



# PUBLIC NOTICE

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## PROCEDURES FOR MOBILE NETWORK COVERAGE AND MILESTONE TESTING IN PUERTO RICO AND THE UNITED STATES VIRGIN ISLANDS

WC Docket No. 18-143

### I. INTRODUCTION

1. In this Public Notice, the Wireline Competition Bureau (Bureau or WCB) and the Office of Economics and Analytics (OEA) announce approved parameters and a testing methodology that mobile support recipients of the Bringing Puerto Rico Together Fund and the Connect USVI Fund (collectively, the PR-USVI Funds) may use to submit network data to verify that they have met their deployment obligations.<sup>1</sup> Alternatively, in accordance with the *2019 PR-USVI Order*, recipients may elect to employ alternative testing procedures, subject to review and final approval by the Bureau, to demonstrate that they have met their network coverage and performance commitments. The Bureau will use these drive and drone test results to ensure that mobile support recipients met their performance commitments required by the *2019 PR-USVI Order*.

### II. BACKGROUND

2. In 2017, Hurricanes Irma and Maria caused massive devastation to Puerto Rico and the United States Virgin Islands (collectively, Territories). As part of the Commission's restoration efforts, in 2019, the Commission adopted Stage 2 of the Bringing Puerto Rico Together Fund and the Connect USVI Fund, which authorized approximately \$385.9 million in universal service support to facilitate the hardening and deployment of advanced broadband networks in the Territories. More than \$258 million of this funding was dedicated to support the expansion and hardening of 4G long term evolution (4G-LTE) and 5G-New Radio (5G-NR) technologies for voice and broadband services in the Territories over a three-year period.<sup>2</sup> Nearly all of the eligible mobile providers elected to receive Stage 2 mobile support from the PR-USVI Funds to support state-of-the-art 4G-LTE and 5G-NR communication networks.<sup>3</sup>

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<sup>1</sup> 47 CFR §§ 54.1513, 54.1514(a), (b); *The Uniendo a Puerto Rico Fund and the Connect USVI Fund*, WC Docket Nos. 18-143, 10-90, Report and Order and Order on Reconsideration, 34 FCC Rcd 9109, 9110, paras. 1-3 (2019) (*2019 PR-USVI Order*).

<sup>2</sup> *2019 PR-USVI Order*, 34 FCC Rcd at 9162-63, paras. 101-102.

<sup>3</sup> See *Wireline Competition Bureau Authorizes Stage 2 Mobile Support for Certain Providers Participating in the Uniendo a Puerto Rico Fund and the Connect USVI Fund*, WC Docket Nos. 18-143, 10-90, Public Notice, 35 FCC Rcd 6321, 6324, Attach. A (WCB 2020); *Wireline Competition Bureau Authorizes Stage 2 Mobile Support for T-Mobile in Puerto Rico*, WC Docket Nos. 18-143, 10-90, Public Notice, 35 FCC Rcd 10303, 10305, Attach. A (WCB 2020); *Wireline Competition Bureau Authorizes Stage 2 Mobile Support for Viya in the U.S. Virgin Islands*, WC Docket Nos. 18-143, 10-90, Public Notice, 35 FCC Rcd 11555, 11557, Attach. A (WCB 2020) (collectively, *Mobile Authorization Notices*).

3. As a condition of receiving mobile support, the Commission required that providers meet interim and final network coverage area milestones and network performance speeds.<sup>4</sup> At the end of the three-year term of support, each mobile support recipient must have restored its mobile network coverage to an area that is equal to or greater than 100% of its pre-hurricane network coverage.<sup>5</sup>

4. In addition to the full restoration of mobile coverage, the Commission targeted high-cost support towards advanced mobile services. The Commission observed that consumers increasingly relied on greater performing networks, including faster data transfer speeds, and the rapid investment in 5G deployment across the country.<sup>6</sup> Therefore, the Commission found it was in the public interest to ensure that universal service funds were directed to support 4G-LTE and more advanced technologies.<sup>7</sup>

5. The Commission adopted minimum service requirements for 4G-LTE and 5G-NR technologies to promote efficient use of support and to encourage rapid deployment of advanced, high-quality, storm-hardened networks. For 4G-LTE, the Commission required support recipients to meet minimum baseline performance requirements in data speeds, data latency, and data allowances. By the end of the three-year support term, recipients must demonstrate that the 4G-LTE network areas where they used support offer at least 10 Mbps download speed and 1 Mbps upload speed by the end of the three-year support term. For latency, the required measurement must have a data latency of 100 milliseconds or less round trip.<sup>8</sup> Similarly, for the support used to deploy 5G-NR networks, the Commission adopted 35 Mbps as the minimum download speed and 3 Mbps as the minimum upload speed for Stage 2 mobile support recipients.<sup>9</sup>

6. The Commission adopted reporting requirements to ensure compliance with section 254(e) of the Act and to monitor the restoration and performance of supported mobile networks.<sup>10</sup> Specifically, mobile support recipients must file FCC Form 477 network deployment data for their final 100% network coverage submission.<sup>11</sup> Mobile support recipients must demonstrate, by no later than January 30, 2024, that they fully restored or expanded on their coverage prior to the 2017 hurricanes.<sup>12</sup> As directed by the Commission, the final network coverage area report shall be based on FCC Form 477 data and reflect the network coverage area for a provider as of the end of its three-year Stage 2 support term.<sup>13</sup>

7. Mobile participants must certify their final milestone submission and network performance commitments.<sup>14</sup> The certification must be accompanied by drive, drone, or scattered site test

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<sup>4</sup> 47 CFR §§ 54.1513, 54.1514(a), (b); *2019 PR-USVI Order*, 34 FCC Rcd at 9172-74, paras. 126-30.

<sup>5</sup> 47 CFR § 54.1513(b).

<sup>6</sup> *2019 PR-USVI Order*, 34 FCC Rcd at 9170-71, para. 121.

<sup>7</sup> *Id.* at 9170-71, para. 121.

<sup>8</sup> *Id.* at 9171, para. 122.

<sup>9</sup> *Id.* at 9172, para. 124.

<sup>10</sup> *Id.* at 9172-74, paras. 126-32.

<sup>11</sup> *Id.* at 9173, para. 128.

<sup>12</sup> 47 CFR § 54.1514(a).

