

# OET Bulletin

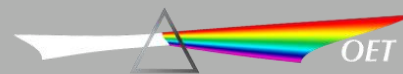
OFFICE OF ENGINEERING AND TECHNOLOGY

FEDERAL COMMUNICATIONS COMMISSION

## **Broadband Data Collection Program: Third-Party Speed Test Mobile Application Approval Process Guidance**



**April 14, 2022**



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## 1. Introduction

In this Bulletin, the Office of Engineering and Technology (OET) of the Federal Communications Commission (FCC or Commission) provides guidance on the approval process for third-party mobile speed test applications (third-party apps) that consumers, governmental entities, and other third-party entities may use to submit data for the Broadband Data Collection (BDC) mobile challenge and crowdsource processes.

In 2020, Congress adopted the Broadband Deployment Accuracy and Technological Availability Act (Broadband DATA Act),<sup>1</sup> in which, among other things, it directed the Commission to “establish a user-friendly challenge process through which consumers, State, local, and Tribal governmental entities, and other entities or individuals may submit coverage data to the Commission” to challenge either the coverage maps created pursuant to the Broadband DATA Act or the underlying broadband availability data forming the basis of the coverage maps.<sup>2</sup> In its *Third Report and Order* in the BDC proceeding, the Commission required consumers to submit speed test data to support their challenges to mobile broadband coverage data,<sup>3</sup> and, in order “[t]o ensure that consumer challenge data meet necessary reporting requirements, . . . require[d] consumers to use a speed test application that has been approved by OET, in consultation with the Office of Economics and Analytics (OEA) and the Wireless Telecommunications Bureau (WTB), for use in the challenge process.”<sup>4</sup> The *Third Report and Order* included categories of information that all speed test applications must automatically collect, and it directed OET to approve third-party apps that can collect these necessary data elements and that include other minimum functionalities adopted by the Commission.<sup>5</sup> Third-party apps may also include, as an add-on feature to the challenge process, functionality to allow consumers to submit to the Commission crowdsourced mobile coverage data.<sup>6</sup> Any speed test data submitted from approved third-party apps must contain all of the specified metrics and parameters for the challenge process including crowdsource process if implemented.<sup>7</sup>

Requirements for third-party speed test apps have been established in the *Second Report and Order and Third Notice of Further Proposed Rulemaking*,<sup>8</sup> the *Third Report and Order*<sup>9</sup>, the *Mobile Technical*

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<sup>1</sup> Broadband Deployment Accuracy and Technological Availability Act, Pub. L. No. 116-130, 134 Stat. 228 (2020) (codified at 47 U.S.C. §§ 641-646) (Broadband DATA Act).

<sup>2</sup> 47 U.S.C. § 642(b)(5)(A).

<sup>3</sup> *Establishing the Digital Opportunity Data Collection; Modernizing the FCC Form 477 Data Program*, WC Docket Nos. 11-10 & 19-195, Third Report and Order, 36 FCC Rcd 1126, 1166, para. 102 (2021) (*Third Report and Order*).

<sup>4</sup> *Id.* at 1166, para. 103. Governmental agencies and other entities may use (but are not required to use) a Commission-approved speed test application when submitting speed-test data in support of their challenges. *Id.* at 1171-72, paras. 116-17.

<sup>5</sup> *Id.* at 1166-67, paras. 103-04.

<sup>6</sup> *Establishing the Digital Opportunity Data Collection*, WC Docket No. 19-195, Order, DA 22-241, 2022 WL 743185, at \*48, para. 122 (2022) (*Mobile Technical Requirements Order*).

<sup>7</sup> See *Mobile Technical Requirements Order* at \*7, para. 18 & n.73.

<sup>8</sup> *Establishing the Digital Opportunity Data Collection; Modernizing the FCC Form 477 Data Program*, WC Docket Nos. 19-195 & 11-10, Second Report and Order and Third Further Notice of Proposed Rulemaking, 35 FCC Rcd 7460 (2020) (*Second Order and Third Further Notice*).

<sup>9</sup> *Third Report and Order*, 36 FCC Rcd 1126.

*Requirements Order*,<sup>10</sup> the *BDC - Data Specifications for Mobile Speed Test Data*,<sup>11</sup> and the *Third-Party Mobile Speed Test App Public Notice*<sup>12</sup> to implement the mobile challenge requirements of the Broadband DATA Act. This Bulletin is intended to provide additional guidance to third-party app developers that seek to submit proposals for approval of a speed-test application, by describing OET’s substantive review process and the criteria established by the Commission to evaluate a speed test app’s proposed design, architecture, and methodology.<sup>13</sup> All proposals should provide, at a minimum, responses to each requirement in Appendix A of the *Third-Party Mobile Speed Test App Public Notice* entitled “Template for Third-Party App Proposals” (Template). Sections 3 and 4 of this Bulletin provide additional guidance. To be clear, the requirements should be answered by Third-party app developers may also supplement their proposals with speed test results based either on their own preferred testing procedure or on OET’s third-party app review procedure outlined in Appendix A, attached hereto. Certain defined terms as used in this Bulletin are included in Appendix B, attached hereto. OET may supplement or amend the guidance provided in this Bulletin, subject to providing public notice that it has published a revised version of the Bulletin.

## 2. Notional Test System Architecture

In this notional test system architecture, all approved third-party apps will be able to collect data using a set of geographically distributed measurement servers.<sup>14</sup> For the data-collection process, end users will be able to download the third-party app on their Android or iOS mobile device via the respective app store to perform connection speed measurements on the mobile broadband network to which they subscribe (i.e., mobile service provider).

If the connection is over the end user’s subscribed mobile network, then the test is eligible for either challenge or crowdsourcing submissions.<sup>15</sup> If the connection is over a roaming mobile network or the end

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<sup>10</sup> *Mobile Technical Requirements Order*.

<sup>11</sup> *Broadband Data Task Force and Office of Economics and Analytics Publish Additional Data Specifications for the Submission of Mobile Speed Test and Infrastructure Data into the Broadband Data Collection*, Public Notice, DA 22-242, at 1 (OEA Mar. 9, 2022); see also FCC, *Broadband Data Collection Data Specifications for Mobile Speed Test Data* (2022), <https://us-fcc.app.box.com/v/bdc-mobile-speedtest-spec> (*BDC - Data Specifications for Mobile Speed Test Data*).

In the *Mobile Technical Requirements Order*, OEA, WTB, and OET stated that they “require on-the-ground challenge test data to include all other metrics required per the most recent specification for mobile test data.” *Mobile Technical Requirements Order* at \*7, para. 18 (“Finally, we require on-the-ground challenge test data to include all other metrics required per the most recent specification for mobile test data . . . .”); *id.* at \*7, para. 18 n.73 (stating that “[t]he specification for speed test data includes additional fields derived from the high-level metrics defined herein, as well as other identifiers to facilitate management of the submission of such data”).

<sup>12</sup> *Broadband Data Task Force and Office of Engineering and Technology Announce Procedures for Third-Party Mobile Speed Test Applications Seeking Approval for Use in the FCC’s Broadband Data Collection*, Public Notice, DA 22-408 (OET Apr. 14, 2022) (*Third-Party Mobile Speed Test App Public Notice*).

<sup>13</sup> To the extent any inconsistencies arise between this Bulletin and the aforementioned Commission or Commission staff orders and Public Notice, the rules and Orders and Public Notice will control.

<sup>14</sup> *Mobile Technical Requirements Order* at \*10, para. 26 (determining that “speed test apps [must] use multiple servers that are geographically diverse”).

<sup>15</sup> *Third Report and Order*, 36 FCC Rcd at 1167, para. 104 (“Approved speed test applications also must require users submitting challenges to certify that the user is the subscriber or authorized user of the provider being challenged . . . .”).

user is a customer of an MVNO (Mobile Virtual Network Operator), then the test is eligible for crowdsource submissions only.<sup>16</sup> The third-party app may notify the end user to turn on the mobile connection and/or turn off the non-mobile (e.g., Wi-Fi) connection prior to a measurement test for purposes of collecting and submitting either challenge or crowdsource data.<sup>17</sup>

The test system architecture is defined as “[a] system architecture view that shows, at a high level, the measurement client, measurement server, and any other pertinent system components in the third-party app developer’s core infrastructure.”<sup>18</sup> The measurement client derives and records certain metrics based on a traffic payload exchanged between the measurement client and a measurement server. The system architecture for the third-party app will include multiple geographically dispersed measurement servers<sup>19</sup> that will be located outside the mobile service provider’s network (off-net servers) to ensure unbiased measurements.<sup>20</sup> The measurement client will first identify and select an optimal measurement server that may not be the geographically closest server from the measurement client. As a result, the metrics will measure the network performance along a specific path within each mobile broadband provider’s network, through the point of interconnection between the mobile broadband provider’s network and the network on which the chosen measurement server resides.<sup>21</sup>

The third-party app will be able to collect data throughout the United States or for a limited geographic area using a set of geographically distributed test servers (measurement servers) that are statistically sound in proportion to the user base and minimize the impact of latency for each test.<sup>22</sup> Due to the bursty nature of the Internet and its traffic congestion dynamics, the measurement client will consider multiple measurement servers to select an optimal measurement server and conduct a complete test sequence. Each measurement server will monitor its traffic rate at a reasonable interval to maintain the servers’ optimal utilization and availability rates to support server provisioning.

