-Data-Formating-Guide.pdf>.

⁴³ See *CAF Performance Measures Order*.

⁴⁴ See BEAD NOFO, § IX.G.4, p. 95.

6. Appendix A: Computing a Publicly Verifiable Random Set of Locations

The algorithm for random sampling follows the Internet Draft “Simple Random Candidate Selection.”⁴⁵ The timing aligns with the FCC BDC reporting dates.

The set of steps below creates a set of locations:

1. Start with the complete, numerically ordered list of location IDs within a committed speed tier and technology and state or territory, called the selection list. The list corresponds to the list of locations reported for the FCC Broadband Data Collection (i.e., either as of June 30 or December 31) as described in Section 3.6.
2. Providers are encouraged to use the “Day” value for the as-of dates of the *NIST Interoperable Randomness Beacon Version 2.0*.⁴⁶ Alternatively, they may use the FTSE 100 closing price from either December 30th⁴⁷ (for the December 31st as-of date) or June 30 (for the June 30 as-of date) as the difficult-to-predict string.
3. The candidate’s name is the location identifier as a UTF-8 string, with no leading zeroes.
4. Create SHA-256 hash values of the location ID and the difficult-to-predict string.
5. The list is sorted by hash value, expressed in hexadecimal encoded as UTF-8, and the highest values are selected until enough candidates have been identified for the sample set.

Along with the final list of measurement locations, the provider submits to the Eligible Entity the initial location list and the difficult-to-predict string used, as well as locations removed as non-subscribers.⁴⁸

7. Appendix B: Policy Notice Change Log

This appendix tracks changes to the Performance Measures for BEAD Last-Mile Networks Policy Notice.

Version Number	Page Number	Date of Change (mm/dd/yyyy)	Location of Change	Description of Change
1				

⁴⁵ Available at <https://datatracker.ietf.org/doc/draft-hoffman-random-candidate-selection/> (last retrieved November 21, 2023).

⁴⁶ Available at [Interoperable Randomness Beacons | CSRC \(nist.gov\)](https://www.nist.gov/interoperable-randomness-beacons) (last retrieved May 13, 2024).

⁴⁷ The FTSE 100 is not available for December 31. If there is no closing price for the designated date because the as-of date is a bank holiday or falls on a weekend, choose the most recent date preceding that date.

⁴⁸ Start with the list of built-out locations rather than the list of customer locations since this avoids disclosing the complete list of subscribers.