<sup>13</sup> The end of each mobile recipient's three-year support term is determined based on the date it was authorized to receive high-cost mobile support. *See supra note 3.*

<sup>14</sup> 47 CFR § 54.1514(a)-(c).

data.<sup>15</sup> The test data must show mobile transmissions to and from the network that meet or exceed the minimum speeds for 4G-LTE and 5G-NR set out by the *2019 PR-USVI Order*.<sup>16</sup>

8. In the March 27, 2023 Public Notice, the Bureau and OEA directed providers to file mobile data consistent with previous FCC Form 477 instructions using the special collections portal of the Broadband Data Collection (BDC).<sup>17</sup> Because the FCC Form 477 portal does not accept filing of data after June 30, 2022, the Bureau and OEA provided data specifications, attached hereto as Appendix A, necessary for submitting the requisite data through the BDC special collections portal;<sup>18</sup> the public notice further stated that separate instructions would be provided for filing drive, drone, and/or scattered site test data.<sup>19</sup> Based on the final network coverage data to be submitted by providers, the Bureau and OEA will provide an approved sample of locations where carriers must conduct drive and drone tests for network coverage and network performance as part of the final 100% milestone report.<sup>20</sup> A recipient will have the option to perform the approved drive and drone testing methodology we announce in this Public Notice, or it may propose its own methodology to the Bureau for approval. A recipient must submit the test results pursuant to section 54.1514, regardless of the methodology used, to demonstrate its final milestone and network performance commitments have been met.<sup>21</sup>

### III. DISCUSSION

9. Appendices A-C set forth the parameters and methodology that providers should use in their network coverage and performance testing in order to enable the Commission to determine whether recipients have met their commitments. In particular, we provide parameters that service providers may use in conducting drive and drone testing, which includes two tests in each sampling unit in a statistically significant sample of the network coverage areas. Our methodology selects random geographies inside the coverage maps submitted by PR-USVI mobile providers purporting to reflect their final milestone coverages. Providers will conduct drive or drone testing in random locations within the specific geographies selected by OEA. WCB and OEA will analyze the data from the test results submitted by providers and calculate a point estimate to determine whether or not each mobile provider met its network coverage and speed commitments.

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<sup>15</sup> *Id.*

<sup>16</sup> *Id.*

<sup>17</sup> *Comment Sought on Continued Filing of Alaska Plan FCC Form 477 Mobile Deployment Data; Waiver of Interim PR-USVI Mobile Milestone Filing and Information Provided for Final Milestone Filing*, WC Docket Nos. 16-271; 18-143; 19-195, Public Notice, -- FCC Rcd --, para. -- (2023).

<sup>18</sup> *See generally Establishing the Digital Opportunity Data Collection; Modernizing the FCC Form 477 Data Program*, WC Docket Nos. 19-195, 11-10, Order, FCC 22-93 (rel. Dec. 9, 2022) (*Form 477 Sunset Order*) (discussing the effort to replace FCC Form 477 deployment data with Broadband Data Collection data); *see also Connect America Fund—Alaska Plan; Establishing the Digital Opportunity Data Collection*, WC Docket Nos. 16-271, 19-195, Order, DA 23-699, Appx. (WTB, OEA rel. Aug. 15, 2023) (providing a data specification for FCC Form 477 type of mobile coverage filings).

<sup>19</sup> In the *2019 PR-USVI Order*, the Commission provided that carriers may use propagation studies or scattered site testing to demonstrate that network speed and latency meet or exceed minimum service requirements where drive or drone testing is not feasible. *2019 PR-USVI Order*, 34 FCC Rcd at 9174, n.431. Consistent with the *2019 PR-USVI Order*, the Bureau provides the approved methodology for drive and drone testing in this Public Notice based on our expectation that recipients will be capable of performing drive or drone testing because of their familiarity with and use of a substantially similar test methodology as part of the Broadband Data Collection reporting requirements. As discussed in this Public Notice, a recipient may otherwise propose to the Bureau the use of a scattered site test where drive or drone testing is not feasible. *See infra* Section B; *see also* 47 CFR § 54.1514(a)(1)(iii).

<sup>20</sup> 47 CFR § 54.1514(a)-(b).

<sup>21</sup> *Id.* § 54.1514(a)-(c).

### A. Network Coverage and Drive/Drone Test Parameters

10. The parameters we adopt in this Public Notice are similar to drive and drone test methodologies adopted in other Commission proceedings, such as the BDC, to minimize the reporting burden on providers.<sup>22</sup> The parameters specify the categories of data to be collected, as well as the data structure and format in which the data must be reported. We approve these parameters and data specifications to aid in our understanding of the data derived from testing based on the Commission's experience with the BDC.

11. As provided by the *2019 PR-USVI Order* and the Commission's rules, providers must submit data demonstrating that they have met their final network coverage area milestone and network performance speeds for 4G-LTE and 5G-NR technologies following the end of the support term.<sup>23</sup> As with former FCC Form 477 data submissions, recipients will report broadband deployment coverage areas using polygons defined by the accessible, open-source H3 geospatial indexing system representing the geographic coverage for each technology specifically deployed in Puerto Rico or the U.S. Virgin Islands. The data associated with each polygon should indicate the provider's minimum advertised upstream and downstream data speeds associated with that network technology, and the coverage area should depict the boundaries where users should expect to receive those advertised speeds consistent with the data specifications found in Appendix A to this Public Notice.<sup>24</sup> Recipients should also submit separate polygons showing the coverage areas where Stage 2 mobile support was used to expand, restore, or upgrade 4G-LTE and 5G-NR technologies. A change in technology or speed will require a recipient to submit a separate polygon.

12. Concurrent with the submission of network coverage data, we require providers to notify the Bureau via electronic mail to [ConnectAmerica@fcc.gov](mailto:ConnectAmerica@fcc.gov) whether it will use the approved testing procedures provided in this Public Notice or seek approval of an alternative testing methodology. If the mobile support recipient intends to utilize the Bureau's approved testing methodology, the recipient should also provide notice whether network testing will be done by drive or drone testing. Based on a recipient's election and reported network coverage data, OEA will provide the recipient with a random sample of locations for the approved drive or drone testing detailed herein and for the completion and submission of these test results using the BDC Mobile Verification module. Alternatively, a recipient may elect to utilize an alternative testing methodology that requires approval from the Bureau and also submit its test results using the BDC Mobile Verification module to show that it has met its Stage 2 mobile commitments.

13. The approved drive and drone test model uses simple random sampling to determine test locations within a nested hexagon system based on each recipient's reported coverage area. OEA will prepare a list of eligible areas for random drive and drone testing to create the sample frame. The sample frame will be unique to each recipient, taking into account mergers and acquisitions since the adoption of the *2019 PR-USVI Order*. In other words, if a provider servicing Puerto Rico or the U.S. Virgin Islands acquired another provider also serving some of the same area, the frame will be the combined coverage of the 2017 FCC Form 477 filings of both providers, at the highest mobile technology for any given location.

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<sup>22</sup> *Establishing the Digital Opportunity Data Collection*, Order, 37 FCC Rcd 3007 (2022) (*BDC Mobile Technical Requirements Order*).

<sup>23</sup> 47 CFR §§ 54.1513, 54.1514(a), (b); *2019 PR-USVI Order*, 34 FCC Rcd at 9172-74, paras. 126-30.

<sup>24</sup> *Infra* Appx. A.