As illustrated below in Figure 1, the end user will execute a test sequence via the third-party app installed on a mobile device to accurately measure the network performance of the mobile broadband connection. The third-party app will measure and report required data as discussed in Section 3, including download speed, upload speed, and round-trip latency by exchanging network traffic with the selected measurement server.

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<sup>16</sup> See *Mobile Technical Requirements Order* at \*12, para. 30.

<sup>17</sup> *Id.* at \*11, para. 27 (explaining validation criteria for speed tests, including that the BDC system will compare speed tests for a particular mobile network technology to the coverage maps for the corresponding technology or higher-generation technology).

<sup>18</sup> See *infra* Appx. B.

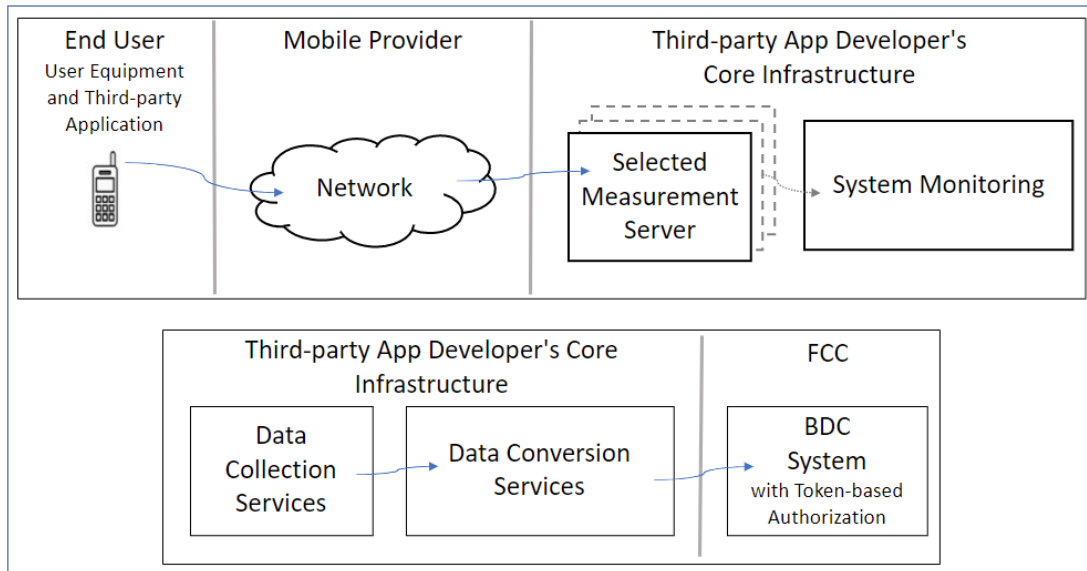
<sup>19</sup> See *Mobile Technical Requirements Order* at \*11, para. 26 (determining that “speed test apps [must] use multiple servers that are geographically diverse”).

<sup>20</sup> *Id.* at \*47, para. 120 (finding that “the FCC Speed Test app is designed to minimize bias in test results” because its “test system architecture implements dedicated off-net servers hosted by a Content Delivery Network (CDN) to provide robust and reproducible test results for effective representation of network performance”).

<sup>21</sup> *Id.* at \*7, \*11, paras. 18, 26.

<sup>22</sup> *Id.* at \*10, para. 26 (“We [ ] agree with commenters who recommend requiring speed test apps to use multiple servers that are geographically diverse . . . . The FCC Speed Test app’s test servers are overprovisioned based upon statistics of the utilization rate and usage pattern, which are automatically monitored for the highest system availability, to maintain the optimal connectivity rate. A utilization rate of 80% or more is classified as a critical state and triggers the provisioning of new servers to stabilize load across the platform.”).

Figure 1: Notional System Architecture



Upon completion of the test sequence, the third-party app will report measurement results and other required data to the Data Collection Services component of the third-party app developer's core infrastructure, as further illustrated in Figure 1. Then, the Data Conversion Services component (or functional equivalent) will validate, transform, and structure the collected data into the JavaScript Object Notation (JSON) format, per the instructions defined in *BDC - Data Specifications for Mobile Speed Test Data*<sup>23</sup> before the third-party app developer submits the data to the BDC system through an Application Programming Interface (API).

### 3. System Approval Process and Proposal Requirements

The third-party app approval process requires that the third-party app developer's system be able to accurately measure and capture the metrics of the tested mobile broadband network according to the requirements established by the Commission. Accordingly, OET will follow a multistep process to approve third-party apps. As part of the process, the third-party app developer must submit a proposal that provides evidence of how it meets the requirements summarized further below. In addition, the third-party app developer must provide to the Commission and the public, as applicable, one of the following three options for review and public comment:

- A production version of the third-party app via the appropriate app store (e.g., Google Play or Apple App Store);<sup>24</sup>
- A beta version via Google Play Console, Apple TestFlight, or similar media;<sup>25</sup> or
- Detailed wireframes depicting the planned user interface for the third-party app, along with actual test data results and a detailed speed test measurement methodology description to enable OET staff and the public to confirm that the underlying testing methodology meets the minimum

<sup>23</sup> See, e.g., FCC, Broadband Data Collection Data Specifications for Mobile Speed Test Data <https://us-fcc.app.box.com/v/bdc-mobile-speedtest-spec> (*BDC - Data Specifications for Mobile Speed Test Data*).

<sup>24</sup> *Third-Party Mobile Speed Test App Public Notice*, para. 17.

<sup>25</sup> *Id.*

requirements established by the Commission (this option should only be used if a working version, either the production or beta version, of the third-party app is not available for download).<sup>26</sup>

The third-party app developer must indicate in their proposal how to find/download the app. To the extent a third-party app developer submits only wireframes or a beta version for review, any approval of such proposal by OET will be conditional on the production version of the third-party app's compliance with applicable technical requirements.<sup>27</sup> A third-party app developer whose proposal has been conditionally approved must submit, prior to BDC system registration, the production version of the app for OET's full review and approval.<sup>28</sup> The production version of the app will be designated by OET for use in the challenge and, if implemented, crowdsource processes.<sup>29</sup> Additionally, any deviations in the production version from the submitted wireframes or beta version will be subject to either minor or major (depending on the deviation) change procedures.<sup>30</sup>

We restate below the categories of information and requirements, which have previously been adopted, that third-party app developers must include in their third-party app proposals. The third-party app developer must describe how the proposed third-party app meets all requirements (i.e., those described as "must" or "shall" in this Bulletin and specified in the *Public Notice* released on April 14, 2022<sup>31</sup>). For any third-party app proposal that deviates from these requirements or does not implement recommended practices (i.e., described as "may" or "should" herein), the third-party app developer must (1) explain its reasoning why its particular circumstances warrant a deviation, and (2) show that such a deviation will serve the public interest. Technical requirements for third-party apps, including testing parameters and data metrics, are covered further in Section 4 (Required Testing Parameters and Data Metrics).

OET may also require a third-party app developer to participate in workshops and meetings as part of the review and approval process.<sup>32</sup> A third-party app developer must comply with all instructions from OET and must provide any requested information in a timely manner as a condition of receiving and maintaining approval.<sup>33</sup>

Each proposal seeking approval of a third-party app must include, at a minimum, the information described under the following subsections.<sup>34</sup>

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<sup>26</sup> *Id.*

<sup>27</sup> *Id.*

<sup>28</sup> *Id.*

<sup>29</sup> *Id.*

<sup>30</sup> *Id.*

<sup>31</sup> See generally *Third-Party Mobile Speed Test App Public Notice*.

<sup>32</sup> *Third-Party Mobile Speed Test App Public Notice*, para. 19.

<sup>33</sup> *Id.*

<sup>34</sup> See generally *Third-Party Mobile Speed Test App Public Notice*.