14. We will use hexagons at resolution 8 (hex-8s) as the geographic sampling unit for our methodology.<sup>25</sup> To allow flexibility for service providers to choose drive or drone<sup>26</sup> testing, a hexagon will be considered as a valid sample if the hex-8 lies inside both the provider's FCC Form 477 coverage map as of June 2017 and its current coverage map as submitted for the BDC. For both drone testing and drive testing, we will randomly select the testing location (a hex-9) within the hex-8. Providers must perform one mobile<sup>27</sup> and one stationary test for each selected test location. Similar to other testing parameters adopted by the Commission, we require both testing while in motion and stationary testing because it strikes a balance of ensuring that drive tests sufficiently represent the environments in which consumers use their mobile devices.<sup>28</sup> Tests conducted in motion further ensure that testing is conducted in multiple locations within the hexagon. In the event providers have recently conducted testing or started testing prior to the release of this Notice, we permit providers to submit a complete set of tests already performed if the selected sample area is the same as selected by OEA. To be considered valid, a prior test performed by the provider must (a) have occurred within the 12 months prior to the January 30, 2024 deadline for submission of the final milestone test results, (b) must align with the sample provided by OEA, and (c) must meet the data specifications described in Appendix C.

15. Following the completion of drive and drone tests, all mobile support recipients will submit the data to the Commission using the BDC Mobile Verification module. We will evaluate the test results for each sampling unit on whether the provider delivers the coverage at the minimum speeds to which it committed for Stage 2 mobile support. We will conclude that a provider has met its commitment in a hex-8 if: (1) both tests show measurements that are greater than zero indicating the newest technology was present in their June 2017 FCC Form 477 submission; and (2) at least one test measures the greatest minimum upload and download speeds reported in their June 2017 FCC Form 477 submission. In other words, both tests must demonstrate that the technology is present, and at least one test must show that the prior level of service has been fully restored or improved upon.

### **B. Alternative Testing Submitted by Mobile Recipients**

16. We believe the approved parameters described above for demonstrating network coverage and performance provide a reasonable methodology to demonstrate providers' fulfillment of Stage 2 commitments. This simplified testing methodology provides a uniform means by which the Commission can objectively and fairly evaluate all support recipients, rather than through varied, *ad hoc* procedures for each provider. Nevertheless, as provided in the *2019 PR-USVI Order*, the Commission granted mobile providers the flexibility to choose alternative parameters and sampling methodology for

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<sup>25</sup> We will use Uber H3 hexagons, which are an open-source geospatial indexing system developed by Uber Technologies, Inc. It utilizes a nesting cell structure, such that a larger hexagon, or a "parent" fits approximately 7 of the next size smaller hexagons, or "children" within it. See Isaac Brodsky, *H3: Uber's Hexagonal Hierarchical Spatial Index*, (Jun 27, 2018), <https://eng.uber.com/h3/>. For reference, hex-8s are approximately 0.74 sq. km. and hex-9s are approximately 0.11 sq. km. in size.

<sup>26</sup> Providers that choose to use drones—also known as unmanned aircraft systems (UAS)—for drive testing may need to seek waivers regarding airborne restrictions. See, e.g., *Connect America Fund—Alaska Plan; GCI Communication Corp. Petition for Limited Waiver in the Alaska Plan to Permit use of Unmanned Aircraft Systems for Drive-Test Data Collection; GCI Communication Corp. Request for Limited Waiver of 47 CFR § 22.295*, WC Docket No. 16-271, Order, DA 22-921, at 5-6, paras. 10-12 (WTB rel. Sept. 1, 2022) (granting a waiver of Section 22.925 restricted airborne usage of 800 MHz).

<sup>27</sup> Consistent with the approach for the Alaska Plan, a mobile test should initiate when moving away from the location of a stationary test after having reached the speed of the surrounding traffic or a safe and reasonable operating speed in the event no traffic is present. See *Connect America Fund—Alaska Plan*, WC Docket No. 16-271, Order and Request for Comment, 37 FCC Rcd 5882, Appx. B (WTB 2022). In motion tests that are deemed to have been conducted at an unreasonably slow speed are subject to a failed score or retesting.

<sup>28</sup> *BDC Mobile Requirements Order*, 37 FCC Rcd at 3030-31, 34-35, 85, paras. 38, 47, Appx. A & n.7.

network coverage and network performance.<sup>29</sup> The Commission also made clear, however, that any proposed alternative parameters and methodology will be subject to review and approval by the Bureau.<sup>30</sup>

17. We expect any proposed alternative methodology submitted to the Bureau for approval to fully describe in detail the testing parameters to be employed. The Bureau and OEA will review the proposal to determine whether the proposed sampling methodology includes a statistically valid sample of tests of network coverage areas, including areas where recipients have used Stage 2 mobile support to restore, harden, and expand 4G-LTE and 5G-NR technologies. Recipients proposing an alternative sampling methodology that is based on the H3 system should include sample data that follows data specifications for hex-8 and hex-9 polygons using the Commission's data template for Puerto Rico or the U.S. Virgin Islands.<sup>31</sup> When providing the relevant H3 template data, a recipient should identify the hex-8s polygons where it plans to conduct testing with a value of "1" in the corresponding "sampled\_flag" column of the template and enter the child hex-9s in which it will conduct drive or drone tests. If a recipient proposes to perform its own sampling and does not use the H3 system, the recipient should provide the Bureau with a detailed narrative of the proposed methodologies used to collect their data, including information where it proposes to conduct or has already conducted speed tests. In analyzing a proposal, staff may request additional information or seek modifications to a proposed methodology as may be necessary to ensure the reliability and accuracy of the data prior to approval.

18. The Bureau and OEA will review proposals to determine whether the alternate methodology will sufficiently sample coverage areas to determine that a recipient has met its commitments for Stage 2. Recipients must file their proposed methodology in **WC Docket No. 18-143** using the Commission's Electronic Comment Filing System<sup>32</sup> and email a copy to [ConnectAmerica@fcc.gov](mailto:ConnectAmerica@fcc.gov). Recipients must submit their proposed methodology to the Bureau at least two weeks prior to the January 30, 2024 deadline for submitting final milestone results to provide sufficient time for review and approval of the proposed testing. The Bureau or OEA will notify the provider of the determination on the recipient's proposed alternative methodology.

### C. Testing Period and Data Submission

19. Lastly, we again remind all recipients that their final network coverage data must be submitted to the Bureau through the BDC special collections portal and use the data specification format provided in Appendix A. The window for submitting the required coverage data will be open beginning on December 1, 2023, and close at 11:59 p.m. Eastern Time (ET) on January 30, 2024.

20. For network performance testing, all recipients will have 60 calendar days to complete and submit the network performance testing regardless of the methodology selected. A recipient that elects to utilize the approved drive or drone test consistent with the parameters in this Public Notice must complete its drive or drone tests and submit the test data no more than 60 calendar days after OEA provides the recipient with its random test sample from the BDC Mobile Verification module. The 60-day testing window begins the day immediately following the day OEA provides the test sample to a recipient. Similarly, for a recipient that proposes an alternative testing methodology, its 60-day testing window will begin the day immediately after the Bureau or OEA approves an alternative methodology and provides a Mobile Verification request to the mobile recipient. For any methodology used, if the 60th day falls on a non-business day, the due date for that particular recipient shall be the next business day. A

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<sup>29</sup> 2019 PR-USVI Order, 34 FCC Rcd at 9173-74, para. 130.