## A. Filer Information

The third-party app developer shall submit the following information for the entity seeking approval:

- (A.1) Entity Legal Name
- (A.2) Business Name (if applicable)
- (A.3) Mailing Address: Street Address, City, State, Zip Code
- (A.4) Third-Party App Name
- (A.5) Third-Party App Version Number

## B. Contact Information

The third-party app developer shall submit the following information for an individual that Commission staff may contact for related inquiries, such as information and data requests or to provide enforcement instructions:

- (B.1) Contact First Name
- (B.2) Contact Last Name
- (B.3) Contact Phone Number
- (B.4) Contact Email Address
- (B.5) Contact Mailing Address: Street Address, City, State, Zip Code

## C. Architecture Description

The third-party app developer shall provide and submit a complete description of (C.1) the proposed test system architecture, (C.2) a technical diagram, and (C.3) the testing methodologies (including test flows and calculations).<sup>35</sup> (C.4) The third-party app developer must indicate whether the third-party app is intended for Android or iOS.

Note: If the third-party app developer has third-party apps for both Android and iOS operating systems, the third-party app developer must submit separate proposals for each third-party app.

(C.5) The third-party app developer must indicate whether it is making the app available for download as part of the proposal.<sup>36</sup>

(C.5.1) If a working version of the app will be made available, the third-party app developer must indicate whether the app is a production or beta version, and provide access information for FCC staff and the public to download and review the app. Furthermore, the third-party app developer may provide their speed test data from testing the app and a description of the test configuration used to capture the speed test measurements.

Note: For a working version, either the production or beta, the third-party app developer has the option to use the overall performance review procedure outlined in Appendix A of this Bulletin for statistical assessment of the app's performance to supplement its third-party app proposal.

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<sup>35</sup> See *Mobile Technical Requirements Order* at \*10, para. 25 (“In their applications, app developers will be required to describe their performance-centric speed test methodologies and how their app complies with the data collection requirements set forth in this *Order*.”).

<sup>36</sup> *Third-Party Mobile Speed Test App Public Notice*, para. 17.



(C.5.2) If a working version of the app is not available, the third-party app developer must submit “wireframes” depicting the planned user interface for the third-party app; the wireframes must depict each screen that a user will see when using the speed test application. Third-party app developers submitting wireframes must also provide the speed test data from testing the app and a detailed speed measurement methodology description, along with actual test data results to demonstrate compliance with the applicable requirements outlined in Sections 3 and 4 of this Bulletin. As a reference, an example of OET’s third-party app performance review procedure is provided in Appendix A of this Bulletin.

(C.6) The third-party app developer shall indicate whether the third-party app is intended for collecting data only for the challenge process or for both the challenge and crowdsourcing processes.

## D. Privacy Notice and End User Consent Requirements

(D.1) The third-party app shall, for both challenge and, if implemented, crowdsource processes, include a brief privacy notice that is displayed to end users at the point of collection<sup>37</sup> that explains how all of the data collected by the app, including personally identifiable information (PII), will be stored, used, and protected consistent with the minimum requirements set forth in applicable privacy and security policies.<sup>38</sup>

(D.2) At a minimum, the privacy notice must disclose that the Commission will make public the coordinates (latitude and longitude), the name of the provider, and relevant details concerning the basis for the challenge, but that individual contact information will not be disclosed.<sup>39</sup>

(D.3) The third-party app developer must describe how the app will obtain required privacy-related consents and must also include all necessary opt-in provisions,<sup>40</sup> including a prompt for end users to grant location permissions for the third-party app to assist in reporting geographic coordinates for the start and end of each test metric<sup>41</sup> and a prompt for end users to grant their consent to allow the end user’s service provider to divulge customer-specific information to the FCC (such as IP address and service plan details) as necessary to respond to challenges.<sup>42</sup>

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<sup>37</sup> *Third Report and Order*, 36 FCC Rcd at 1167, para. 104.

<sup>38</sup> An app developer may choose to include a link or reference to its privacy policy in the notice at the point of collection.

<sup>39</sup> *Id.* at 1174, para. 125.

<sup>40</sup> *Third-Party Mobile Speed Test App Public Notice*, para. 12.

<sup>41</sup> *See Mobile Technical Requirements Order* at \*7, para. 18 (stating that speed tests must include “geographic coordinates . . . measured at the start and end of each test metric”).

<sup>42</sup> *See id.* at \*7, para. 18 (listing timestamp and source IP address and port of the device, as measured by the measurement server, as another standardized metric that must be included with all on-the-ground mobile speed test data); *id.* at \*7, para. 18 n.72 (noting that “[g]iven concerns that challengers may conduct tests after exceeding data limits, we will collect the timestamp that test measurement data were transmitted to the app developer’s servers, as well as the source IP address and port of the device, as measured by the server, so that a service provider may determine if a challenger’s device is subject to reduced speeds or otherwise lacks full network performance”).

## E. Certification, Testing Environment, and Display

- **Certification**

(E.1) The third-party app shall require the end user to indicate, prior to conducting a speed test, whether the test is intended for the challenge process or crowdsourcing process. Prior to conducting a speed test for purposes of the challenge process, the third-party app may inform the end user of the speed test period, which is required to be between the hours of 6:00 a.m. and 10:00 p.m. local time for valid challenge data submissions.<sup>43</sup>

Note: Per table 5.1 Common Mobile Speed Test Data of the *BDC - Data Specifications for Mobile Speed Test Data*, the third-party app must record and report the data submission category in order to indicate the data as either challenge or crowdsourced data.

The third-party app, during the challenge process, shall require the end user to make the following certifications, in accordance with 47 CFR § 1.7006(e)(1):<sup>44</sup>

(E.2) A certification that the challenger is a subscriber or authorized user of the provider being challenged;

(E.3) A certification that the speed test measurements were taken outdoors; and

(E.4) A certification that, to the best of the person's actual knowledge, information, and belief, the handset and the speed test application are in ordinary working order and all statements of fact contained in the submission are true and correct.

(E.5) The third-party app developer shall describe how the app is designed and configured for the end user to certify the challenge data submission requirements prior to initiating the network performance test sequence and confirm that, once the test sequence is initiated, all test results are automatically submitted to avoid potential biases<sup>45</sup> in challenge process data.

Note: Speed test data that do not meet the criteria necessary to create a cognizable challenge or are otherwise not intended to be used to challenge the accuracy of a mobile service provider's map will be considered as crowdsourced data.<sup>46</sup>

The third-party app, during the crowdsource process, shall require the end user to make the following certification in accordance with 47 CFR § 1.7006(b)(1)(v):<sup>47</sup>

(E.6) A certification that to the best of the filer's actual knowledge, information, and belief, all statements in the filing are true and correct.

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<sup>43</sup> See *id.* at \*11, para. 27.

<sup>44</sup> See *Third Report and Order*, 36 FCC at 1167, para. 104.

<sup>45</sup> See *Second Order and Third Further Notice*, 35 FCC Rcd at 7488, para. 66. The Commission delegated to the Bureaus and Offices the authority to "consider . . . whether the application is designed so as not to introduce bias into test results." *Id.*

<sup>46</sup> See *Mobile Technical Requirements Order* at \*13, \*48, paras. 34, 122.

<sup>47</sup> See 47 CFR § 1.7006(b)(1)(v); *Second Order and Third Further Notice*, 35 FCC Rcd at 7489, para. 70.

Note: Some of the speed test metrics are optional for crowdsourced data.<sup>48</sup> Submitted crowdsourced data may include any combination of download speed and upload speed test metrics rather than requiring both (as is required for challenge data).<sup>49</sup>

- **Testing Environment**

(E.7) The third-party app shall require end users to indicate whether the test was taken in an in-vehicle mobile or outdoor, pedestrian stationary environment.<sup>50</sup>

(E.8) The third-party app developer must describe, for in-vehicle tests, how the third-party app will report the speed the vehicle was traveling when the test was taken, where available,<sup>51</sup> and the speed accuracy of measured velocity for each location measurement.<sup>52</sup>

- **Data Display**

(E.9) To ensure that the challenge process remains user-friendly and encourage public participation,<sup>53</sup> the third-party app developer should indicate whether the app will display, at a minimum, the following information to the end user and, for each, (E.10) confirm whether, if any metric fails to be collected (e.g., connection with the mobile network is not established), the app will display “-” instead of “0” or other values.

- Download speed;
- Upload speed;
- Latency;
- Date and time at which the test submission data were transmitted to the app’s servers;
- The network technology that was used (e.g., 3G, 4G, or 5G);
- The service provider that the end user used; and
- An indication that the end user is on their home network or not, if available (i.e., whether the test was performed while roaming).<sup>54</sup>

## F. Test Servers

(F.1) The third-party app developer shall describe how the third-party app will collect data using a set of geographically distributed test servers (measurement servers) that are statistically sound proportional to the user base and minimize the impact of latency for each test.<sup>55</sup>

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<sup>48</sup> See *Mobile Technical Requirements Order* at \*49, para. 124; *id.* at \*50, para. 126.

<sup>49</sup> See *id.* at \*49, para. 124.

<sup>50</sup> *Id.* at \*7, para. 18.