<sup>30</sup> *Id.* at 9173-74, para. 130.

<sup>31</sup> The Commission's H3 system data templates for Puerto Rico or the U.S. Virgin Islands are available at <https://us-fcc.box.com/v/Template-PR-Hex8s> and <https://us-fcc.box.com/v/Template-USVI-Hex8s>, respectively.

<sup>32</sup> A recipient may electronically file its proposed methodology through the Commission's Electronic Comment Filing System (ECFS) at <https://www.fcc.gov/ecfs/>.

recipient must submit the test data by 11:59 p.m. ET on the due date. All recipients will submit drive or drone test data using the BDC portal regardless of the testing method it selected.

#### IV. PROCEDURAL MATTERS

##### A. Legal Authority

21. We establish procedures for the milestone and performance reporting for Stage 2 mobile support recipients pursuant to the authority contained in sections 1, 2, 4(i), 214, 254, 303(r), and 403 of the Communications Act of 1934, as amended, 47 U.S.C. §§ 151, 152, 154(i), 214, 254, 301, 303(r), 332, and 403 and sections 1.1, 1.3, and 1.425 of the Commission's rules, 47 CFR §§ 1.1, 1.3, and 1.425.

##### B. Paperwork Reduction Act Analysis

22. This document implements the information collections adopted in the *2019 PR-USVI Order* and does not contain any additional information collection(s) subject to the Paperwork Reduction Act of 1995 (PRA), Public Law 104-13. In addition, the reporting parameters and methodology we release today specifically apply only to the four existing recipients of Stage 2 mobile support in Puerto Rico and the USVI.<sup>33</sup> The reporting and recordkeeping requirements are imposed on fewer than ten persons and are not subject to the Paperwork Reduction Act.<sup>34</sup> Therefore, this document does not contain any new or modified information collection burden for small business concerns with fewer than 25 employees, pursuant to the Small Business Paperwork Relief Act of 2002, Public Law 107-198.<sup>35</sup>

##### C. Supplemental Regulatory Flexibility Analysis

23. The Regulatory Flexibility Act of 1980, as amended (RFA),<sup>36</sup> requires that a regulatory flexibility analysis be prepared for rulemaking proceedings, unless the agency certifies that “the rule will not have a significant economic impact on a substantial number of small entities.”<sup>37</sup> The RFA generally defines “small entity” as having the same meaning as the terms “small business,” “small organization,” and “small governmental jurisdiction.”<sup>38</sup> In addition, the term “small business” has the same meaning as the term “small business concern” under the Small Business Act.<sup>39</sup> A small business concern is one which: (1) is independently owned and operated; (2) is not dominant in its field of operation; and (3) satisfies any additional criteria established by the Small Business Administration (SBA).<sup>40</sup>

24. In the *PR-USVI Stage 2 Order*, the Commission conducted a Final Regulatory Flexibility Analyses (FRFAs) as required by the Regulatory Flexibility Act of 1980, as amended (RFA).<sup>41</sup> The

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<sup>33</sup> *Transitional Support FNPRM* at 11, para. 27, n.75.

<sup>34</sup> 44 U.S.C. § 3502(3)(A)(i), (10).

<sup>35</sup> *See* 44 U.S.C. § 3506(c)(4).

<sup>36</sup> The RFA, *see* 5 U.S.C. § 601-612, has been amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA), Pub. L. No. 104-121, Title II, 110 Stat. 857 (1996).

<sup>37</sup> 5 U.S.C. § 605(b).

<sup>38</sup> *Id.* § 601(6).

<sup>39</sup> *Id.* § 601(3) (incorporating by reference the definition of “small business concern” in Small Business Act, 15 U.S.C. § 632). Pursuant to 5 U.S.C. § 601(3), the statutory definition of a small business applies “unless an agency, after consultation with the Office of Advocacy of the Small Business Administration and after opportunity for public comment, establishes one or more definitions of such term which are appropriate to the activities of the agency and publishes such definition(s) in the Federal Register.”

<sup>40</sup> Small Business Act, 15 U.S.C. § 632.

<sup>41</sup> *2019 PR-USVI Order*, 34 FCC Rcd at 9186, paras. 163-66.

Commission anticipated that the Order would not affect a substantial number of carriers and, therefore, certified the Order would not affect a substantial number of small entities.<sup>42</sup>

25. This Public Notice establishes reporting and approved testing parameters for mobile support recipients of the Bringing Puerto Rico Together Fund and the Connect USVI Fund. The procedures established in this Public Notice are consistent with the *2019 PR-USVI Order* and a RFA is not required for this Public Notice.

**D. Congressional Review Act**

26. The Commission has determined, and the Administrator of the Office of Information and Regulatory Affairs, Office of Management and Budget, concurs that these rules are “non-major” under the Congressional Review Act, 5 U.S.C. § 804(2). The Commission will send a copy of this Public Notice to Congress and the Government Accountability Office pursuant to 5 U.S.C. § 801(a)(1)(A).

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<sup>42</sup> *Id.* at 9186, para. 165.



**APPENDIX A**  
**Mobile Broadband Coverage Data Specification**

Field	Data Type	Example	Description / Notes
<b>brandname</b>	String	Acme Wireless	Name of the entity or service advertised or offered to consumers.
<b>technology</b>	Integer	400	Code for the technology used for the deployed service. <sup>43</sup> - <i>Value must be one of the following codes:</i> 200 – 2G 300 – 3G 400 – 4G LTE 500 – 5G-NR
<b>mindown</b>	Decimal (5,3)	10.0	The minimum advertised downstream bandwidth, or the downstream speed users should expect to receive in the coverage area, in Mbps with a precision of three decimal digits. - <i>Value must be greater than or equal to 0.</i>
<b>minup</b>	Decimal (5,3)	1.0	The minimum advertised upstream bandwidth, or the upstream speed users should expect to receive in the coverage area, in Mbps with a precision of three decimal digits. - <i>Value must be greater than or equal to 0.</i>

<sup>43</sup> For commitments made using older technology codes of FCC Form 477, for technology codes 85 (CDMA) and 86 (GSM), enter them as 200 (2G); for 80 (WCDMA/UMTS/HSPA), 81 (HSPA+), and 82 (EVDO/EVDO Rev A), enter them as 300 (3G); for 83 (LTE), enter as 400 (4G). See Instructions For Filings Through June 30, 2019 at 30, <https://us-fcc.app.box.com/v/Form477InstThruJune19>.

## APPENDIX B

### Technical Appendix: Verification of Coverage Restoration or Upgrade in Puerto Rico and the U.S. Virgin Islands

#### I. BACKGROUND

Under Stage 2 of the Bringing Puerto Rico Together Fund and the Connect USVI Fund, participating service providers in Puerto Rico and the U.S. Virgin Islands must demonstrate that by the end of the support period, they provide the same or better mobile network coverage as was available prior to the 2017 hurricanes. Providers are required to report their network coverage information and certification by January 30, 2024. Additionally, providers must demonstrate that their 4G-LTE and 5G-NR networks constructed with this funding meet speeds of at least 10/1 and 35/3, respectively, with no more than 100 milliseconds of latency.