<sup>51</sup> *Id.*

<sup>52</sup> *Id.* at \*7, para. 18 & n.73.

<sup>53</sup> *Id.* at \*8, para. 20.

<sup>54</sup> *Id.* at \*48, para. 121 (“The FCC Speed Test app currently has the ability to provide network roaming information via the app’s local data export feature for download and upload speed tests and latency tests; however, this capability is not available for Apple iOS devices as certain technical network information and RF metrics are currently not available on those devices.”)

<sup>55</sup> *Third-Party Mobile Speed Test App Public Notice*, para. 9.

(F.2) The third-party app developer shall report the location(s) of the test servers (e.g., hostname or IP address) to the Commission.<sup>56</sup>

(F.3) The third-party app developer shall describe its plan for establishing initial measurement server capacity.<sup>57</sup>

(F.4) The third-party app developer shall describe how the app will monitor the health and quality of the measurement infrastructure and the collected data, including how the developer will maintain test servers to meet/exceed capacity upgrade thresholds.<sup>58</sup>

(F.5) The third-party app developer shall describe how capacity-upgrade thresholds for its servers will be established.<sup>59</sup>

(F.6) The third-party app developer shall describe the strategy for monitoring the system for server failures.<sup>60</sup>

(F.7) The third-party app developer shall describe the failover strategy to maintain a high system availability rate for the end users.<sup>61</sup>

(F.8) The third-party app developer shall describe the procedures for performing tests against an optimal measurement server.<sup>62</sup> Including how optimal server selection shall be determined at the start of each test sequence, and a confirmation that the same server shall be used for all tests in that sequence.

Note: One approach to determine an optimal measurement server is by measuring and comparing “the lowest round-trip time by ICMP ping[] or TCP ping.”<sup>63</sup>

(F.9) The third-party app developer should indicate if the optimal measurement server(s) will be located outside the mobile service provider’s network (off-net servers) to ensure unbiased measurements.<sup>64</sup>

(F.10) The third-party app developer should describe the processes and procedures for determining whether each measurement server shall have sufficient network capacity.<sup>65</sup>

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<sup>56</sup> *Mobile Technical Requirements Order* at \*7, para. 18.

<sup>57</sup> *Third-Party Mobile Speed Test App Public Notice*, para. 9.

<sup>58</sup> *Id.*

<sup>59</sup> *Id.*

<sup>60</sup> *Id.*

<sup>61</sup> *Id.*

<sup>62</sup> *Id.*

<sup>63</sup> FCC Office of Engineering and Technology, 2021 FCC Speed Test App Technical Description at 5, sec. (II)(A)(2) (2021), [https://www.fcc.gov/sites/default/files/2021\\_fcc\\_speed\\_test\\_app\\_technical\\_description.pdf](https://www.fcc.gov/sites/default/files/2021_fcc_speed_test_app_technical_description.pdf) (2021 FCC Speed Test App Technical Description).

<sup>64</sup> *Third-Party Mobile Speed Test App Public Notice*, para. 9.

<sup>65</sup> *Id.*

(F.11) The third-party app developer should describe the procedures for monitoring and maintaining the test servers so that the operational capacity is not exceeded.<sup>66</sup>

(F.12) The third-party app developer should describe its processes and procedures for ensuring these requirements are continuously met.

## G. Mobile Broadband Performance

Once an optimal test server is selected, the third-party app tests the download, upload, and latency performance of the mobile broadband connection either using the procedures described in the following subsections G.3 - G.9 below (i.e., the procedure used for the FCC Speed Test app) or through another methodology that may be proposed by the third-party app developer.

(G.1) Each test sequence, consisting of three parts (download, upload, and latency), must be preceded by the measurement client selecting a measurement server.

(G.2) If the third-party app developer proposes an alternative methodology, a sufficient justification must be provided in the proposal. Third-party app developers may conduct upload and download speed tests based either on their own preferred testing procedure or on OET's third-party app review procedure outlined in Appendix A for statistical assessment of the app's performance. *[If not, respond to G.3 - G.9 below. Otherwise, skip to G.10.]*

- **Download Speed Test Methodology**

(G.3) The third-party app developer shall describe how the download speed metric are measured by establishing multi-TCP connections to a target test node.<sup>67</sup> Each test cycle shall begin with a warm-up period, followed by the download speed test.<sup>68</sup> Each download test shall conclude after an elapsed minimum time of 5 seconds and a maximum elapsed time of 30 seconds.<sup>69</sup> The client shall attempt to download as much of the binary non-zero content, herein referred to as the payload, as possible for the duration of the test.<sup>70</sup>

(G.4) The third-party app developer shall describe how each test is executed using at least three concurrent TCP connections for byte streams between the third-party app and the measurement server.<sup>71</sup> Hence, each connection used in the test must count the number of bytes of the target payload transferred between two points in time and shall calculate the speed of each thread as the

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<sup>66</sup> *Id.*

<sup>67</sup> See *Mobile Technical Requirements Order* at \*6, para. 15. For example, the FCC Speed Test app performs the measurement using three HTTP GET requests over TCP/IP to the target test node. See 2021 FCC Speed Test App Technical Description at 6, sect. (II)(C) (“tests measure the download and upload speed in megabits per second by establishing multi-TCP connections to perform HTTP GET and POST requests to a target test node, [respectively]”).

<sup>68</sup> *Id.* at \*6, para. 15.

<sup>69</sup> See *id.* at \*6, para. 14. However, we will relax the minimum duration requirement once a download or upload test metric has transferred at least 1,000 megabytes of data. *Id.* at \*6, para. 14, n.53. “Specifically, when a speed test transfers at least 1,000 megabytes of data, we will validate the test if it has a duration value of greater than 0 seconds and less than or equal to 30 seconds. Otherwise, a speed test must have a duration value of greater than or equal to 5 seconds and less than or equal to 30 seconds to be valid.” *Id.*

<sup>70</sup> 2021 FCC Speed Test App Technical Description at 6, sect. (II)(C).

<sup>71</sup> *Mobile Technical Requirements Order* at \*6, para. 15 (“The FCC Speed Test app . . . establish[es] three concurrent TCP connections and sum[s] the three resulting data rates for each test.”).

number of bits transferred over the number of seconds in the active test window (i.e., excluding the warm-up time).<sup>72</sup> The speeds of the multiple threads shall be summed to determine the total download speed.<sup>73</sup> In addition, the third-party app shall report all other data required in table 5.1.4 Download Test Object of the *BDC - Data Specifications for Mobile Speed Test Data*.

(G.5) The third-party app developer shall describe how factors such as TCP slow start are taken into account by letting a “warm-up” period elapse before the data transfer rate computation begins.<sup>74</sup> The concurrent individual connections shall be established, each on its own thread, and shall be confirmed as all having completed the warm-up period before the 5- to 30-second testing period begins.

- **Upload Speed Test Methodology**

(G.6) The third-party app developer shall describe how the upload speed metric is measured by establishing multi-TCP connections to a target test node.<sup>75</sup> Each upload test cycle shall begin with a warm-up period, followed by the upload speed test.<sup>76</sup> Each upload test shall conclude after an elapsed minimum time of 5 seconds and a maximum elapsed time of 30 seconds.<sup>77</sup> The client shall generate and attempt to upload as much of the payload as possible for the duration of the test.

(G.7) The third-party app developer shall describe how tests are executed using at least three concurrent TCP connections for byte streams.<sup>78</sup> Each connection used in the test must count the number of bytes of the target payload transferred between two points in time and shall calculate the speed of each thread as the number of bits transferred over the number of seconds in the active test window (i.e., excluding the warm-up time).<sup>79</sup> The speeds of the multiple threads shall be summed to determine the total upload speed.<sup>80</sup> In addition, the third-party app shall report all other data required in table 5.1.5 Upload Test Object of the *BDC - Data Specifications for Mobile Speed Test Data*.

(G.8) The third-party app developer shall describe how factors such as TCP slow start are taken into account by transferring a portion of the target payload before the real testing begins.<sup>81</sup> The concurrent individual connections shall be established, each on its own thread, and shall be confirmed as all having completed the warm-up period before the 5 to 30-second testing period begins.

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<sup>72</sup> 2021 FCC Speed Test App Technical Description at 6, sect. (II)(C).

<sup>73</sup> *Mobile Technical Requirements Order* at \*6, para. 15.

<sup>74</sup> *See id.* at \*6, 7, paras. 15, 17. *See also id.* at \*7, para. 17 (“To account for [ramp up time], we . . . apply the following formula: [(total bits received – ramp up bits) divided by (total test time – ramp up time)].”).

<sup>75</sup> *See id.* at \*6, para. 15. *See discussion infra* note 118.

<sup>76</sup> *Id.* at \*6, para. 15.

<sup>77</sup> *Id.* at \*6, para. 14. *See discussion infra* note 118.