In this Appendix, the Wireline Competition Bureau (WCB) and the Office of Economics and Analytics (OEA) provide a statistically valid methodology that can verify whether these service providers have met this requirement. The methodology is a simplified version of drive and drone testing methodologies we have adopted in similar proceedings.<sup>44</sup> That is, we first select random geographies inside the coverage maps submitted by these providers purporting to reflect their current coverage, and then providers will conduct drive or drone testing in random locations within the selected random geographies. We next analyze the data from these tests and calculate a point estimate that determines whether or not the requirement has been met.

#### II. GEOGRAPHIC SAMPLING UNIT

We will use Uber H3 hexagons<sup>45</sup> at resolution 8 (hex-8s) as the geographic sampling unit for our methodology.<sup>46</sup> To allow flexibility for service providers to choose drive or drone testing, hex-8s will be included as sampling units for a particular provider as long as the centroid of the hex-8 lies inside both the provider's FCC Form 477 coverage map as of June 2017 (for testing coverage restoration) and its current coverage maps as submitted for the BDC (for both coverage restoration and 4G-LTE and 5G-NR testing), regardless of whether there are enough drivable roads in the hex-8. If the provider chooses to conduct drive testing only, hex-8s that do not have enough drivable roads will be excluded. For both drone testing and drive testing, we will randomly select one child hex-9 as the testing location within the hex-8.

#### III. SAMPLING FRAME

Before we can select random hex-8s for drive or drone testing, we will need to prepare a list of all hex-8s that are eligible for selection. This list is called the sampling frame. We will construct separate sampling frames based on region, service provider, and technology. We will also distinguish the frames for testing coverage restoration ("restoration frame") and for testing new 4G-LTE or 5G-NR coverage ("supported construction frame"), if any. In cases where a provider has built both 4G-LTE and 5G-NR networks, we will take the union of the areas covered by these two networks and consider it as the single supported construction frame. If the restoration frame and the testing frame intersect for the same provider and technology, we will divide both the restoration frame and the supported construction testing frame into

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<sup>44</sup> See, e.g., *Establishing the Digital Opportunity Data Collection*, Order, 37 FCC Rcd 3007, Appx. A (WTB/OEA/OET Mar. 9, 2022) (*BDC Mobile Requirements Order*) (establishing statistical methodologies for drive testing used for the verification of wireless service providers' mobile networks).

<sup>45</sup> Uber H3 hexagons are an open-source geospatial indexing system developed by Uber Technologies, Inc. It utilizes a nesting cell structure, such that a larger hexagon, or a "parent" fits approximately 7 of the next size smaller hexagons, or "children" within it. See Isaac Brodsky, *H3: Uber's Hexagonal Hierarchical Spatial Index*, (June 27, 2018), <https://eng.uber.com/h3/>.

<sup>46</sup> For reference, hex-8s are approximately 0.74 sq. km. and hex-9s are approximately 0.11 sq. km. in size.

two parts: (1) the part that does not include the intersection with the other frame; and (2) the intersection with the other frame.

We construct the sampling frames so that the geographic areas covered by the hex-8s therein take into account mergers and acquisitions that have occurred since the 2017 hurricanes. In other words, if a provider servicing Puerto Rico or the U.S. Virgin Islands acquired another provider also serving some of the same area, the frame for the testing of coverage restoration will be the combined coverage of the 2017 FCC Form 477 filings of both providers, at the highest technology for any given location.

#### IV. SAMPLE DESIGN AND SAMPLE SIZE CALCULATION

We will use simple random sampling and calculate the minimum sample size for the coverage restoration frame using the standard formula for estimating a proportion or rate. The sample size formula is given by:<sup>47</sup>

$$n = \frac{z_{\alpha}^2 p (1 - p)}{\delta^2}$$

The formula requires three parameters:

- an assumed value,  $p$ , for the proportion of covered areas that met or exceeded the minimum download and upload requirements before the hurricanes (the “status quo”);
- an absolute margin of error,  $\delta$ ; and
- a critical value,  $z_{\alpha}$ , corresponding to a desired confidence interval.<sup>48</sup>

For our purpose, we will set the values of these parameters as follows:

- $p = 0.95$ ;
- $\delta = 0.03$ ; and
- $z_{\alpha} = 1.645$  (corresponding to a one-sided 95% confidence interval)<sup>49</sup>

With these parameter values, the sample size is:

$$n = \frac{z_{\alpha}^2 p (1 - p)}{\delta^2} = \frac{1.645^2 \times 0.95 \times (1 - 0.95)}{0.03^2} = 143$$

We will determine the sample size for the supported construction frame based on the size of the intersection between the restoration frame and the supported construction frame.

For providers subject to testing on both coverage restoration and supported construction, we will select the coverage restoration sample proportionally from the hex-8s both inside and outside the intersection of the coverage restoration and supported construction frames. For example, if 25% of the coverage restoration frame intersects the supported construction frame, then 25% of the coverage restoration sample would be drawn from the intersection and 75% of the sample would be drawn from the complement. If the number of hex-8s drawn from the intersection is greater than 30, we will then use the selection from the intersection as the complete sample from the supported construction frame. If fewer than 30 hex-8s were selected from the intersection, we will select additional hex-8s until the total sample

<sup>47</sup> William G. Cochran, *Sampling Techniques*, ch. 4 (3d ed. 1977).

<sup>48</sup> As noted in section I, only the point estimate will be used to evaluate compliance with the program’s requirements. We specify these three parameters for the purpose of calculating the appropriate sample size.

<sup>49</sup> The value  $p = 0.95$  is derived from the Wireless Benchmarking Project: Puerto Rico and US Virgin Islands, which is the most reliable, independent source of information on the status quo for broadband service in these areas. We will be using this value for all providers. The values  $\delta = 0.03$  and  $z_{\alpha} = 1.645$  for a 95% confidence interval are typical values used in general-purpose simple random sample designs.

for the supported construction frame is at least 30.<sup>50</sup> In this way, selecting from the intersection will reduce the burden on the providers subject to testing on both coverage restoration and supported construction.

## V. DRIVE TESTING/DATA COLLECTION

We require service providers to perform two tests in a single randomly selected hex-9 within a hex-8. For drive testing only, the hex-9 must contain at least 200 meters of covered roads with the following TIGER classifications: S1100, S1200, and S1400.<sup>51</sup>

Service providers must perform one mobile and one stationary test in each selected hex-9. In the unlikely event that a selected hex-8 has no eligible hex-9s, we will instead produce a proxy hex-8 as a replacement for providers to test. This hex-8 will be the unselected hex-8 that is nearest to the selected hex-8 and contains eligible hex-9s. Consistent with the rest of this methodology, this proxy hex-8 will have a randomly selected child hex-9 for providers to test.

Providers may have already commenced testing prior to the publication of this methodology, including in some areas that would be randomly selected for testing. In order to prevent providers from revisiting areas they have already tested, it will be possible in some cases for providers to use these previously collected data as part of this testing. Providers will have the option of submitting the complete set of tests they have already performed within the selected hex-8s and hex-9s in lieu of retesting these locations. The Bureau will evaluate the first two valid test results, ordered chronologically. To be considered valid, a prior test performed by the provider must a) have occurred within the 12 months prior to the January 30, 2024 deadline for submission of the final milestone test results, b) must align with the sample provided by OEA, and c) must meet the data specifications described in Appendix C.

Additionally, some hexes will be selected for more than one frame; in other words, the hexes will be tested for both the restoration testing and the supported construction testing. In this case, the results of a single pair of tests can be used for both the restoration testing and the 4G-LTE/5G-NR testing. If, for example, a provider demonstrates that it has 5G-NR service with at least 35/3 speeds in a hex-8, then it would necessarily have demonstrated that it has restored service in the same hex-8, and not need to conduct additional testing. Similarly, if a provider tested for 5G-NR and found speeds less than 35/3, but greater than or equal to its reported speeds in June 2017, it would pass for the restoration coverage testing even if it failed the 5G-NR supported construction testing in the same area. In this manner we hope to reduce burden on providers so that they are less likely to need to conduct multiple tests for the same area. Note, however, that the 4G-LTE and 5G-NR networks have separate requirements. Accordingly, in areas with this funding overlap where the recipient constructed networks, it is possible that the same hexagon will be selected for both. In this case, a successful 5G-NR test would not necessarily demonstrate that the LTE network also passed, and separate testing is required of the LTE network.

## VI. COVERAGE ESTIMATION

We propose that a sampled hex-8 will have passed the restoration testing if: (1) both tests have positive measurements, in other words, speed tests that are greater than 0 for both download and upload, of a technology (2G, 3G, 4G-LTE, 5G-NR) of at least the newest generation represented in the provider's June 2017 FCC Form 477 submission that covered the centroid of the selected hex-8; and (2) at least one test

---

<sup>50</sup> In the unlikely event that the supported construction frame contains 30 or fewer hex-8s, we will select every hex-8 for testing.

<sup>51</sup> Note, however, that a test need only begin in the selected hex-9. A provider does not need to confine itself to testing only in the hex-9 areas here described if it determines that such restrictions would not be possible for its testers.

measuring at least the greatest minimum upload and download speeds as reported in the provider's June 2017 FCC Form 477 filing that covered the centroid of the selected hex-8.<sup>52</sup> For the supported construction testing, a sampled hex-8 will have passed if: (1) both tests have positive measurements of the given technology (i.e., 4G-LTE or 5G-NR); and (2) at least one test measuring at least 10 Mbps download, 1 Mbps upload and a maximum latency of 100 milliseconds in the case of 4G-LTE testing, or at least 35 Mbps download, 3 Mbps upload, and a maximum 100 milliseconds latency in the case of 5G-NR. Passing hex-8s will be assigned a value of 1; failing hex-8s will be assigned a value of 0.

We will estimate the prevalence of restored coverage,  $\hat{p}_r$  and the prevalence of supported coverage  $\hat{p}_s$  as the proportion of passing hex-8s relative to the number of sampled hex-8s from the respective frames.

$$\hat{p}_r = \frac{k_r}{n_r}$$

Where  $k_r$  is the total number of passing hex-8s, and  $n_r$  is the number of sampled hex-8s for coverage restoration testing.

$$\hat{p}_s = \frac{k_s}{n_s}$$

Where  $k_s$  is the total number of passing hex-8s, and  $n_s$  is the number of sampled hex-8s for coverage supported construction testing.

## VII. TESTING EVALUATION

We will use the point estimates of  $\hat{p}_r$  and  $\hat{p}_s$  obtained in Section VI of this Appendix as our estimate of the coverage rates of hex-8s covered in both 2017 and today. Additionally, when evaluating restored coverage, we will account for any hex-8s that were not covered in both 2017 and the current coverage by multiplying  $\hat{p}_r$  by the ratio of the number of hex-8s in the restored coverage frame and in the FCC Form 477 2017 coverage. The percentage of locations with restored or improved coverage and the percentage of locations with supported coverage are represented by the following equations:

$$\% \text{ of Restored Coverage} = \widehat{\hat{p}}_r \left( \frac{\# \text{ of Hexagons in Restoration Sample Frame}}{\text{Total Covered Hexagons in June 2017}} \right)$$

$$\% \text{ of Supported Coverage} = \hat{p}_s$$

<sup>52</sup> For example, a provider may have shown both 2G and 3G coverage in the centroid of a hex-8 in 2017, with 3G speeds at a minimum download of 1 Mbps and a minimum upload of 0.5 Mbps. The provider would get credit for covering this hex if both tests demonstrated coverage at 3G or newer technologies (i.e. LTE or 5G), and if at least one of the tests demonstrated speeds of at least 1 Mbps download and 0.5 Mbps upload.

## APPENDIX C

## Mobile Speed Test Data Specifications

**1. Overview**

The verification of the restoration of network coverage in Puerto Rico and the U.S. Virgin Islands requires providers to conduct and report speed tests of their networks. If a provider uses the methodology described in this Public Notice and appendices, it should follow the instructions presented in Appendix B that describe the methodology for the restoration and data collection and the format in which it is to be reported. In this Appendix C, we specifically describe the data structure for the submission of mobile speed test data..