<sup>78</sup> *Id.* at \*6, para. 15 (“The FCC Speed Test app . . . establish[es] three concurrent TCP connections and sum[s] the three resulting data rates for each test.”).

<sup>79</sup> 2021 FCC Speed Test App Technical Description at 6, sect. (II)(C).

<sup>80</sup> *Mobile Technical Requirements Order* at \*6, para. 15.

<sup>81</sup> *Id.* at \*6, 7, paras. 15, 17. “To account for [ramp up time], we . . . apply the following formula: [(total bits received – ramp up bits) divided by (total test time – ramp up time)].” *Id.* at \*7, para. 17.

- **Latency Methodology**

(G.9) The third-party app developer shall describe how the latency test measures the round-trip time of User Datagram Protocol (UDP) packets for an elapsed minimum time of 5 seconds and a maximum elapsed time of 30 seconds between the device and a target test site.<sup>82</sup> The test shall record the start time, duration, number of packets sent, number of packets received, and round-trip jitter. In addition, the third-party app shall report all other data required in the table 5.1.6 Latency Test Object of the *BDC - Data Specifications for Mobile Speed Test Data*.

(G.10) The third-party app developer shall provide similar procedures as described in items G.3 - G.9 and describe in their proposal how the third-party app measures the download speed, upload speed, and latency using a different methodology from the methodology above. In such case, the proposal must detail the proposed methodology and must provide a technical justification for how such methodology measures download, upload, and latency as compared to the FCC Speed Test app, described in the 2021 FCC Speed Test App Technical Description document.

## H. Data Collection and Submission into the BDC System

(H.1) The third-party app developer shall indicate that the collected data shall be transmitted to the third-party app developer's data repository system after the completion of active test measurements.<sup>83</sup>

(H.1.1) The third-party app developer should confirm if its data repository system is located within the United States, and provide the location of the data repository system.

(H.2) The third-party app developer should indicate if a third-party app is designed to serve a limited geographic area rather than the entire United States. *[If “Yes”, respond to H.2.1 – H.2.3 below. Otherwise, skip to H.3.]*

(H.2.1) The app developer should provide the details of the limited geographic area (e.g., state, city, community, and boundaries) in which the third-party app is intended for use.

(H.2.2) The app developer should describe how the app provides the information concerning the limitation on geographic area to the end users within the third-party app.

(H.2.3) The app developer should describe how the data repository system will compile and filter the collected data to the designated area's boundary prior to transmission to the BDC system.

(H.3) When there is no connectivity to the network, the third-party app developer shall describe how the collected test results will be stored and submitted when connectivity becomes available (i.e., “store-and-forward” capability).<sup>84</sup>

(H.4) The third-party app developer should indicate how often the app will transmit test results from its data repository system to the BDC system.

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<sup>82</sup> *Id.* at \*6, 7, paras. 14, 15, 18; *see also id.* at \*6, para. 15 (noting that, for the FCC Speed Test app, “the round-trip latency testing runs for a fixed five seconds to transmit up to 200 UDP (User Datagram Protocol) packets (i.e., datagrams) to calculate the average latency of those datagrams”).

<sup>83</sup> *Third-Party Mobile Speed Test App Public Notice*, para. 10.

<sup>84</sup> *Mobile Technical Requirements Order* at \*10, para. 24 (“The FCC Speed Test app is designed to record and store measurements conducted in areas without internet connectivity and then to automatically transmit such failed tests once the app is opened when the device next has broadband connectivity. Moreover, third-party apps will be required to function in a similar way to be granted approval for use in the challenge process”).

Note: The third-party app should only transmit stored mobile network connection test results on a regular basis to the BDC system from its data repository system.

(H.5) The third-party app developer shall indicate if the test result data transmitted to the BDC system from its servers through an API in a JSON format matches the structure in accordance with the *BDC - Data Specifications for Mobile Speed Test Data*.<sup>85</sup>

(H.5.1) The third-party app developer must provide sample(s) for collected data in JSON format.

(H.5.2) The third-party app developer should indicate if test results other than for the subscribed mobile network connections (e.g., Wi-Fi) will be filtered and not transmitted to the BDC system.

## I. Privacy Policies

(I.1) In addition to having a privacy *notice* at the point of collection, the third-party app developer must have a comprehensive privacy *policy*, which must document the developer's practices with respect to storage, use, and protection of challenge data.<sup>86</sup>

(I.2) An appropriate privacy policy must be easily accessible to prospective challengers: Such a policy must be clear and concise and written in plain language; it must not be overly technical, vague, opaque, or lengthy, and it must not require specialized knowledge to understand.<sup>87</sup>

(I.3) The privacy policy must include a high-level description of the administrative, technical, and physical safeguards and controls that the developer has adopted to protect the personally identifiable information (PII) collected by the third-party app against any hazards to confidentiality, integrity, or availability.<sup>88</sup> This description must specifically address whether the developer will maintain all test data containing PII within the United States, or, if not, what alternative measures the developer is taking to ensure the security of the data maintained in a foreign jurisdiction.<sup>89</sup>

(I.4) The privacy policy must explain how, if at all, the third-party app developer will "use" individual challenge data, including to monetize such data (e.g., through the delivery of advertisements or the promotion of other products and services).<sup>90</sup>

## 4. Required Testing Parameters and Data Metrics

This Section describes the required testing parameters and data metrics that third-party apps must use to collect mobile broadband service availability data. The methodology and metrics set out in the Commission's Orders and the *Mobile Technical Requirements Order* effectuate Congress's intention, in the Broadband DATA Act, that the Commission collect additional data to validate and supplement the service availability data submitted by mobile broadband providers.

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<sup>85</sup> See *BDC - Data Specifications for Mobile Speed Test Data* at 2-3, sect. 1.

<sup>86</sup> *Third-Party Mobile Speed Test App Public Notice*, para. 12.

<sup>87</sup> *Id.* at para. 13.

<sup>88</sup> *Id.* at para. 14.

<sup>89</sup> *Id.* at para. 14.

<sup>90</sup> *Id.* at para. 14.



To be approved by OET and data acceptance by the BDC system, a third-party app must report the information and test metrics outlined in this Section. In addition to the guidance contained in this Bulletin, the *BDC - Data Specifications for Mobile Speed Test Data* provides further definitions and formatting of the data that is required to be captured and reported by the third-party app developer. The *BDC - Data Specifications for Mobile Speed Test Data* supersedes this Bulletin in the event of inconsistencies.

The majority of mobile devices employ either Apple's iOS or Google's Android operating system to run mobile applications. The Commission has therefore developed different methodologies for the respective Software Development Kits (SDKs), security features, and hardware of each of these mobile devices operating systems. The Android operating system is supported on hardware devices from multiple vendors and provides a consistent Application Programming Interface (API), which exposes certain technical network information and RF metrics available for use by the third-party speed test apps. In contrast, the iOS operating system, which supports iPhone and iPad hardware devices, does not permit access to certain technical network information and RF metrics included in the data elements the Commission would otherwise collect through the challenge and crowdsource processes. As indicated in the *BDC - Data Specifications for Mobile Speed Test Data*, these metrics can be null until they become available in the iOS operating system.

## A. End User Contact Details

The end user contact data are defined in table 5.1.1 Contact Object of the *BDC - Data Specifications for Mobile Speed Test Data*.

The third-party app shall collect the name of the end user submitting a test measurement using the third-party app.<sup>91</sup>

The third-party app shall collect the email address of the end user submitting a test measurement using the third-party app.<sup>92</sup>

For the challenge process, the third-party app shall also collect the mobile phone number of the device on which the speed test was conducted, to the extent technically feasible.<sup>93</sup> For the crowdsourcing process, the value may be null as indicated in table 5.1.1 Contact Object of the *BDC - Data Specification for Mobile Speed Test Data*.

## B. App Details

The data relating to the third-party app details are defined in table 5.1.2 Submission Object of the *BDC - Data Specifications for Mobile Speed Test Data*.

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<sup>91</sup> *Mobile Technical Requirements Order*, at \*5, para. 13 (“At the outset, we will require the FCC Speed Test app and approved third-party apps to collect the name and email address of the end user and mobile phone number of the device on which the speed test was conducted, to the extent technically feasible.”).

<sup>92</sup> *Id.*

<sup>93</sup> *Id.*

The third-party app name shall be an internal name used for the Commission to uniquely identify a third-party app in the BDC API.<sup>94</sup>

Note: The third-party app name, along with the third-party app version, will be used (in part) for accepting and cataloging data into the BDC system.

The third-party app version(s) shall have a unique version label.<sup>95</sup>

The third-party app version that is reported to the BDC API shall be the same version as advertised in the relevant app store.