**2. Sample Data**

```
{
  "submission_type": "Provider Response",
  "submissions": [
    {
      "test_id": "1599236609",
      "device_type": "Android",
      "manufacturer": "Google",
      "model": "PIXEL 6",
      "operating_system": "Android 12",
      "device_tac": "35142059",
      "app_name": "FCC Speed Test app",
      "app_version": "2.0.4058",
      "provider_name": "T-Mobile",
      "tests": {
        "download": {
          "timestamp": "2023-11-08T09:02:42-08:00",
          "warmup_duration": 3000622,
          "warmup_bytes_transferred": 31900808,
          "duration": 4997185,
          "bytes_transferred": 97382448,
          "bytes_sec": 19487461,
          "locations": [
            {
              "timestamp": "2023-11-08T09:02:42-08:00",
              "latitude": 18.470820,
              "longitude": -66.123860,
              "horizontal_accuracy": 2.0,
              "speed": 0,
              "speed_accuracy": 1.0
            },
            {
              "timestamp": "2023-11-08T09:02:47-08:00",
              "latitude": 18.470820,
              "longitude": -66.123860,
              "horizontal_accuracy": 2.0,
              "speed": 0,
              "speed_accuracy": 1.0
            }
          ]
        }
      }
    }
  ]
}
```

```
}
],
"cells": [
  {
    "cell_id": 32193025,
    "physical_cell_id": 192,
    "cell_connection": 1,
    "network_generation": "4G",
    "network_subtype": "LTE",
    "rssi": -77.1,
    "rsrp": -95.2,
    "rsrq": -16.5,
    "sinr": 11.9,
    "ec_io": -8.3,
    "rcsp": -84.2,
    "cqi": 10,
    "spectrum_band": 66,
    "spectrum_bandwidth": 20,
    "arfcn": 66786
  },
  {
    "cell_id": 10283265,
    "physical_cell_id": 101,
    "cell_connection": 2,
    "network_generation": "4G",
    "network_subtype": "LTE",
    "rssi": -77.1,
    "rsrp": -97.2,
    "rsrq": -10.1,
    "sinr": 21.2,
    "ec_io": -8.3,
    "rcsp": -84.2,
    "cqi": 10,
    "spectrum_band": 71,
    "spectrum_bandwidth": 15,
    "arfcn": 68686
  }
],
"success_flag": true
},
"upload": {
  "timestamp": "2023-11-08T09:02:51-08:00",
  "warmup_duration": 3000213,
  "warmup_bytes_transferred": 8337402,
  "duration": 5000085,
  "bytes_transferred": 15129062,
  "bytes_sec": 3025761,
  "locations": [
    {
      "timestamp": "2023-11-08T09:02:51-08:00",
      "latitude": 18.470820,
```

```
"longitude": -66.123860,
"horizontal_accuracy": 2.0,
"speed": 0,
"speed_accuracy": 1.0
},
{
"timestamp": "2023-11-08T09:02:56-08:00",
"latitude": 18.470820,
"longitude": -66.123860,
"horizontal_accuracy": 2.0,
"speed": 0,
"speed_accuracy": 1.0
}
],
"cells": [
{
"cell_id": 32193025,
"physical_cell_id": 192,
"cell_connection": 1,
"network_generation": "4G",
"network_subtype": "LTE",
"rssi": -77.1,
"rsrp": -96.2,
"rsrq": -9.1,
"sinr": 10.5,
"ec_io": -8.3,
"rcsp": -84.2,
"cqi": 10,
"spectrum_band": 66,
"spectrum_bandwidth": 20,
"arfcn": 66786
},
{
"cell_id": 35988099,
"physical_cell_id": 192,
"cell_connection": 2,
"network_generation": "4G",
"network_subtype": "LTE",
"rssi": -71.1,
"rsrp": -99.1,
"rsrq": -6.9,
"sinr": 9.7,
"ec_io": -8.3,
"rcsp": -84.2,
"cqi": 10,
"spectrum_band": 41,
"spectrum_bandwidth": 20,
"arfcn": 39874
}
],
"success_flag": true
```



```

    }
  }
}
]
}

```

### 3. Mobile Speed Test Data

This section details the data structure common for all mobile speed test data in the Puerto Rico and U.S. Virgin Islands restoration. This file contains records of each mobile speed test in JavaScript Object Notation (JSON) format matching the specification in the table and sections below:

Field	Data Type	Example	Description / Notes
<b>submission_type</b>	Enumerated	Provider Response	Type of data submission. - <i>Value must be "Provider Response".</i>
<b>submissions</b>	Array [Submission Object]		List of drive-test data submissions. <i>Note: the specification for the Submission Object is described in <b>Section a</b>.</i>

#### a. Submission Object

Field	Data Type	Example	Description / Notes
<b>test_id</b>	String	1599236609	Unique identifier used by the app or entity to differentiate tests. - <i>Value must be unique across all data submitted by the same entity.</i>
<b>device_type</b>	Enumerated	Android	Type of device. - <i>Value must be "Android".</i>
<b>manufacturer</b>	String	Google	Name of the device manufacturer.
<b>model</b>	String	PIXEL 6	Name of the device model.
<b>operating_system</b>	String	Android 12	Name and version of the device operating system.
<b>device_tac</b>	String	35142059	8-digit Type Allocation Code of the device. - <i>Value may be null if the device does not return a valid value or else returns a value of unknown.</i>
<b>app_name</b>	String	FCC Speed Test app	Name of the mobile speed test app.
<b>app_version</b>	String	2.0.4058	Version of the mobile speed test app.
<b>provider_name</b>	String	T-Mobile	Name of the mobile service provider.
<b>tests</b>	Test Object		Information about the test metrics. <i>Note: the specification for the Test Object is described in <b>Section b</b>.</i>

#### b. Test Object

Field	Data Type	Example	Description / Notes
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Field	Data Type	Example	Description / Notes
<b>download</b>	Download Test Object		Information about the download test metric. <i>Note: the specification for the Download Test Object is described in <b>Section c</b>.</i>
<b>upload</b>	Upload Test Object		Information about the upload test metric. <i>Note: the specification for the Upload Test Object is described in <b>Section d</b>.</i>

### c. Download Test Object

Field	Data Type	Example	Description / Notes
<b>timestamp</b>	Datetime	2023-11-08T09:02:42-08:00	Timestamp of the time at which the test metric commenced. <i>- Value must match valid ISO-8601 format, including seconds and timezone offset, i.e.: YYYY-MM-DD[T]hh:mm:ss±hh:mm</i>
<b>warmup_duration</b>	Integer	3000622	Duration in microseconds that connection took to stabilize (e.g., TCP slow start) before the test metric commenced.
<b>warmup_bytes_transferred</b>	Integer	31900808	Measured total amount of data in bytes that were transferred during the period the connection took to stabilize (e.g., TCP slow start) before the test metric commenced.
<b>duration</b>	Integer	4997185	Duration that the test metric took to complete in microseconds.
<b>bytes_transferred</b>	Integer	97382448	Measured total amount of data in bytes that the test metric transferred.
<b>bytes_sec</b>	Integer	19487461	Measured number of bytes per second that the test metric transferred.
<b>locations</b>	Array [Location Object]		List of geographic coordinates of the locations measured during the speed test. <i>Note: the specification for each Location Object element is described in <b>Section e</b>.</i>
<b>cells</b>	Array [Cell Object]		List of cellular telephony information measured during the speed test. <i>- Value may be null or an empty array if the test fails (i.e., success_flag is False). Note: the specification for each Cell Object element is described in <b>Section f</b>.</i>
<b>success_flag</b>	Boolean	True	Boolean flag indicating whether the test completed successfully and without a change in state or connectivity.

#### d. Upload Test Object

Field	Data Type	Example	Description / Notes
<b>timestamp</b>	Datetime	2023-11-08T09:02:51-08:00	Timestamp of the time at which the test metric commenced. - Value must match valid ISO-8601 format, including seconds and timezone offset, i.e.: YYYY-MM-DD[T]hh:mm:ss±hh:mm
<b>warmup_duration</b>	Integer	3000213	Duration in microseconds that connection took to stabilize (e.g., TCP slow start) before the test metric commenced.
<b>warmup_bytes_transferred</b>	Integer	8337402	Measured total amount of data in bytes that were transferred during the period the connection took to stabilize (e.g., TCP slow start) before the test metric commenced.
<b>duration</b>	Integer	5000085	Duration that the test metric took to complete in microseconds.
<b>bytes_transferred</b>	Integer	15129062	Measured total amount of data in bytes that the test metric transferred.
<b>bytes_sec</b>	Integer	3025761	Measured number of bytes per second that the test metric transferred.
<b>locations</b>	Array [Location Object]		List of geographic coordinates of the locations measured during the speed test. <i>Note: the specification for each Location Object element is described in Section e.</i>
<b>cells</b>	Array [Cell Object]		List of cellular telephony information measured during the speed test. - Value may be null or an empty array if the test fails (i.e., success_flag is False). <i>Note: the specification for each Cell Object element is described in Section f.</i>
<b>success_flag</b>	Boolean	True	Boolean flag indicating whether the test completed successfully and without a change in state or connectivity.