The third-party app version shall be available from within the third-party app for end users to view.<sup>96</sup>

### C. Consumer Device Type, ID, and TAC

The data relating to the third-party app details are defined in table 5.1.2 Submission Object table of the *BDC - Data Specifications for Mobile Speed Test Data*.

The third-party app shall report the type of operating system on the device (e.g., “iOS,” “Android”), including the device ID, 15-digit International Mobile Equipment Identity (IMEI), and 8-digit Type Allocation Code (TAC).<sup>97</sup>

The third-party app shall report the manufacturer (brand) of the device (e.g., Apple, Google, Nokia, Samsung).<sup>98</sup>

The third-party app shall report the device model name (e.g., iPhone13,1; Pixel 5; Galaxy S10) as given by the manufacturer.<sup>99</sup>

The third-party app shall report the source IP address and port of the measurement client as measured by the server when the test measurement data is transmitted to the app developer’s servers.<sup>100</sup> The IP address shall have valid IPv4 or IPv6 format defined in table 5.1.2 Submission Object of the *BDC - Data Specifications for Mobile Speed Test Data*, “server\_source\_ip\_address.”

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<sup>94</sup> *Id.* at \*7, para. 18 (requiring speed test data to include “the app name and version”).

<sup>95</sup> *Id.*

<sup>96</sup> *Id.*

<sup>97</sup> *Id.* at \*7, para. 18, n.72, 73.

<sup>98</sup> *Id.* at \*19, para. 48 (“[A] challenger must disclose the manufacturer and model of its device so that providers will have this information when rebutting challenges and can seek to invalidate tests from devices that are not compatible with a specific network or band.”).

<sup>99</sup> *Id.* at \*7, \*19, paras. 18, 48. For example, “iPhone13,1” would be the mobile device model for an iPhone 12 Mini. See generally GitHub Gist, *Apple Mobile Device Types*, <https://gist.github.com/adamawolf/3048717> (last visited Apr. 5, 2022).

<sup>100</sup> *Id.* at \*7, para. 18 (requiring speed test data to include “the timestamp that test measurement data were transmitted to the app developer’s servers, as well as the source IP address and port of the device, as measured by the server”).

The third-party app shall report the timestamp of the time at which the test submission data were transmitted to the app’s servers, as measured by both the device<sup>101</sup> and server.<sup>102</sup>

The third-party app shall report the name and version of the operating system (e.g., “iOS 15.1.1,” “Android 11”) installed and used on the device during the test.<sup>103</sup>

## D. Mobile Service Provider

The data relating to the third-party app details are defined in table 5.1.2 Submission Object of the *BDC - Data Specifications for Mobile Speed Test Data*.

The third-party app shall report the name of the mobile service provider, including the mobile country code and mobile network code reported from the SIM card and the connected network.<sup>104</sup>

For any mobile speed test data collected for submission into the BDC system, the third-party app shall either prompt the end user to turn on the mobile wireless connection and/or turn off any non-mobile connection (e.g., Wi-Fi), so that the test will evaluate the mobile network connection or, alternatively, the third-party app developer’s data repository system shall compile and filter the collected data to exclude any non-mobile network test results prior to transmission to the BDC system.<sup>105</sup>

Provide either details of alternative or suggested methodology.

For third-party apps running on Android operating systems, the third-party app, during the download, upload, and latency tests, shall indicate if the end user is roaming or not (i.e., the mobile network the end user is on is different from their subscribed network).<sup>106</sup>

Per table 5.1.2 Submission Object of the *BDC - Data Specifications for Mobile Speed Test Data* “scheduled\_test\_flag,” if the submission category is consumer crowdsourcing, then the third-party app shall have a flag indicating whether the test was automated/scheduled or was user-initiated.

## E. Cell Attributes

The below cell attributes, subject to change, are defined and maintained in table 5.1.8 Cell Objects of the *BDC - Data Specifications for Mobile Speed Test Data*.

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<sup>101</sup> *Id.* at \*7, para. 18 (requiring speed test data to include “the timestamp that test measurement data were transmitted to the app developer’s servers”).

<sup>102</sup> *Id.* at \*7, para. 18 (requiring speed test data to include “the timestamp that test measurement data were transmitted to the app developer’s servers”).

<sup>103</sup> *Id.* at \*7, para. 18 (requiring speed test data to include “the operating system used for the test”).

<sup>104</sup> *Id.* at \*7, para. 18 & n.73.

<sup>105</sup> *Id.* at \*11, para. 27 (explaining validation criteria for speed tests, including that the BDC system will compare speed tests for a particular mobile network technology to the coverage maps for the corresponding technology or higher-generation technology).

<sup>106</sup> *Id.* at \*5, para. 13 & n.44. This data is not currently available in iOS.

Both Android and iOS versions of third-party apps shall report the broadcast Cell ID and the time at which the cell information is measured.<sup>107</sup>

The third-party app shall report the network generation of the cell used during the test (e.g., 3G, 4G, or 5G) and the network subtype of the cell.<sup>108</sup>

The third-party app shall record the following cell attributes<sup>109</sup> for the applicable technologies (e.g., 4G and 5G) and operating systems (e.g., Android), where available:

- Physical Cell ID (PCI) of the cell;
- Cell Connection status;
- Signal Strength, in dBm;
- Received Signal Strength Indicator (RSSI), in dBm;
- Reference Signal Received Power (RSRP), in dBm;
- Reference Signal Received Quality (RSRQ), in dB;
- Signal to Interference and Noise Ratio (SINR), in dB;
- Channel State Information (CSI) RSRP, in dBm;
- CSI RSRQ, in dB;
- CSI SINR, in dB;
- Channel Quality Indicator (CQI);
- Spectrum Band used by the cell (noting that the reported band corresponds to the Operating Bands table as follows: - 4G LTE: 3GPP TS 36.101 section 5.5, - 5G-NR: 3GPP TS 38.101 table 5.2-1);<sup>110</sup>
- Spectrum Bandwidth used by the cell (in megahertz); and
- Absolute RF Channel Number (ARFCN).

To the extent that the above cell attributes are currently not available in iOS or 3G networks, then the values of these attributes may be null. For third-party apps with crowdsourcing-only capability, the cell attributes are optional, or values may be null.

## F. Test ID of the Test Sequence

Each speed test<sup>111</sup> shall be identified by a unique identifier as indicated in table 5.1.2 Submission Object of the *BDC - Data Specification for Mobile Speed Test Data*.

Each download, upload, and round-trip latency test shall be performed consecutively, shall have a minimum test length of 5 seconds, and shall have a maximum test length of 30 seconds.<sup>112</sup>

The duration shall be recorded at least to the nearest microsecond for each of the tests of download speed, upload speed, and round-trip latency under the field “duration” in table 5.1.4 Download Test

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<sup>107</sup> *Id.* at \*7, para. 18 & n.73.

<sup>108</sup> *Id.* at \*7, para. 18 (requiring speed test data to include “the network technology (e.g., 4G LTE, 5G-NR) . . . used for the test”).

<sup>109</sup> *Id.* at \*7, para. 18 & n.73.

<sup>110</sup> *Id.* at \*7, para. 18 (requiring speed test data to include “spectrum bands used for the test”).

<sup>111</sup> *Id.* at \*7, para. 18 & n.73.

<sup>112</sup> *Id.* at \*4, \*6, paras. 10, 14.

Object, 5.1.5 Upload Test Object, and Latency Test Object 5.1.6 of the *BDC - Data Specifications for Mobile Speed Test Data*.

The date and time shall be stored and handled with appropriate time zone offset so that the actual time is determinable, and must match valid ISO-8601 format including seconds and timezone offset, i.e.: YYYY-MM-DD[T]hh:mm:ss±hh:mm under the field “timestamp” in table 5.1.4 Download Test Object, 5.1.5 Upload Test Object, and Latency Test Object 5.1.6 of the *BDC - Data Specifications for Mobile Speed Test Data*.

## G. Geographic Coordinates

The Commission will use the geographic coordinates, location fix timestamp, and measurement timestamps to calculate a single georeferenced measurement.

The geographic coordinates should be retrieved as close to the start and end of the individual test metrics as practical, since any attempt to request geographic coordinates during network testing segments could affect the measurement itself.

The third-party app shall collect geographic coordinates measured at the start and end of each test metric with typical Global Positioning System (GPS) Standard Positioning Service accuracy or better, with horizontal accuracy specified.<sup>113</sup>

The geographic coordinates shall be recorded in decimal degrees latitude and longitude in the World Geodetic System 1984 (WGS-84) datum and the value shall have a minimum precision of six decimal places per table 5.1.7 Location Objects.

## 5. BDC System Registration

Fully approved third-party apps will be eligible for BDC system registration with these required parameters:

- Third-party app’s name (string);
- Third-party app’s version (string);
- Approval start date (date);
- Approval end date (date);
- Whether the third-party app is approved for challenge reporting (Boolean); and
- Whether the third-party app is approved for crowdsourcing reporting (Boolean).

## 6. Major Change

A major change is any modification that affects testing methodology or compliance with technical and data requirements, including a change to the upload, download, or latency testing protocols, or to the measurement procedures.<sup>114</sup> If a third-party app developer makes a major change in its app, it must submit a new proposal that will be made available for public comment. This process will ensure that the updated third-party apps continue to comply with applicable requirements. No major changes may be made to an approved third-party app without prior approval; if any such changes are made without

<sup>113</sup> *Id.* at \*7, para. 18 & n.67.

<sup>114</sup> *Third-Party Mobile Speed Test App Public Notice*, paras. 18, 25.

approval, data from such third-party app will not be considered for either challenge or crowdsourcing processes unless and until such changes have been approved by OET.

## 7. Minor Change and Renewal

A minor change is a change that does not modify the third-party app’s testing methodology or technical and data requirements. Minor changes include, for example, updates to the end user interface, adding support for new operating system versions and hardware, security updates, or withdrawal.<sup>115</sup> If a third-party app developer is uncertain whether a change qualifies as a major or a minor change, then it should contact OET for guidance.

Minor changes do not warrant a new third-party app approval process. When a third-party app developer intends to make a minor change, it must notify OET of the proposed change prior to updating the third-party app in the app store. In the notification, the third-party app developer shall describe the change, identify the new third-party app version, and indicate the date when older third-party app versions will no longer be used for BDC challenge and crowdsourced data submissions. OET reserves the right to not use submitted challenge and crowdsourced data after the minor change and, if any concern arises as to the substance of the modification, OET may require the third-party app developer to file the change as a major change.<sup>116</sup>

Third-party app developers who wish to extend their third-party app approval shall notify OET no later than six months before the end of their current approval term. OET will review such notifications to determine whether to extend its approval for an additional period of five years.<sup>117</sup> Third-party app developers who wish to withdraw their app from the BDC program shall submit a notification to withdraw at least 60 days before the specified effective date of such discontinuance, and shall provide notice to all affected end users at least 30 days before such discontinuance.<sup>118</sup>

## 8. Change Log

Date	Comments
April 14, 2022	Initial release.

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<sup>115</sup> *Id.* at paras. 19, 26.

<sup>116</sup> *Id.* at para. 17. (“Additionally, any deviations in the production version from the conditionally approved wireframes or beta version will be subject to either a minor or major change (depending on the deviation) procedures set forth in this Bulletin.”).

<sup>117</sup> *Id.* at para. 23.

<sup>118</sup> *Id.* at para. 25.

## APPENDIX A

### OET's Third-Party App Performance Review Procedure

#### 1. Overview

This Appendix provides guidance to third-party app developers on a possible (but not required) approach to analyzing the overall performance of the production version of third-party apps proposed for full approval. Although the analysis of each third-party app will turn on the relevant facts and circumstances of the new, renewal, major change request, or conditionally approved third-party app wireframes and beta version, OET will reference this performance review procedure to assess the operational and performance aspects of those requests to confirm the functionalities required for the challenge process (and crowdsourcing process, if included<sup>1</sup>), observe the test sequence and results, and evaluate against the upload and download speed test metrics described in Section 3 of this Bulletin. Third-party app developers may also conduct and submit test results based on the statistical analysis set forth in this Appendix to assess the app's overall performance.<sup>2</sup>

The download and upload test metrics required for the BDC are run separately from each other and their minimum and maximum ranges can be impacted due to the network traffic and resource allocation dynamics. Accordingly, under this performance review, OET could consider whether the third-party app produces download and upload that are statistically indistinguishable from the FCC Speed Test app. OET could perform all speed tests between the hours of 6:00 a.m. and 10:00 p.m. local time. A set of tests (test-set) could include one download (DL) speed and one upload (UL) speed measurement completed by the third-party app.

OET could conduct a random sampling process from multiple geographic locations to aggregate test-sets of the three nationwide wireless carriers: AT&T, T-Mobile, and Verizon Wireless. However, if the carriers claim different technology types at the test locations, the test-sets could be separately aggregated

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<sup>1</sup> The *Third Report and Order* included minimum requirements for all speed test applications and directed OET to approve third-party apps that allow for the collection of the information and data elements that mobile speed tests must include to qualify as a valid mobile challenge process submission. *Establishing the Digital Opportunity Data Collection; Modernizing the FCC Form 477 Data Program*, WC Docket Nos. 11-10 & 19-195, Third Report and Order, 36 FCC Rcd 1126, 1166-67, para. 103-04 (2021). Third-party apps may also include, as an add-on to the challenge process system features, capabilities for consumers to submit crowdsourced mobile coverage data to the Commission. *Establishing the Digital Opportunity Data Collection*, WC Docket No. 19-195, Order, DA 22-241, 2022 WL 743185, at \*48, para. 122 (2022); *see also id.* (“We will thus only find third-party apps to be ‘highly reliable’ and to ‘have proven methodologies for determining network coverage and network performance’ if OET has approved them based upon the processes and procedures we will adopt for review of third-party apps for use in the mobile challenge process, and we will only allow for submission of crowdsourced data from such approved apps.”).

<sup>2</sup> Alternatively, third-party app developers may consider their own test methodology and provide their test results along with the test methodology description to OET to supplement their proposal. *Broadband Data Task Force and Office of Engineering and Technology Announce Procedures for Third-Party Mobile Speed Test Applications Seeking Approval for Use in the FCC's Broadband Data Collection*, Public Notice, DA 22-408, at \*7, para. 15 (OET Apr. 14, 2022).

and evaluated per the same technology type. The test-sets at an individual geographic location sampled from multiple carriers could be taken close together in time to minimize the potential for changes in the network state during measurement. The sample size for these statistical analyses could be large enough to apply the central limit theorem and law of large numbers. Specifically, OET could assemble a minimum of 40 successfully completed test-sets that include measurement of DL and UL performance for each carrier. The test results would then be aggregated within each technology at a location for a total of 120 test-sets per location, provided that all three carriers claim the same technology type and the devices can connect to the claimed technology.

In short, OET's sample collection process could be as follows:

1. The device will be turned on and allowed to warm up to normal operating conditions without any potential resource constraints by removing/closing unnecessary applications on the device.
2. Identify a test location to conduct all tests, between the hours of 6:00 a.m. and 10:00 p.m. local time, within a coverage area that provides a minimum 4G or 5G connection with a sufficient and stable signal strength displayed on the device for completing multiple samples of test-sets. Publicly available coverage maps of the carriers and the device displayed connection type will be cross-referenced.
3. The third-party app will be run and if the first test-set completes successfully, the DL and UL speeds will be recorded. Subsequently, the first test-set using the FCC Speed Test app will perform its DL and UL speed tests from the same location, same device, same network technology, and with the same mobile broadband provider. This sequential process for every pair of test-sets between the third-party app and the FCC Speed Test app will alternate serially to minimize temporal differences and the network congestion effects; i.e., perform Test-set #1 for third-party app and FCC Speed Test app, perform Test-set #2 for third-party app and FCC Speed Test app, Test-set #3, Test-set #4, etc.
4. For both the third-party app and the FCC Speed Test app, each will record a minimum of 40 successfully completed test-sets per carrier. For instance, if all three carriers claim the same technology type (and the same speed threshold if 5G), a total of 120 test-sets would be recorded at the location in which the devices can also confirm the connection. If different technology types are claimed or connected, the sample sets from the carriers will be treated separately to conduct independent studies.
5. Perform the third-party app statistical evaluation procedure described in Section 4 below.

## 2. Equipment

Under the performance review procedure, the hardware equipment used by OET for performance review will consist of commercially available 5G-compatible Android devices (e.g., Google Pixel 6), iOS devices (e.g., iPhone 13), and a nominal 1.5-meter phone stand to ensure tests are conducted at the appropriate height above ground level (AGL).<sup>3</sup> The Android and iOS devices will not be inside a phone case.

OET could internally track the requirements' status and test execution progress of the third-party app. Once the technical methodology is confirmed to align with this Appendix, OET could collect, store, and analyze the data.

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<sup>3</sup> 47 CFR § 1.7004(c)(3)(v).



### 3. Testing Locations

When evaluating third-party apps, tests could be conducted at multiple (at least two) geographic locations. At each individual geographic location, the coordinates of the conducted test, and the attributes of the environment including temperature, humidity, and atmospheric pressure could be recorded. The tests could occur inside each carrier’s 4G or 5G coverage area, if available. Furthermore, photos of the test setup could be included.