#### e. Location Objects

Each element of the “locations” array contains the geographic coordinates of the locations measured at the start and end of the speed test, as well as during the test (if measured).

Field	Data Type	Example	Description / Notes
<b>timestamp</b>	Datetime	2023-11-08T09:02:58-08:00	Timestamp of the time at which the location was recorded. - Value must match valid ISO-8601 format, including seconds and timezone offset, i.e.: YYYY-MM-DD[T]hh:mm:ss±hh:mm

Field	Data Type	Example	Description / Notes
<b>latitude</b>	Numeric	18.470820	Unprojected (WGS-84) geographic coordinate latitude in decimal degrees of the reported location where the test was conducted. - Value must have minimum precision of 6 decimal places.
<b>longitude</b>	Numeric	-66.123860	Unprojected (WGS-84) geographic coordinate longitude in decimal degrees of the reported location where the test was conducted. - Value must have minimum precision of 6 decimal places.
<b>horizontal_accuracy</b>	Numeric	2.0	Horizontal accuracy of the location, radial, in meters measured from the device. - Value may be null if the device does not return a valid value or else returns a value of unknown.
<b>speed</b>	Numeric	0	Speed in meters per second measured from the device. - Value may be null if the device does not return a valid value or else returns a value of unknown.
<b>speed_accuracy</b>	Numeric	1.0	Speed accuracy in meters per second measured from the device. - Value may be null if the device does not return a valid value or else returns a value of unknown.

#### f. Cell Objects

Each element of the “cells” array contains telephony information about the cell / carrier.

Field	Data Type	Example	Description / Notes
<b>timestamp</b>	Datetime	2023-11-08T09:02:42-08:00	Timestamp of the time at which the cell information was measured. - Value must match valid ISO-8601 format including seconds and timezone offset, i.e.: YYYY-MM-DD[T]hh:mm:ss±hh:mm
<b>cell_id</b>	Numeric	32193025	Measured cell identifier. - Value may be null if the device does not return a valid value or else returns a value of unknown.
<b>physical_cell_id</b>	Integer	192	Measured Physical Cell Identity (PCI) of the cell. - Value is only required for tests with a network generation of 4G or 5G and must be null for all other network generations.
<b>cell_connection</b>	Enumerated	1	Connection status of the cell. - Value must be one of the following codes: 0 – Not Serving 1 – Primary Serving

Field	Data Type	Example	Description / Notes
			2 – Secondary Serving - Value may be null if the device does not return a valid value or else returns a value of unknown.
<b>network_generation</b>	Enumerated	4G	String representing the network generation of the cell. - Value must be one of the following: {2G 3G 4G 5G Other}
<b>network_subtype</b>	Enumerated	LTE	String representing the network subtype of the cell. - Value must be one of the following: {1X EVDO WCDMA GSM HSPA HSPA+ LTE NRSA NRNSA}
<b>rsi</b>	Decimal	-57.2	Measured Received Signal Strength Indication (RSSI) in dBm of the cell. - Value is required for all network generations and subtypes.
<b>rxlev</b>	Decimal	-80.2	Measured Received Signal Level in dBm of the cell. - Value is only required for tests with a network generation of 2G and network subtype of GSM, and must be null for all other network generations or network subtypes.
<b>rsrp</b>	Decimal	-92.1	Measured Reference Signal Received Power (RSRP) in dBm of the cell. - Value is only required for tests with a network generation of 4G or 5G and must be null for other network generations. - Note: this value represents the Synchronization Signal (SS) for 5G-NR tests and the Channel-specific Reference Signal (CRS) for 4G LTE tests.
<b>rsrq</b>	Decimal	-12.5	Measured Reference Signal Received Quality (RSRQ) in dB of the cell. - Value is only required for tests with a network generation of 4G or 5G and must be null for other network generations. - Note: this value represents the Synchronization Signal (SS) for 5G-NR tests and the Channel-specific Reference Signal (CRS) for 4G LTE tests.
<b>sinr</b>	Decimal	21.3	Measured Signal to Interference and Noise Ratio (SINR) in dB of the cell. - Value is only required for tests with a network generation of 4G or 5G and may be null for other network generations. - Note: this value represents the Synchronization Signal (SS) for 5G-NR tests and the Channel-specific Reference Signal (CRS) for 4G LTE tests.
<b>rxqual</b>	Integer	3	Measured Received Signal Quality of the cell

Field	Data Type	Example	Description / Notes
			<ul style="list-style-type: none"> <li>- Value must be between 0 and 7.</li> <li>- Value is only required for tests with a network generation of 2G and network subtype of GSM, and must be null for all other network generations or network subtypes.</li> </ul>
<b>ec_io</b>	Decimal	-8.3	<p>Measured Energy per Chip to Interference Power Ratio in dB of the cell.</p> <ul style="list-style-type: none"> <li>- Value is only required for CDMA 1X, EVDO, WCDMA, HSPA, and HSPA+ network subtypes, and must be null for all other network subtypes.</li> </ul>
<b>rscp</b>	Decimal	-87.2	<p>Measured Received Signal Code Power in dBm of the cell.</p> <ul style="list-style-type: none"> <li>- Value is only required for WCDMA, HSPA, and HSPA+ network subtypes, and may be null for all other network subtypes.</li> </ul>
<b>cqi</b>	Integer	11	<p>Measured Channel Quality Indicator (CQI) of the cell.</p> <ul style="list-style-type: none"> <li>- Value is only required for WCDMA, HSPA, HSPA+, LTE, and NR network subtypes, and may be null for all other network subtypes.</li> </ul>
<b>spectrum_band</b>	Integer	66	<p>Spectrum band used by the cell.</p> <ul style="list-style-type: none"> <li>- Value may be null for tests with a network generation of 2G or 3G.</li> <li>- Value may be null if the device does not return a valid value or else returns a value of unknown.</li> <li>- Note: the reported band value corresponds to the Operating Bands tables as follows: <ul style="list-style-type: none"> <li>- 4G LTE: 3GPP TS 36.101 section 5.5</li> <li>- 5G-NR: 3GPP TS 38.101 table 5.2-1</li> </ul> </li> </ul>
<b>spectrum_bandwidth</b>	Numeric	15	<p>Total amount of spectral bandwidth used by the cell in MHz.</p> <ul style="list-style-type: none"> <li>- Value may be null if the device does not return a valid value or else returns a value of unknown.</li> </ul>
<b>arfcn</b>	Integer	66786	<p>Absolute radio-frequency channel number, measured absolute physical RF channel number of the cell.</p>