### 4. Optional Statistical Analysis of Test-Sets

The test-sets could be evaluated in two phases: 1) *Two Means* (Means) test to determine whether there is a statistically significant difference between the mean upload and download speeds calculated from the third-party app and the FCC Speed Test app based on collected samples; and 2) *Two Independent Proportions* (TIP) test to determine whether there is a statistically significant difference in the proportion of “positive” and “negative” test results between the two sample sets. The “positive” or “negative” categorization of test results could be classified, as adopted in the BDC challenge process, against the carrier’s coverage data submitted to the BDC system that recognizes the minimum speed threshold requirements of the network technology types.

#### 4.1 Means Testing

For the Means test, the collected samples could be used to calculate separate mean values of the DL and UL speeds for the third-party app to confirm the values in correlation to the second standard deviation (95.4%) of the second sample set collected by the FCC Speed Test app. The two standard deviations could allow accounting for the variable nature of the network connection reliability and will support to minimize approval of third-party apps that produce extreme outliers, which could adversely affect both challenge and crowdsourced data collection.

#### 4.2 TIP Testing

For the TIP test, we could conduct a two-tailed hypothesis test as follows:

- Use a 95% confidence level; i.e., 5% significance level ( $\alpha = 0.05$ ) such that there will be a 5% probability of rejecting the null hypothesis when it is in fact true.
- The null hypothesis ( $H_0$ ) is that the observed pass proportion of the first test sample is equal to the pass proportion from the second test sample.
- The alternative hypothesis ( $H_A$ ) is that the pass proportions from the two samples are not equal.

*TIP Test Example 1:* Acceptance of the null hypothesis.

1. OET collects 40 test-sets per the temporal threshold requirement in a geographic location for each carrier. Total 120 test-sets =  $n_1 = n_2 =$  sample size, if all three carriers satisfy the condition required to aggregate tests by the connected technology type and its speed threshold.
2.  $\hat{p}_1 =$  Second sample set = 87.5% “positive” results that exceeds the speed threshold of the three carriers; e.g., total 30+35+40 positive tests from all three carriers out of the total 120 test-sets.

3.  $\hat{p}_2 =$  Third-party app = 83.3% “positive” results; e.g., total 30+35+35 positive tests from all three carriers out of the total 120 test-sets.
4.  $H_0: p_1 = p_2$  that the two population proportions (i.e., the results from both sample sets) are the same, then  $H_A: p_1 \neq p_2$ .
5. The overall sample proportion,  $\hat{p} = (105 + 100) / (120 + 120) = 0.854$ .
6. Substitute the values into the test statistic to find the Z-value for the null hypothesis ( $p_1 = p_2$ ):

$$Z\text{-value} = \frac{(\hat{p}_1 - \hat{p}_2) - (p_1 - p_2)}{\sqrt{\hat{p}(1-\hat{p})(1/n_1 + 1/n_2)}} = \frac{(0.875 - 0.833) - 0}{\sqrt{0.854(1-0.854)(1/120 + 1/120)}} = 0.92$$

7. The z-score of the desired significance level ( $\alpha = 0.05$ ) for a two-tailed test  $z(\alpha/2)$  is 1.96.
8. Since the Z-value 0.92 falls outside the rejection region,  $0.92 < 1.96$ , we accept the null hypothesis.
9. The area of the two-tails of a standard normal distribution for a Z-value of 0.92 is  $(1 - 0.82121) \times 2 = 0.358$ , which is the p-value.
10. This confirms, as the p-value is greater than  $\alpha$  ( $0.358 > 0.05$ ), that there is insufficient statistical evidence to reject the null hypothesis at a 95% confidence level.

*TIP Test Example 2: Rejection of the null hypothesis*

1. OET collects 40 test-sets per the temporal threshold requirement in a geographic location for each carrier. Total 120 test-sets =  $n_1 = n_2 =$  sample size.
2.  $\hat{p}_1 =$  Second sample set = 87.5% “positive” results that exceeds the speed threshold of the three carriers; e.g., total 30+35+40 positive tests from all three carriers out of the total 120 test-sets.
3.  $\hat{p}_2 =$  Third-party app = 75.0% “positive” results; e.g., total 25+30+35 positive tests from all three carriers out of the total 120 test-sets.
4.  $H_0: p_1 = p_2$  that the two population proportions (i.e., the results from both sample sets) are the same, then  $H_A: p_1 \neq p_2$ .
5. The overall sample proportion,  $\hat{p} = (105 + 90) / (120 + 120) = 0.813$ .
6. Substitute the values into the test statistic to find the Z-value for the null hypothesis ( $p_1 = p_2$ ):

$$Z\text{-value} = \frac{(\hat{p}_1 - \hat{p}_2) - (p_1 - p_2)}{\sqrt{\hat{p}(1-\hat{p})(1/n_1 + 1/n_2)}} = \frac{(0.875 - 0.750) - 0}{\sqrt{0.813(1-0.813)(1/120 + 1/120)}} = 2.48$$

7. The z-score of the desired significance level ( $\alpha = 0.05$ ) for a two-tailed test  $z(\alpha/2)$  is 1.96.
8. Since the Z-value 2.48 falls inside the rejection region,  $2.48 > 1.96$ , we can reject the null hypothesis that the two population proportions are equal.
9. The area of the two-tails of a standard normal distribution for a Z-value of 2.48 is  $(1 - 0.99343) \times 2 = 0.01314$ , which is the p-value.

10. This confirms, as the p-value is less than  $\alpha$  ( $0.01314 < 0.05$ ), there is sufficient statistical evidence to reject the null hypothesis at 95% confidence level.

## 5. Other Test Results

OET may use various methodologies to evaluate the submitted third-party app against all other requirements defined in Sections 3 and 4. One methodology may be the use of visual inspection of the outputted values and formatting in the JSON file to determine that the third-party app provides the proper data to the BDC system. The data specifications and JSON format must conform with the *BDC - Data Specifications for Mobile Speed Test Data*.<sup>4</sup> In addition, OET may use the displayed values, before and after a test is completed, to ensure that the third-party app operates as expected.

OET will also review the third-party app developer's proposed system architecture, including technical diagrams, methodologies, and operations used to collect data, as discussed in Section 3. As part of the evaluation, OET will ensure that the proposed system architecture will be adequate to provide a highly reliable data collection process.

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<sup>4</sup> *Broadband Data Task Force and Office of Economics and Analytics Publish Additional Data Specifications for the Submission of Mobile Speed Test and Infrastructure Data into the Broadband Data Collection*, Public Notice, DA 22-242, at 1 (OEA Mar. 9, 2022); *see also* FCC, *Broadband Data Collection Data Specifications for Mobile Speed Test Data* (2022), <https://us-fcc.app.box.com/v/bdc-mobile-speedtest-spec>.

## APPENDIX B

### Terminology

- **App** – The mobile application that is installed on the end user’s equipment.
- **BDC API** – Broadband Data Collection (BDC) Application Programming Interface (API) is a web service that provides for submitting crowdsourcing, challenge, and other data to the Commission in a secure authenticated manner. The BDC API leverages HTTPS security, token-based authentication, and authorization with JavaScript Object Notation (JSON) formatted payloads.
- **End User** – The person operating the app on the measurement client. This person is referred to in the rules as a consumer, challenger, entity, individual, or filer.
- **Measurement Client** – The measurement client is made up of the third-party app, the user equipment (mobile device and operating system), and an active mobile network service plan.
- **Measurement Server** – A server that is used in conjunction with the measurement client to carry out the performance measurements. May also be referred to as a test server or a measurement node.
- **Metric** – A particular measurement or calculation that is recorded during the test sequences, such as warm-up duration, warm-up bytes, download duration, download bytes, latency, etc.
- **Off-Net** – A location for equipment that is outside the carrier’s network at a neutral location.
- **Test** – The individual download, upload, and latency test. A test also may be referred to as a “test component.”<sup>1</sup>
- **Test Sequence** – A series of tests where one of each download, upload, and latency tests are run serially. A test sequence also may be referred to as a “test cycle.”<sup>2</sup>
- **Test-Set** – A set of download and upload speed test results from a test sequence.
- **Test System Architecture** – A system architecture view that shows, at a high level, the measurement client, measurement server, and any other pertinent system components in the third-party app developer’s core infrastructure.
- **Third-Party App Developer** – The entity that is responsible for the third-party app, measurement servers, data collection servers, monitoring, maintenance, and interfacing with the Commission’s services.
- **Warm-up Period** – A TCP slow start algorithm which balances the speed of a network connection which occurs at the beginning of both the upload and download tests. This period also may be referred to as “ramp-up time.”<sup>3</sup>

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<sup>1</sup> *Establishing the Digital Opportunity Data Collection*, WC Docket No. 19-195, Order, DA 22-241, 2022 WL 743185, at \*7, para. 16 (2022).

<sup>2</sup> *Id.* at \*6, para. 15.

<sup>3</sup> *Id.* at \*7, para. 17.